RESTRICTED

AN 01-45HD-2

Erection and Maintenance Instructions

for

NAVY MODELS
F4U-5, F4U-5N, F4U-5P Aircraft

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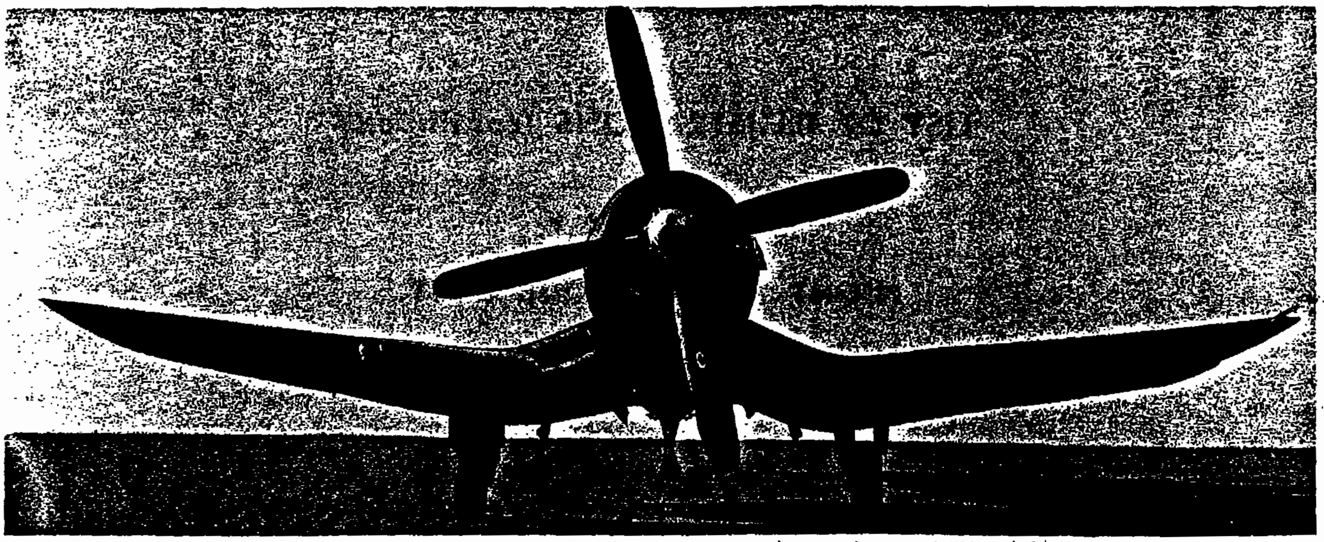
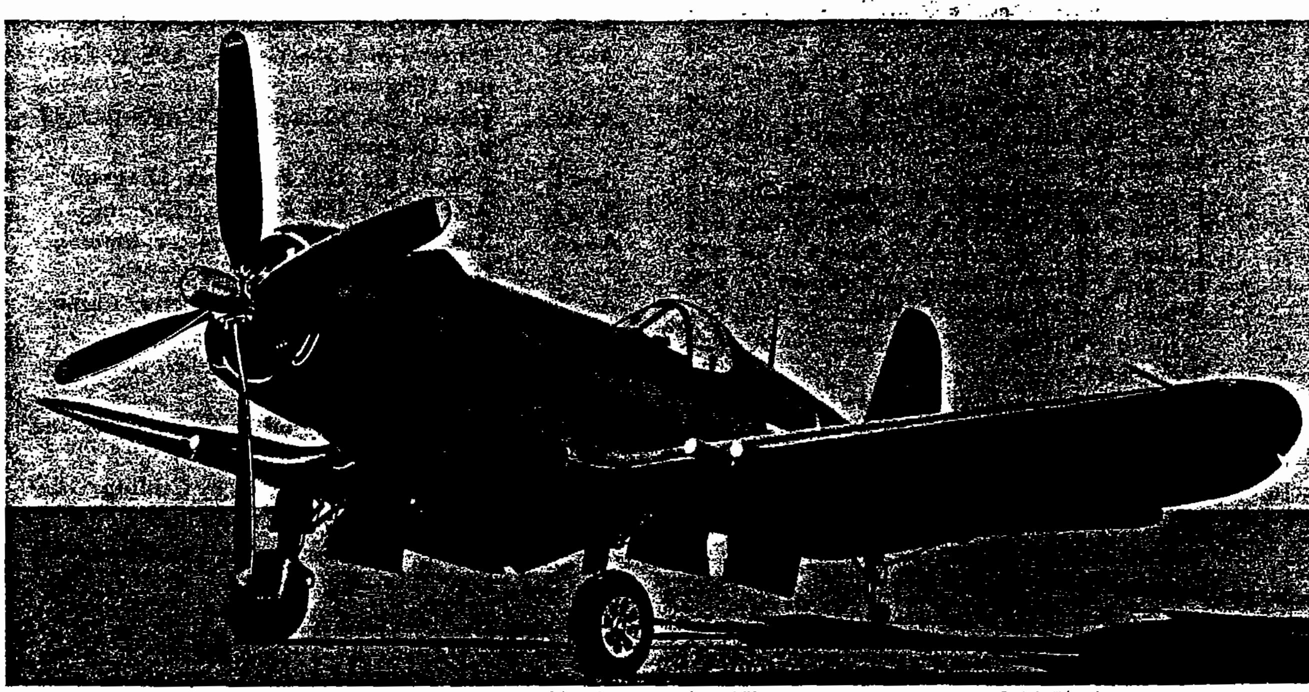
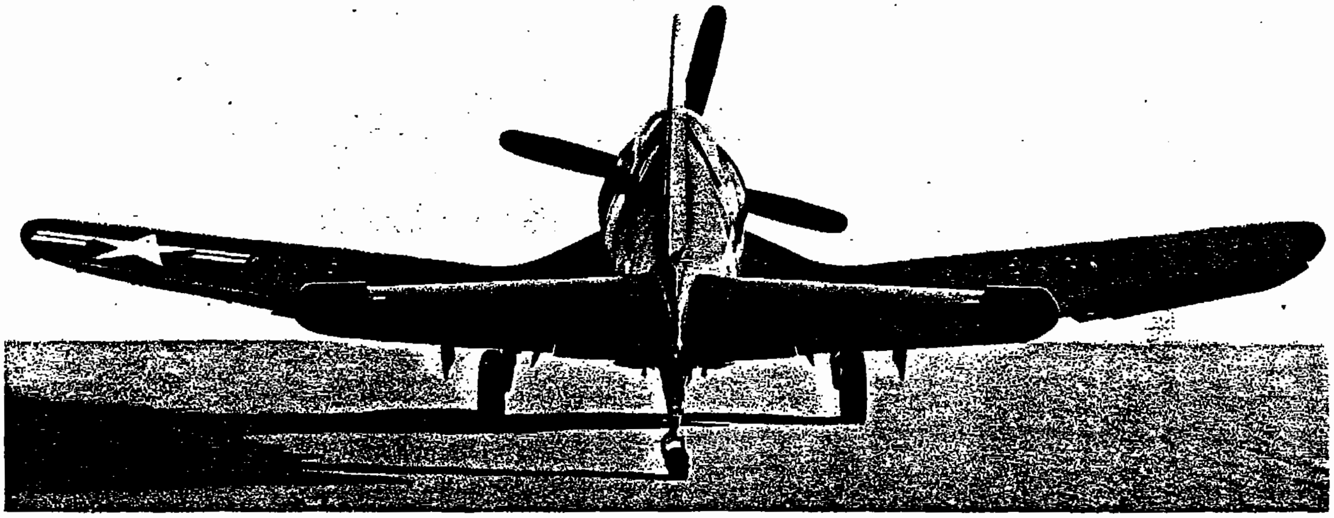
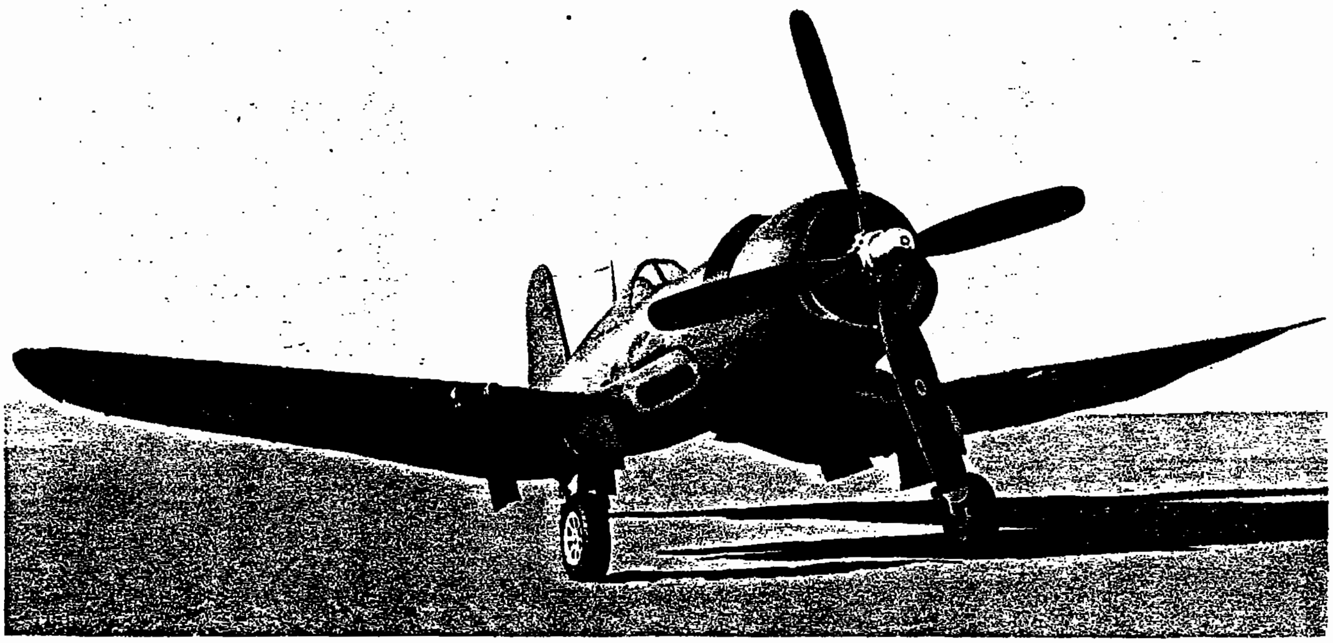
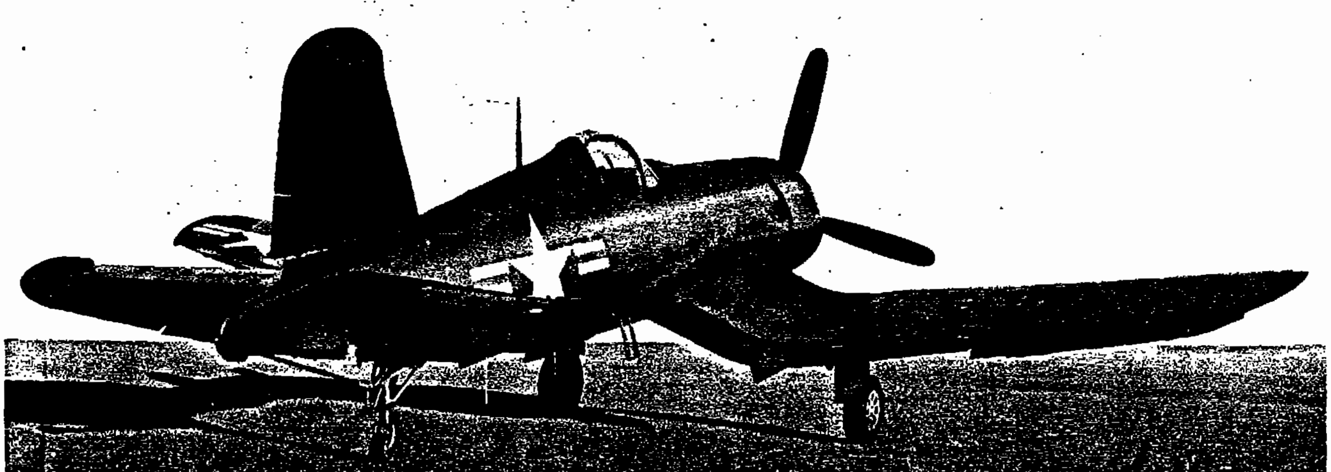










INTRODUCTION

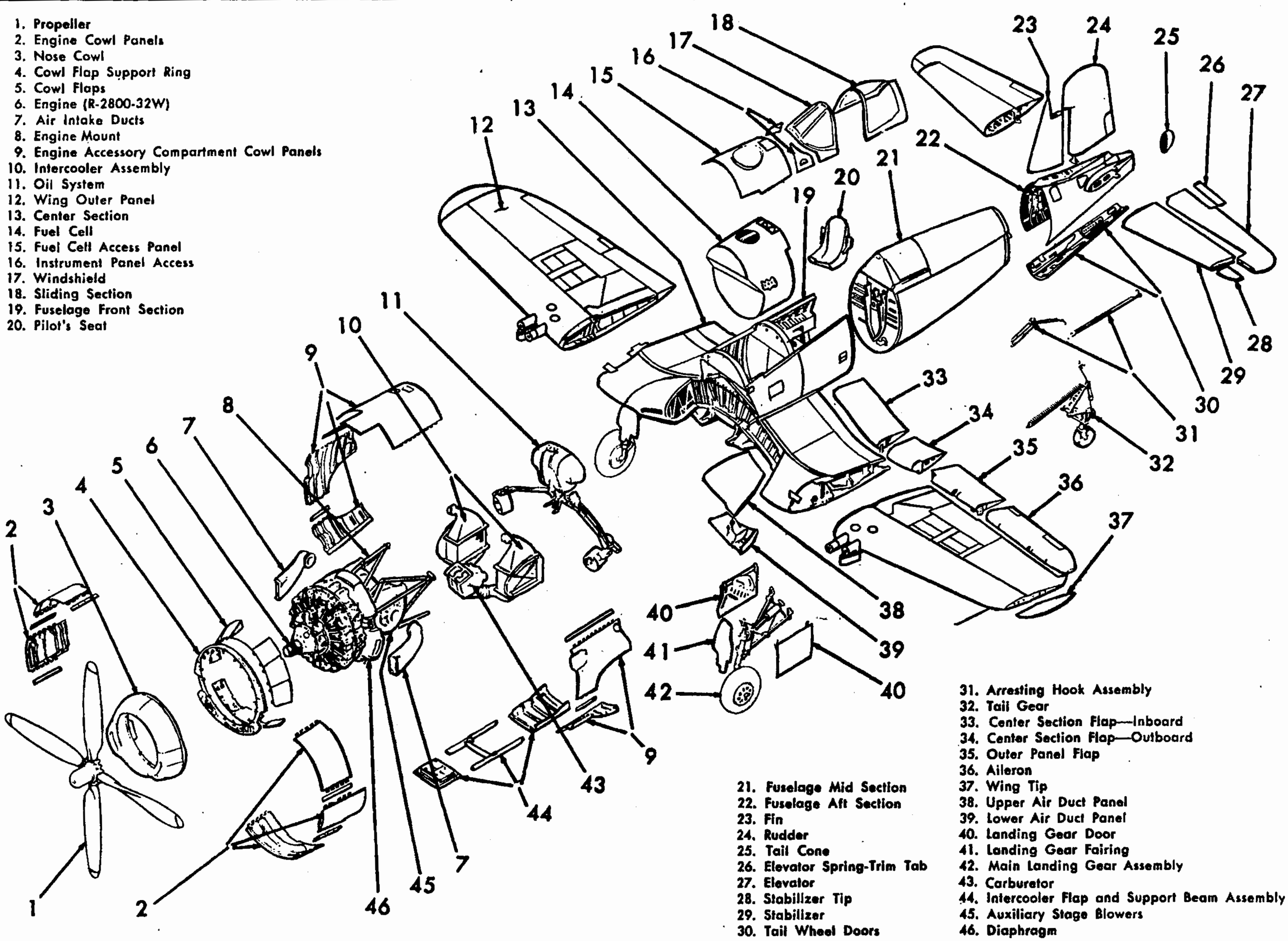
The F4U-5 Handbook of Erection and Maintenance Instructions has been prepared to provide service personnel with the information required to service and maintain the F4U-5 Airplane efficiently.

It is recommended that service personnel become thoroughly acquainted with the arrangement and content of this handbook. The seven main sections are:

I. DESCRIPTION, DIMENSIONS AND LEADING PARTICULARS
II. SHIPMENT AND ERECTION PROCEDURES
III. GROUND HANDLING AND SERVICING INSTRUCTIONS
IV. GENERAL MAINTENANCE
V. ELECTRICAL AND ELECTRONIC SYSTEMS
VI. CHARTS AND TABLES
VII. MAINTENANCE INSPECTION

The detailed table of contents at the beginning of the handbook lists, in numerical paragraph sequence, each system, sub-system and unit discussed. The index at the end of the handbook lists each system, sub-system and unit in alphabetical order.

The "E & M" covers the work performed by the maintenance mechanic to keep the airplane in good flying condition. For part number identification and when ordering parts from supply, use the Illustrated Maintenance Parts List (NavAer 01-45HD-504). For structural repair information, see the Structural Repair Manual (AN 01-45HD-3). For flight operating information, see the Pilot's Handbook (AN 01-45HD-1). Although all pertinent "E & M" data will be found in this handbook, service personnel should acquaint themselves with the purpose and application of each of the other handbooks in order to gain a complete working knowledge of the F4U-5 Airplane.



1. Propeller
2. Engine Cowl Panels
3. Nose Cowl
4. Cowl Flap Support Ring
5. Cowl Flaps
6. Engine (R-2800-32W)
7. Air Intake Ducts
8. Engine Mount
9. Engine Accessory Compartment Cowl Panels
10. Intercooler Assembly
11. Oil System
12. Wing Outer Panel
13. Center Section
14. Fuel Cell
15. Fuel Cell Access Panel
16. Instrument Panel Access
17. Windshield
18. Sliding Section
19. Fuselage Front Section
20. Pilot's Seat
21. Fuselage Mid Section
22. Fuselage Aft Section
23. Fin
24. Rudder
25. Tail Cone
26. Elevator Spring-Trim Tab
27. Elevator
28. Stabilizer Tip
29. Stabilizer
30. Tail Wheel Doors
31. Arresting Hook Assembly
32. Tail Gear
33. Center Section Flap—Inboard
34. Center Section Flap—Outboard
35. Outer Panel Flap
36. Aileron
37. Wing Tip
38. Upper Air Duct Panel
39. Lower Air Duct Panel
40. Landing Gear Door
41. Landing Gear Fairing
42. Main Landing Gear Assembly
43. Carburetor
44. Intercooler Flap and Support Beam Assembly
45. Auxiliary Stage Blowers
46. Diaphragm

Exploded View of Airplane

SECTION I

DESCRIPTION, DIMENSIONS, AND LEADING PARTICULARS

1—1. DESCRIPTION.

1—2. The F4U-5 is a single engine, single seat, low wing monoplane, designed and built by Chance Vought Aircraft, Division of United Aircraft Corporation, Stratford, Connecticut, for use as a carrier-based or land-based fighter or light dive bomber. The F4U-5 airplane is a development of the F4U series or airplanes known as "Corsairs." Although structurally similar to the F4U-4 airplane, a number of major and minor changes have been made, among which is the installation of the Pratt and Whitney R-2800-32W "E" series engine, developing approximately 200 more horsepower for military power rating and maintaining greater power to a higher critical altitude than the "C" series engine used on the F4U-4 airplane. Additional changes include structural reinforcement required by the more powerful engine, the addition of a radio compartment door which provides convenient access to the area directly aft of the pilot's cockpit, a telescoping step and handgrip for easy access to the cockpit, a fully retractable tail wheel and arresting hook, and a modernized cockpit providing increased comfort, visibility, and accessibility to controls and equipment. The 1500 psi hydraulic system in this airplane is supplied with power by an engine-driven variable displacement pump. The F4U-5 airplane may be readily identified by the two ducts on the lower half of each side of the nose cowl, instead of the single, bottom centerline duct used on the F4U-4 airplane. The distinguishing characteristics of the F4U-5 airplane are the inverted gull wings, the nose cowl inlets, the four-bladed hydromatic propeller, and the two 20-mm guns projecting from each wing outer panel.

1—3. The fuselage is of conventional aluminum alloy construction. The cockpit controls have been rearranged and the engine control unit no longer includes a supercharger control, since supercharger function is automatic. A heater is installed and provisions are also made to ventilate the cockpit with fresh unheated air. A hydraulically operated, clear vision canopy, provided with an emergency and mechanical system of operation, completely encloses the modernized cockpit. The wings consist of two readily removable, folding outer wing panels and an inverted gull-wing shaped center section. The outer panels are metal covered and are provided with detachable metal wing tips. Ailerons are constructed of fabric covered plywood, and are provided with balance tabs. The left hand aileron incorporates an electrically operated trim tab, adjustable in flight. Conventional wing flaps, with a load relieving device, are hydraulically operated and readily controllable by the pilot for landing, take-off, and maneuvering. The tail group consists of conventional stabilizers, elevators, fin, and rudder. The movable tail surfaces are composed of metal covered with fabric. The rudder and both elevators are equipped with electrically operated trim tabs. The fin is of metal construction and is covered with metal sheet while the stabilizer is composed of Metalite (a new material developed by Chance Vought Aircraft). Readily replaceable stabilizer tips are of metal. The hydraulically operated landing gear consists of two main wheels, and a tail wheel and arresting hook, completely retractable into the wing center section and fuselage respectively. Non-skid, high pressure tires and inner tubes are provided on the main wheels. The tail wheel tire is solid. The landing gear is equipped with oleo-pneumatic shock struts, and multiple-disc, low pressure type hydraulic brakes. The fuel tank is located forward of the pilot's cockpit. Additional fuel may be carried in external auxiliary fuel tanks on the centerline pylon or center section pylons. A water injection system is provided. The "E" series engine can be readily distinguished from the "C" by the large "side-wheeler," hydraulically driven and automatically controlled variable speed auxiliary stage blower on each side of the accessory section of the engine. Because of the size and location of these blowers, a two-piece engine mount, split along the vertical centerline of the mounting ring is used. A redesigned air induction system is utilized in connection with up-draft carburetion. The cowl flaps in this airplane are electrically actuated and automatically controlled. A parallel oil system has been installed. The thrustline of the engine is 3° nose down with respect to the airplane reference line. Armament on the F4U-5 consists of four M3, 20-mm guns. Maximum possible ammunition load is 924 rounds. Gun fire, bombing, and rocket launching are directed through a Mark 8 sight unit. Mark 51 bomb racks are located on the wing center section and centerline of the airplane. Each outer panel is equipped for the installation of four Mark 9 launchers carrying several sizes of rockets.

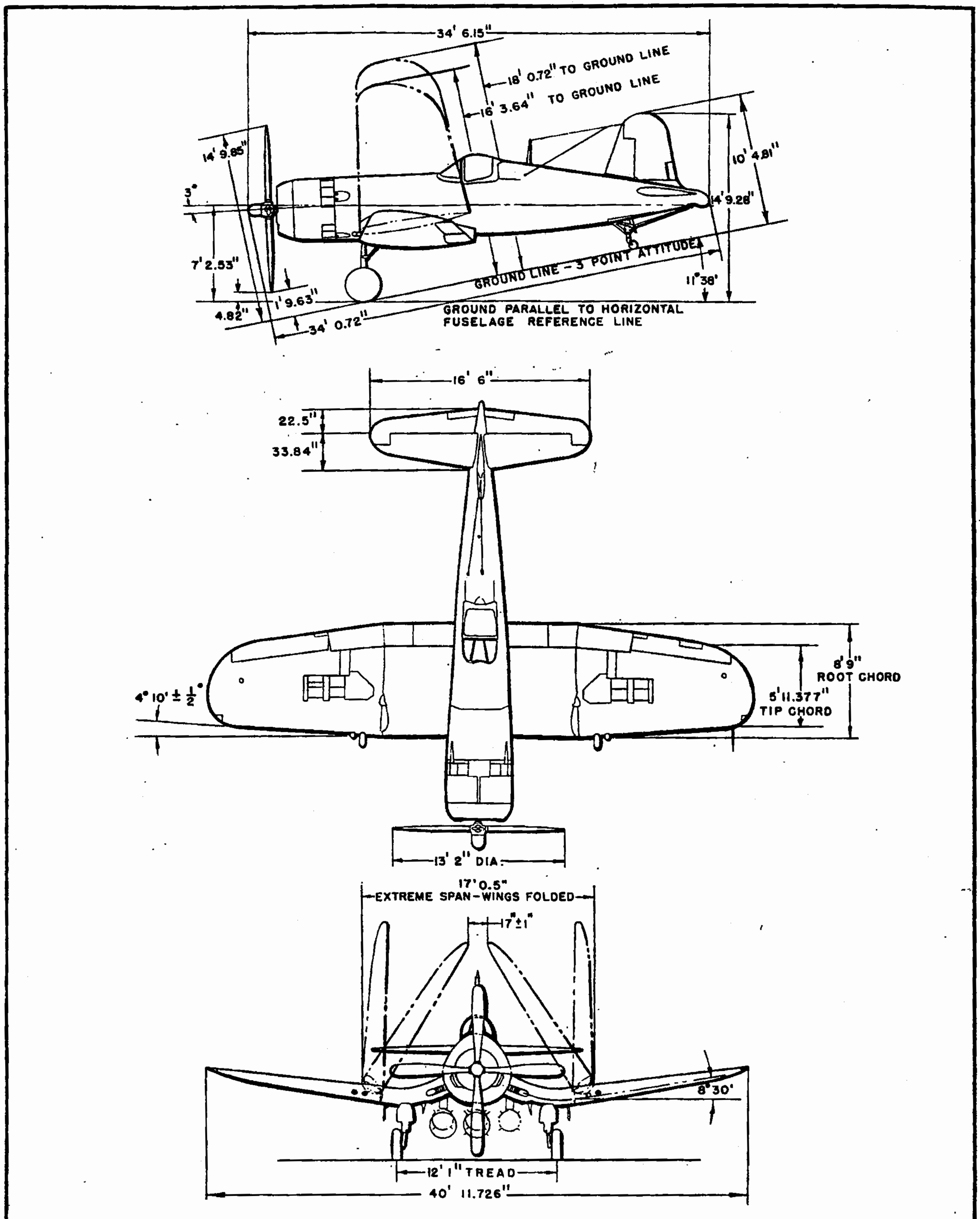


Figure 1—1. General Arrangements.

1–4. PRINCIPAL DIMENSIONS.

1–5. GENERAL. *(See figure 1–1.)*

a. Span (wing spread)	40 ft. 11.726 in.
b. Length (over-all, fuselage reference line level)	34 ft. 6.15 in.
(over-all, three point attitude)	34 ft. 0.72 in.
c. Height (hoisting attitude, height over propeller 45°)	13 ft. 0.2 in.
(three-point attitude, tip of propeller at top)	14 ft. 9.85 in.
d. Propeller Ground Clearance (fuselage reference line level)	4. 82 in.
(three point attitude)	1 ft. 9.63 in.
e. Wings Folded – Span	17 ft. 0.5 in.
Height (three-point attitude, max. during folding operation)	18 ft. 0.72 in.
Height (three-point attitude, outer panel completely folded)	16 ft. 3.64 in.

1–6. WINGS.

a. Airfoil Section (curve identification at root of center section)	NACA 23018
(curve identification at wing fold line)	NACA 23015
(curve identification at theoretical wing tip)	NACA 23009
b. Chord at root	8 ft. 9 in.
Theoretical chord at construction tip section (20 ft. 5.86 in. from fuselage centerline)	5ft. 11.377 in.
c. Incidence (average angle between wing butts and fuselage reference line)	2° + 0′ –30′)
(Right and left sides shall not differ by more than 15 minutes with the right side never lower than the left.)	
d. Dihedral (measured from leading edge of chord plane)	8°30′
e. Sweepback (leading edge of outer panel)	4°10′
Tolerance	+ or –1/2°

1–7. STABILIZER.

a. Span	16 ft. 6 in.
b. Maximum chord (measured from centerline of hinge)	33.84 in.
c. Incidence	1.25°
d. Dihedral	0°

1–8. FUSELAGE.

a. Width (maximum)	53.23 in.
b. Height – exclusive of canopy (maximum)	69.44 in.
c. Length (without engine mount)	24 ft. 1 in.
d. Length (with engine mount)	29 ft. 1-1/2 in.

1–9. AREAS.

a. Wings (less ailerons and 37.7 sq. ft. fuselage area)	258.2 sq. ft.
b. Ailerons (total aft of hinge)	18.1 sq. ft.
c. Flaps Area (total aft of hinge line, normal to reference plane)	36.4 sq. ft.
d. Stabilizers (including elevators – total horizontal tail surface)	57.9 sq. ft.
e. Elevators – two (including tabs)	21.9 sq. ft.
f. Elevator trim tabs (total)	1.36 sq. ft.
g. Fin (including 0.86 sq. ft. fin area aft of rudder hinge centerline and 1.66 sq. ft. contained rudder balance)	9 sq. ft.
h. Rudder (including tabs – total aft of hinge)	13 sq. ft.
i. Rudder trim tabs (total)	0.85 sq. ft.

1–10. SETTINGS AND RANGES OF MOVEMENT OF CONTROL SURFACES AND FLAPS.

1–11. AILERONS.	*Maximum Deflection Degrees*
a. Up (from neutral)	19°
b. Down (from neutral)	14°

1—12. ELEVATORS.

a. Normal travel without spring tab deflection
- Up (from neutral) .... 23.5°
- Down (from neutral) .... 21°

b. Maximum travel with full deflection of spring tab
- Up (from neutral) .... 18.5°
- Down (from neutral) .... 14.5°

1—13. RUDDER.

a. Normal travel without spring tab deflection
- Left (from neutral) .... 25°
- Right (from neutral) .... 25°

b. Maximum travel with full deflection of spring tab
- Left (from neutral) .... 21.75°
- Right (from neutral) .... 21.75°

1—14. FLAPS — Up .... 0°
Down .... 50° (+ or −7°)

1—15. TRIM TABS.

a. Elevator:
- Spring tab — Up .... 20°
- Down .... 15°
- Trim tab — Up .... 5° (+4° −1°)
- Down .... 15° (+4° −0°)

b. Rudder:
- Spring tab — Left .... 3° 45′
- Right .... 3° 45′
- Trim tab — Left .... 10° (+4° −1°)
- Right .... 10° (+4° −1°)

c. Aileron:
- Trim tab — Up .... 15° (+4° −1°)
- Down .... 15° (+4° −1°)

1—16. Tolerance on all control movements except as noted above .... + or −1°

1—17. LEADING PARTICULARS.

1—18. MAIN GEAR.

a. Type .... Wheel type, single strut, hydraulically retractable

b. Tread (width from center of tire to center of tire) .... 12 ft. 1 in.

c. Shock Struts
- Type .... oleo pneumatic
- Maker .... Chance Vought Aircraft, Division of United Aircraft Corporation
- Part Number VS-55274

d. Fluid Required .... Mineral oil
- AN Specification Number .... AN-O-366 (red fluid)

e. Strut Lengths (from top of strut to centerline of axle)
- Fully extended .... 51 57/64 in.
- Static .... 41 61/64 in.
- Fully compressed .... 41 57/64 in.

f. Air Pressure (approx. max. psi) .... 1200 psi

g. Wheels
- Type .... 32 in. x 8 in. Goodyear No. 530204
- Size .... 32 in. x 8 in.
- Chance Vought Part Number VS-15194

h. Tires
- Type tread .... 8 ply nylon cord, non-skid
- Size .... 32 in. x 8 in.
- Inflation pressure (for gross wt. of 12,000 lbs.) .... 90 psi
- Inflation pressure (for max. load of approx. 15,800 lbs. .... 120 psi

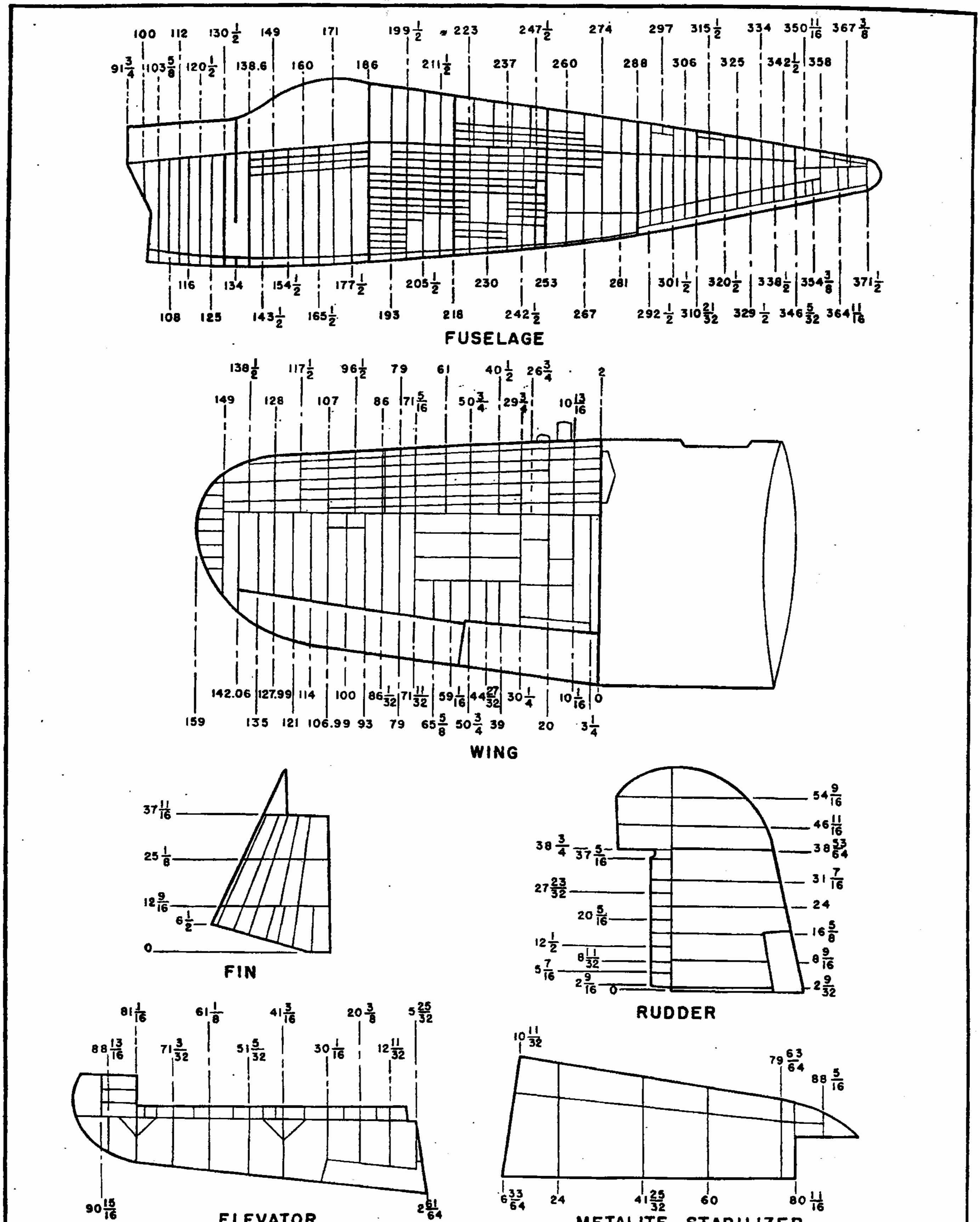


Figure 1—2. Stations and Frames Diagram.

i. Brakes
- Type .... Multiple disc, low pressure – Goodyear No. 510807
- Actuating medium – mineral oil Specification .... AN-O-366 (red fluid)
- Chance Vought Part Number VS-15195

1–19. TAIL GEAR.

a. Type .... Full swiveling, hydraulically retractable, with locking device

b. Shock Strut
- Type .... Oleo pneumatic
- Maker .... Bendix Products Division of Bendix Aviation Corporation
- Model .... Chance Vought Part No. VS-41371
- Fluid Required .... Mineral oil
- AN Specification Number .... AN-O-366 (red fluid)

c. Strut Lengths (from top of strut to centerline of axle)
- Fully extended .... 29 3/16 in. (+ or −1/16 in.)
- Static .... 27 in. (+ or −1/4 in.)
- Fully compressed .... 20 11/16 in. (+ or −1/16 in.)

d. Air Pressure (approx. max. psi) .... 3000 psi

e. Wheel
- Type .... Solid
- Size .... 8-1/2 in. x 4 in.

f. Tire .... none

1–20. ENGINE.

a. Designation .... Pratt and Whitney R-2800-32W

b. Propeller Speed to Engine Speed 0.450:1

c. Fuel .... Spec. AN-F-48, Grade 115/145

d. Oil .... Spec. AN-O-8, Grade 1100/1120

1–21. SUPERCHARGER.

a. Type .... Dual stage, variable speed

b. Number Required .... one

c. Oil .... Spec. AN-O-8, Grade 1100/1120

1–22. PROPELLER.

a. Manufacturer .... Hamilton Standard

b. Type .... Constant speed, 4 bladed, Hydromatic

c. Hub .... Hamilton Standard No. 24E60-159

d. Diameter .... 13 ft. 2 in.

e. Propeller Governor Control .... Hamilton Standard No. 4U18-S20G

f. Blades .... Hamilton Standard No. 6837A-O

g. Pitch Setting (at 42 in. station)
- Low .... 27°
- High .... 65°

1–23. TANK CAPACITIES.

a. Fuel
- Main tank .... 234 U. S. Gal.
- External Auxiliary Fuel Tanks (each tank) .... 150 U. S. Gal.

b. Oil (one tank) .... 27.5 U. S. Gal.

c. Hydraulic Reservoir (Spec. AN-O-366, red fluid)
- Tank Capacity (one tank) .... 8-3/4 qt.

d. Water Injection Fluid (two tanks – total) .... 28 U. S. Gal.

e. Oxygen Cylinder
- Number .... One
- Size (capacity) .... 514 cu. in.

SECTION II

SHIPMENT AND ERECTION PROCEDURE

2–1. SHIPMENT.

2–2. GENERAL. *(See figure 2–1.)* The F4U-5 airplanes are to ferried to the port of embarkation and from there shipped fully assembled as an aircraft carrier deck load.

a. As a fully assembled aircraft carrier deck load, the wings of the airplane are folded (see paragraph 4–1105), jury struts are installed (see paragraph 3–10), the wheels are chocked and the airplane moored in accordance with current aircraft directives. Refer to figure 1–1 for overall airplane dimensions establishing required shipping space and clearances. Refer to paragraphs 3–32 through 3–42 for recommended towing and tie-down procedures. The gross weight of the F4U-5 airplane is approximately 12,900 pounds, and a derrick of sufficient hoisting capacity to handle this load safely shall be employed to hoist the airplane to the carrier deck. Refer to paragraph 3–15 for recommended procedure of hoisting the entire airplane.

b. Due to the corrosive and deteriorating effects of sea air, water, adverse weather conditions and handling incidental to shipping, as well as to prevent corrosion (particularly in the engine and power plant section caused by periods of idleness), a thorough preservation of the entire airplane is essential.

2–3. PRESERVING AND PROTECTING THE AIRPLANE FOR SHIPMENT AS AN UNCRATED DECK LOAD.

2–4. GENERAL. Aboard ship, the airplane as a deck load in the fully assembled state is particularly liable to corrosion and deterioration. In order to insure arrival of the airplane at its destination in a satisfactory condition, a careful procedure of preservation and protection should be carried out. In general, this consists of cleaning, lubricating, and coating with corrosion preventive compounds, all critical parts of the airplane.

a. Never coat rubber or synthetic rubber with corrosion preventive compounds. To prevent rubber from coming in contact with these compounds, protect exposed tires, etc., with tape, a suitable coating, or canvas covers. Small rubber parts such as rubber insulated wires need not, however, be masked to prevent accidental overspray.

b. Doped fabric will deteriorate markedly from contact with corrosion preventive compounds. Take care in the application of compounds that fabric covered surfaces are not coated. Temporary canvas covers are convenient.

c. Where disassembly is necessary, all bolts, nuts, lock washers, and other hardware and fittings must be replaced in the holes or in the assembly from which they were taken, if practicable. Place hardware that must necessarily be removed, in substantial cloth bags, properly identified, and tied to the part from which it was removed. All such hardware must be coated with preservative compound, Spec. AN-C-124 or AN-C-52. Close all tubing that is open as a result of disassembly with plugs or cap in accordance with Technical Order 37-44. Fasten securely all tubing and disconnected parts to prevent chafing during shipment.

d. Coat all non-moving external unpainted metal parts exposed to spray and weather, such as assembly bolts, nuts, and safety wire with type I or type II compound conforming to Spec. AN-C-124 or grade B aluminum soap grease conforming to Spec. AN-G-4.

e. Do not apply corrosion preventive compound to painted metal parts.

f. Planes should be moored in accordance with current Navy directives and field policy. Make certain that airplane is moored in a position facing into prevailing wind whenever practical; with wing lift reduced to a minimum; airplane securely anchored to prevent lateral and perpendicular movement; main wheels securely chocked fore and aft and tail wheel locked in position; parking brake set and controls locked.

g. Where installation of dehydrator plugs is called for, the seating torque shall be applied as follows:

Dehydrator Plug No.	*Seating Torque Lb. In.*
AN4060-1	25
AN4060-2	25
AN4061-1	45
AN4061-2	45
AN4061-3	45 (to normal engagement)
AN4064-1	18

2–5. PREPARING THE AIRPLANE FOR PRESERVING.

a. Clean interior of airplane.

b. Clean exterior of airplane.

c. Remove ammunition and radio destructor, if present.

d. Touch up any scratches or scars with primer and paint. Refer to paragraph 4–1884.

e. Inflate tires.

f. Fill oxygen cylinder. Refer to paragraph 3–79.

g. Disconnect battery, charge fully, and coat terminals with grease, Spec. AN-G-15.

h. Repair any corroded or damaged parts.

i. Lubricate the entire airplane. Refer to figure 3–14 for lubrication points.

j. Prepare a complete inventory of the airplane.

2–6. PRESERVING AND PROTECTING WING.

a. Seal all seams, link ejection chute and case ejection chute opening, on the wings with Spec. AN-T-12 tape. Cover edges of upper and lower match angles and abutting edges of ailerons and flaps with oilcloth and Spec. AN-T-12 tape. Thoroughly mask flap gap doors.

b. Cover the glass and metal surfaces of the wing lights with Spec. AN-P-13a paper. Cover the greaseproof paper with waterproof paper or oilcloth and secure with Spec. AN-T-12 tape.

Note

After application of the tape, if necessary, brush a coat of solvent conforming to Federal Spec. No. PS-661 to improve adhesion.

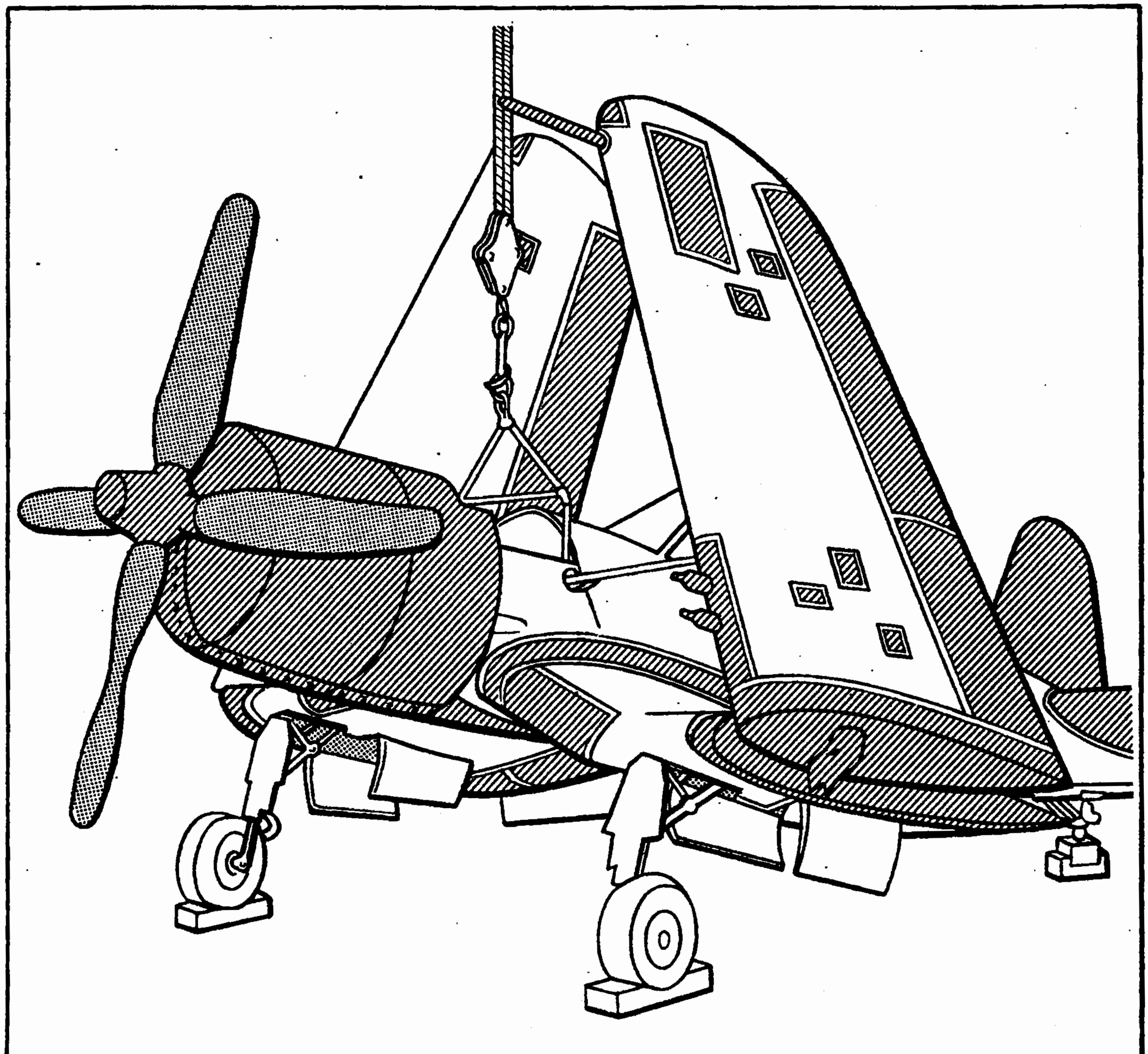


Figure 2–1. Carrier Deck Load.

c. Seal flap downlock indicator with AN-T-12 tape.

d. Fold the wings and install jury struts; see paragraph 3—10.

e. Install dehydrating agent in recesses of the wing butts and cover with plywood panels. Seal with oilcloth and Spec. AN-T-12 tape.

2—7. PRESERVING AND PROTECTING EMPENNAGE.

a. Wrap the stabilizers and elevators in oilcloth. Seal the edges and openings on the wrapping with Spec. AN-T-12 tape. Wind tape lightly around to keep the wrapping in place.

b. Install battens and wrap the rudder and fin in oilcloth. Seal the edges and openings on the wrapping with AN-T-12 tape. Use additional tape, wound around to keep the wrapping in place.

2—8. PRESERVING AND PROTECTING SURFACE CONTROLS.

a. Lock all control surfaces and flaps or secure with battens to prevent movement.

b. Oil all piano hinges with Type II compound, conforming to Spec. AN-VV-C-576.

c. Coat the chains in the control mechanisms with AN-G-3 grease.

d. Cover the butt edges of the ailerons and flaps with oilcloth and AN-T-12 tape.

2—9. PRESERVING AND PROTECTING FUSELAGE.

a. Pack dehydrating agent around the instrument and control panels; cover them with waterproof paper.

b. Anchor Silica Gel bags (Spec. AN-D-6 Type V), in quantities necessary to maintain twenty per cent humidity for the location, to the interior side of all access panels and doors.

c. Seal all access panels (except bottom access door, see paragraph 2—39) and doors with oilcloth and Spec. AN-T-12 tape.

d. Seal all drain holes with Spec. AN-T-12 tape.

e. Install plywood panels with attached dehydrating agent in the wing leading edge air entrance ducts. Cover them with oilcloth and seal with Spec. AN-T-12 tape.

f. Cover the intercooler flap and oil cooler air exit doors with oilcloth and secure with Spec. AN-T-12 tape.

g. If the baggage compartment is used for storage, be sure to install dehydrating agent.

h. Wrap the tail cone in oilcloth. Seal the edges with Spec. AN-T-12 tape. Seal the fairings and all possible openings on fairings with Spec. AN-T-12 tape.

Note

If necessary, after application of Spec. AN-T-12 tape, brush a coat of solvent conforming to Federal Spec. No. PS-661 to improve adhesion.

2—10. PRESERVING AND PROTECTING MAIN LANDING GEAR.

a. Coat the bright steel working parts of the landing gear, shock strut pistons, and locking devices with AN-G-15 or AN-G-5 grease.

b. Install dehydrating bags in the main wheel wells. Seal the wells with plywood panels and oilcloth and secure with Spec. AN-T-12 tape.

2—11. PRESERVING AND PROTECTING TAIL GEAR AND ARRESTING HOOK.

a. Coat the bright steel working parts of the tail gear, shock strut piston, and locking device with AN-G-15 or AN-G-5 grease.

b. Place the tail wheel in a plywood encasement built up from the wheel chock. Cover the tail wheel doors with oilcloth secured with AN-T-12 tape. Install dehydrating agent and cover the tail wheel and the arresting hook cavity with plywood. Place oilcloth over the plywood and seal it with Spec. AN-T-12 tape.

2—12. PRESERVING AND PROTECTING WHEELS, TIRES, AND BRAKES.

a. Clean tires and paint with tire paint.

b. Dismount the wheels and remove the brakes. Clean the wheels and, if necessary, anodize, prime, and paint. Coat thoroughly with Spec. AN-C-52 Type I compound. After the compound has hardened, coat the clips for the brake ears and the clip retaining ring with hot AN-C-52, Type II compound. Do not coat the bearings and interior of the hubs with corrosion-preventive compound but pack with grease, Spec. AN-G-5. Remount the wheels without brakes and install plywood covers on the outboard surfaces sealed with oilcloth and Spec. AN-T-12 tape.

c. Coat brake discs with internal preservative compound, Spec. AN-VV-C-576. The discs shall then be wrapped in Spec. AN-P-12 grease-proof paper, packed in a carton and stowed securely in the cockpit. The insulating discs in each assembly are not subject to corrosion. They shall be wrapped separately in waterproof paper and stowed with the others.

2—13. PRESERVING AND PROTECTING ENGINE COWLING.

a. A can or container may be hung at the lower rear edge of the engine cowl flaps to collect any oil which may drip from the engine to keep it off the decks and any installed oil covers.

b. Install engine cover (VS-55001) and propeller hub cover (VS-45064) after preserving original as directed in paragraphs 2—14 through 2—26.

c. Refer to paragraph 2—14 for further information.

2—14. PRESERVING AND PROTECTING POWER PLANT. In order to prevent corrosion in the engine, during periods of idleness, the engine must be properly preserved and protected. If it is definitely known that the airplane will be inoperative for more than one day, but will be operated within four days, follow procedure described in paragraph 2–15. When it is definitely known that the airplane will be inoperative for more than four days but will be operated within thirty days, preserve and protect the engine in accordance with paragraph 2–16. For engines stored for more than thirty days, follow the procedure described in paragraph 2–17.

Note

The preservative compound (oil mixture) referred to in paragraphs 2–16 through 2–18 shall be 25 percent, Spec. AN-VV-C-576, Type I compound and 75 percent AN-O-8 oil of the grade specified, or Spec. AN-VV-C-576 Type II, which is already mixed and ready for use.

2–15. ONE TO FOUR DAY ENGINE PRESERVATION. Rotate the propeller shaft on alternate days at least four complete revolutions by hand.

CAUTION

Unless it is definitely known that the airplane will be operated within four days, barring exceptional and unpredictable circumstances, the engine shall be prepared for four to thirty days storage; see paragraph 2–16. If unforseen difficulties arise which prevent the airplane from being flown on or before the fourth day, the engines shall be given a ground run-up of sufficient duration for normal operating temperatures to be attained, after which the engines shall be treated in accordance with the procedure outlined in paragraph 2–16.

2–16. FOUR TO THIRTY DAY ENGINE PRESERVATION. When it is definitely known that the airplane will be inoperative for more than four days, but will be operated within thirty days, the engine shall be treated at the beginning of the period of idleness as described in steps a., b., or c. (according to its condition previous to preservation) and step d., or as described in the alternate procedure in paragraph 2–17.

a. If the oil system has been filled with preservative compound (oil mixture) by the same activity at which the period of idleness will take place and if less than five hours engine time has accumulated on the engine, operate the engine on fuel conforming to service requirements at speeds and power that will produce an oil inlet temperature of 95° to 102°C (203° to 216°F) for 15 minutes. The oil coolers may be blanked off to produce this temperature; however, measures which restrict the flow of air over the engine, such as the closing of cowl flaps, must not be used.

b. If an airplane arrives at a facility with the preservative compound (oil mixture) already in the oil system and/or if more than five hours engine time has acumulated on the engine, drain the oil system and refill with fresh preservative compound (oil mixture). Operate the engine on fuel conforming to service requirements at speeds and power that will produce an oil inlet temperature of 95° to 102°C (203° to 216°F) for 15 minutes. The oil coolers may be blanked off in order to produce this temperature; however do not use measures which restrict flow of air over engine, such as closing the cowl flaps.

c. If an airplane arrives at a facility with preservative compound (oil mixture) already in the oil system and with less than five hours engine time accumulated on the engine, operate the engine as described in step a.

d. Following the preliminary run in accordance with step a., b., or c., ground run the engine on fuel conforming to service requirements at speeds and power to produce an oil inlet temperature of 95° to 102°C (203° to 216°F) for 15 minutes, at periods not exceeding seven days and preferably every six days for the duration of the 30 day period of idleness. This procedure shall in no case be extended beyond 30 days.

2–17. As an alternate preservation process to that described in paragraph 2–16, a., b., or c., and d., use the following procedure:

a. Service the oil system with preservative compound (oil mixture) as described in paragraph 2–16, steps a., b., or c.

b. Remove all spark plugs. Thoroughly spray the exhaust valves with corrosion preventive mixture through the spark plug holes with the exhaust valves fully open. This can be accomplished by the use of a spray gun, extreme care being taken to insure that dry air is used. Hydraulic pressure may be used, if desired. Upon completion of these operations, rotate the crankshaft at least four revolutions to thoroughly work the corrosion preventive mixture into the valve guides. Corrosion preventive mixture shall then be sprayed into the cylinder through the spark plug holes, with the piston at the bottom of the stroke, in such a manner as to cover all interior surfaces. This shall be followed by an additional spraying of each cylinder, without rotating the crankshaft. Should the crankshaft be rotated hereafter, the procedure must be repeated. Install cylinder dehydrator plugs, conforming to Drawing AN4062, into the spark plug holes.

c. Place a minimum of one pound of dehydrating agent, Spec. AN-D-6, Type V, in the exhaust outlet and carburetor air intake. Anchor firmly. Cover the ends with a suitably anchored double thickness of moisture-resistant material conforming to Spec. AN-P-54 or Spec. AN-C-67. Firmly attach the dehydrating agent to a plainly evident tag or to the opening cover. Cover all openings with suitable moisture-resistant plugs or covers. Tape, Spec. AN-T-12, may be used. Cover the engine with the waterproof and dustproof engine cover VS-55001 supplied with Ground Handling Equipment—Loose Accumulations.

d. Place a warning tag or plate in the most conspicuous place in the cockpit, stating that the engine shall not be rotated or operated until all dehydrating materials have been removed from the engine. Attach a similar warning tag to the propeller shaft.

2—18. PRESERVING ENGINE INOPERATIVE OVER 30 DAYS. When it is not definitely known that the airplane will be operated within 30 days, the engine shall be given the following treatment:

a. Drain the oil in the engine and oil tank into a clean container.

Note

This oil may be used to reservice the aircraft upon return to service.

b. Fill the oil tank with a sufficient quantity of corrosion preventive mixture to insure lubrication during the running period. Blank off the oil coolers in order to produce the maximum permissible oil temperature. Then run the engine for at least 15 minutes, at speed and power to produce 95° to 102°C (203° to 216°F) oil inlet temperature, on fuel conforming to service requirements, while using the corrosion preventive mixture as a lubricant.

c. While the engine is still warm, drain the corrosion preventive mixture from the crankcase, strainer, and sumps. Remove screens and strainer; clean, reoil, and replace. Replace and safety all drain plugs.

d. Spray each exhaust port with a sufficient quantity of corrosion preventive mixture to thoroughly coat the exhaust valve. This spraying should be accomplished through the spark plug holes with the exhaust valve fully open. Place one bag, containing 1/2 pound dehydrating agent conforming to Spec. AN-D-6 Type V, in the exhaust opening of the exhaust manifold. Anchor the bag in place and seal the opening by covering with an oil and moisture-resistant diaphragm conforming to Spec. AN-P-54 or Spec. AN-C-67.

e. Seal the oil intake and outlet with suitable oil and moisture-resistant blank caps or covers of appropriate size.

f. Seal the breather openings in the engine against oil and moisture by means of suitable oil and moisture-resistant covers or dehydrating plugs. Tape conforming to Spec. AN-T-12 may be used.

g. Remove the oil sump plug and replace with a crankcase dehydrator plug, Pratt and Whitney No. 72688. Attach the replaced plug to the sump.

h. The carburetor need not be removed. However, drain the carburetor of residual fuel and flush with lubricating oil, Grade 1065, Spec. AN-O-8, as follows. Disconnect fuel line. Drain fuel by removing drain plugs from bottom and vent plugs from top of regulator and fuel control units. Replace drain plugs and introduce lubricating oil through fuel inlet until oil flows from vents of regulator and control units. Set the carburetor in the automatic rich position with the regulator vents closed. Inject oil by pressure into the fuel inlet. Drain oil. Replace and secure all drain and vent plugs. Coat fuel pressure diaphragms, which are not part of the carburetor and which would not be acted upon by flushing the carburetor, with oil conforming to Grade 1065, Spec. AN-O-6.

CAUTION

Do not exceed 8 psi, as damage to the diaphragm in the carburetor may result.

i. Inject oil conforming to Grade 1065, Spec. AN-O-6 into the fuel pump, while rotating the shaft of the engine in order to insure complete coverage of the fuel pump parts. Leave the fuel lines of the airplane fuel system disconnected and close the openings in the carburetor and fuel lines with suitable plugs.

j. Treat all cylinder bores and openings as described in paragraph 2—17b.

k. Cover the engine with the engine cover and fasten securely. Inspect the condition of the cylinder and crankcase dehydrator plugs every seven days and replace plugs at any time that they indicate a relative humidity above 20 percent, as shown by comparison with a humidity indicator color card conforming to Drawing AN7514. At the same time, replace the dehydrator bags in the air intake and exhaust manifolds. If frequent replacement of a given plug is necessary, that section of engine concerned should be examined for moisture tightness.

l. Place a warning tag or plate in the most conspicuous position in the cockpit, stating that the engine shall not be turned over or operated until all dehydrating materials have been removed from the engine. Fasten a similar warning tag to the propeller shaft.

2—19. PRESERVING AND PROTECTING AIR INDUCTION SYSTEM.

a. Remove the carburetor air box (see paragraph 4—558) and stow within the fuselage.

b. Install a one-pound bag of Type V dehydrating agent, Spec. AN-D-6 in each exhaust manifold opening and carburetor air intake, in such a manner that it will be removed with cover or observed when the cover is removed.

c. Completely seal the air induction system with a double thickness of Type I or a single thickness of Type II moisture vapor sheet barrier material, conforming to Spec. AN-B-20, and held in place with Grade A, Type I tape, Spec. AN-T-12.

d. Place a tag on the covering of each sealed opening that contains dehydrating agent, stating the exact number of bags of dehydrating agent enclosed in the sealed opening.

Note

Use extreme care in handling activated dehydrating agent to prevent impairment of its useful absorptive capacity by premature exposure to the atmosphere. The silica dehydrating agent or dissicant begins to absorb moisture immediately upon exposure to the atmosphere. It must, therefore, be kept in its moisture-proof shipping can until immediately before use. The can should be resealed carefully after each use to protect any unused bags remaining in the can.

2—20. PRESERVING AND PROTECTING ENGINE WATER INJECTION SYSTEM. Use the following procedure for water injection system preservation without the unit being removed from the aircraft or engine, with the water regulator removed from the carburetor and without running the engine:

a. Remove the drain cover and gasket located on the bottom of the regulator and held by one 1/4 inch stud.

b. Remove the 1/8 inch NPT (National Pipe Thread) vapor vent return plug.

c. Remove the 1/2 inch NPT water inlet plug.

d. Loosen only those water metering valve cover screws which hold down the metered and unmetered fuel channel cover plate.

e. Remove the 1/8 inch NPT plug in the water metering valve cover, and replace it with a special plug incorporating a pin to displace the diaphragm and metering valve.

Note

Special plug is made by drilling and tapping for an AN 520-6-24 screw through the center of an AN 913-1D pipe thread plug. It should be distinctly marked so that there is no danger of leaving it in on completion of preserving procedure.

f. Rotate the water regulator until no further fuel or water drains out. Air pressure, not to exceed 15 psi may be introduced into the 1/2 inch NPT water inlet to assure removal of all fuel or water.

g. Apply oil pressure, not in excess of 15 psi, into the 1/2" NPT inlet connection.

CAUTION

Do not allow oil to enter the electric switch spacer vent hole or electrical connectors.

h. Restrict the flow of oil from the water regulator check valve so that sufficient pressure is built up to permit oil to flow through the reset valve passages. This can be noted by observing oil flow out of the drain passages nearest the reset switch.

i. When the bubble-free oil is noted at the vapor vent tap and drain cover holes, replace the 1/8 inch NPT plug and drain cover respectively. Allow oil to continue to discharge from check valve for 30 seconds.

j. Place the regulator so that the switch box is on top, and apply an oil pressure of from 3 to 5 psi to the metered and scoop vent passages on the water regulator mounting pad. These passages are the two end holes of the three in a line. Continue applying oil pressure until bubble-free oil is noted coming out from under the plate cover mentioned in step d.

k. Remove the special plug mentioned in step e, reinstall plugs and covers, and safety wire.

l. Reinstall the regulator on the carburetor using a copper gasket VS-53686 between the water regulator gasket, and another water regulator gasket added to the mounting pad of the carburetor.

Note

Place in the pilot's cockpit in a conspicuous place a tag bearing the following inscription: "Water injection system preserved. Remove copper gasket between carburetor and water regulator before using."

m. Fill the water tanks with oil, Spec. AN-VV-O-446 Grade 1065. Run the water pump until oil flows freely out of the discharge line.

n. Remove, clean, re-oil and reinstall strainer.

o. Remove plugs in the bottom of the tanks and drain oil. Reinstall plugs and reconnect the pump discharge line.

p. Safety wire the water injection master switch in the "OFF" position.

2—21. PRESERVING AND PROTECTING ENGINE CONTROLS. No special preserving and protecting procedure is necessary for the engine controls.

2—22. PRESERVING AND PROTECTING PROPELLER AND ACCESSORIES.

a. Operate propeller throughout entire pitch range of operation during last operation of engine prior to idleness.

b. Propellers shall remain installed. Bright metal portions of the propeller blades, hub, and dome shall be protected by painting with non-specular black paint. All bright metal parts not so painted shall be preserved with material conforming to Spec. AN-C-124 or AN-G-4, Grade B grease.

c. Place a card on the propeller reading as follows: "ENGINE PRESERVED, DO NOT MOVE PROPELLER."

2—23. PRESERVING AND PROTECTING STARTING SYSTEM. Refer to paragraph 2—35 PRESERVING AND PROTECTING ELECTRICAL SYSTEM.

2—24. PRESERVING AND PROTECTING OIL SYSTEM. Refer to paragraphs 2—14 through 2—18 PRESERVING AND PROTECTING POWER PLANT.

Note

Do NOT remove the oil sump plug and replace it with a crankcase dehydrator plug since the corrosion preventive compound is not drained from the oil tank.

2—25. PRESERVING AND PROTECTING FUEL SYSTEM.

a. Drain the main fuel cell. Refer to paragraph 3—52.

WARNING

All fuel lines shall be drained and purged with carbon dioxide. Drain fuel transfer system if external auxiliary fuel tanks have been used; drain and purge fuel lines to heater.

b. Spray inside surface of fuel cell with a light coat of Grade 1042 engine lubricating oil, Spec. AN-O-8.

c. Fill the main fuel cell slowly with carbon dioxide by placing hose at the bottom of the cell. Blank off the defueling valve when CO_2 begins to flow from it. Allow air to escape from the vent and filler openings. Since the CO_2 is heavier than the air, air will be forced out at the top of the cell.

CAUTION

The CO_2 pressure must not exceed 1.0 pounds at any time or the cell will be ruptured. Use a hand valve and .064 inch orifice to keep the pressure under control.

d. Take readings on an explosion meter throughout the interior of the tank. When a 100% inexplosive reading is obtained, put a filler cap on, but DO NOT seal the vent openings. Place a red "DANGER" tag on the cell until it has been purged. When these operations are completed, attach a white tag bearing the date of purging.

2–26. PRESERVING AND PROTECTING HYDRAULIC SYSTEM. Fill the hydraulic system. Refer to paragraph 4–911.

2–27. PRESERVING AND PROTECTING INSTRUMENTS.

a. All instruments, indicators, transmitters, and accessory components are to remain installed.

b. Fit pitot head with waterproof canvas cover, or tape with a double thickness of tape conforming to Spec. AN-T-12, Type I, Grade A or B, to prevent the entrance of foreign matter. Seal the opening and the static vent on the left hand side of the fuselage at Station 256 with Spec. AN-T-12 tape. Use paper under the tape to prevent clogging. Coat with Spec. AN-C-52 compound. Seal the supporting tube and system lines in the same manner. Use oilcloth for exterior wrapping.

c. Cage the P-3 gyro flux gate compass by means of the switch installed to the right of the indicator on the instrument panel.

d. Seal the anti-blackout vent on the left side of the fuselage at the trailing edge of the center section flap with Spec. AN-T-12 tape.

e. If not already installed, a pilfer-proof clock installation shall be made as follows: (1) countersink the mounting holes in the instrument panel sufficiently to allow the 100 degree countersunk non-magnetic screws to be flush with the panel; (2) secure the clock to the instrument panel using screws conforming to AN507-B632R13 (Phillips head); (3) drill out the slots in the screw heads with a 5/32 drill.

2–28. PRESERVING AND PROTECTING FUSELAGE EQUIPMENT.

a. Stow all loose gear and equipment in the fuselage, and secure to prevent shifting. Stow gear in such a manner that it will not be damaged by personnel entering the cockpit.

2–29. PRESERVING AND PROTECTING HEATING AND VENTILATING EQUIPMENT. Seal the heater ram air intake (located in left center section air intake), heater exhaust overboard line and heater fuel overboard line with Spec. AN-T-12 Tape. No additional procedure is necessary to preserve and protect the heating and ventilating equipment beyond the general preservation described in paragraph 2–4.

2–30. PRESERVING AND PROTECTING OXYGEN SYSTEM. Fill the oxygen cylinder. Refer to paragraph 3–79 for procedure.

2–31. PRESERVING AND PROTECTING ARMAMENT. If guns are to be shipped installed in the airplane, preservative action must be taken in accordance with paragraph 2–32. For the preservation of guns over long storage periods when frequent inspection is impractical, the guns should be removed and packaged in accordance with approved Navy specifications. This consists, in brief, of the following procedure:

a. Disassemble, clean, and dip guns in the lubricating preservative, medium oil, Spec. O.S.-1363.

b. Wrap guns in Grade C, Type I, greaseproof barrier material (AN Spec. P-121) to form a conforming wrap about the entire gun and cradle. All edges of the wrap should be firmly pressed together to form an unbroken package.

c. Dip the wrapped gun in sealing dip coating compound, AN Spec. P-115 and store in a wooden gun box.

d. An alternate method of preserving guns for long storage periods consists of lubricating with special lubricating preservative oil Spec. O.S. 1361, and packing with a disicant (moisture-absorbing medium) within a moisture-barrier envelope. The quantity of disicant originally furnished should give protection against corrosion under average storage conditions for a period of 18 months. An indicator is packed within each envelope to allow ready determination of the relative humidity within the envelope.

2–32. PRESERVING AND PROTECTING ARMAMENT – GUNS INSTALLED.

a. Remove the guns from the airplane, taking care not to disturb the bore sight adjustments. Refer to paragraph 4–1729 for removal procedure.

b. Tag each gun so it can be identified and installed in the same location and in the same airplane from which it was removed.

c. Disassemble, clean gun, and dip in medium preservative lubricating oil, Spec. O.S. 1365.

d. Wrap the gun solenoids, heater, and hydraulic chargers in greaseproof paper, Spec. AN-P-12, seal with tape, Spec. AN-T-12, and lash them down in an ammunition box or in the gun bay.

e. Wrap all electrical connections with tape, Spec. AN-T-12.

f. Reinstall the guns in their proper locations. Touch up exterior surfaces with AN-C-52 compound where preservative film has been disturbed by handling.

g. Pack dehydrating agent, Spec. AN-D-6 Type V around guns and tag with date of preservation.

h. Wrap protruding gun barrels securely with greaseproof paper, Spec. AN-P-12 and oilcloth and seal with tape, Spec. AN-T-12.

i. Seal gun ports with oilcloth and tape, Spec. AN-T-12.

j. Cover the gunsight with oilcloth and seal securely with tape, Spec. AN-T-12.

k. Inspect guns every four days if installed in aircraft parked outdoors, and every seven days if installed in aircraft stored indoors. Adverse weather conditions may require more frequent inspection. Special attention should be given the bore, chamber, gas cylinder piston, and breechblock for signs of rusting. If inspection reveals signs of corrosion, the gun should be cleaned thoroughly and the rust-preservative coating renewed.

Note

When installed guns are not to be fired for a month or more, they shall be removed, disassembled, cleaned and dipped in medium preservative lubricating oil, Spec. O.S. 1365. Guns thus oiled should be inspected every seven days if stored outdoors and every twenty days, if stored outdoors and every twenty days, if stored indoors. More frequent inspection may be necessary under adverse climatic conditions.

2—33. PRESERVING AND PROTECTING GUN CAMERA.

a. If the installed gun camera has not previously been preserved, remove the camera from the mount; see paragraph 4—1822.

Note

Avoid any unnecessary handling. Perspiration may cause contamination of the part.

b. Enclose the entire unit in a moisture-vapor-impervious container and dry the enclosed air to 20 per cent or less humidity with Spec. AN-D-6 dehydrating agent.

2—34. PRESERVING AND PROTECTING PYLONS AND SHACKLES, AND MK 9 LAUNCHERS.

a. Disconnect electrical connections and seal the receptacle and terminal plug with AN-T-12 tape.

b. Wrap the electrical release mechanism with waterproof paper and seal with tape.

c. Spray or paint the castings and inside of fairings with AN-C-52 compound. Pack with dehydrating agent.

d. Replace fairings and cover the entire assembly with oilcloth, and secure and seal with AN-T-12 tape.

2—35. PRESERVING AND PROTECTING ELECTRICAL SYSTEM.

a. Coat the unpainted metal flexible shielding on electrical cables with preservative compound, Spec. AN-C-52, when there is possibility of exposure to salt spray. If Type I compound is used, apply with as little solvent as possible so that penetration will be kept at a minimum.

b. The interior of electrical cable connectors shall be waterproofed in accordance with T.O. No. 64-45. Unpainted connectors, exposed to the weather, shall have their exteriors smear-coated with insulating and sealing compound, Spec. AN-C-128. Tighten all connectors as necessary.

2—36. PRESERVING BATTERIES.

a. Check the battery for water content and fill, if necessary.

b. Check the specific gravity of each cell, and, if necessary, recharge before storing.

Note

Idle batteries have a tendency to discharge themselves and should, therefore, always be kept in a fully charged condition. This self-discharge occurs much more rapidly at high temperatures; hence stored, wet batteries should be given a recharge once a month in temperatures below 80°F, and every two weeks in temperatures above 80°F.

c. Disconnect and grease with Spec. AN-G-4, Grade B, battery leads and terminals. Wrap the leads and terminals in AN-P-12 paper and tape them.

d. Clean the battery posts and coat them with grease.

e. Tie the cables away from the battery.

2—37. PRESERVING AND PROTECTING RADIO AND RADAR EQUIPMENT.

a. Check, tag, and cover with oilcloth or reinforced waterproof paper all major units of the radio and radar equipment. Be sure that the covering is adequately secured against moisture with AN-T-12 tape.

b. Remove wire type radio antennas and insulators, coil, and stow within a container inside the fuselage.

c. Remove rod type radio and radar antennas and tape to the pilot's stick. Apply tape, Spec. AN-T-12, Type I, Grade A or B over the mounting sockets.

Note

All gear and equipment which has been stowed in the cockpit or baggage compartment should be secured so as to positively prevent shifting and should be separately tagged, indicating the date and kind of preservation.

2–38. TIRE ROTATION DURING SHIPMENT. Tires shall not be allowed to remain depressed at one area by the weight of the aircraft for more than four weeks. Roll airplane forward or backward a few feet to accomplish this requirement.

2–39. VENTILATION DURING SHIPMENT. Proper ventilation of airplanes will reduce interior sweating. Therefore, maintenance crews should take advantage of conditions which will permit ventilation of the airplane. During storage where dust and rain are not severe, and during shipment when the airplane is not subject to salt spray, do not install canvas covers on the airplane. Bottom doors, through which rain cannot enter, should remain open at all times on stored airplanes. In any case, canvas covers and cockpit enclosures shall be open for at least one clear day per week.

2–40. INSPECTION AND MAINTENANCE CHECK-LIST DURING SHIPMENT. The following list includes the minimum number of items to be inspected and corrected, if necessary, daily during shipment and weekly during storage:

a. Maintain film of corrosion preventive compound on parts requiring such protection.

b. Maintain tire pressures.

c. Maintain charge and level of electrolyte in storage batteries.

d. Check battens and spoiler boards on control surfaces for security.

e. Check tie-downs used to secure the airplanes.

f. Inspect wheels, shock struts and brakes for corrosion.

g. Inspect the engine dehydrator plugs to determine if they have reached 20% relative humidity. When these dehydrator plugs reach 20% relative humidity, they and the dehydrating agent in the air intake and exhaust ducts shall be replaced. At the same time, the engine cylinders, without rotating the crankshaft, shall be resprayed with Type II engine corrosion preventive compound conforming to Spec. AN-VV-C-576. If frequent replacement of a given plug is necessary, the appropriate exhaust port or intake duct (depending upon which valve in the cylinder is open) shall be checked for the adequacy of the moisture-proof sealing.

h. Reoil guns preserved with medium preservative lubricating oil, Spec. O.S. 1363 every three weeks.

2–41. ERECTION.

2–42. GENERAL. Following arrival of the airplane at its destination, a careful process of depreserving, and a rigging check must be carried out, as follows, in addition to a daily, 30, 60 or 120 hour check as deemed necessary by the cognizant activity. Start stripping by removing the tape around the protective coverings of the power plant, cockpit enclosure, or aft section. No solvents should be used around the hull and wing areas, as they affect the finish of the airplane. The entire fuselage interior and exterior should be inspected to see that all fittings, bindings, blocks, etc., which have been used to prevent movement, have been removed.

2–43. DEPRESERVING WING.

a. Strip all tape and protective paper from wing and remove residue from painted surfaces with Stoddard solvent or kerosene.

b. Remove jury struts and unfold wings.

2–44. DEPRESERVING EMPENNAGE.

a. Remove all oilcloth and wrappings, strip off tape and remove residue with Stoddard solvent or kerosene.

b. Remove battens.

2–45. DEPRESERVING SURFACE CONTROLS.

a. Remove battens from control locks.

b. Remove oilcloth and all protective tape and covering. Remove residue with Stoddard solvent or kerosene.

c. Check all surface control throws; refer to applicable portions of paragraphs 4–116 through 4–206.

2–46. DEPRESERVING FUSELAGE.

a. Remove the protective oilcloth, plywood, paper, and tape covers.

CAUTION

Remove all Silica Gel bags.

b. Inspect the structure for dents or other signs of damage. If any damage is discovered, a report of the extent shall be made to the proper authority.

c. If possible, wash entire airplane with fresh water.

d. Clean interior of airplane as necessary for flight.

2–47. DEPRESERVING MAIN LANDING GEAR.

a. Remove protective grease from the bright steel working parts of the landing gear.

b. Remove plywood panels, tape and oilcloth from the main wheel wells and remove dehydrating bags.

2–48. DEPRESERVING TAIL GEAR AND ARRESTING HOOK.

a. Remove protective grease from the tail gear and arresting hook.

b. Remove oilcloth, tape and dehydrating agent from the tail wheel and arresting hook cavity after removing plywood panel.

c. Fill arresting hook dashpot; see paragraph 4–396.

2–49. DEPRESERVING WHEELS, TIRES AND BRAKES.

a. Remove AN-C-52 compound from wheels, and remove grease packing from bearings and interior of hubs, after first stripping tape and removing plywood covers from wheels.

b. Remove grease-proof paper and internal preservative compound, Spec. AN-VV-C-576 from brake discs which have been stored in cockpit. Reassemble brakes.

c. Inspect, repair and adjust brakes as necessary.

2–50. DEPRESERVING ENGINE COWLING.

a. Remove engine cover.

b. Open the cowling and cowl flaps and clean the interior with naphtha or other solvent. Remove all preservative oil mixture.

c. Remove drip can, if hung from engine cowl flaps.

2–51. DEPRESERVING POWER PLANT.

a. Engines installed in airplanes which have been prepared for a storage period of from one to four days need no preparation for service.

b. Engines installed in airplanes which have received the ground run procedure (refer to paragraph 2–16) require no preparation for service. Engines which have been preserved in accordance with the alternate procedure (paragraph 2–17) shall be prepared for service as follows. Remove plugs and cover plates, nipples, wrappings, etc. Before installing the spark plugs, slowly rotate the crankshaft four or five revolutions and observe for proper operation of the valve mechanism; also see that excessive corrosion preventive mixture is not present in the cylinders. Remove any excessive corrosion preventive mixture with a hand pump or by draining. Any valves that are found to be sticking shall have the stems generously lubricated with a mixture of gasoline and lubricating oil. Continue to turn the engine over by hand until all evidence of sticking valves has been eliminated. If the mixture of gasoline and lubricating oil does not free all the valves, necessary repairs shall be made before the engine is placed in service. Install spark plugs, using anti-seize compound (Spec. AN-C-147) on the threads. Avoid using an excessive amount of anti-seize compound. Tighten spark plugs to the recommended torque. Refer to paragraph 4–670 for further information.

2–52. Engines stored for more than 30 days shall receive the following treatment in addition to the treatment outlined in step b. above. Clean the propeller hub and propeller, if treated with the engine. Remove, clean, and replace oil strainer. Remove oil screens, clean in gasoline, dry, reoil and reinstall.

Note

Additional details are contained in Bureau of Aeronautics General Engine Bulletin No. 6.

a. Remove cylinder dehydrator plugs.

b. Remove oil tank and crankcase breather seals.

c. Remove carburetor drain plugs, drain oil. Slush the fuel to be used in service through the inlet connection at 8 psi pressure until no sign of oil is observed in the fuel as it is discharged. By forcing, drain, fill the fuel chambers of both the carburetor and adapter with fuel, install all plugs, allow diaphragm to stand full of fuel for an absolute minimum of eight hours (this soaking is very important to restore flexibility of the diaphragms to prevent flooding and incorrect metering), drain, wipe exposed surfaces, install fuel lines, replace plugs and lock wires, and oil joints and control linkages with Grade 1065 oil (Spec. AN-O-8).

d. As a minimum for pre-oiling the engine (after the oil tank has been checked and is full), rotate propeller thirty complete revolutions with all spark plug holes open. The engine may run for a maximum of thirty hours of flight, using Type II engine corrosion preventive compound, Spec. AN-VV-C-576. Engine operation during this period must not exceed minimum safe takeoff power.

e. Remove protectors and clean spark plug terminal sleeves. (Do not use carbon tetrachloride, alcohol or acetone. Use other non-chlorinated cleaning agents such as kerosene or dry cleaning solvent.)

f. Install new or newly overhauled spark plugs. Leave front plugs out of bottom cylinders, Nos. 7, 8, 9, 10, and 11.

g. Install oil escape valves (engine depreservation valves) in the foregoing front plug holes.

h. Ground check engine without running-up.

i. Check fuel system to see that it is functioning, after first filling fuel cell.

j. Rotate propeller at least four complete revolutions by hand.

k. Inspect engine and engine accessories.

l. Ground run-up for about one minute with engine cowling removed, to remove additional oil from intake pipes, after first observing other depreserving procedures directed in paragraphs 2–53 through 2–59.

m. Check fuel and oil systems for leaks.

n. Remove oil escape valves.

o. Wipe off excess oil on engine exterior.

p. Install remaining spark plugs.

q. Install baffles and engine cowling.

r. Remove tags on front of engine.

s. Ground run-up engine and check (see Pilot's Handbook for F4U-5 Airplane, AN 01-45HD-1).

2–53. DEPRESERVING AIR INDUCTION SYSTEM.

a. Remove all dehydrating material from air induction system, after unsealing openings. Tag on the opening states the exact number of bags enclosed.

b Replace carburetor air duct.

2–54. DEPRESERVING ENGINE WATER INJECTION SYSTEM.

a. Remove drain cover and gasket located on the bottom of the water regulator and held by one 1/4 inch stud. Unsafety water injection master switch.

b. Remove 1/8 inch NPT water vapor vent return plug.

c. Remove 1/2 inch NPT water inlet plug.

d. Loosen only those water metering valve cover screws which hold down the metered and unmetered fuel channel cover plate.

e. Remove 1/8 inch NPT plug in water metering valve cover, and replace with special plug incorporating a pin to displace the diaphragm and metering valve.

Note

Special plug is made by drilling and tapping for an AN 520-6-24 screw through the center of an AN 913-1D pipe thread plug. It should be distinctly marked so that there is no danger of leaving it in on completion of preserving procedure.

f. Drain all oil possible from the water regulator. Air pressure may be introduced into the inlet connections to aid in the removal of the oil. Air pressure must not exceed 15 psi.

g. Restrict the water regulator outlet.

h. Apply clear gasoline to the inlet connection at a pressure not exceeding 15 psi.

i. Allow clear gasoline to flow from the check valve drain cover pad and vapor vent for 1/2 minute.

j. Reinstall drain cover pad and vapor vent plugs and continue applying clear gasoline for one minute.

k. Allow water regulator to stand filled with clear gasoline for two hours.

l. Repeat steps h through j.

m. Drain clear gasoline from the water regulator. Air pressure not exceeding 15 psi may be applied to the inlet to insure the removal of all gasoline.

n. Remove special plug mentioned in step e, reinstall plug and covers. Reinstall water regulator on carburetor.

o. Disconnect and plug the discharge line at the strainer.

p. Use five gallons of clear gasoline in the water tanks; ground airplane.

q. Remove the plug and connect an air hose to discharge line.

r. Remove the water tank filler cap and agitate the gasoline with the air hose connected to the discharge line.

s. Remove the air hose and reconnect the discharge line to the strainer.

t. Start water pump, and pump system dry.

u. Using three gallons of water injection mixture (see paragraph 4—569), repeat steps o, q, r, s, and t.

v. Reinstall outlet lines on water regulator, being sure to remove solid copper gasket and the extra water regulator gasket, between carburetor and water regulator, and retaining the standard water regulator gasket. Clean strainer. System is now ready for operation.

w. Remove water injection preservation tags from cockpit and tank filler neck.

2—55. DEPRESERVING ENGINE CONTROLS. No special depreserving procedure is necessary.

2—56. DEPRESERVING PROPELLER AND AND ACCESSORIES.

a. Remove preserving material from the propeller blades, hub and dome.

2—57. DEPRESERVING STARTING SYSTEM.

a. No depreservation of the starting system is necessary.

2—58. DEPRESERVING OIL SYSTEM.

a. Drain oil tank of corrosion preventive compound and refill with oil, Spec. AN-O-8, Grade 1100/1120; see paragraph 3—56.

Note

Engine may be operated within the limitations of T. O. 48-43, for a maximum of thirty hours of flight using Type II engine corrosion preventive compound, Spec. AN-VV-C-576.

2—59. DEPRESERVING FUEL SYSTEM.

a. Fill fuel cell; see paragraph 3—48.

2—60. DEPRESERVING HYDRAULIC SYSTEM.

a. Check to see that hydraulic tank is full.

2—61. DEPRESERVING INSTRUMENTS.

a. Remove cover or tape from pitot head, and unseal static vent.

b. Compensate compass on airplanes making other than local contact flights.

c. Remove tape from the anti-blackout vent on the left side of the fuselage at the trailing edge of the center section flap.

2—62. DEPRESERVING FUSELAGE EQUIPMENT.

a. Replace and check all equipment stowed in the fuselage.

2—63. DEPRESERVING HEATING AND VENTILATING EQUIPMENT.

a. Untape main ram air intake and overboard outlets.

2—64. DEPRESERVING OXYGEN SYSTEM. No depreservation of the oxygen system is necessary other than checking to see that cylinder is full.

2—65. DEPRESERVING ARMAMENT.

a. Guns which have been stored in accordance with paragraphs 2—32 or 2—31 will be coated with either lubricating, preservative special oil, (Spec. O.S. 1361), or lubricating, preservative medium oil (Spec. O.S. 1363) after shipment and storage.

b. Guns which have been packaged with lubricating preservative special oil require only normal care preparatory to firing.

c. Guns preserved with lubricating preservative medium oil require dry-cleaning solvent, Federal PS-661a, to remove all oil, shop coats, dirt, and other foreign substances from all surfaces.

d. Apply the solvent with rag swabs to large parts, and as a bath for small parts. Take care to remove foreign matter from all recesses in which springs or plugs operate.

CAUTION

Do not dip recoil adapter, rear buffer, or charger (except manual) in cleaning solution, or subject these parts to vapor degreasing. After through cleaning, allow the parts to dry and then wipe with a clean dry rag.

e. Reinstall gun solenoids, heaters and hydraulic chargers (stored in ammunition box or gun bay).

2–66. DEPRESERVING GUN CAMERA.

a. Reinstall gun camera.

2–67. DEPRESERVING PYLONS AND SHACKLES AND MK 9 LAUNCHERS.

a. Remove dehydrating agent from around castings.

b. Remove tape and waterproof paper from electrical release mechanism.

c. Connect all electrical connections disconnected prior to shipment.

2–68. DEPRESERVING ELECTRICAL SYSTEM.

a. Remove AN-C-52 compound with dry cleaning solvent from the unpainted metal flexible shields on electrical cables.

b. Check battery for water content and fill, if necessary; see paragraph 3–75.

c. Connect battery terminals.

2–69. DEPRESERVING RADIO AND RADAR EQUIPMENT.

a. Unwrap radio and radar equipment.

b. Replace antennas.

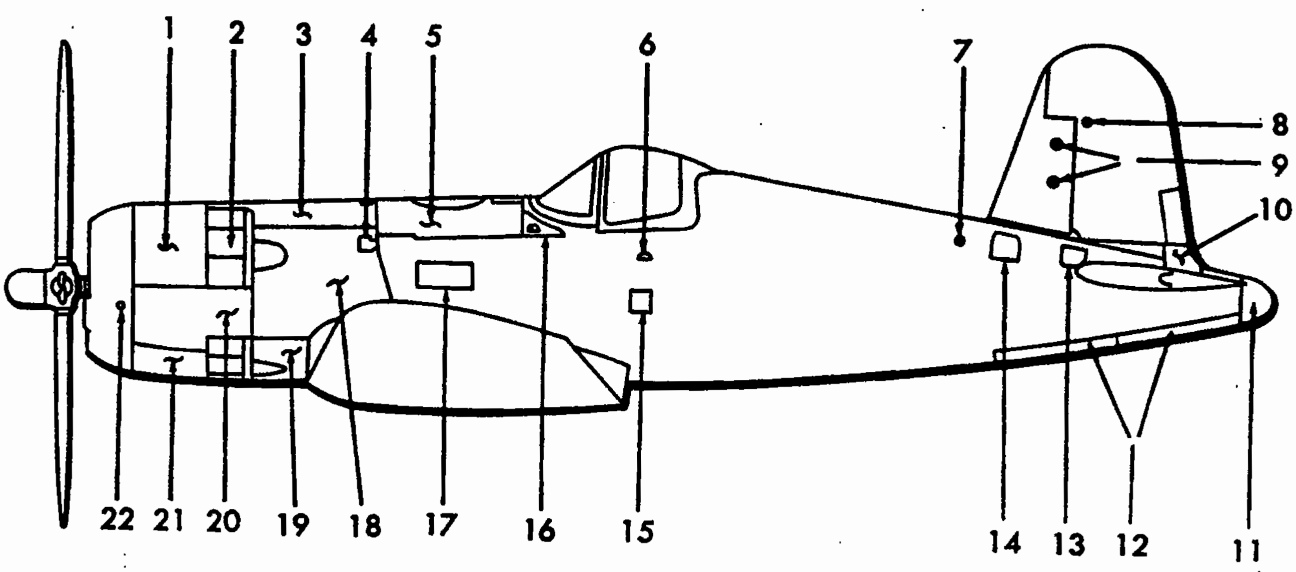
c. Make radio operative and test, if necessary, for the intended immediate flight operation.

SECTION III

GROUND HANDLING AND SERVICING INSTRUCTIONS

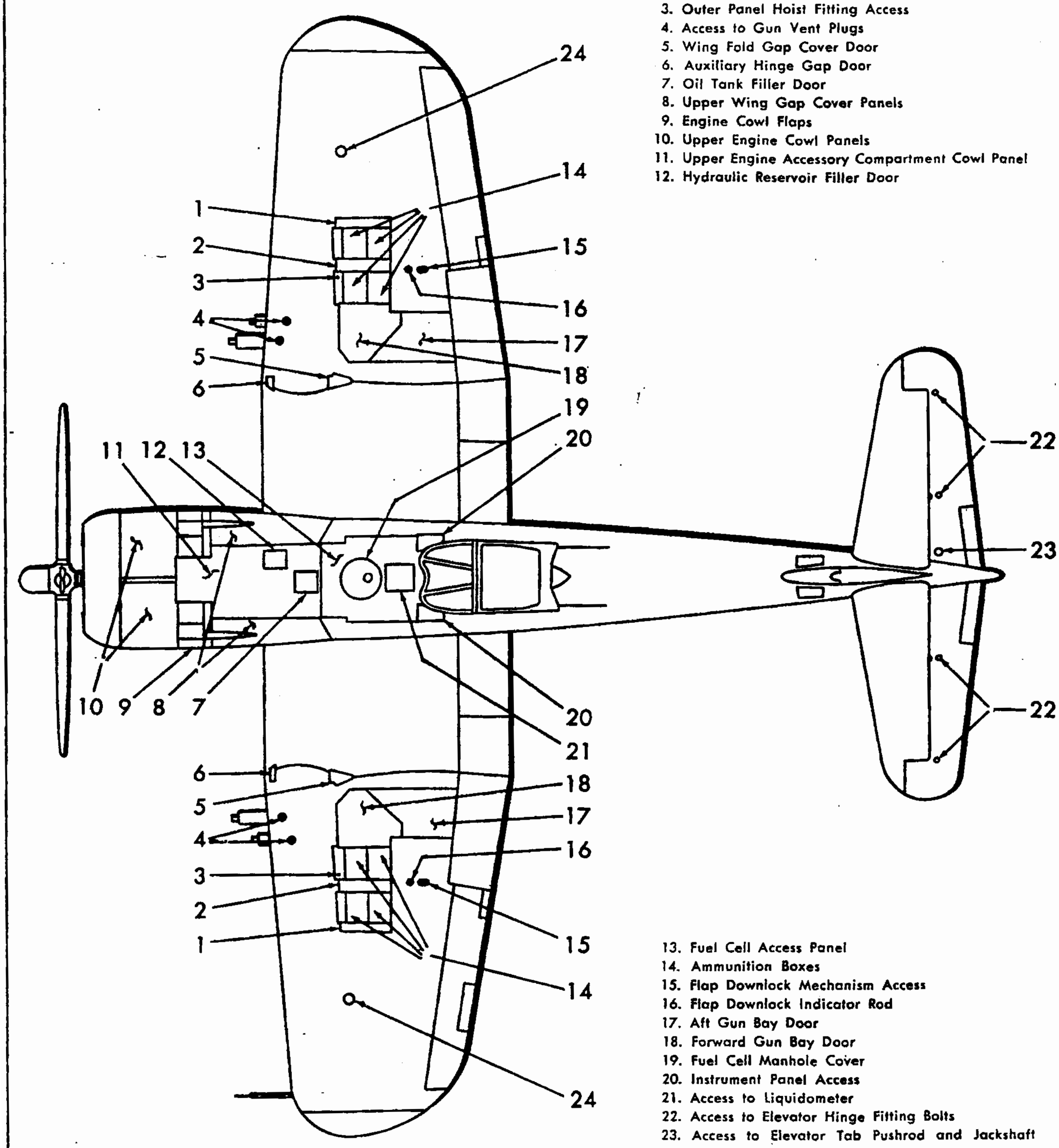
3—1. ACCESS AND INSPECTION PROVISIONS.

3—2. DESCRIPTION. The access and inspection provisions shown on figure 3—1 (sheets 1, 2, 3, and 4), consist of doors, removable panels, plates, etc. which permit quick access to all parts of the airplane requiring frequent inspection or service.



1. Upper Engine Cowl Panel
2. Engine Cowl Flaps
3. Upper Engine Accessory Compartment Cowl Panel
4. Jury Strut Socket Access Door
5. Fuel Cell Access Panel
6. Handgrip
7. Lift Tube Access
8. Access to Upper Rudder Hinge Fitting Bolt
9. Fin Access Handholes
10. Removable Rudder Fairing
11. Tail Cone
12. Tail Wheel Doors
13. Access to Fin and Rudder
14. Upper Access Door—Tail Wheel Compression Strut
15. Mechanics Step
16. Instrument Panel Access
17. Fuel Cell Hanger Door
18. Upper Wing Gap Cover Panel
19. Lower Wing Gap Cover Panel
20. Side Engine Cowl Panel
21. Bottom Engine Cowl Panel
22. Service Beam Support

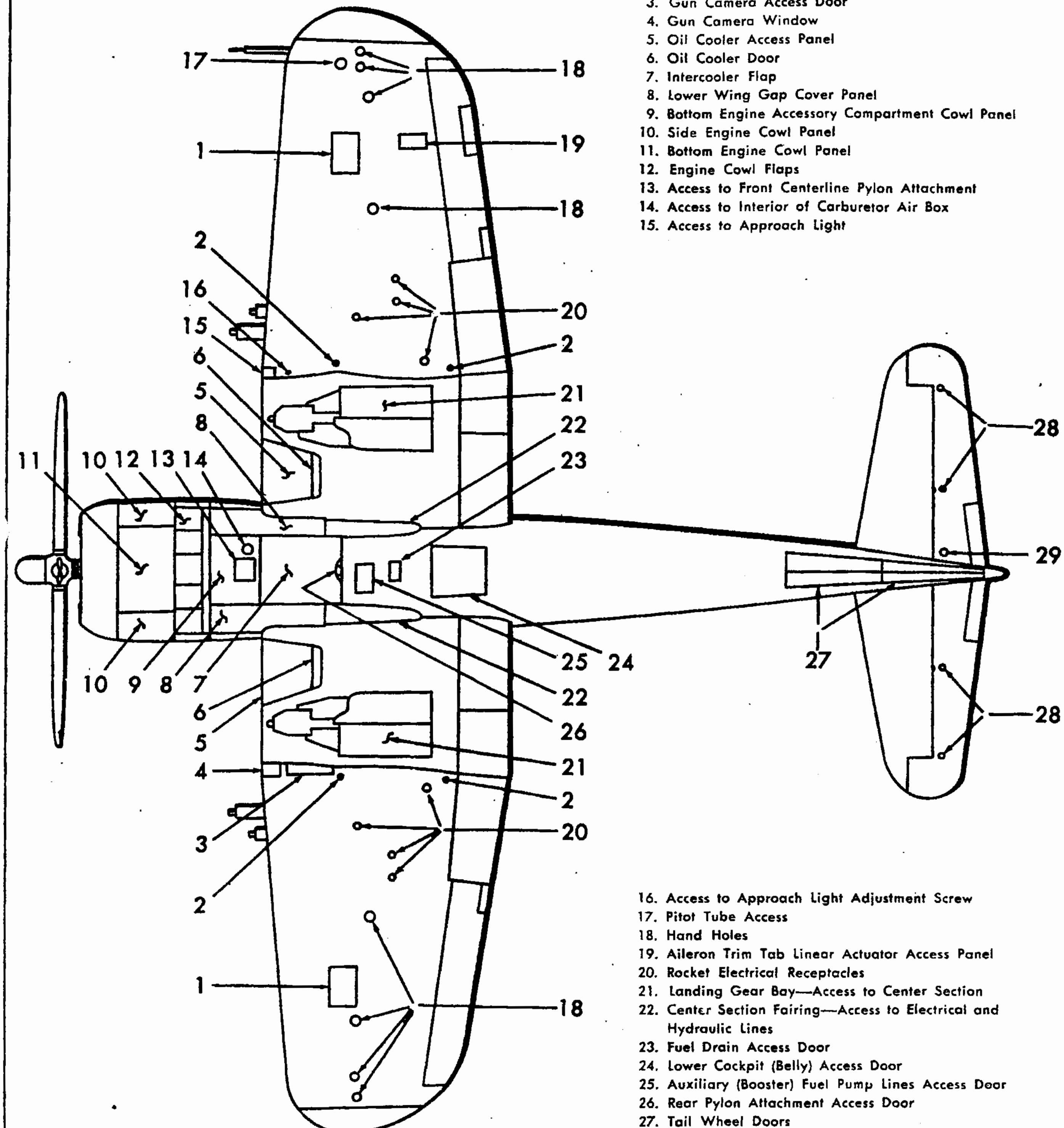
Figure 3—1. (Sheet 1 of 4 Sheets). Access and Inspection Provisions — Left Hand Side.



1. Outboard Gap Cover Door
2. Inboard Gap Cover Door
3. Outer Panel Hoist Fitting Access
4. Access to Gun Vent Plugs
5. Wing Fold Gap Cover Door
6. Auxiliary Hinge Gap Door
7. Oil Tank Filler Door
8. Upper Wing Gap Cover Panels
9. Engine Cowl Flaps
10. Upper Engine Cowl Panels
11. Upper Engine Accessory Compartment Cowl Panel
12. Hydraulic Reservoir Filler Door
13. Fuel Cell Access Panel
14. Ammunition Boxes
15. Flap Downlock Mechanism Access
16. Flap Downlock Indicator Rod
17. Aft Gun Bay Door
18. Forward Gun Bay Door
19. Fuel Cell Manhole Cover
20. Instrument Panel Access
21. Access to Liquidometer
22. Access to Elevator Hinge Fitting Bolts
23. Access to Elevator Tab Pushrod and Jackshaft Fitting
24. Outer Panel Aileron Bellcrank Access Door

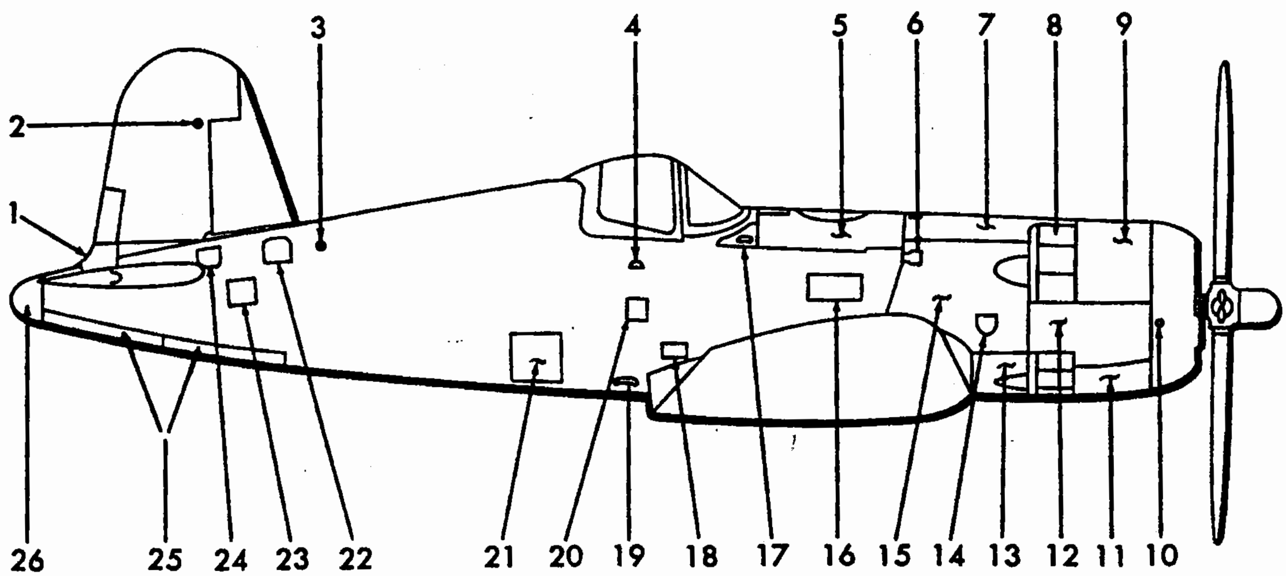
Figure 3—1. (Sheet 2 of 4 Sheets). Access and Inspection Provisions — Top View.

1. Aileron Mechanism and Tie-down Access Door
2. Access for Installation of Boresight Posts
3. Gun Camera Access Door
4. Gun Camera Window
5. Oil Cooler Access Panel
6. Oil Cooler Door
7. Intercooler Flap
8. Lower Wing Gap Cover Panel
9. Bottom Engine Accessory Compartment Cowl Panel
10. Side Engine Cowl Panel
11. Bottom Engine Cowl Panel
12. Engine Cowl Flaps
13. Access to Front Centerline Pylon Attachment
14. Access to Interior of Carburetor Air Box
15. Access to Approach Light



16. Access to Approach Light Adjustment Screw
17. Pitot Tube Access
18. Hand Holes
19. Aileron Trim Tab Linear Actuator Access Panel
20. Rocket Electrical Receptacles
21. Landing Gear Bay—Access to Center Section
22. Center Section Fairing—Access to Electrical and Hydraulic Lines
23. Fuel Drain Access Door
24. Lower Cockpit (Belly) Access Door
25. Auxiliary (Booster) Fuel Pump Lines Access Door
26. Rear Pylon Attachment Access Door
27. Tail Wheel Doors
28. Access to Elevator Hinge Fitting Bolts
29. Access to Elevator Tab Pushrod and Jackshaft Fitting

Figure 3—1. (Sheet 3 of 4 Sheets). Access and Inspection Provisions — Bottom View.



1. Removable Rudder Fairing
2. Access to Upper Rudder Hinge Fitting Bolt
3. Lift Tube Access
4. Handgrip
5. Fuel Cell Access Panel
6. Jury Strut-Socket Access Door
7. Upper Engine Accessory Compartment Cowl Panel
8. Engine Cowl Flaps
9. Upper Engine Cowl Panel
10. Service Beam Support
11. Bottom Engine Cowl Panel
12. Side Engine Cowl Panel
13. Lower Wing Gap Cover Panel
14. Water Injection Tank Filler Door
15. Upper Wing Gap Cover Panel
16. Fuel Cell Hanger Door
17. Instrument Panel Access
18. Access to External Power Receptacle
19. Telescopic Step
20. Upper Step
21. Radio Compartment Access Door
22. Upper Access Door—Tail Wheel Compression Strut
23. Lower Access Door—Tail Wheel Shock Strut
24. Access to Fin and Rudder
25. Tail Wheel Doors
26. Tail Cone

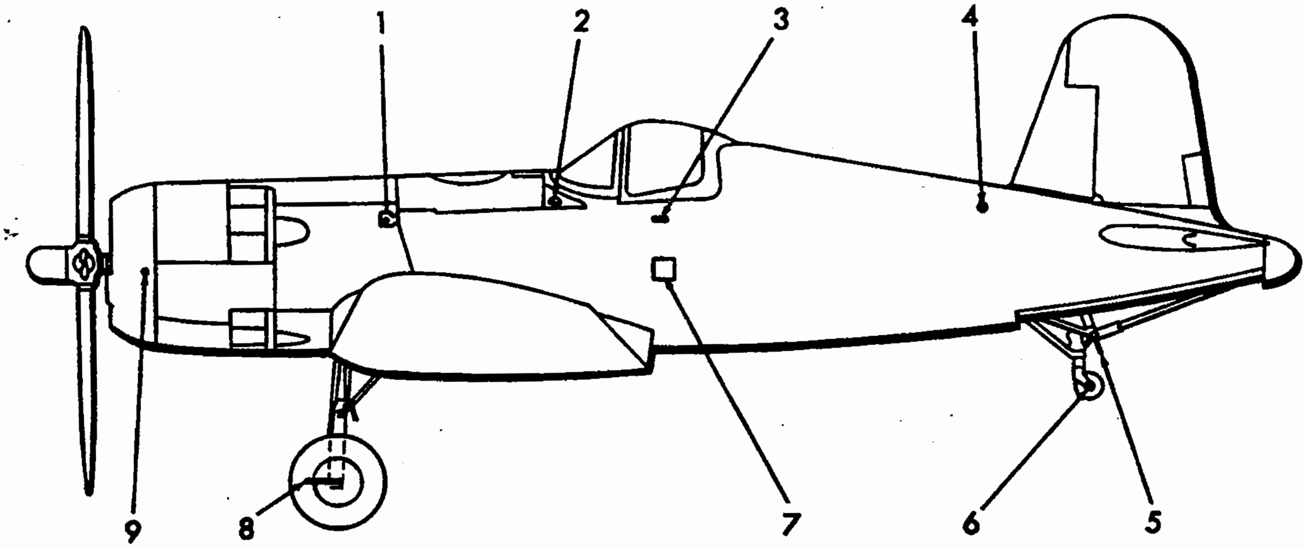
Figure 3–1. (Sheet 4 of 4 Sheets). Access and Inspection Provisions — Right Hand Side.

3–3. GROUND HANDLING.

3–4. DESCRIPTION. The location of lift points, push points, towing shackles, catapult hooks, handgrips, steps, and walkways is shown on figure 3–2 (sheets 1 and 2). The airplane may be pushed on any of the edges indicated on figure 3–2 (sheet 2). If the wings are folded, the outboard edges of the center section and the wing folding piston rods provide good pushing surfaces.

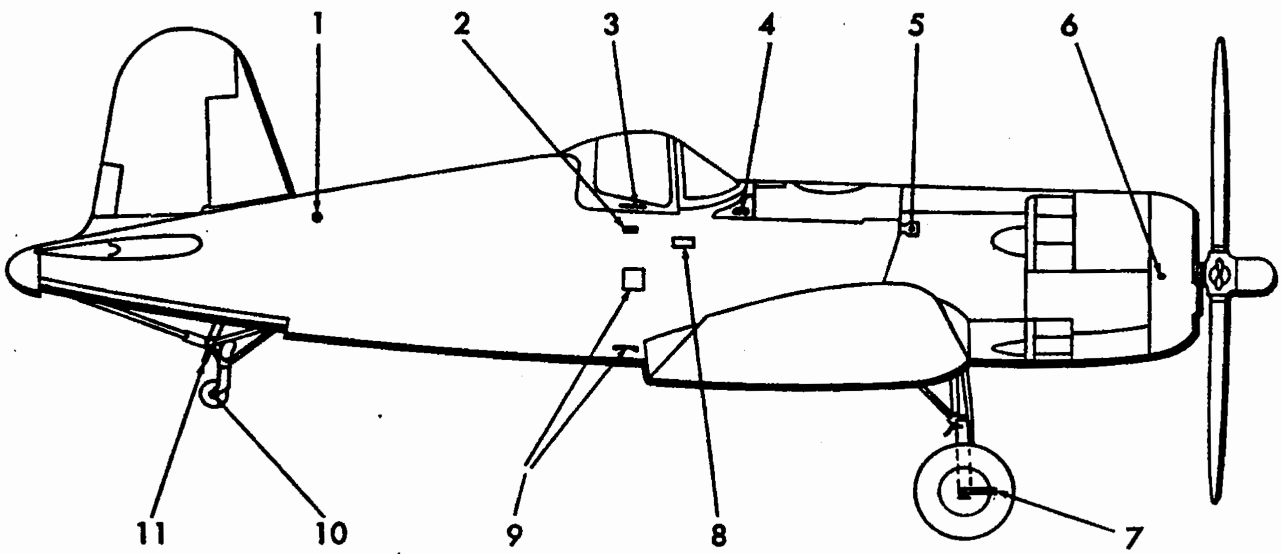
CAUTION

Install the jury struts before pushing the airplane at the wing butt.



LEFT HAND SIDE

1. Engine Mount Jury Strut Socket
2. Handgrip in Instrument Panel Access
3. Handgrip
4. Lift Tube
5. Hold Back Link
6. Hollow Axle (Tail Wheel Tow)
7. Mechanics Exit Step
8. Towing Shackle
9. Work Beam Socket



RIGHT HAND SIDE

1. Lift Tube
2. Handgrip
3. Sliding Section Handgrip
4. Handgrip in Instrument Panel Access
5. Engine Mount Jury Strut Socket
6. Work Beam Socket
7. Towing Shackle
8. Sliding Section External Release
9. Pilot's Access Steps
10. Hollow Axle (Tail Wheel Tow)
11. Hold Back Link

Figure 3—2. (Sheet 1 of 2 Sheets). Push Points, Handling Points and Walkways — Side Views.

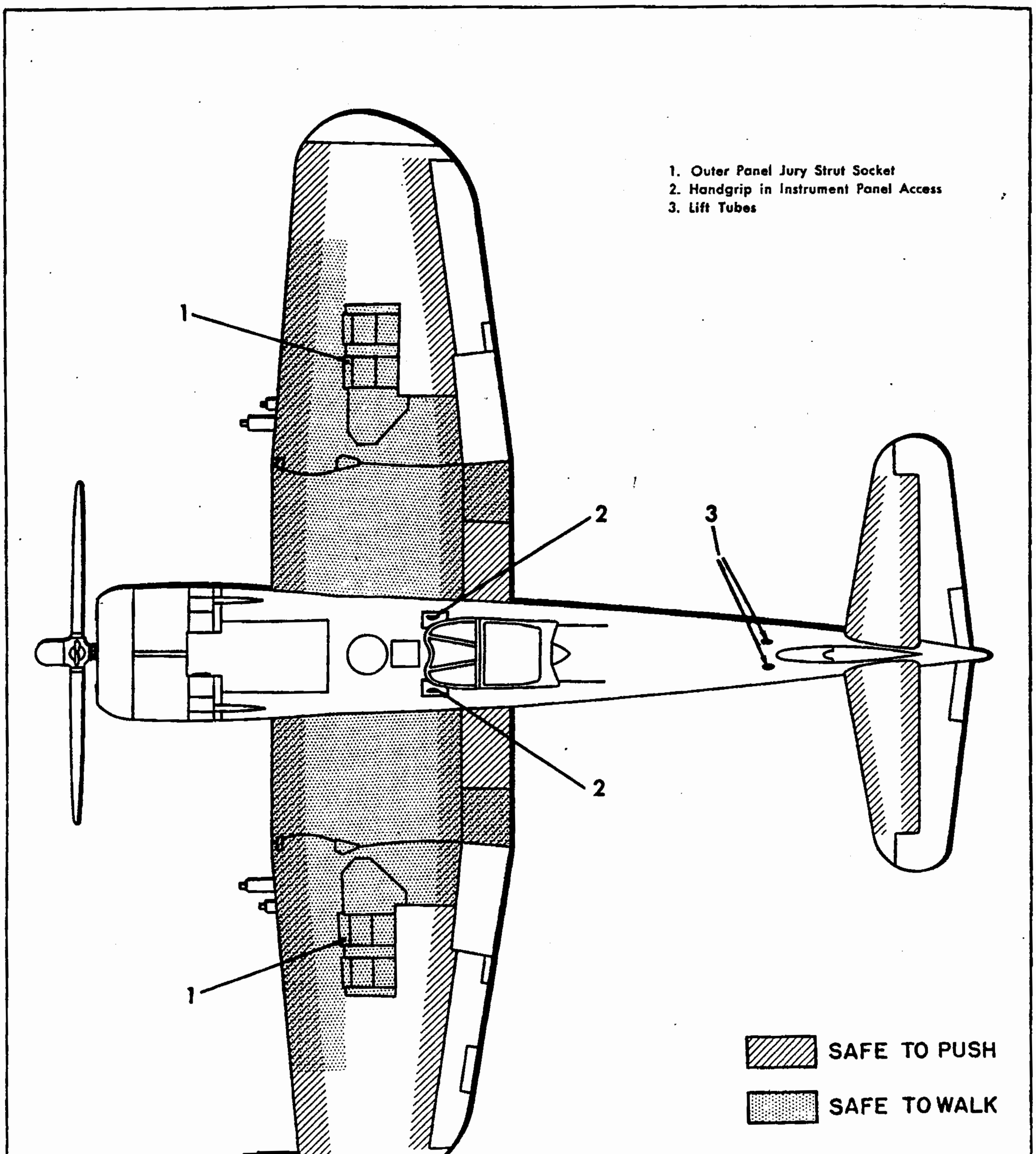


Figure 3—2. (Sheet 2 of 2 Sheets). Push Points, Handling Points and Walkways — Top View.

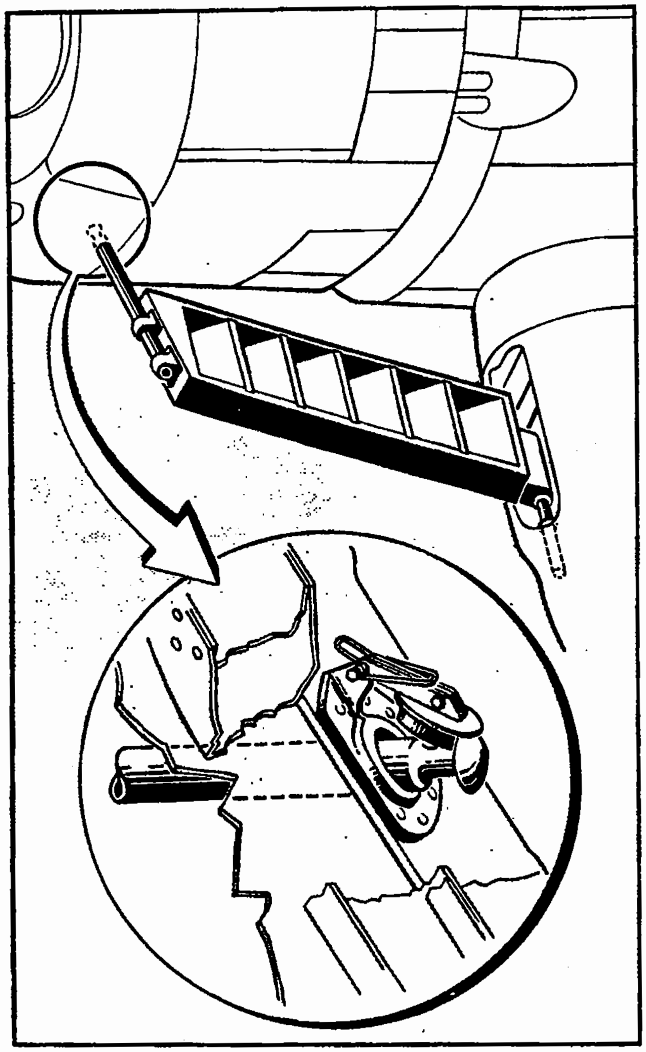


Figure 3–3. Engine Service Platform.

3–5. ENGINE SERVICE PLATFORM.

3–6. DESCRIPTION. *(See figure 3–3.)* An engine service platform (VS-55652), together with front and rear support tubes is supplied as part of Ground Handling Equipment — Loose Accumulations.

3–7. PROCEDURE. To install the engine service platform, proceed as follows:

a. Insert the rear support tube (VS-12547) of the service platform into the socket provided for this purpose in the center section upper air duct panel.

b. Press the front support tube (VS-56536) of the service platform into the socket on the nose cowl until it is locked by the cover in the socket.

CAUTION

Make sure that the beam is tightly installed before stepping on it.

c. To release the service platform, slide the collar of the front support in, until the nose cowl cover is unlocked. Then pull out collar and tube together.

3–8. WORK PLATFORM.

3–9. DESCRIPTION. *(See figure 3–4.)* A work platform (VS-10447), made to fit on either side of the gull-shaped center section, provides secure footing for the mechanic during refueling operations or when working on the upper accessory section. Small support hooks are located on each side of the platform. When installed, one of these hooks engages a slot in the side panel of the fuel compartment, just above the center section skin line. The work platforms are included in Ground Handling Equipment – Loose Accumulations.

3–10. JURY STRUT.

3–11. DESCRIPTION. *(Refer to figure 3–4.)* Telescopic jury struts (VS-53731) are provided in Ground Handling Equipment – Loose Accumulations. They are used to hold the wing in various folded positions from fully folded up to vertical. A jury strut socket is located in the outer panel on the walkway along the main beam, its position being noted by a decal. A socket fitting is located on both right and left aft ends of the upper engine mount behind a small access door in each upper wing gap cover panel.

3–12. PROCEDURE. *(Refer to figure 3–4.)*

a. Connect the outer tube end of the jury strut to the fuselage socket.

b. Fold the wings of the airplane.

c. Disengage the lock pin of the jury strut and attach the sliding tube end of the jury strut to the socket in the outer panel.

d. Relieve all pressure in the hydraulic system.

e. Move the wing folding cockpit control to "SPREAD." Push outer panel to the desired position. It is possible to push the outer panel into any desired position between fully folded and vertical by bracing the feet against the center section, facing inboard, and forcing the shoulders back against the outer panel.

f. Just before the wing has reached the desired position, adjust the jury strut lock pin, so that the plunger will automatically slip into the next stop hole.

Note

The jury strut is fully extended when seven holes (of the second series of holes) are exposed.

CAUTION

If the knob of the plunger does not bottom on the housing, the jury strut is not locked.

g. Remove the jury strut by moving the wing folding cockpit control to "FOLD," unlocking the plunger, and pulling the wing to the fully folded position. Remove the jury strut.

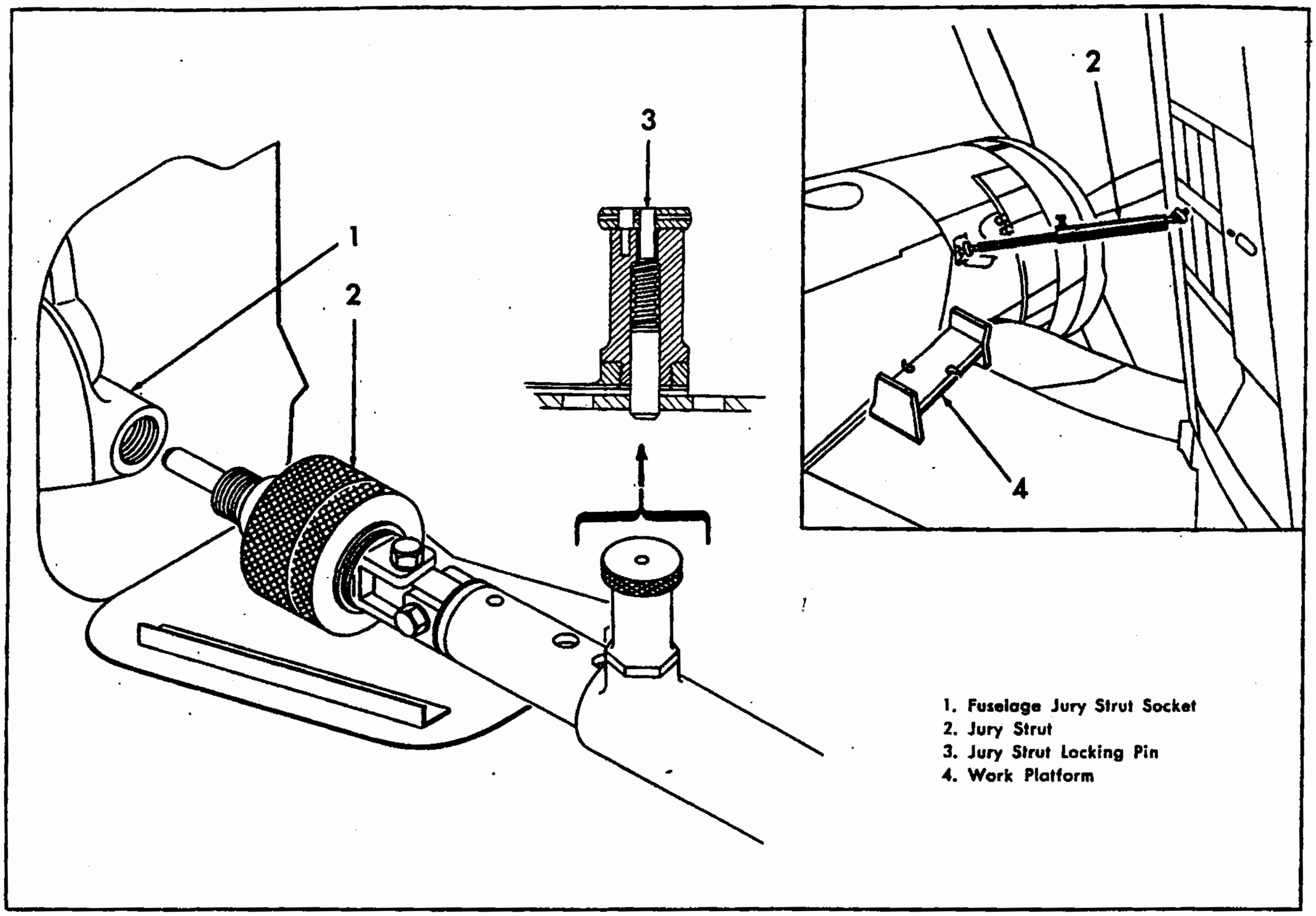


Figure 3–4. Jury Strut and Work Platform.

3–13. HOISTING PROVISIONS.

3–14. DESCRIPTION. Paragraphs 3–15 through 3–22 cover the procedures to be used in hoisting the entire airplane, the engine quick change unit, the tail, and the outer panel wing.

3–15. HOISTING ENTIRE AIRPLANE.

3–16. PROCEDURE. *(Refer to figure 3–5.)*

a. Fasten the hoisting sling (VS-78495) to the two lugs on the aft ends of the engine mount near the jury strut sockets by inserting bolts. Hoisting slings are included in the Ground Handling Equipment – Loose Accumulation.

b. Guide the tail by hand while the airplane is lifted.

3–17. HOISTING ENGINE QUICK CHANGE UNIT.

3–18. PROCEDURE. For procedure to be followed in hoisting the engine quick change unit, refer to paragraph 4–501.

3–19. HOISTING TAIL.

3–20. PROCEDURE. *(Refer to figure 3–6.)*

a. Install a lift bar in the lift tube located just below the forward end of the fin.

b. Hang approximately 600 pounds of weight from the lift bar, 300 pounds on each side.

c. Attach the ends of a rope or cable to the lift bar as shown in figure 3–6, and raise tail.

WARNING

Do not raise the tail beyond level flight attitude. Always apply weight to, and hoist at, both sides of the lift bar.

Note

Airplane may be hoisted by tail wheel structure during salvage operation.

3–21. HOISTING OUTER PANEL WING.

3–22. PROCEDURE. Refer to paragraph 4–28 for procedure to be used in removing and hoisting the outer panel. The special hoist (VS-54614) is inserted in the outer panel jury strut socket. The location of this socket and its use as a lift point is noted by a decal on the outer panel. Refer to paragraph 3–10 for additional information on the outer panel jury strut socket.

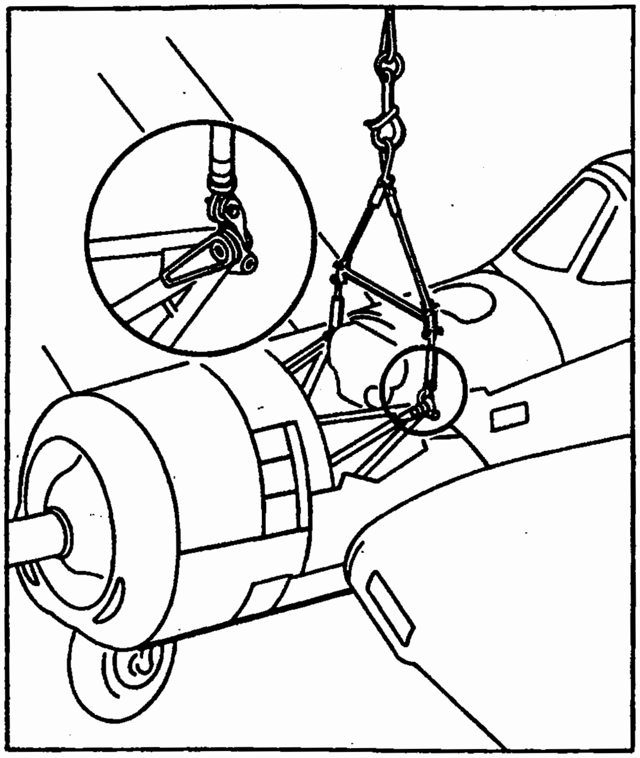


Figure 3–5. Hoisting Entire Airplane.

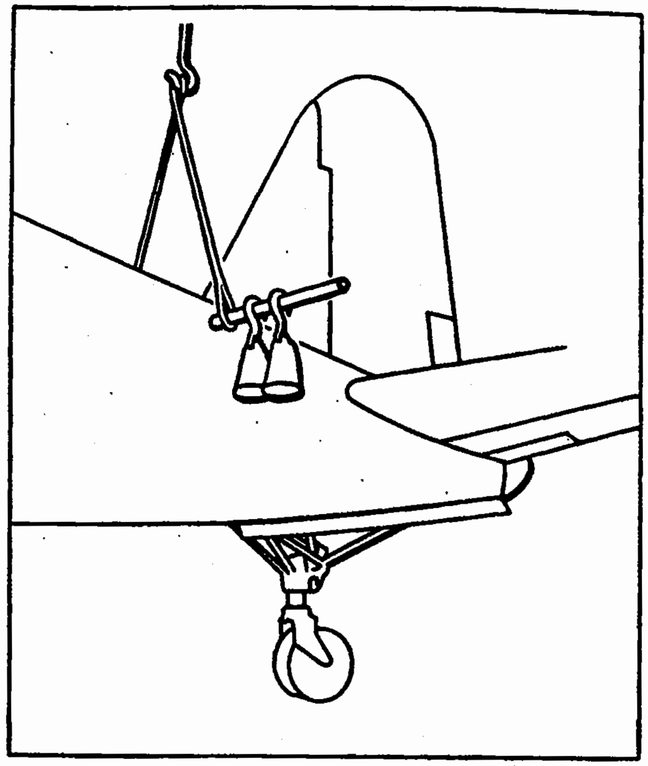


Figure 3–6. Hoisting Tail.

3–23. JACKING ARRANGEMENT.

3–24. DESCRIPTION. *(See figure 3–7.)* For jacking purposes, five jacking points are provided on the airplane; the jacking pads which fit into them are included in Ground Handling Equipment – Loose Accumulations. For jacking the forward end of the airplane, two jack pads are provided for insertion in the center section jack pad points (C). The jack pad points consist of three small holes which form a triangle near the inboard edge of the landing gear doors. For jacking the aft section of the airplane, a jack pad is provided for insertion in the aft section jack pad point (D) consisting of two holes in the bottom of the fuselage just forward of bulkhead 288. For work such as a main wheel tire change, when it is not necessary to jack up the entire airplane, a jack pad and fitting is provided on the point (B) on each main landing gear shock strut. An alternate point (A) of jack contact for the main landing gear is located on the axle stub, the exact position being marked by a decalcomania. The forward and aft ends of the airplane may be jacked separately. To jack the entire airplane, it is recommended that the forward end be jacked first as described in paragraph 3–25 and the tail then jacked as described in paragraph 3–26.

3–25. JACKING FORWARD END.

a. Place 600 pounds weight on the lift tube or tail wheel and block the tail wheel.

b. Place wing jacks under the jacking points (C) located on the center section of the wing near the inboard edge of the landing gear doors.

c. Insert the studs (8) of the jackpads (9) (VS-19166-1, L.H. and VS-19166-2, R.H.) into the holes in the center section so that the upper surfaces of the jack pads are snug against the wing surface. (See figure 3–7.)

CAUTION

Do not apply jacks directly to the skin of the center section.

d. Raise the wheels about five inches off the ground.

Note

Operate both jacks simultaneously to equalize the loads and maintain balance.

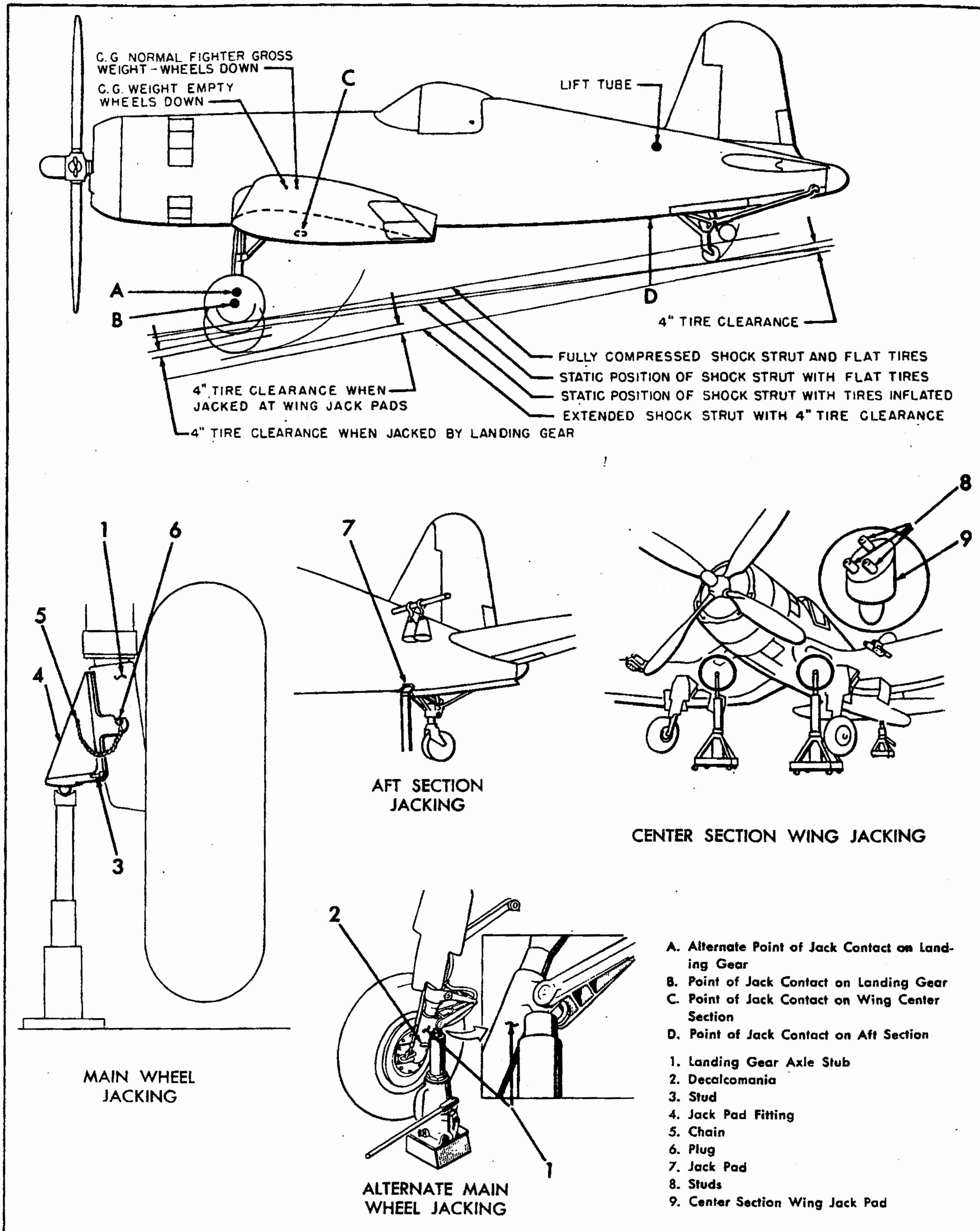
e. Lock the jacks in their raised position by means of their locking collars.

f. When removing jacks, lower the front end of the airplane before lowering the tail.

3–26. JACKING TAIL. *(See figure 3–7.)*

a. Block the main gear wheels to prevent the airplane from moving forward. Place 600 pounds weight on the lift tube or tail wheel.

b. Insert the studs of the aft section jack pad (7) (VS-47509) into the holes just forward of bulkhead 288, so that the cushion of the pad fits snug against the fuselage.



A. Alternate Point of Jack Contact on Landing Gear
B. Point of Jack Contact on Landing Gear
C. Point of Jack Contact on Wing Center Section
D. Point of Jack Contact on Aft Section

1. Landing Gear Axle Stub
2. Decalcomania
3. Stud
4. Jack Pad Fitting
5. Chain
6. Plug
7. Jack Pad
8. Studs
9. Center Section Wing Jack Pad

Figure 3—7. Jacking Arrangement.

CAUTION

1. Do not apply jack directly to the skin of the aft section, as it will distort or puncture the skin.
2. DO NOT RAISE TAIL BEYOND LEVEL FLIGHT POSITION.
3. After jacking tail, make sure tail wheel is locked in normal aft position to prevent damage to tail gear doors in the event that the landing gear is cycled.

3–27. JACKING MAIN WHEELS. *(See figure 3–7.)* Jack the main wheels only, for work such as a main wheel tire change.

a. Lock the tail wheel and block tail wheel to prevent the airplane from moving. Place 600 pounds weight on the lift tube or tail wheel.

b. Insert the plug (6) at the free end of the chain (5) on the jack pad fitting (VS-47497) (4) in the bushing on the forward side of the left and right hand axle stub (1). The decalcomania (2) marks the correct jack pad location.

c. Insert stud (3) of jack pad in the hole in the lower part of the axle stub and fit jack pad under the bolt in aft bushing of the shock strut and under the plug installed in the forward bushing in step b.

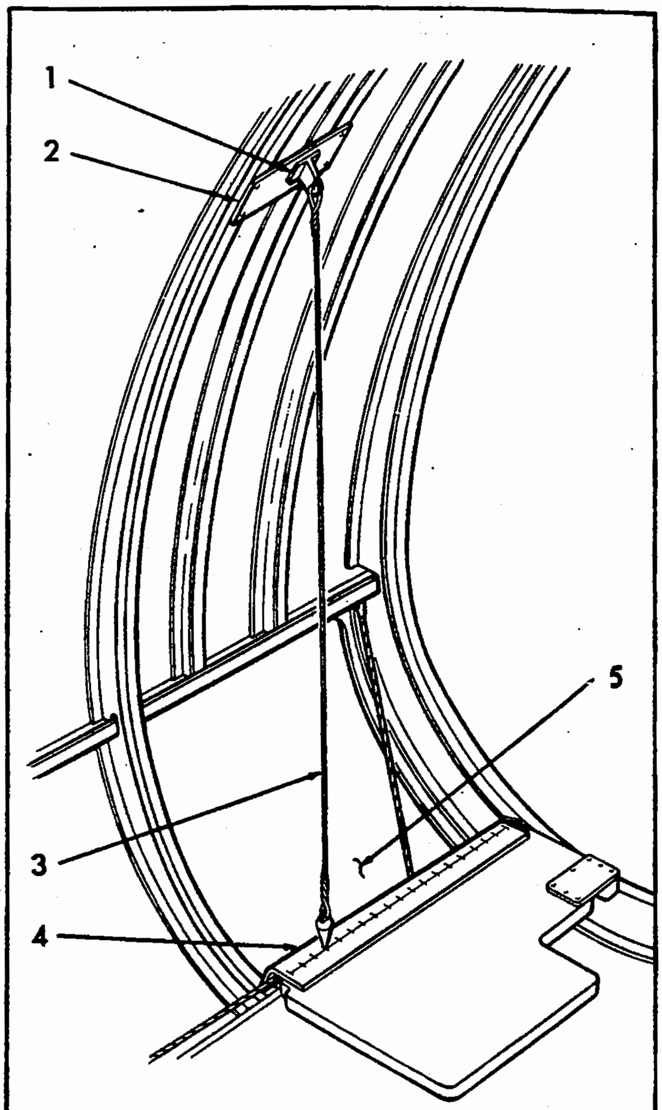
d. Place a small jack under the pad and raise the wheel about two inches.

Note

The landing gear axle stub (1) may be used as an alternate jacking point.

3–28. LEVELING.

3–29. DESCRIPTION. *(See figure 3–8.)* A target scale (4) on the rudder cable guard and a plate (2) and bracket (1) have been installed in the mid-section to provide for lateral and longitudinal leveling of the airplane. The plate with the bracket, is riveted to frames on the right hand side of the airplane at stations 199-1/2 and 205-1/2. A decalcomania on the plate indicates its usage as the plumb bob level suspension fitting. Since the plate and bracket has been jigged at the factory, it must not be disturbed. The target scale is located directly beneath the plate on the rudder cable guard, between stations 200 and 217 on the right hand side of the radio compartment floor. As is indicated on the target scale, the datum line is used for lateral leveling and the cross lines, marked off in degrees and minutes, are used for longitudinal leveling and for gun boresighting. Access to the fitting plate and bracket and the guard scale is readily available through the radio compartment access door.



1. Bracket
2. Plate
3. Plumb Bob and Line (ref.)
4. Target Scale on Rudder Cable Guard
5. Radio Compartment Access—R. H. Side (ref.)

Figure 3–8. Leveling Arrangement.

3–30. PROCEDURE.

a. Attach a plumb bob and line (3) to the bracket (1) located on the plumb bob level suspension plate (2).

b. Raise the tail wheel, check, and adjust the airplane until the plumb bob falls on the datum line of the target scale (4) (laterally level) and on the 0° cross line of the scale (longitudinally level) or on the gun boresighting cross line.

3–31. LOCATING THE CENTERLINE OF THE AIRPLANE. The centerline of the airplane may be determined from a punched hole located on the forward face of the top flange of the main beam, directly under the intercooler flap hydraulic actuating cylinder.

3–32. PARKING AND TIE-DOWN.

3–33. PARKING PROCEDURE. When the airplane is to be parked for a short time, use the following procedure:

a. Park the airplane with its nose into the wind.

b. If possible, park the airplane where it will not be affected by the "propwash" of other airplanes. If exposure is unavoidable or if the day is windy, lower the wings.

c. Keep the tail at least seven feet away from any obstructions when parking outdoors.

d. Keep the forward end of the airplane away from objects which might fall against the propeller.

e. Lock the tail wheel.

f. Check that the battery switch is turned to "OFF."

g. Ground the airplane.

h. Tie the stick to the rudder pedals with the surface control lock (VS-58050, included in Ground Handling Equipment – Loose Accumulations). If a control lock is not available, pull back the stick and tie it down with the right hand lap strap.

i. Place chocks fore and aft of the front wheels.

j. Tie down, if necessary. Refer to paragraph 3–35.

3–34. The following additional steps should be taken if the airplane is to be parked over an extended period:

a. When the engine has cooled, close the cowl flaps, the intercooler flap, and the oil cooler doors by moving switches to the "CLOSE" position.

b. Put on the engine, cockpit cabin, and propeller hub covers. (Refer to paragraph 3–36.) It is particularly important to cover the air intake ducts in sandy or dusty areas to prevent foreign matter from entering the air induction system.

c. Put on the pitot tube cover, or lacking one, cover the opening with tape. Be sure to remove covers before airplane takes off.

CAUTION

Pitot tube covers should be installed and removed gently in order to avoid damaging the indicator.

d. Turn over the engine daily three complete revolutions by hand (be sure that the ignition switch is "OFF") in order to keep engine parts lubricated and to drain any excess oil that may accumulate in the lower cylinders.

3–35. TIE-DOWN. *(Refer to figure 3–9.)* If weather conditions are unfavorable, or if the airplane is to remain parked for an appreciable length of time, make certain that the airplane is tied down securely as follows:

a. Lock the tail wheel.

b. Place chocks fore and aft of the front wheels.

c. Tie down the tail by means of the holdback shackle.

d. When the wings are spread, tie down the outer panels by means of the tie-down rings.

e. When the wings are folded, hold them in this position by means of jury struts. Refer to paragraph 3–12 for installation of jury struts. (Wings should be in the spread position when weather conditions are unfavorable.)

f. If additional tie-down points are desired, the towing shackle on the landing gear and the base of the landing gear drag links may be used.

3–36. COVERS.

3–37. DESCRIPTION. *(See figure 3–9.)* Three covers are provided in Ground Handling Equipment – Loose Accumulations: engine cover (VS-55001), propeller hub cover (VS-45064), and cockpit cabin flat front windshield cover (VS-58707). The engine cover consists of reinforced neoprene-coated fabric panels which fit over the front of the engine around the propeller hub, and aft to the wing butt. The cover is held in position by means of a cord pulled tight in a casing at the aft end of the cover. The neoprene-coated fabric propeller hub cover, which fits closely over the propeller hub, is fastened in place by means of twelve studs and an elastic cord. The cockpit cabin flat front windshield cover is composed of waterproof, vinyl-coated, napped cotton fabric. Three fasteners at the forward end of the cover snap into snap fastener holes in bulkhead 134 just forward of the windshield. The cover is tied down with three pieces of 3/16 inch sash cord passed through six grommets along the lower edge of the cover around the belly of the fuselage. The napped surface must be on the inside of the cover when it is installed.

3–38. SURFACE CONTROL LOCK.

3–39. DESCRIPTION. A surface control lock (VS-58050) is provided for each airplane, and is used to lock the control stick, and rudder pedals when the airplane is parked. Refer to paragraph 4–202 for additional information on the surface control lock.

3–40. TOWING.

3–41. TOWING WITH A TRACTOR AND TOW BAR. *(See figure 3–9.)*

a. Center the tractor between the front wheels, and back up, taking care not to hit the brake housing with the ends of the tow bars.

b. Attach the towing bars to the towing shackles on the main landing gear.

c. Make sure that the tail wheel is unlocked, that the arresting hook is up, and that the landing gear lever has not been moved from the "DOWN" position before towing.

d. Station a man in the cockpit of the airplane to apply the brakes in case the tow bar fails or breaks loose. In towing the airplane in confined areas or in places where airplane or automotive traffic is heavy, a director should be stationed to aid the tractor driver in determining clearances and to observe other traffic.

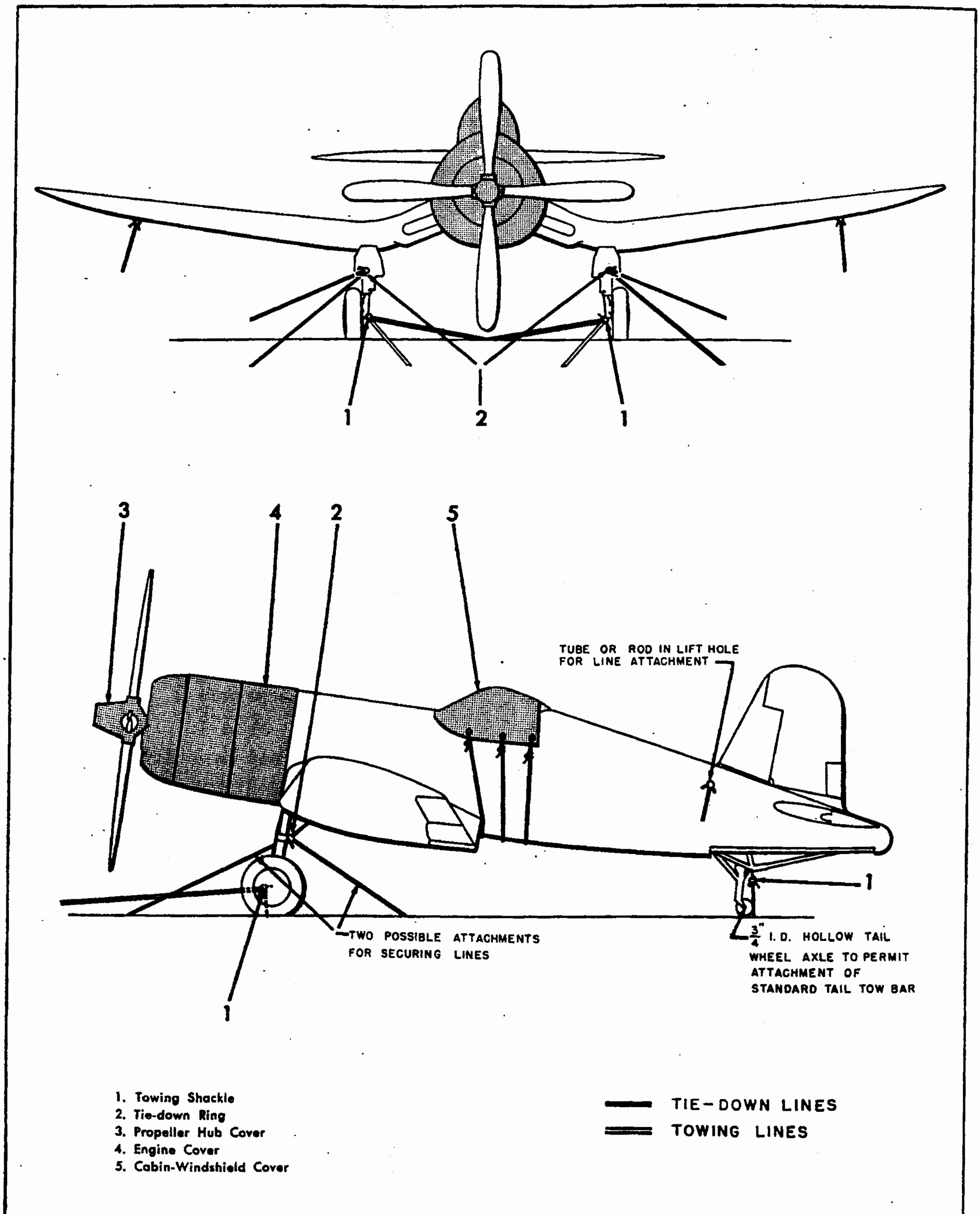


Figure 3—9. Towing and Tie-down Provisions.

e. Do not tow at more than 15 miles per hour. Tractor drivers should be warned to avoid sudden starts and stops insofar as possible and high speed towing over rough terrain, since excessive loads may be thereby placed on the airplane structure, possibly resulting in structural failure.

WARNING

Do not ride on the bars of the towing rig.

f. The hollow tail wheel axle may be used for the attachment of the standard tail tow bar, if it is desired to tow the airplane by the tail.

3–42. TOWING WITH A TRACTOR AND ROPE. *(See figure 3–9.)*

a. Tie the tow rope to the towing shackle on the tractor so that the rope will not slip when pulled from either end. Leave equal lengths of rope on each side of the tractor shackle.

b. Center the tractor between the front wheels of the airplane and back up, taking care not to hit the propeller.

c. Tie the rope ends to the towing shackles on the main landing gear.

d. Make sure that the tail wheel is unlocked, the arresting hook is up, and the landing gear lever has not been moved from the "DOWN" position before towing.

e. Tow the airplane in the same manner as described in paragraph 3–41 d. and e.

3–43. CATAPULTING.

3–44. DESCRIPTION. The two submerged, cantilever hooks for catapulting the airplane are attached to forgings mounted on the forward face of the main beam between the air duct ribs and the intercooler support ribs. The hooks are supported forward of the main beam by steel "straps." Only a small portion of the hooks protrudes below the lower skin line of the wing. The location of the catapult hooks permits catapulting with full external stores installed (including a centerline external auxiliary fuel tank or bomb). A catapult holdback shackle is provided on the tail wheel assembly.

WARNING

The catapult hooks and holdback shackle should be thoroughly inspected for cracks and signs of damage. Security of all attaching parts must be checked.

3–45. REMOVING CATAPULT HOOKS.

Note

In order to remove the intercoolers, the catapult hooks and supporting structure must be removed.

a. Open the intercooler flap for access to the center section main beam.

b. Remove bolt attaching upper end of each strap of the left and right hand catapult hook assemblies to the catapult hook stiffener fitting on the center section main beam. Remove bolt attaching the lower end of each strap to the hook.

c. Remove the left and right hand catapult hooks and the fillers from the lower flange of the main beam by removing twelve bolts on each side.

Note

The holdback link (or tiedown shackle) is removed when the tail gear is disassembled; refer to paragraph 4–348.

3–46. INSTALLING CATAPULT HOOKS. Install the catapult hooks by reversing removal procedure.

3–47. SERVICE.

3–48. FILLING MAIN TANK.

3–49. PROCEDURE. *(See figure 3–10.)*

a. Fill fuel tank after each flight and check fuel quantity prior to flight. Check fuel quantity with a suitable dip stick rather than depending on the fuel gage.

WARNING

When fueling, always ground the truck and the airplane to each other and make sure that the truck is grounded to the ground.

Note

If a chain is not available to ground the airplane to the truck, the airplane may be grounded separately. The towing shackles at the base of the main shock struts make good grounding points. Lowering the arresting hook effectively grounds the airplane. Any part of the truck chassis will serve as a grounding point.

b. FUEL. Use only Spec. AN-F-48 Grade 115/145 fuel.

Note

If lower grade fuel is used, i.e., 100 octane, the engine must be operated at lower ratings. See F4U-5 Pilot's Handbook of Flight Operating Instructions (AN 01-45HD-1).

c. Fill the main tank through the filler unit in the fuel cell manhole cover. Stand on the center section walkway to gain access.

d. The tank is full when the gage on the instrument panel indicates "FULL." The capacity of the tank is 234 U. S. gallons.

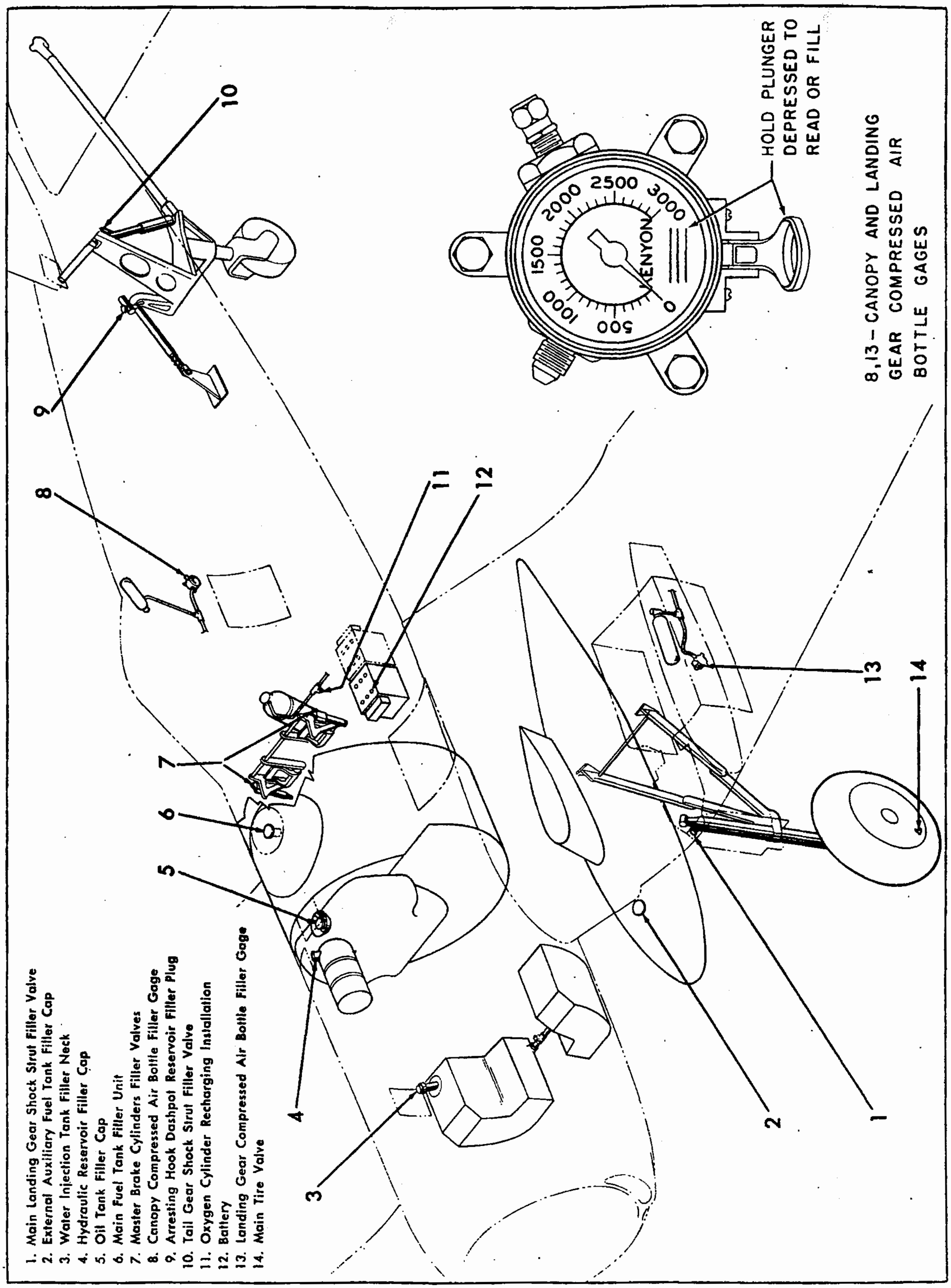


Figure 3—10. Filler Cap Diagram.

WARNING

When servicing the airplane with fuel, plug the grounding line connected to the hose nozzle, into the grounding jack labeled "GROUND HERE" on the liquidometer access door. If the ground line is not available, insert the nozzle into the filler hole so that the nozzle makes definite contact with the airplane.

WARNING

If any gasoline is spilled, do not turn on any switches for at least 25 minutes.

3–50. FILLING EXTERNAL AUXILIARY FUEL TANKS.

3–51. PROCEDURE. *(Refer to figure 3–10.)*

a. Provision is made on the left and right center section pylons, and on the centerline pylon to carry MK 5, 150 U. S. gallon external auxiliary fuel tanks. Fill tank through filler hole.

b. The warnings notes in paragraph 3–49 apply to the procedure for filling droppable tanks.

c. Refer to paragraphs 4–856 and 4–857 for installation of external auxiliary fuel tanks.

3–52. DEFUELING.

3–53. PROCEDURE.

a. Open the fuel drain access door located on the bottom of the airplane on the centerline directly below the main fuel cell.

b. Connect suitable defueling hose to the defueling valve connection.

c. Open the valve handle and drain fuel from the main cell.

d. Refer to paragraph 4–821 for additional information on the defueling valve.

3–54. FILLING WATER INJECTION SYSTEM TANKS.

3–55. PROCEDURE. *(Refer to figure 3–10.)*

a. Mixture: The term, "water" indicates any mixture that may be used in the water injection system. In order to provide a satisfactory engine performance, the use of a standard mixture of twenty-five percent ethyl alcohol, twenty-five percent methyl alcohol, and fifty percent water will provide freezing protection down to −35°F. For cold weather operation, wherein ground temperatures are below 0°F., the alcohol-water mixture ratio should be increased to 60/40, which will provide freezing protection down to −55°F. The use of alcohol-water mixture ratios greater than 60/40 is not recommended. The proportions of alcohol and water, Spec. AN-A-24 are on a volume basis. Components of water injection fluid shall be thoroughly mixed, and all mixing shall be accomplished prior to the addition of the water injection fluid to the tanks of the airplane.

b. Open the water injection filler access door located on the right hand side of the fuselage just forward of the wing butt in order to obtain access to the right hand water injection tank. An identification decalcomania appears on each tank.

c. Fill the tank through the filler neck. The capacity of each tank is approximately 14 gallons of fluid.

Note

Only the right hand tank contains a filler neck for filling purposes. Both tanks are filled simultaneously through the one filler neck.

d. After filling both tanks, test the water injection system. Refer to paragraphs 4–564 through 4–598 for additional information on the water injection system.

3–56. FILLING OIL TANK.

3–57. PROCEDURE. *(Refer to figure 3–10.)*

a. Check oil quantities daily.

b. Oil: Use grade 1100/1120, Spec. AN-O-8 oil.

CAUTION

Open the oil tank filler cap with care since pressure may accumulate in the tank during engine operation.

c. Open the oil filler access door located on the centerline of the airplane in the top accessory compartment panel for access to the oil tank filler cap. A decalcomania on the filler cap notes the capacity of the oil tank (27.5 U. S. gallons oil). An identification decal is located on the oil tank.

d. The following WARNING decalcomania appears on the oil tank drain valve located on the lower left hand side of the engine mount:

WARNING

Close oil drain valve before filling oil tank.

e. Fill the tank, not exceeding the rated oil capacity of 27.5 U. S. gallons. Use the bayonet-type gage attached to the filler cap to determine when the tank is full.

Note

The tank will actually hold more oil than the rated capacity, but should not be filled beyond this volume to provide foaming or expansion space.

f. The following warning decal is located on the right hand accessory compartment panel and should be noted after filling.

CAUTION

To remove air trapped in the feed line after filling an empty tank, open the oil drain valve rapidly until oil flows.

3—58. DRAINING OIL TANK.

3—59. PROCEDURE.

a. Drain the oil tank by cutting the safety wire and opening the oil drain valve located on the engine mount lower left hand side. Catch the oil in a clean container.

b. Drain the remaining oil from the tank by removing the oil tank sump plug. This oil contains dirt accumulation and cannot be used.

c. Refer to paragraph 4—676 for complete information on draining the oil system.

3—60. FILLING HYDRAULIC RESERVOIR.

3—61. PROCEDURE. *(Refer to figure 3—10.)*

a. Check daily for proper level of fluid in hydraulic reservoir and before each flight.

b. Fluid: Use Spec. AN-O-366 red hydraulic fluid.

c. Open the hydraulic filler access door on the top of the engine accessory cowling by pushing the flush latches.

d. Break safety wire and remove the cap from the filler neck.

e. Pour Spec. AN-O-366 red hydraulic fluid into the filler neck until the sight gage indicates "FULL." If the reservoir tends to fill slowly and gage indication is sluggish, loosen the nut on the air vent line at the top of the tank.

f. When the gage indicates "FULL," cycle the system and observe fluid level indication after a two-minute interval with the vent port open. If the gage shows a drop in fluid level, pour additional fluid into the tank until "FULL" indication is attained.

g. After filling, make sure that the cap and packing are properly replaced to prevent fluid leakage. Then replace the safety wire.

Note

The fluid level in the hydraulic reservoir should be checked before each flight. At 120 hour inspections, the filter element should be replaced. Refer to paragraph 4—933 for filter replacement procedure.

3—62. DRAINING HYDRAULIC RESERVOIR.

3—63. PROCEDURE.

a. Remove cap at the quick-disconnect on the hydraulic panel.

b. Thread mating half to quick-disconnect with extra hose length attached, and allow tank to drain into bucket. This drains oil down to standpipe level in tank.

c. To drain oil below standpipe level, disconnect pump end of auxiliary pump suction line; cap line temporarily with thumb and move line over bucket.

d. Reconnect pump end of line to pump after draining is complete.

3—64. FILLING MAIN LANDING GEAR SHOCK STRUT.

3—65. PROCEDURE. *(Refer to figure 3—10.)*

a. Fluid: Use Spec. AN-O-366 red hydraulic fluid.

b. Remove the filler cap on the shock strut and allow the strut to compress fully under the weight of the airplane. A decalcomania on the shock strut indicates filling procedure. Consult local rulings for frequency of filling.

c. Fill the strut slowly with red hydraulic fluid, Spec. AN-O-366 until no more can be added.

d. Replace filler valve and apply air pressure through this valve until the centers of the lubricator fittings on the lower scissors pivots are 3-19/32 inches apart (plus 3/16, minus 0 inches).

Note

Rock airplane during inflation of shock strut to prevent sticking of strut.

e. It is recommended that a checking gage similar to that shown on figure 4—46 be fabricated from .064 stock to aid in checking this dimension.

3—66. FILLING TAIL GEAR SHOCK STRUT.

3—67. PROCEDURE. *(Refer to figure 3—10.)*

a. Fluid: Spec. AN-O-366 red fluid.

b. Open the tail gear shock strut access door located on the right hand side of the fuselage at approximately station 300. A decalcomania on the tail wheel shock strut gives filling and checking instructions. Consult local rulings for frequency of filling.

c. Remove cap from valve assembly on strut and depress valve stem until all air is released and strut is fully compressed.

d. After releasing air, remove entire plug assembly.

e. If strut is in service, refill by adding mineral oil conforming to Spec. AN-O-366 red fluid to the level of the filler plug with the strut in fully compressed position.

f. For the first filling of a new strut or after inspection or overhaul, extend strut to maximum length. Fill with approximately one pint of mineral oil conforming to Spec. AN-O-366 red fluid. Compress and extend slowly two or three times. With strut fully compressed, add oil to bring level up to filler holes with strut in approximately vertical position.

g. To inflate strut, attach high pressure air hose to air valve. Inflate to 11-3/4 inches between upper bolt centerline and shock strut cap, with airplane loaded for take-off.

h. Seat air valve hex cap lightly with wrench.

i. Check valve and filler plug seat for leaks.

j. Replace plug, valve, body, and gasket.

3—68. FILLING ARRESTING HOOK DASHPOT.

3—69. PROCEDURE. *(Refer to figure 3—10.)*

a. It is recommended that the arresting hook dashpot be filled daily during carrier operation.

b. Fluid: Use Spec. AN-O-366 red fluid.

c. Raise the tail of the airplane so the hook in the "down" position clears the deck. Refer to paragraph 3—26 for tail jacking procedure.

d. With the hook in full "up" position, remove dashpot filler plug and fill the reservoir with Spec. AN-O-366 red fluid. A decalcomania on the reservoir gives filling instructions.

e. Move hook slowly from full "up" to full "down" position several times to remove air from dashpot cylinder.

f. Check the gage in the reservoir. If the oil level is below the "FULL" mark on the gage, add sufficient oil to bring it only to the "FULL" mark and replace filler plug.

g. If the position of the airplane is such that step c. cannot be accomplished, steps d., e. and f. should be accomplished within the limits as defined by the position of the airplane. This deviation from the recommended procedure should be corrected as soon as practicable thereafter.

CAUTION

Do not overfill dashpot by adding fluid to reservoir or strut with the hook in "down" or partially "down" position. This, if done, results in a hydraulic fluid "lock" prior to full bottoming of the strut and will cause excessive leakage or possible physical failure of the strut and/or connecting related parts.

3—70. INFLATING TIRES.

3—71. PROCEDURE. *(Refer to figure 3—10.)*

a. Check tire pressure with a gage and inflate when necessary.

b. Inflate tires to 90 psi for a gross weight of 12,000 pounds.

c. Inflate tires to 120 psi for maximum load (approximately 15,800 pounds).

d. Interpolation may be used for tire pressures between these two weights.

e. The above pressures apply for both land and carrier-based operations.

3—72. FILLING MASTER BRAKE CYLINDER.

3—73. PROCEDURE. *(Refer to figure 3—10.)*

a. Fill master brake cylinder whenever brake pedal travels excessively far or at 30 hour check periods, whichever comes first. If brakes are spongy or fail to hold, the fluid level is so low as to require filling and bleeding. Refer to paragraph 4—430 for filling and bleeding procedures.

b. Fluid: Use Spec. AN-O-366 red fluid.

c. To check the fluid level in the master cylinder, remove the screw from the level indicator plug at the top of the master cylinder, located outboard of the brake pedal. Add a small quantity of Spec. AN-O-366 red fluid until overflow through the level indicator indicates the correct oil level.

d. Insert a clean, fine wire three inches long into the level indicator hole to break any surface tension and insure draining of fluid to proper level. Catch the overflow oil.

Note

The importance of using clean fluid cannot be overemphasized. Fluid which has been discharged during the bleeding operation should be run through a micronic filter before being reused. The supply of fluid should be carefully protected from entrance of foreign material.

3—74. FILLING BATTERY.

3—75. PROCEDURE. *(Refer to figure 3—10.)*

a. Check the specific gravity of the electrolyte (refer to paragraph 5—47 for procedure) daily, weekly, (or every 25 hours), and monthly (or every 200 hours). Add water at the same check periods until it is 3/8 inch above the protector over the separators.

b. Distilled water should be used for refilling the battery, if available, but the impurities of clear drinking water are negligible and it can be safely used without affecting the life of the battery.

c. Open the lower cockpit access door to obtain access to the battery located beneath the cockpit floor at approximately station 160, slightly to the left of the centerline of the airplane. Cut the safety wires, loosen the nuts, and remove the cover.

d. Remove the caps and check for correct water level. If water level is less than 3/8 to 1/2 inch above the protector, add water to bring the level 3/8 to 1/2 inch above the protector. Too much water may cause leakage when the airplane is in operation. Use a self-leveling syringe with water and insert it into the cell. Hold in a vertical position regardless of level of battery and fill the cell. Then withdraw excess water into the syringe until air is sucked in, leaving the electrolyte at the proper level.

e. Hydrometer readings taken too soon after adding water will be inaccurate. It takes several minutes of charging to properly mix the electrolyte.

f. If battery is exposed to freezing temperatures, do not add water unless it is to be charged immediately. In extreme cold, the water tends to stay at the top and freeze, instead of mixing with the electrolyte.

g. For instructions on the testing of batteries, refer to paragraphs 5—46 through 5—50.

3–76. FILLING COMPRESSED AIR BOTTLES—EMERGENCY HYDRAULIC SYSTEM.

3–77. PROCEDURE FOR FILLING EMERGENCY LANDING GEAR COMPRESSED AIR BOTTLE. *(Refer to figure 3–10.)*

a. Before take-off, check the emergency landing gear compressed air cylinder for proper pressure by depressing the lever on the gage.

b. The emergency landing gear compressed air bottle is mounted in the left hand wheel well and secured to the interbeam end rib by two bolted straps. It may be easily reached through the landing gear doors. A decalcomania on the bottle reads "COMPRESSED AIR 1800 LBS. PER SQ. IN. EMERGENCY LANDING GEAR AIR CYLINDER."

c. The air bottle assembly can be filled while installed in the airplane or can be removed for filling. Step f. below, gives filling procedure after the bottle has been removed from the airplane.

Note

The air bottle must be filled after each use of the landing gear emergency system. Check the gage for the proper air pressure prior to take-off.

WARNING

Do not fill the landing gear compressed air bottle with oxygen.

d. For filling the air bottle when installed in the airplane, unscrew the valve cap on the Schrader air valve which is located on the top of the air pressure gage in the left hand wheel well. Depress the lever on the bottom of the gage housing and, with an outside air line, fill the bottle to 1800 psi. Since temperature changes will result in pressure changes, the following limits should be adhered to:

Deck Temperature	*Min. Pressure*	*Max. Pressure*
Above freezing	1600 psi	2000 psi
Below freezing	1400 psi	1900 psi

It is not necessary to bleed or fill air bottle if the above conditions are met.

e. Release lever and replace valve cap.

f. For filling after the air bottle has been removed from the airplane (refer to paragraph 4–1039), connect the bottle to an outside air line with a Kidde coupling nut No. 33825. Fill the bottle to 1800 psi (see step d. above for allowable tolerances) and remove coupling nut. Install the bottle and reconnect the emergency air line.

3–78. PROCEDURE FOR FILLING EMERGENCY CANOPY COMPRESSED AIR BOTTLE. *(Refer to figure 3–10.)*

a. Before take-off, check the emergency canopy compressed air bottle for proper pressure by depressing the lever on the gage.

b. The emergency canopy compressed air bottle is located on the right hand side of the airplane just aft of bulkhead 186 and may be reached through the radio compartment access door. A decalcomania on the bottle reads "COMPRESSED AIR 1800 LBS. PER SQ. IN. EMERGENCY CANOPY AIR CYLINDER."

c. The air bottle assembly can be filled while installed in the airplane or can be removed for filling. Step f. below, gives filling procedure after the bottle has been removed from the airplane. Check the gage before take-off by depressing the lever on the gage.

Note

The air bottle must be filled after each use of the canopy emergency system.

WARNING

Do not fill the canopy compressed air bottle with oxygen.

d. For filling the air bottle when installed in the airplane, unscrew the valve cap on the Schrader air valve which is located on the top of the air pressure gage. Depress the lever on the bottom of the gage housing and, with an outside air line, fill the bottle to 1800 psi. Since temperature changes will result in pressure changes, the following limits should be adhered to:

Deck Temperature	*Min. Pressure*	*Max. Pressure*
Above freezing	1600 psi	2000 psi
Below freezing	1400 psi	1900 psi

It is not necessary to bleed or fill air bottle if the above conditions are met.

e. Releave lever and replace valve cap.

f. For filling, after the air bottle has been removed from the airplane (refer to paragraph 4–1174) connect the bottle to an outside air line with a Kidde coupling nut No. 33825. Fill the bottle to 1800 psi (see step d. above for allowable tolerances) and remove coupling nut. Install the bottle and reconnect the emergency air line.

3–79. FILLING OXYGEN CYLINDER.

3–80. PROCEDURE. *(See figure 3–10.)* Proceed as follows to fill the oxygen cylinder when installed on the airplane.

a. Use only Grade A oxygen, Spec. AN-O-1.

b. Open the lower cockpit access door for access to the oxygen cylinder located underneath the cockpit floor, aft and to the right of the pilot's control stick. A decal on the oxygen installation bracket notes "OXYGEN REFILL."

c. Loosen the filler cap on the recharging installation.

d. Make sure that the line from the charging apparatus is clean and dry.

e. Connect charging line securely to the filler fitting.

f. Turn the oxygen release valve on the oxygen cylinder to the "OPEN" position and charge the oxygen cylinder to an oxygen pressure of 1800 psi, (read on pressure gage installed on filling apparatus).

g. When the cylinder is completely filled, turn the oxygen cylinder release valve to the "CLOSED" position.

h. Remove the charging line and replace the filler cap on the recharging installation.

i. Test the release valve on the cylinder by opening the valve slightly and then turning to the "CLOSED" position.

j. Refer to paragraph 4—1652 for testing of the oxygen system.

3—81. GROUND OPERATING INSTRUCTIONS.

Note

For additional information related to ground and pre-flight check, see Pilot's Handbook of Flight Operating Instructions for Navy Model F4U-5 Airplane (AN-01-45HD-1).

Reference to figures 3—11, 3—12, and 3—13 will prove helpful to the mechanic in familiarizing himself with cockpit arrangement.

3—82. STARTING ENGINE.

3—83. PROCEDURE. The following is the recommended procedure and check list to be used for engine starting:

a. Ignition switch — "OFF."

b. Cowl flap switch — "AUTOMATIC" (flaps full open).

c. Oil cooler door switch — "AUTOMATIC."

d. Intercooler flap switch — "AUTOMATIC."

e. Master water injection switch — "OFF."

f. Mixture control — "IDLE CUT-OFF."

g. Throttle — set to give 800-1000 rpm (approximately one inch from full closed position) after engine start.

h. Propeller control — full "INCREASE."

i. Auxiliary (booster) fuel pump switch — "OFF."

j. Transfer pump switch — "OFF."

k. Oil dilution switch — "OFF."

l. Battery switch — "OFF" and external power source disconnected until propeller is pulled through four or five complete revolutions of the crankshaft to clear out engine; then have external power source connected.

m. Fuel selector — "ON."

n. Auxiliary (booster) fuel pump switch — "LOW." (Check that fuel pressure is approximately 10 psi.)

o. Ignition switch — "BOTH."

p. Prime engine as necessary.

q. Engage starter.

r. If engine does not fire almost immediately, continue to prime. Do not operate the mixture control or pump the throttle to prime.

s. When engine begins to fire regularly on prime, move mixture control to "RICH." Do not pump or move throttle abruptly. There will be a lapse of time after moving the mixture control into the "RICH" position until fuel feeds from the discharge nozzle. Therefore, it is IMPORTANT to keep the engine firing regularly (at least 350-400 rpm) by continuing to use the priming switch until normal carburetion is established. If, for any reason, the engine stops firing, move the mixture control to "IDLE CUT-OFF" immediately, and continue cranking and priming until engine starts.

Note

Normally it should not be necessary to operate the starter any more than 30 seconds in order to start the engine. If the starter switch is held on for one minute and the engine does not start, allow the starter to cool for one minute before making another attempt. After the second and succeeding cranking cycles, allow five minutes for cooling.

t. Idle the engine at 600 to 800 rpm until normal oil pressure is built up (100 psi minimum). If oil pressure does not register on gage almost immediately, STOP engine and investigate.

3—84. FAILURE TO START ON FIRST ATTEMPT. If the engine does not start, wait a few minutes to allow excess fuel to drain out of the blower drain and the carburetor air box drain. Ground crew standing by with fire extinguisher should check for fire in induction system through carburetor air box drain and for fire in exhaust pipe outlets; see paragraph 3—88.

3—85. IMPROPER PRIMING. Inspection of the exhaust pipe outlets of the upper cylinders, should indicate whether the engine has been over- or under-primed.

3—86. UNDER-PRIMING. No trace of smoke from the exhaust pipe outlets indicates under-priming. The use of the primer switch should be governed accordingly.

3—87. OVER-PRIMING. Excessive black smoke from the exhaust pipe outlets indicates over-priming. If the engine is over-primed, clear the cylinders and induction system of excess fuel as follows:

a. Mixture — "IDLE CUT-OFF."

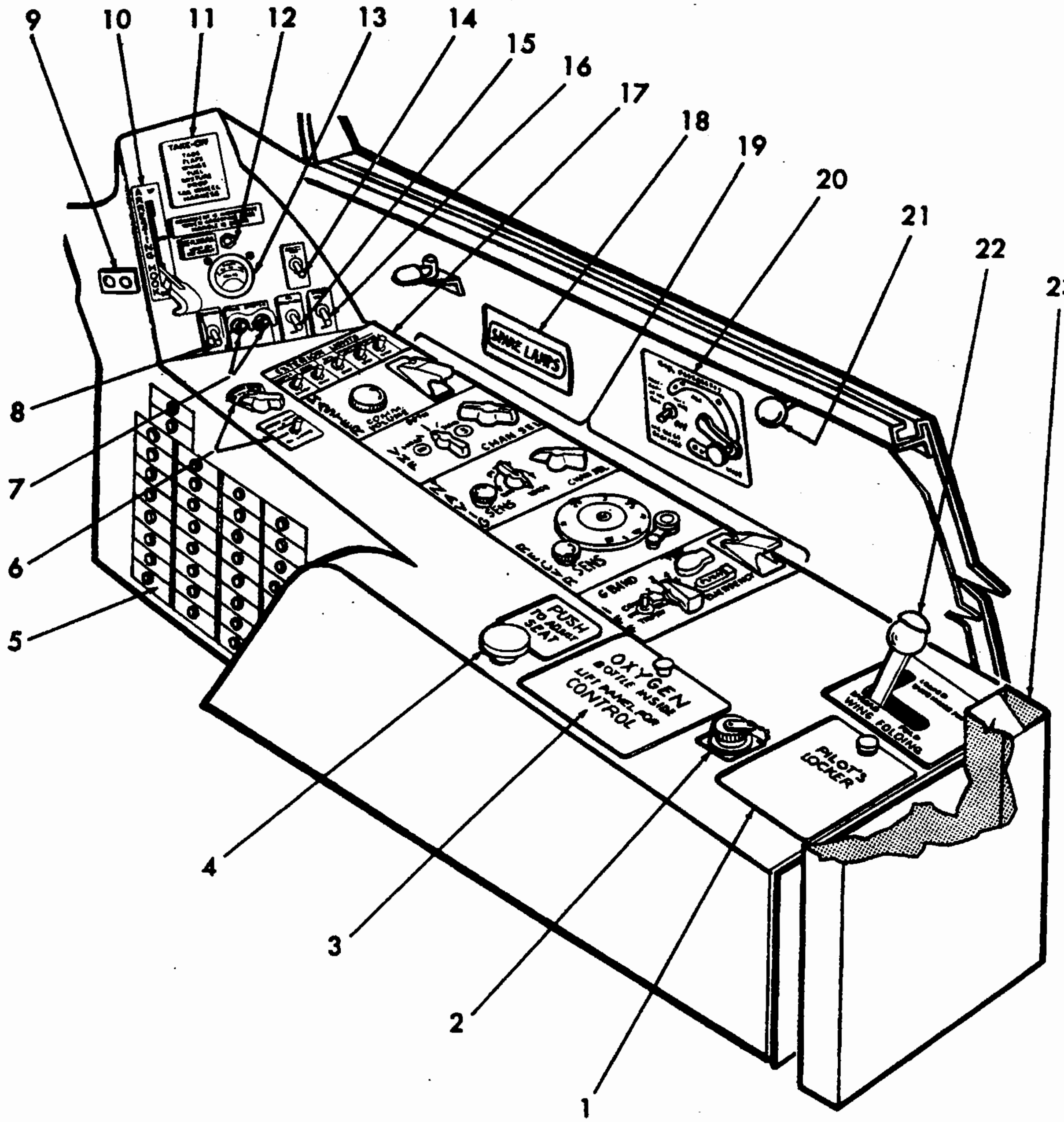
b. Auxiliary (booster) fuel pump switch — "OFF."

c. Ignition switch — "OFF."

d. External power supply — disconnected.

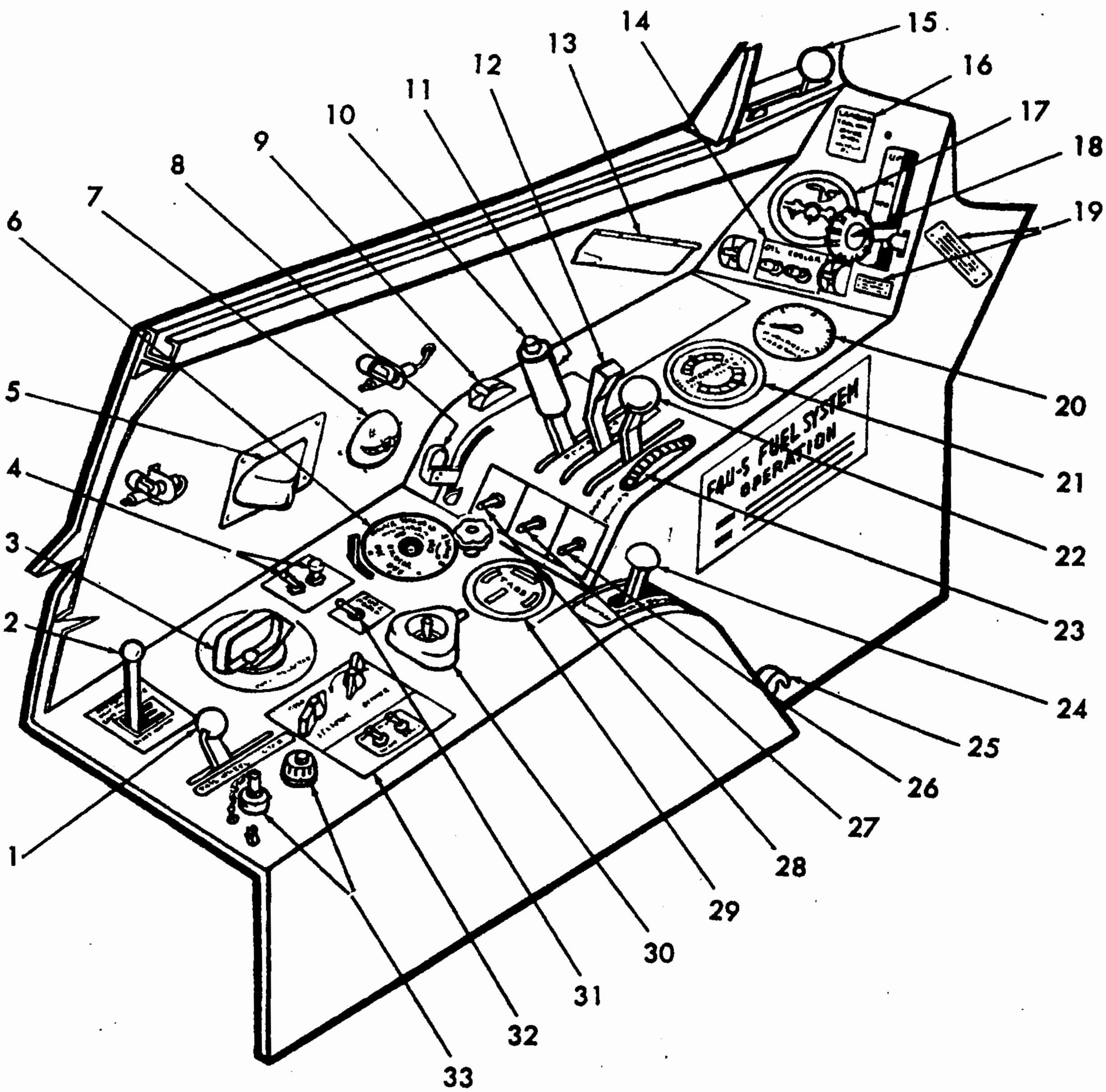
e. Throttle — full open.

f. Clear engine by turning engine over four complete revolutions by hand.



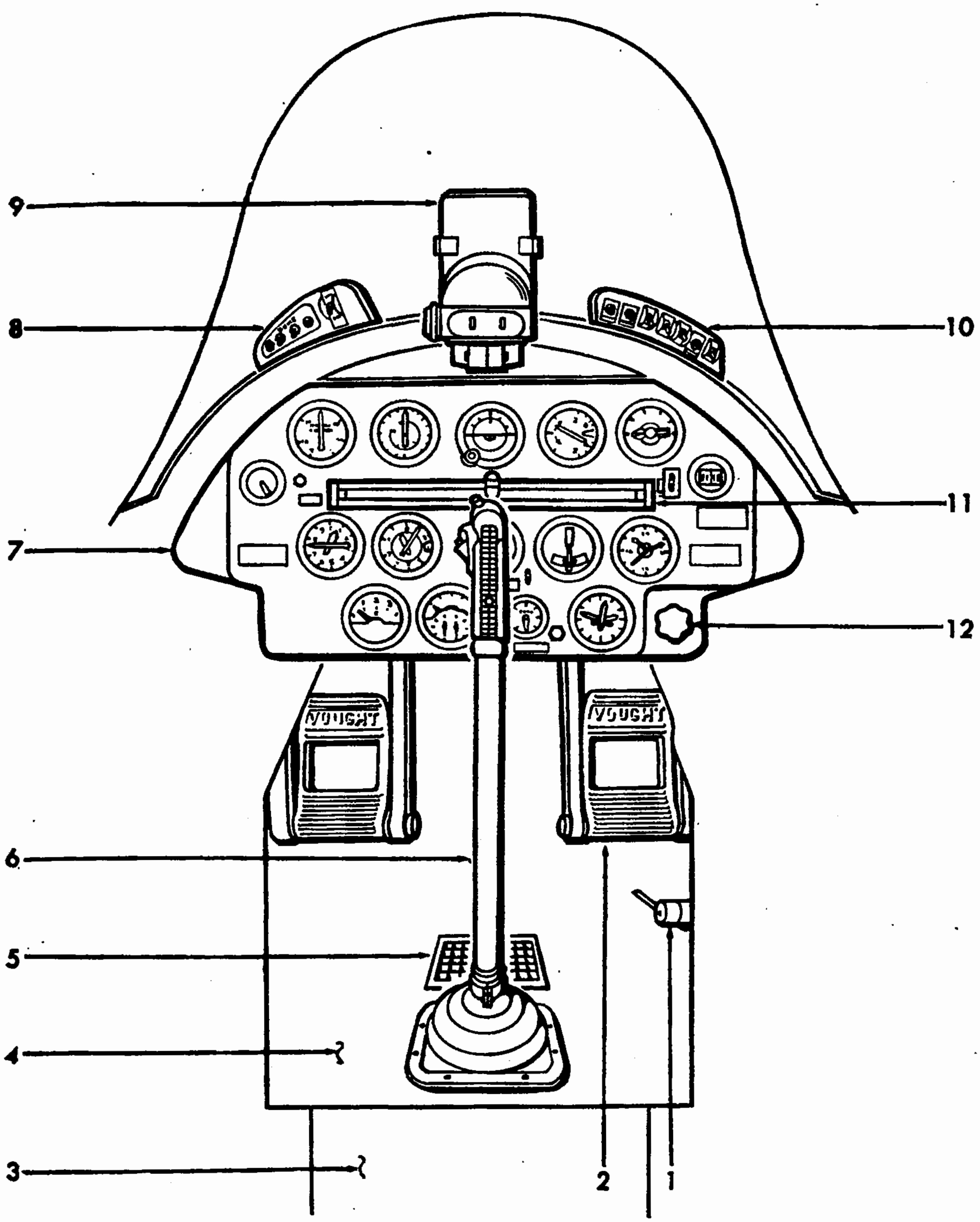
1. Pilot's Locker
2. Portable Equipment Receptacle
3. Access to Oxygen Cylinder Control
4. Seat Adjustment Control
5. Circuit Breaker Panel
6. Interior Lights Switches
7. Primer and Starter Switches
8. Battery Switch
9. Voltmeter Test Jacks
10. Arresting Hook Control
11. Take-off Check List
12. Generator Warning Light
13. Voltammeter
14. Auxiliary Hydraulic Pump Switch
15. Oil Dilution Switch
16. Pitot Heat Switch
17. Exterior Lights Switches
18. Spare Lamps
19. Radio Console Control Panel
20. Heating and Ventilating Control Panel
21. Sliding Section Safety Stop
22. Wing Folding and Locking Control
23. Map Case.

Figure 3—11. Cockpit — Right Hand Side.



1. Tail Wheel Lock
2. Emergency Bomb and External Tank Release
3. Fuel Selector
4. Fuel Transfer Switch and Warning Light
5. Cigarette Lighter
6. Diluter Demand Oxygen Regulator
7. Ash Tray
8. Wing Flap Control Handle
9. Master Water Injection Switch
10. Microphone Switch
11. Throttle and Gunsight Range Control
12. Propeller Governor Control
13. Catapult Handgrip Door
14. Oil Cooler Controls and Indicator Lights (inoperative)
15. Sliding Section Control
16. Landing Check List
17. Landing Gear and Flap Position Indicator
18. Landing Gear Control
19. Emergency Landing Decals
20. Hydraulic Pressure Gage
21. Oil Cooler Door and Intercooler Flap Position Indicator
22. Mixture Control
23. Control Quadrant Friction Adjustment Handwheel
24. Shoulder Harness Lock
25. Tow Target Release
26. Cowl Flaps Switch
27. Oil Cooler Switch
28. Intercooler Switch
29. Trim Tab Position Indicator
30. Trim Tab Control Switches
31. Submerged Auxiliary (Booster) Fuel Pump Switch
32. Gunsight Switch Control Panel
33. Anti-blackout Suit Valve and Quick-disconnect Fitting

Figure 3—12. Cockpit — Left Hand Side.



1. Main Tank Pressure Release
2. Rudder Pedals
3. Removable Canvas Floor
4. Fixed Metalite Floor
5. Ventilator
6. Control Stick
7. Instrument Panel
8. Armament Switch Box — L.H. (Gun Switches and Charging Buttons)
9. Gunsight
10. Armament Switch Box — R.H. (Bomb and External Tank Release, Rocket and Bomb Arming)
11. Chart Board
12. Rudder Pedal Adjusting Knob

Figure 3—13. Cockpit — Forward.

WARNING

Never turn over a hot engine by hand.

3–88. ENGINE FIRE DURING STARTING. If an induction system fire should break out while starting the engine, keep the engine running. In many cases this will draw the flames back up into the cylinders. If this, and the application of CO_2 by the ground crew to the drain valve in the carburetor air box is not effective in extinguishing the flames, (while the ground crew continues to apply CO_2) proceed as follows:

a. Pull mixture control to "IDLE CUT-OFF."

b. Auxiliary (booster) fuel pump switch – "OFF."

c. Throttle – open.

d. Ignition – "OFF."

3–89. WARM-UP AND GROUND TEST.

3–90. WARM-UP CHECK LIST.

a. Mixture – "RICH."

b. Propeller control – full "INCREASE."

c. Cowl flaps switch – "AUTOMATIC." (Check "OPEN" and CLOSED" override positions.)

d. Oil cooler door switch – "AUTOMATIC."

e. Intercooler flap switch – "AUTOMATIC."

f. Throttle – 1000 rpm.

g. Auxiliary (booster) fuel pump switch – "OFF" after engine is running satisfactorily.

h. Oil dilution switch – "OFF."

Warm-up engine until oil temperature reaches a minimum of 40°C (104°F).

3–91. GROUND TEST.

3–92. IGNITION SAFETY CHECK. The ignition safety check may be performed during warm-up with engine idling at 1000 rpm.

a. Switch ignition from "BOTH" to "RIGHT" and back to "BOTH."

b. Switch ignition from "BOTH" to "LEFT" and back to "BOTH."

c. Switch ignition to "OFF" (momentarily) and back to "BOTH."

A slight drop in rpm when operating on each separate magneto and complete cutting out of the engine at the "OFF" position indicates proper connection of the ignition leads.

3–93. ENGINE CHECK. At 2200 rpm, engine instruments should give the following readings:

a. Fuel pressure – 25-1/2 to 26-1/2 psi.

b. Auxiliary (booster) fuel pump – check pump pressure with switch in "HIGH" position. Pressure should read 27-1/2 to 29-1/2 psi.

c. Oil pressure – 115 psi (+5 –0 psi) at

d. Oil temperature – 75°-80°C (167°-176°F).

3–94. MAGNETO CHECK. This check should always be made prior to the idle mixture check to be sure that plugs are not fouled.

a. With engine rpm at 2000, with propeller control in "INCREASE," switch ignition from "BOTH" to "RIGHT." The rpm should drop approximately 50 to 75 and the drop should not exceed 100 rpm.

b. Switch ignition back to "BOTH" and permit engine to stabilize at 2000 rpm.

c. Switch from "BOTH" to "LEFT." The rpm should drop between 50 and 75 and the drop should not exceed 100 rpm. The difference in drop between "RIGHT" and "LEFT" should not exceed 40 rpm.

d. Switch ignition back to "BOTH."

e. Reduce rpm to 1000. Switch ignition "OFF" momentarily; complete cut-out indicates proper magneto lead connections.

3–95. PROPELLER GOVERNOR CHECK.

a. Place propeller governor control in the full "INCREASE" position.

b. Engine speed – 2000 rpm.

c. Move the propeller control from full "INCREASE" to full "DECREASE." The engine speed should drop to about 1200 rpm.

d. Return the propeller control to full "INCREASE;" rpm should return to 2000 rpm.

3–96. IDLE MIXTURE CHECK.

a. Engine speed – 600 rpm (+ or –25 rpm).

b. Auxiliary (booster) fuel pump – "OFF."

c. While observing tachometer, place mixture control handle in "IDLE CUT-OFF" position.

d. Return mixture control to "RICH" position before engine dies.

If a momentary rise of not more than 20 rpm is observed before normal drop-off, mixture strength is correct. If a greater rise in rpm is noted, the mixture is too rich. If there is no rise in rpm, the mixture is too lean.

3–97. ELECTRICAL CHECK WITH ENGINE RUNNING.

a. Disconnect external power source, if used.

b. Battery switch – "ON."

c. Turn on some electrical equipment such as cockpit or instrument lights.

d. Run the engine rpm up, past approximately 1400 rpm to close the reverse current cutout; the generator warning light should go out.

e. As a further check, turn off the battery switch. If the lights stay on, the reverse current cutout has closed.

f. Increase engine rpm and check the voltage by pushing the button. The voltage should increase to approximately 28 volts and stay there regardless of any further increase in engine rpm.

g. If the reverse current cutout does not close, or if the voltmeter does not read between 27.5 and 28.5 volts, investigate the trouble before take-off.

3—98. HYDRAULIC CHECK. The following functional check of the hydraulic system should be made:

a. Check normal operation of wing flaps in all positions from "up" to normal "down," noting positions on combination flap and landing gear indicator. Return flaps to full "up" position.

b. Check operation of oil cooler door and intercooler flap switches by placing them in all positions and noting positions on the indicator just forward of the throttle. The intercooler flap should be closed manually and the switch left in the "OFF" position. The oil cooler door switch should be left in the "AUTOMATIC" position.

c. Check power and manual operation of the canopy. Normal hydraulic system gage pressure is 1500 psi (+ or −100 psi) when no units are operating. Pressure will fluctuate and then stabilize at this value as individual systems are actuated. After the operation of the last sub-system, allow pressure to stabilize before checking to see that it remains constant. Oscillation or noticeable change in dial reading when no unit is in operation indicates malfunctioning of the system.

3—99. TAXIING INSTRUCTIONS. Remember the following when taxiing:

a. Use the S-turn procedure for best forward vision.

b. Let the airplane roll free where possible using the brakes as sparingly as is practicable.

c. Use the tail wheel lock in extended crosswind taxiing to alleviate the need for riding the downwind brake.

d. Use low power, bearing in mind that badly overheated brakes are not fully effective. Overheating the brakes can score the brake discs, requiring replacement.

e. Keep electrical loads at a minimum to minimize battery discharge.

3—100. STOPPING OF ENGINE.

3—101. ENGINE COOLING. Before shutting down the engine, check the following:

a. Cowl flaps — OPEN (switch in "AUTOMATIC").

b. Intercooler flap — OPEN to cool accessory compartment (switch "OPEN" then "OFF").

c. Oil cooler doors — OPEN (switch "AUTOMATIC").

d. Propeller control — full "INCREASE."

3—102. TO STOP ENGINE.

a. Auxiliary (booster) fuel pump switch — "OFF."

b. Dilute oil, if necessary. See paragraph 3—103 below.

c. Mixture control — "IDLE CUT-OFF."

d. Ignition switch — "OFF" when the propeller stops turning.

e. Battery switch — "OFF."

f. Fuel selector — "OFF."

g. Turn off all switches used for flight such as radio, lights, etc.

Note

Cowl flaps, oil cooler doors, intercooler flap and cockpit canopy should be closed as soon as engine is cool.

3—103. OIL DILUTION. In the event of low temperature forecast, ie., below approximately 2°C (35°F) engine oil should be diluted in the following manner:

a. Open the manual shut-off valve in the oil dilution line. This valve is located on the forward side of the fuel strainer and is accessible through the intercooler flap.

b. Engine "oil-in" temperature — not more than 40°C (104°F).

c. Engine speed constant — 1000 rpm.

d. Oil dilution switch — "ON" approximately six minutes.

e. During the last one minute of dilution, dilute the oil in the propeller dome as follows: Set the propeller control to 1600 rpm. Open the throttle until the engine speed reaches 1600 rpm. Then without moving the throttle, operate the propeller control so that the engine speed drops to 1200 rpm and then increases to 1600 rpm. Perform this operation twice. Set throttle to engine speed of 1000 rpm. Return propeller control to full low pitch (increase rpm).

f. Stop engine by moving the mixture control to "IDLE CUT-OFF" position, then turn ignition switch to "OFF." Hold dilution switch "ON" until engine stops turning.

g. Close the manual shut-off valve and safety wire before next take-off.

3—104. In some instances, it may be necessary to dilute the engine oil in two or more periods. Dividing the oil dilution procedure into several periods has no detrimental effect on the general dilution period provided the total time does not exceed that required for the anticipated temperature.

Note

It is recommended that the oil dilution period be divided into two periods when it is necessary to service the oil tank, so that some dilution is accomplished before servicing, and the remainder is accomplished after the oil tank is serviced.

3—105. PRECAUTIONS. Several precautions must be taken when using oil dilution.

a. Dilution will increase considerably the inflammability of the vapors issuing from the crankcase breather. The oil itself will burn at a dilution of 20% or more (at an ambient temperature of 60°F). Therefore, all possible precautions against fire shall be taken during the dilution operation and during subsequent starting and warm-up. It is recommended that personnel with fire extinguishers always be maintained in the vicinty of the engine during dilution. Particular care shall be taken to guard against leaks and in the handling of drained diluted oil in confined places.

b. Oil dilution when it is first used, particularly in an engine which has been operated over 100 hours, has a desludging effect. Any sludge accumulation in the engine oil system may be loosened and carried to the engine oil strainers where it will be deposited. Any trouble which may be likely to occur as a result of an excess deposit of sludge can be prevented by careful checking and cleaning of the strainers after each flight, if necessary. If an excess amount of sludge is found in the strainers subsequent to the first flight after oil dilution is employed, the oil should be changed in addition to cleaning the strainers. After each flight when oil dilution is used regularly, the strainers should be checked, and cleaned when necessary. However, no further oil change should be made until the oil has been used for at least 30 hours of engine operation unless an unusually large amount of sludge is deposited and the strainers are in danger of becoming clogged.

c. Because of the desludging effect of oil dilution as described above it is better to use oil dilution regularly once it has been resorted to. However, if conditions are such that dilution is used infrequently and irregularly, a careful check must be kept on the conditions of the strainers at all times, and the oil changed if the sludge deposit becomes excessive. It is highly important to check the condition of the oil strainers carefully and frequently whenever oil dilution is used, whether it is used regularly or irregularly.

3—106. BEFORE LEAVING THE COCKPIT. Before leaving the cockpit, check the following:

a. Tail wheel — "LOCK."

b. Gun sight switches — "OFF."

c. Fuel tank selector — "OFF."

d. Fuel transfer switch — "OFF."

e. Auxiliary (booster) fuel pump switch — "OFF."

f. Wing flaps — "up."

g. Water injection master switch — "OFF."

h. Throttle — closed.

i. Mixture control — "IDLE CUT-OFF."

j. Ignition switch — "OFF."

k. Armament switches — "OFF."

l. Auxiliary hydraulic pump switch — "OFF."

m. Engine starting switches — "OFF."

n. All light switches — "OFF."

o. All radio switches — "OFF."

p. Install the surface control lock (VS-58050, included in Ground Handling Equipment—Loose Accumulations) by moving rudder pedal slide full aft and inserting forward tubes of the lock into the tubes of the lower end of the rudder pedals. This is done by telescoping the spring-loaded tube of the lock into the tube housing the spring. Release when aligned with rudder pedal tubes. Position control stick in the two retaining clamps of the lock and secure by inserting spring-loaded pins into locking position.

CAUTION

Check that the surface controls are locked whenever the airplane is parked for any extended period.

q. If the airplane is to remain parked for any length of time, before leaving it check the following:

Cowl flaps — closed.

Intercooler flap — closed.

Oil cooler doors — closed.

Canopy — closed.

3—107. LUBRICATION REQUIREMENTS.

To maintain the efficiency of the airplane as a whole and to prevent unnecessary wear of its many moving parts, proper lubrication is of prime importance. Some units require more frequent lubrication than others and differences in construction necessitate various types of lubricants and different methods of application. Figure 3—14 furnishes information on the location of lubrication points, frequency of lubrication, type of lubricant and method of application. When necessary, lubrication prior to assembly or installation is directed in the text for the various units in Sections IV and V.

PARTS NOMENCLATURE KEY (continued)

3. Wing Folding Gap Door Mechanisms
4. Forward Wing Hinge Bearings
5. Wing Folding Hydraulic Cylinder Tracks
6. Wing Folding Hydraulic Cylinders
7. Flap Release Indicators
8. Center Section and Outer Panel Flap Door Hinges
9. Main Wing Hinge Fitting Faces
10. Main Wing Hinge Bearings
11. Flap Disconnect Mechanisms
11A. Flap Hydraulic Actuating Cylinder at Lower Attachment
12. Hydraulic Reservoir
13. Oil Tank
14. Rudder Pedal Adjusting Mechanism Slides
15. Cockpit Control Levers: Shoulder Harness Lock, Tail Wheel Lock, Emergency Bomb and Drop Tank Release, Wing Fold Control
16. Seat Locking Pin Control and Miscellaneous Pivot Points
17. Cabin Track
18. Tow Target Release Installation
19. Rudder Tab Actuator Mounting Pins (pivot point for actuator and screwjack)
20. Rudder Tab Hinges
21. Elevator Tab Actuator Mounting Pins (pivot point for actuator and screwjack)
22. Elevator Tab Hinge Pins
23. Tail Gear Door Hinges
24. Pilot's Arm Rest Pivot Points
25. Pilot's Seat Slides
26. Flap Gap Closure Plate Stiffeners
27. Flap Gap Closure Plate Hinges
28. Main Landing Gear Greased Skid
29. Wing Folding Sequence Valve
30. Rear Gun Bay Door Latch Pins and Sprockets
31. Aileron Tab Hinges
32. Aileron Tab Actuator Mounting Pins (pivot point for actuator and screwjack)
33. Aileron Balance Tab Hinge Points
34. Inboard and Outboard Gap Cover Door Latches
35. Inboard and Outboard Gap Cover Door Hinges
36. Gun Slideways
37. Front Gun Bay Door Latch
38. Front Gun Bay Door Hinges
39. Front Gun Bay Door Latch Pins and Sprockets
40. Guns
41. Inboard and Outboard Landing Gear Door Hydraulic Actuating Cylinders
42. Bomb or External Tank Manual Release Plungers
43. Brake Pedal and Brake Cylinder Pivot Points
44. Rudder Pedal Pivot Point
45. Brake Cylinders
46. Rudder Pedal Adjusting Mechanism Chains

DETAIL A

47. Miscellaneous Friction Points on Sliding Section Operating Mechanism
48. Sliding Section Operating Rack

DETAIL B

49. Drag Link Collar and Drag Link Collar Bolt
50. Landing Gear Knuckle Lubricator
51. Landing Gear Shock Strut Attaching Pin
52. Main Landing Gear Shock Strut
53. Main Landing Gear Scissors Pivots
54. Main Landing Gear Towing Shackle

DETAIL C

55. Forward Attaching Bolt—Tail Gear Hydraulic Actuating Cylinder
56. Forward Attaching Bolt—Arresting Hook Locking Strut
57. Forward Attaching Bolt—Arresting Hook Dashpot
58. Arresting Gear Locking Strut
59. Arresting Gear Dashpot
60. Bolt—Tail Wheel Scissors
61. Tail Wheel Positive Downlock Latch
62. Aft Attaching Bolt—Tail Wheel Actuating Cylinder
63. Upper Attaching Bolt—Compression Strut
64. Upper Attaching Bolt—Tail Gear Shock Strut
65. Tail Gear Shock Strut
66. Bolt—Arresting Hook Retracting Link Snubber Arm
67. Bolts—Tail Gear Shock Strut Compressing Cable
68. Tail Gear Door Actuating Rods
69. Bolts—Arresting Gear and Tail Gear Shock Strut Pivot
70. Tail Wheel Spindle Bearings
71. Tail Wheel Lock Plunger
72. Tail Wheel Bearing
73. Universal Joints—Tail Gear Doors Actuating Rods
74. Forward Attaching Bolt—Tail Wheel Yoke
75. Bolt—Arresting Hook Retracting Link
76. Aft Attaching Bolt—Tail Gear Hydraulic Actuating Cylinder
77. Aft Attaching Bolt—Arresting Hook Dashpot

DETAIL D

78. Links and Attaching Bolts—Main Landing Gear Hydraulic Actuating Cylinder
79. Main Landing Gear Drag Link Shaft Bearings
80. Aft Attaching Bolt—Main Landing Gear Hydraulic Actuating Cylinder
81. Main Landing Gear Hydraulic Actuating Cylinder
82. Bolt—Main Landing Gear Drag Link Pivot
83. Main Landing Gear Lock Links
84. Main Landing Gear Lifting Device
85. Main Landing Gear Wheel Bearings

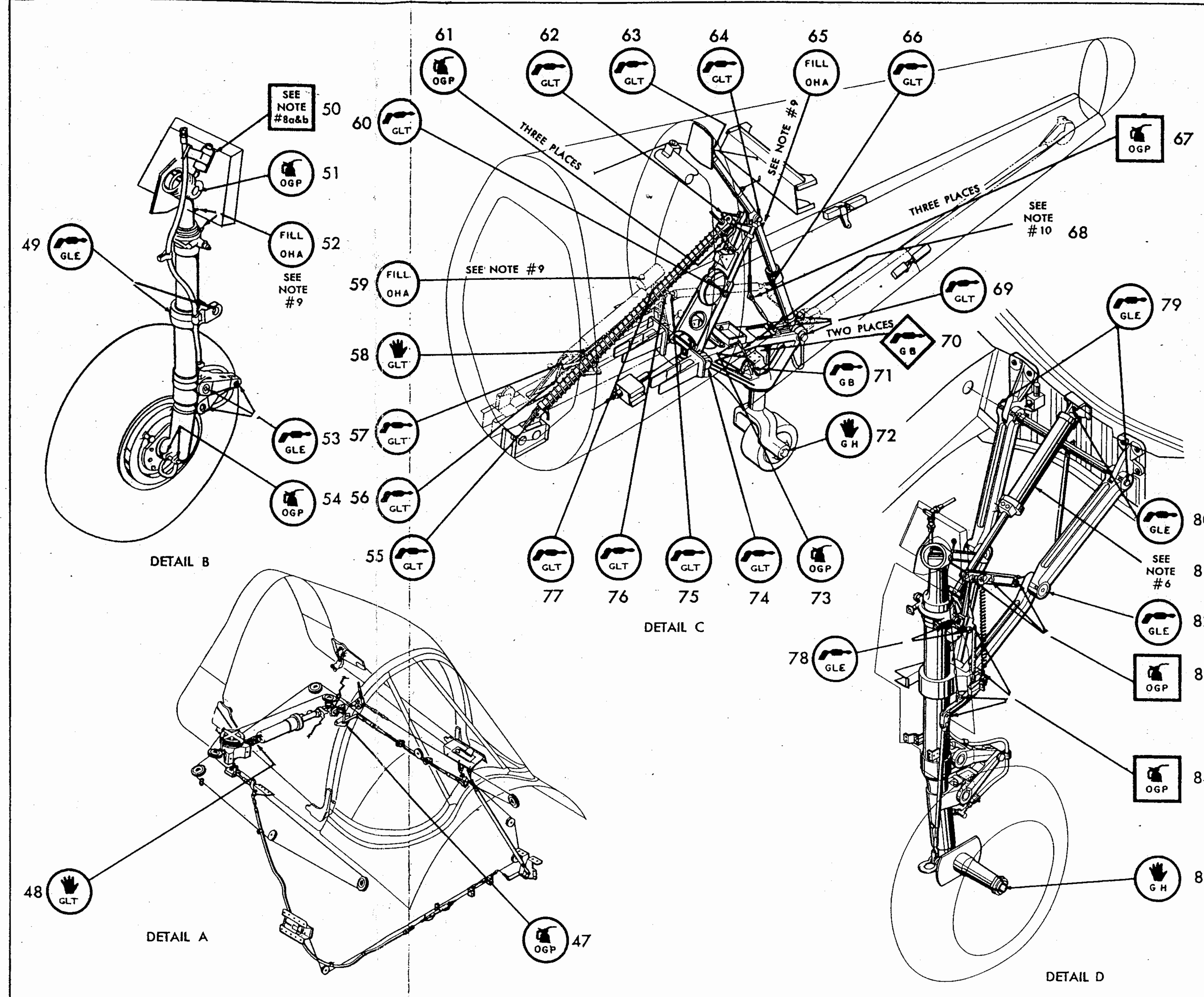


Figure 3–14. (Sheet 2 of 2 Sheets). Lubrication Chart.

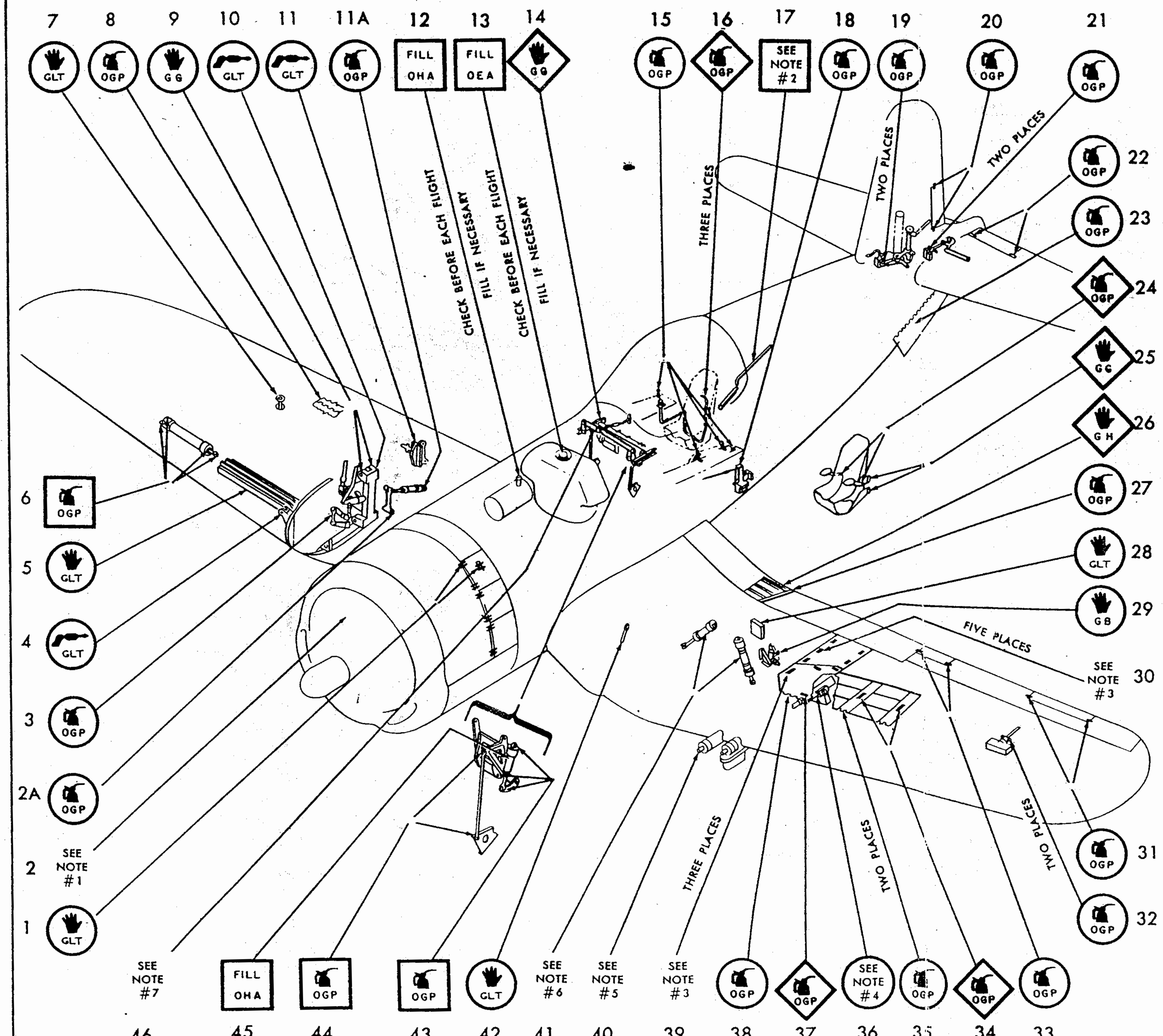


Figure 3—14. (Sheet 1 of 2 Sheets). Lubrication Chart.

SPECIAL SERVICE NOTES

The following notes supplement lubrication information directed on the field of the drawing.

1. Lubricate engine in accordance with Pratt and Whitney Engine Service Instructions Manual (AN 02-10GE-2).
2. Do not use oil or grease on cabin track. Clean daily with kerosene.
3. Lubricate gun bay door latch sprockets every 60 hours with Spec. AN-G-25 Low Temperature Grease (GLT); lubricate latch pins every 60 hours with Spec. AN-G-6 Lubricating Graphite Grease (GG).
4. At time of each replacement of gun, grease rear slideways with Spec. AN-G-25 Low Temperature Lubricating Grease (GLT.)
5. Prior to assembling guns after each cleaning, oil all parts with O. S. 1361 oil.
6. Oil felt wipers of the following hydraulic actuating cylinders every 30 hours with hydraulic oil, Spec. AN-0-366.
   - VS-38317 Wing Flap Hyd. Act. Cyl.
   - VS-46648 Landing Gear Hyd. Act. Cyl.
   - VS-58307 Landing Gear Outboard Door Hyd. Act. Cyl.
   - VS-58256 Landing Gear Inboard Door Hyd. Act. Cyl.
7. Coat all chains with Spec. AN-0-6 General Purpose, Low Temperature Oil (OGP) and wipe off excess oil with a clean cloth.
8. Main Landing Gear:
   a. When the aircraft is used for bounce drill or dive bombing practice, the grease points requiring Spec. AN-G-10 (GLE) every 30 hours shall be greased daily.
   b. Fill VS-53504 lubricator fitting on main landing gear pivot and knuckle daily under all conditions with Spec. AN-G-10 (GLE) grease. (See VS-53507 lubricator installation.)
   c. On overhauls, after removing landing gear shock strut from airplane, clean pivot and knuckle thoroughly, using a solvent to remove any grease. Remove all foreign matter with an air jet and apply generous amounts of Spec. AN-G-10 (GLE) Extreme Pressure, Low Temperature Grease.
9. Fill main landing gear shock strut, arresting gear dashpot and tail gear shock strut in accordance with instruction decal on each assembly.
10. Slide plastic tubing back from outboard threaded end of tail wheel door actuating rod and apply Low Temperature Grease, Spec. AN-G-25 (GLT) every 30 hours. Replace tubing and clamp.

GENERAL NOTES

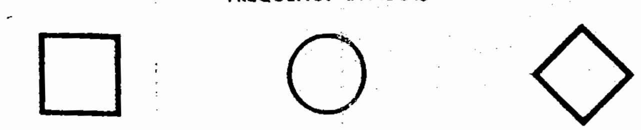
The following notes direct lubrication for systems and moving parts not shown on the field of the drawing, and give general drawing information.

11. Clean fittings before lubricating. Lubricate through fittings until new grease appears at the part being lubricated.
12. Oil all piano hinges with Spec. AN-0-6 General Purpose, Low Temperature Lubricating Oil (OGP) every 30 hours. Wipe off all excess lubricant after lubricating to prevent accumulation of dirt and sand.
13. Wipe daily all exposed piston rods of hydraulic actuating cylinders and shock struts with AN-0-366 (OHA).
14. Control system bearings are sealed and require no lubricant. Keep all control bearings wiped off and clean.
15. Oil miscellaneous friction points in power plant, engine accessory compartment and cockpit (except sealed bearings), every 30 hours with Spec. AN-0-6 General Purpose, Low Temperature Lubricating Oil (OGP).
16. Commercial designation of lubricants acceptable to specifications required are listed in the ANA Bulletins in the table of lubricants.
17. Red key numbers indicate that points must also be lubricated on opposite side of airplane.

TABLE OF LUBRICANTS

IDENTIFICATON LETTERS	BASE SPECIFICATION	TYPE OF LUBRICANT	ANA BULLETIN (See Note 16)
GLT	AN-G-25	Grease; Low Temperature Lubricating	308
GH	AN-G-5	Grease; High Temperature Water Resistant	151
GG	AN-G-6	Grease; Lubricating Graphite	——
GLE	AN-G-10	Grease; Extreme Pressure Low Temperature, Lubricating	167
OGP	AN-0-6	Oil, General Purpose, Low Temperature, Lubricating	263
OHA	AN-0-366	Oil, Hydraulic Petroleum Base	111
OEA	AN-0-8	Oil, Lubricating Aircraft Engine	329
——	O.S. 1361	Oil, Lubricating, Preservative Special	——
GB	AN-G-15	Grease, General Purpose Aircraft Lubricating	247

FREQUENCY SYMBOLS


Daily — Every 30 Hours — Every 60 Hours

APPLICATION SYMBOLS


Hand — Oil Can — Zerk or Alemite Gun

PARTS NOMENCLATURE KEY

1. Cowl Flap Quick-disconnects and Hinge Pins
2. Engine
2A. Flap Actuating Lever at Lower Attachment

Continued on next page

3—108. SPECIAL TOOLS.

3—109. DESCRIPTION. The special tools, adapters, and equipment necessary for servicing the F4U-5 airplane are listed below. Equipment required for airplane ground handling, i.e., hoists, covers, jacking pads, etc. is discussed in the preceding paragraphs of this section. All ground handling equipment, including Special Tools is included in Ground Handling Equipment — Loose Accumulations (VS-58651).

Part No.	Description
VS-34536	Wrench Assem. — M.L.G. and T.W. Metering Pin
VS-16412	Wrench — Metering Pin and Flapper Valve Assem.
VS-34573	Wrench Assem. — Valve Packing — L.G. Door Sequence
VS-45678	Wrench — Landing Gear — Main Wheel Retaining Nut
VS-34580-3	Bolt Pilot — Tail Wheel Assem. 3/4"
VS-34580-2	Bolt Pilot — Tail Wheel Assem. 1/2"
VS-34580-1	Bolt Pilot — Tail Wheel Assem. 5/16"
VS-34581	Bolt Pilot — Wing Hinge
VS-34583	Wrench — Open End — Wing Fold Cylinder Adjustment
VS-34592	Screwdriver — Slotted — Elevator Tab Control Rod
VS-43789	Wrench — Engine Mount Pedestal

3—110. WRENCH ASSEMBLY — MAIN LANDING GEAR METERING PIN. *(See figure 3—15.)* The main landing gear metering pin wrench VS-34536 (large end) is used to remove the metering pin VS-10838 from the main landing gear shock strut piston assembly VS-58612. (Refer to paragraph 4—326.) The removable handle VS-10517 is used with the wrench.

3—111. WRENCH ASSEMBLY — TAIL WHEEL METERING PIN. *(See figure 3—16.)* The tail wheel metering wrench VS-34536 (small end) is used to remove the metering pin VS-41373 from the tail wheel shock strut inner cylinder assembly VS-41372. (Refer to paragraph 4—373.) The removable handle VS-10517 is used with the wrench.

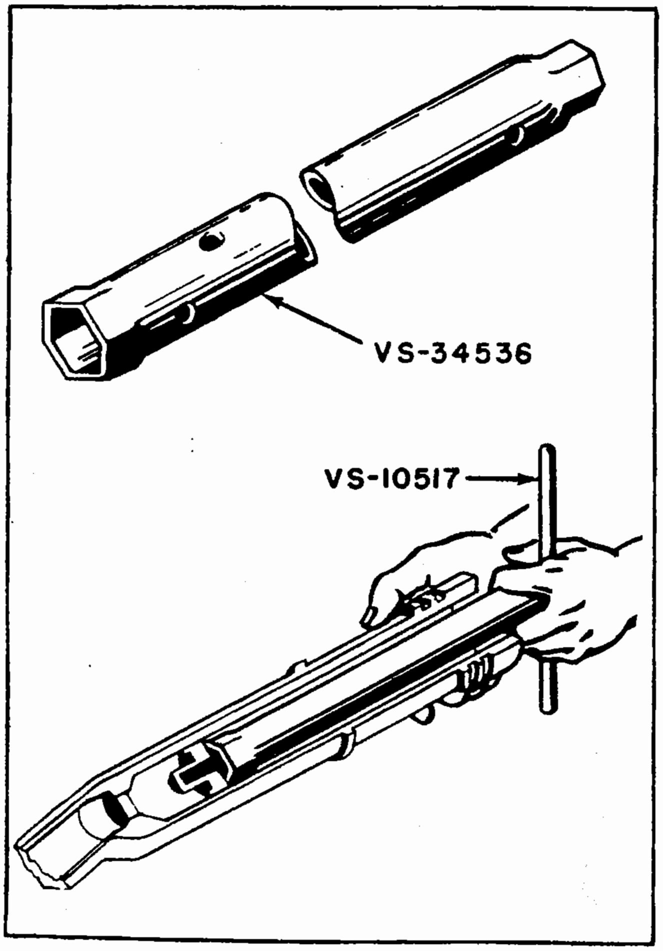


Figure 3—15. Wrench — Used for Removal of Metering Pin from Main L.G. Shock Strut Piston Assembly.

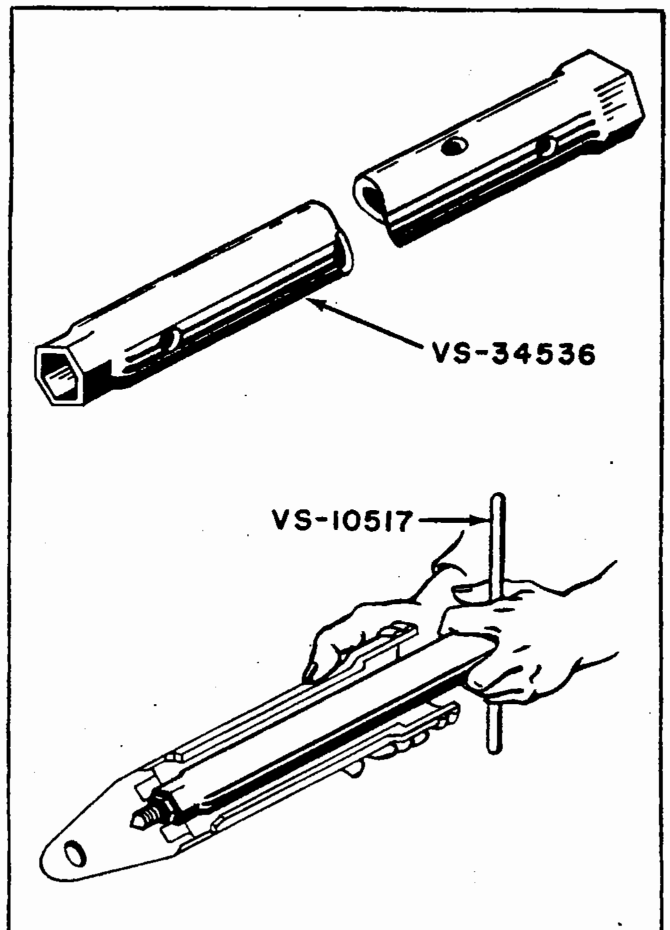


Figure 3—16. Wrench — Used for Removal of Metering Pin from Tl. Whl. Shock Strut Inner Cylinder Assembly.

3—112. WRENCH — MAIN LANDING GEAR FLAPPER VALVE ASSEMBLY. *(See figure 3—17.)* The main landing gear flapper valve wrench VS-16412 (small end) is used to remove the flapper valve and cylinder assembly VS-58609 from the main landing gear shock strut VS-55274. The removable handle VS-10517 is used with the wrench. (Refer to paragraph 4—326.)

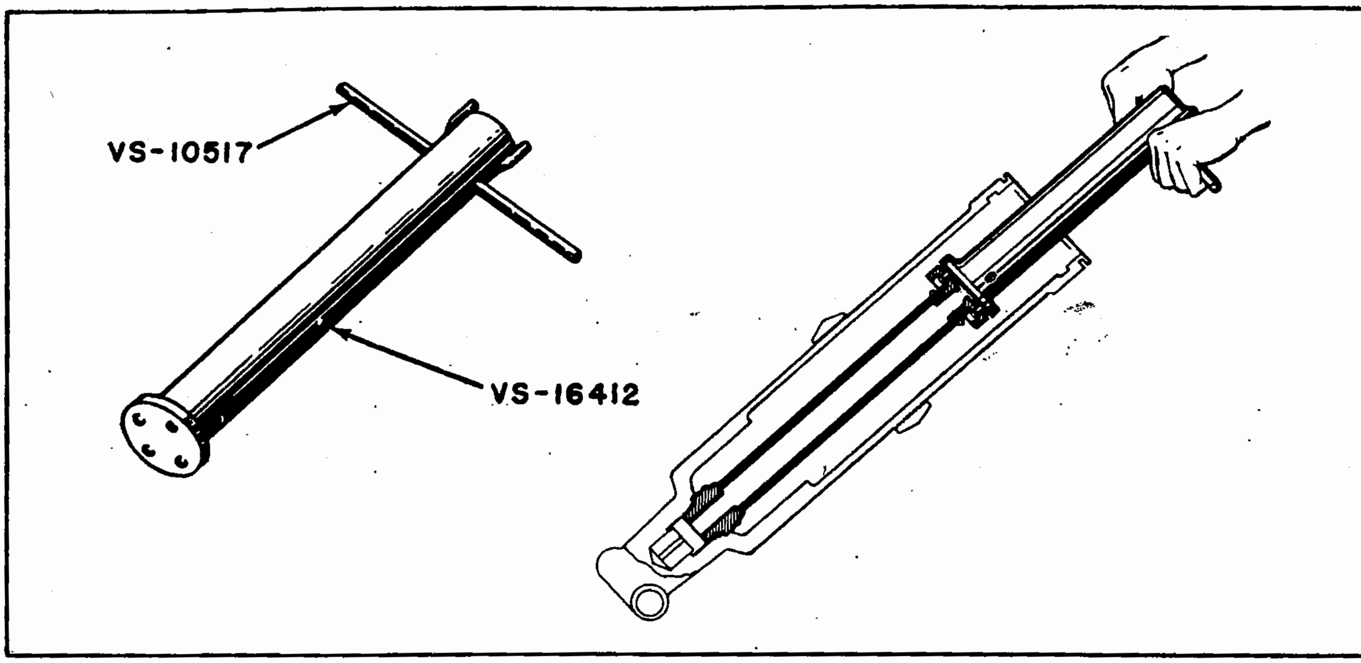


Figure 3—17. Wrench — Used for Removal of Flapper Valve Assembly from Main L.G. Shock Strut.

3—113. WRENCH — MAIN LANDING GEAR METERING PIN. *(See figure 3—18.)* The main landing gear metering pin wrench VS-16412 (large end) is used to remove the metering pin retainer nut VS-10839 from the main landing gear shock strut piston assembly VS-58612. The removable handle VS-10517 is used with the wrench. (Refer to paragraph 4—326.)

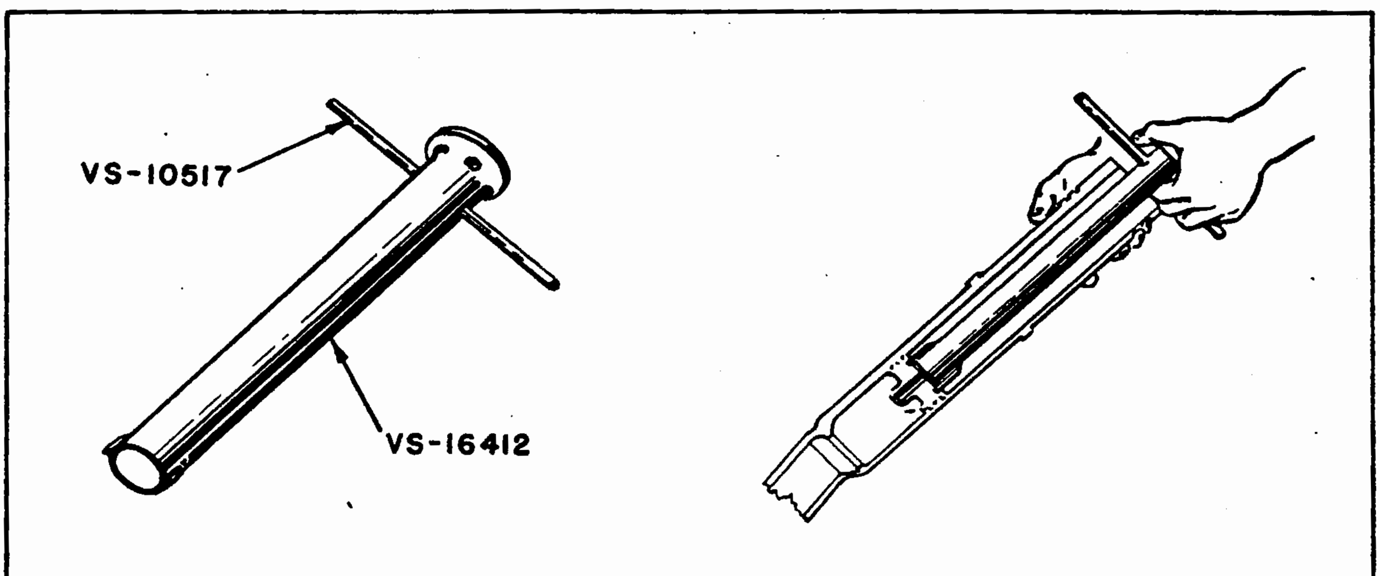


Figure 3—18. Wrench — Used for Removal of Metering Pin Retainer Nut from Main L.G. Shock Strut Piston.

3—114. WRENCH ASSEMBLY — VALVE PACKING — LANDING GEAR DOOR SEQUENCE. *(See figure 3—19.)* The main landing gear door sequence valve wrench VS-34573 is used for quick removal or installation of the packing plug from the landing gear door sequence valve VS-37801. (Refer to paragraph 4—985.)

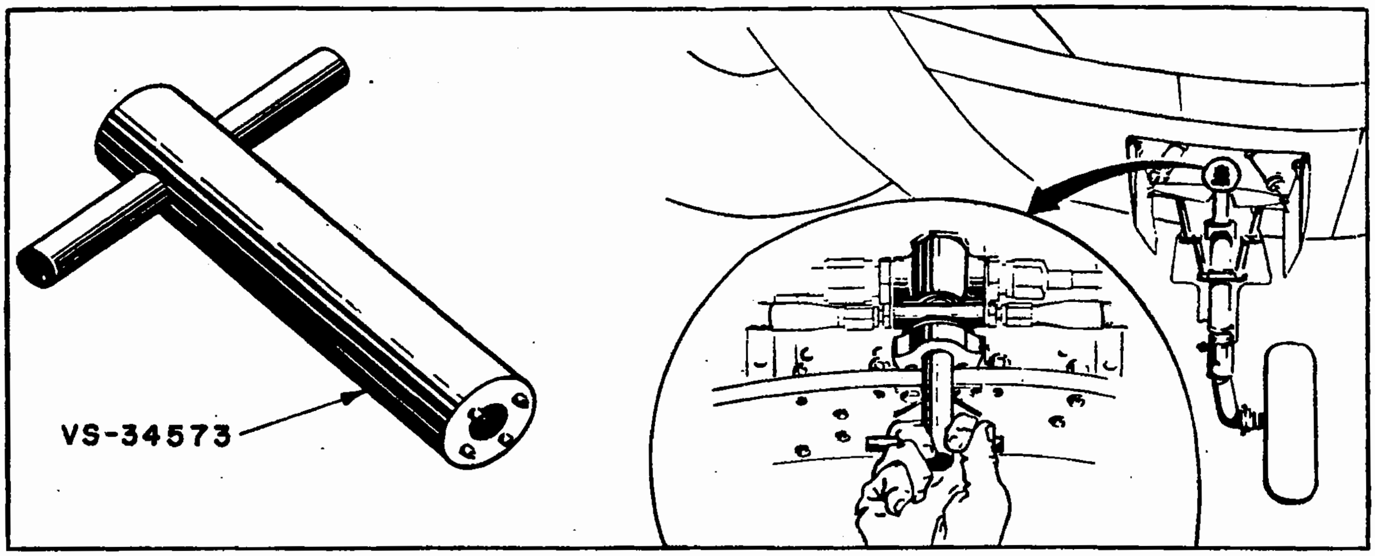


Figure 3—19. Wrench — Used for Removal of Packing Plug from L.G. Door Sequence Valve.

3—115. WRENCH — LANDING GEAR — MAIN WHEEL RETAINING NUT. *(See figure 3—20.)* The main landing gear wheel retaining nut wrench VS-45678 is used to tighten the nut on the main landing gear wheel VS-48955. (Refer to paragraph 4—409.)

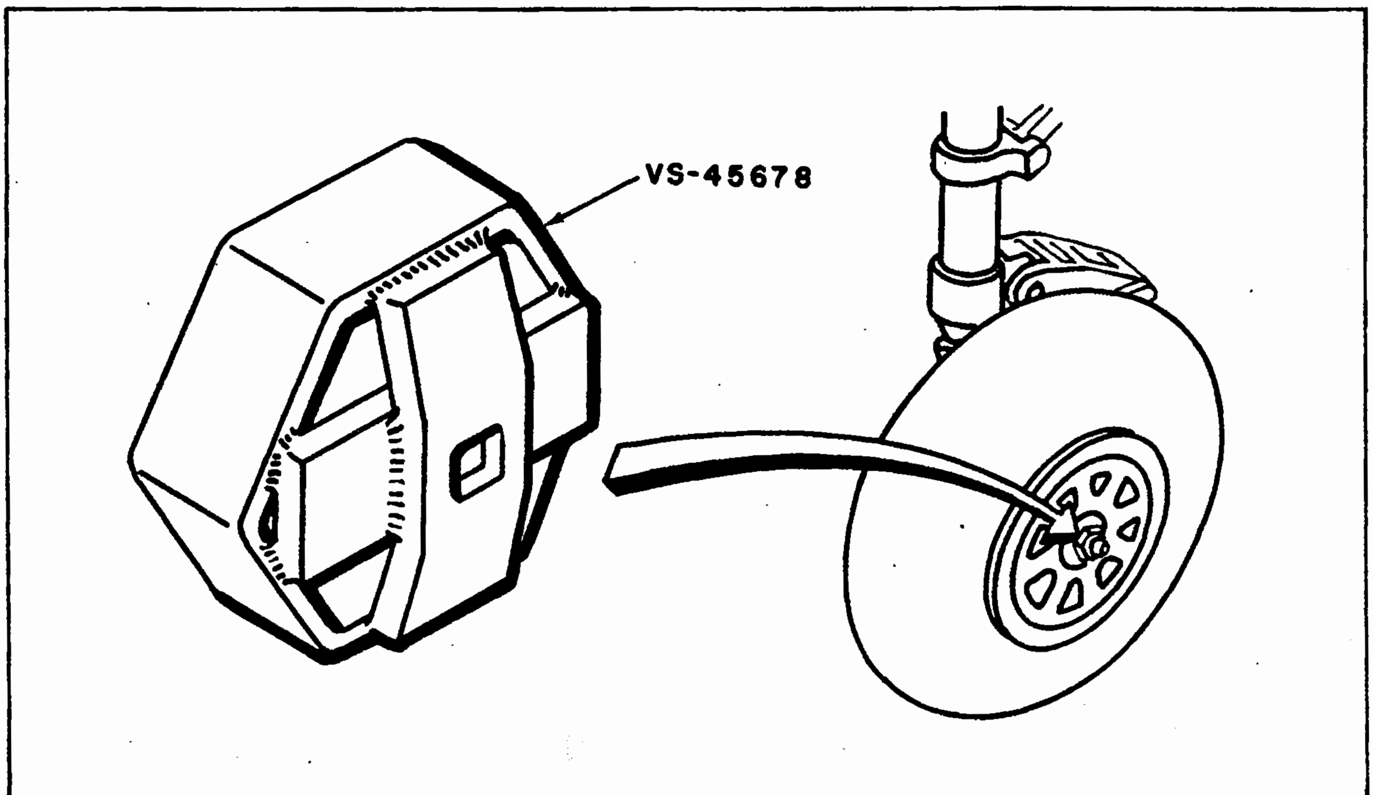


Figure 3—20. Wrench — Used for Tightening Nut on Main L.G. Wheel.

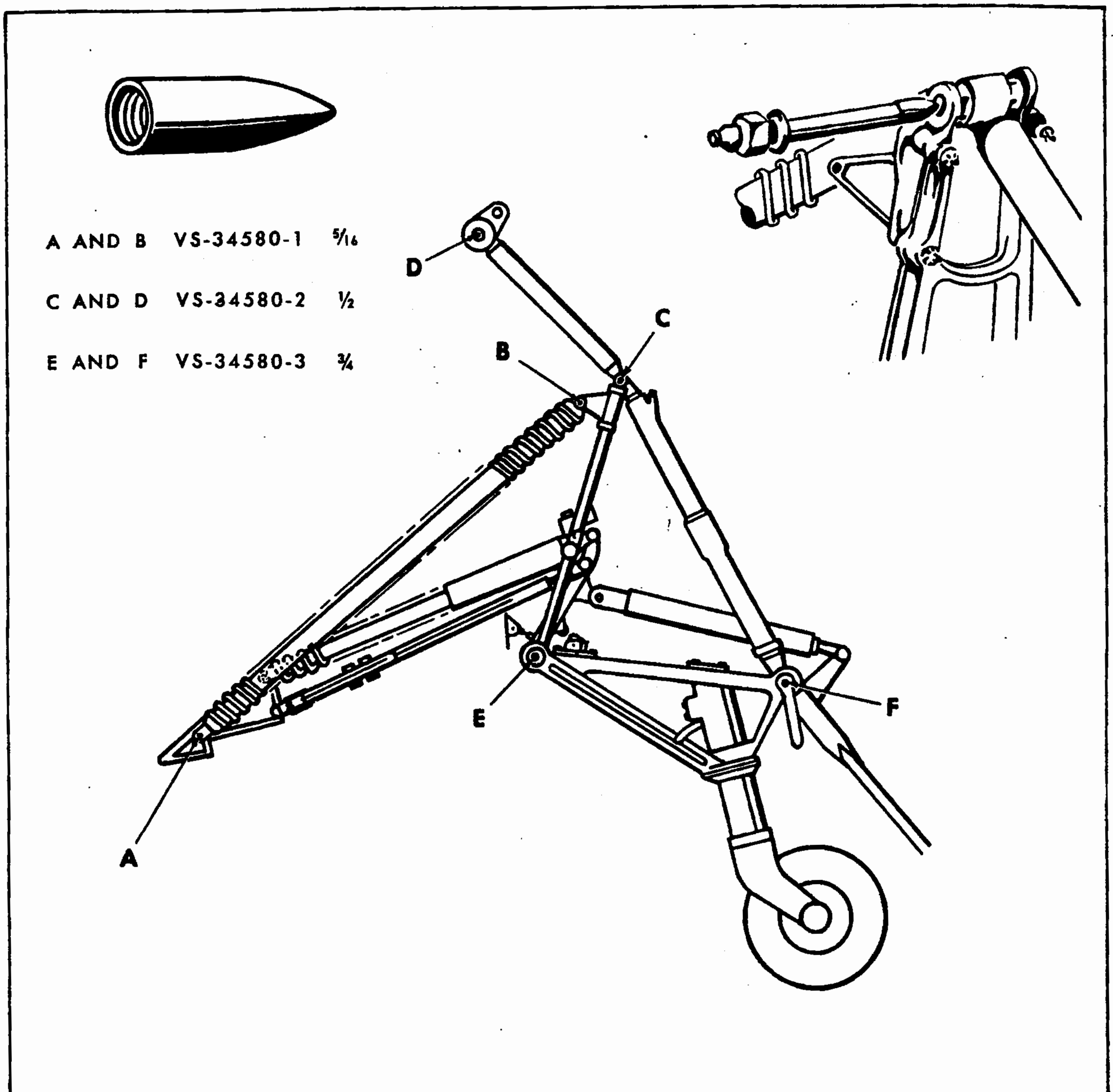


Figure 3–21. Bolt Pilots – Used for Installing Bolts in Tail Gear Assembly.

3–116. BOLT PILOTS – TAIL WHEEL ASSEMBLY. *(See figure 3–21.)* The tail wheel assembly bolt pilots, VS-34580-1, -2 and -3 are used to protect bearing surfaces from being scored by bolt threads. (Refer to paragraphs 4–352, 4–353, 4–367, and 4–375.) These bolt pilots are for use on the tail wheel assembly as follows:

Bolt Pilot	Location on Figure 3–21	Bolt
VS-34580-1	A	AN25-20
	B	VS-47388
VS-34580-2	C	VS-47563
	D	VS-47564
VS-34580-3	E	VS-11879
	F	VS-11878

3–117. BOLT PILOT – WING HINGE. *(See figure 3–22.)* The wing hinge bolt pilot VS-34581 is used on the main hinge bolts VS-17001 connecting the outer panels to the center section in order to protect bearing surfaces from being scored by bolt threads. (Refer to paragraph 4–30.)

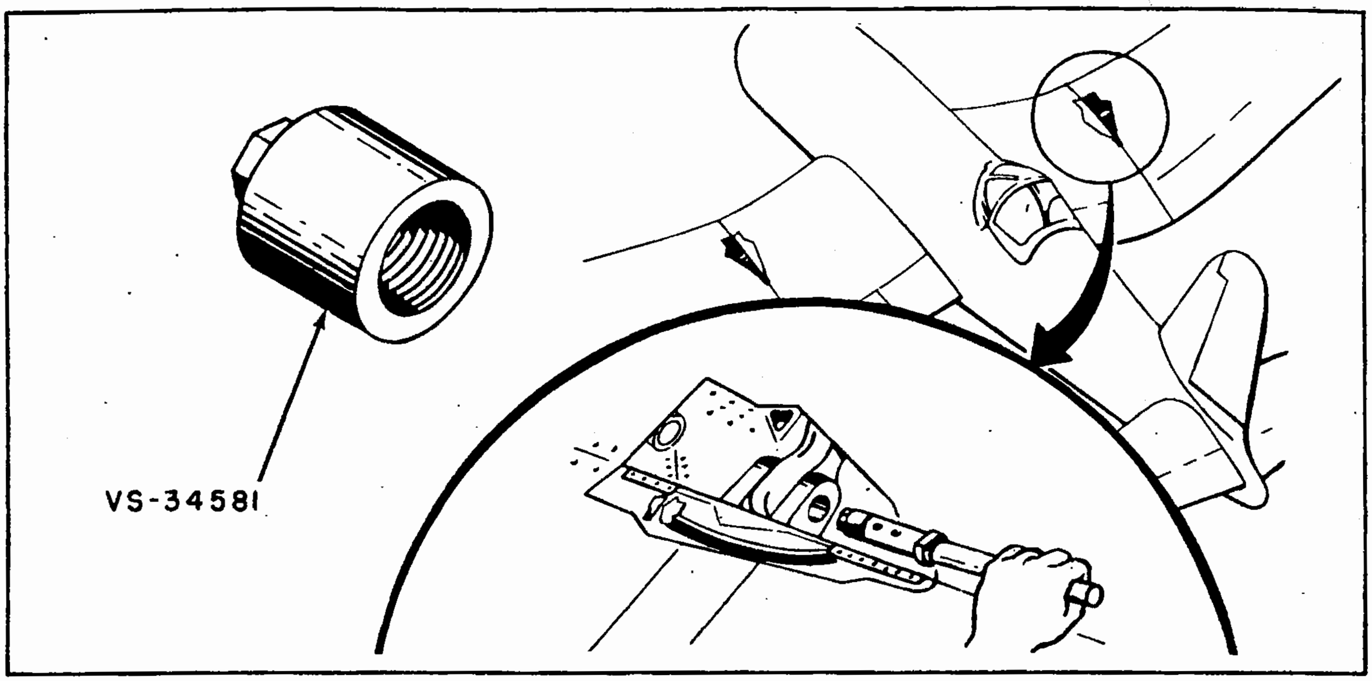


Figure 3–22. Bolt Pilot — Used for Installing Main Wing Hinge Nut.

3–118. WRENCH – OPEN END – WING FOLD CYLINDER ADJUSTMENT. *(See figure 3–23.)* The open end wing fold cylinder wrench VS-34583 facilitates the adjustment of the wing fold cylinder assembly VS-58232, when setting wing tip clearances in the folded position. (Refer to paragraph 4–31.)

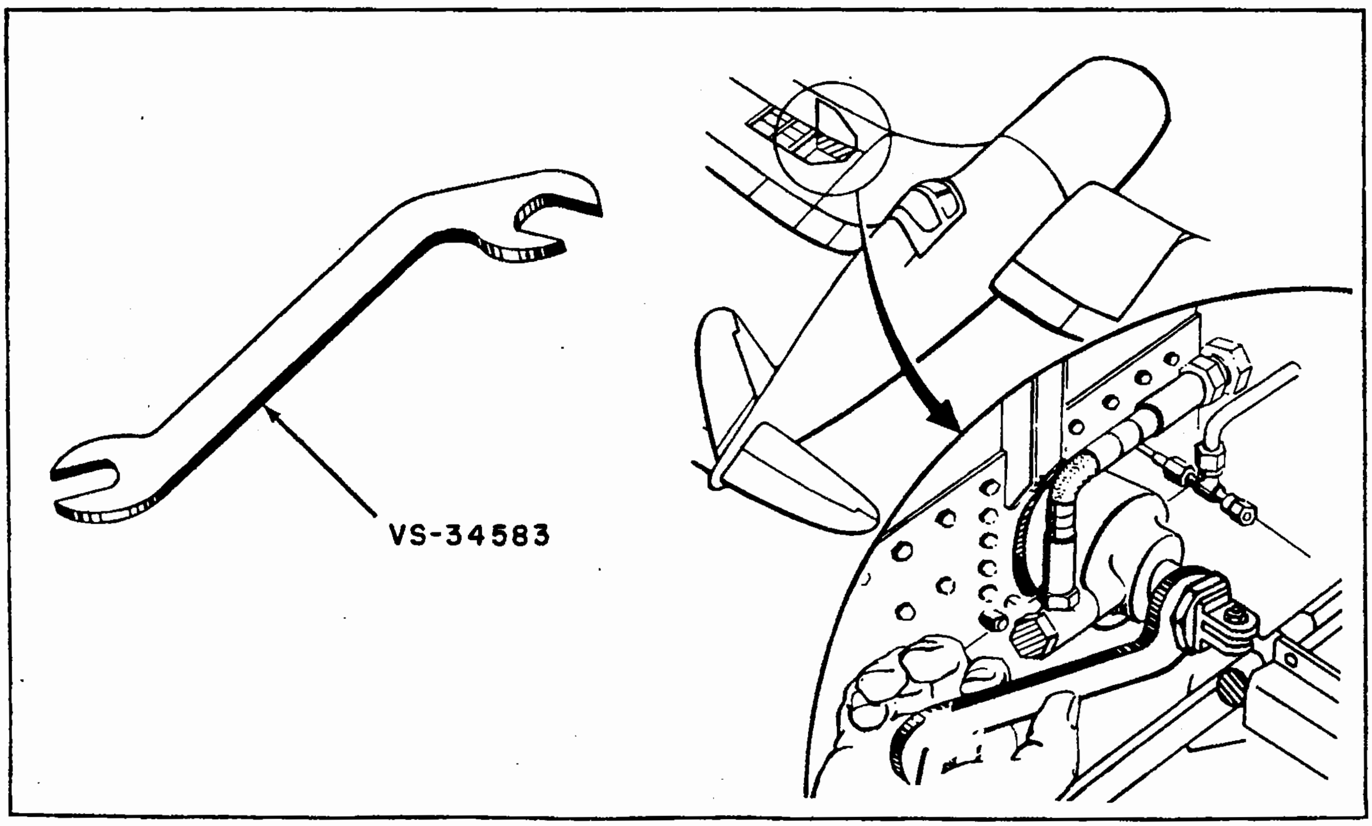


Figure 3–23. Wrench — Used for Adjustment of Piston Rod on Wing Fold Cylinder.

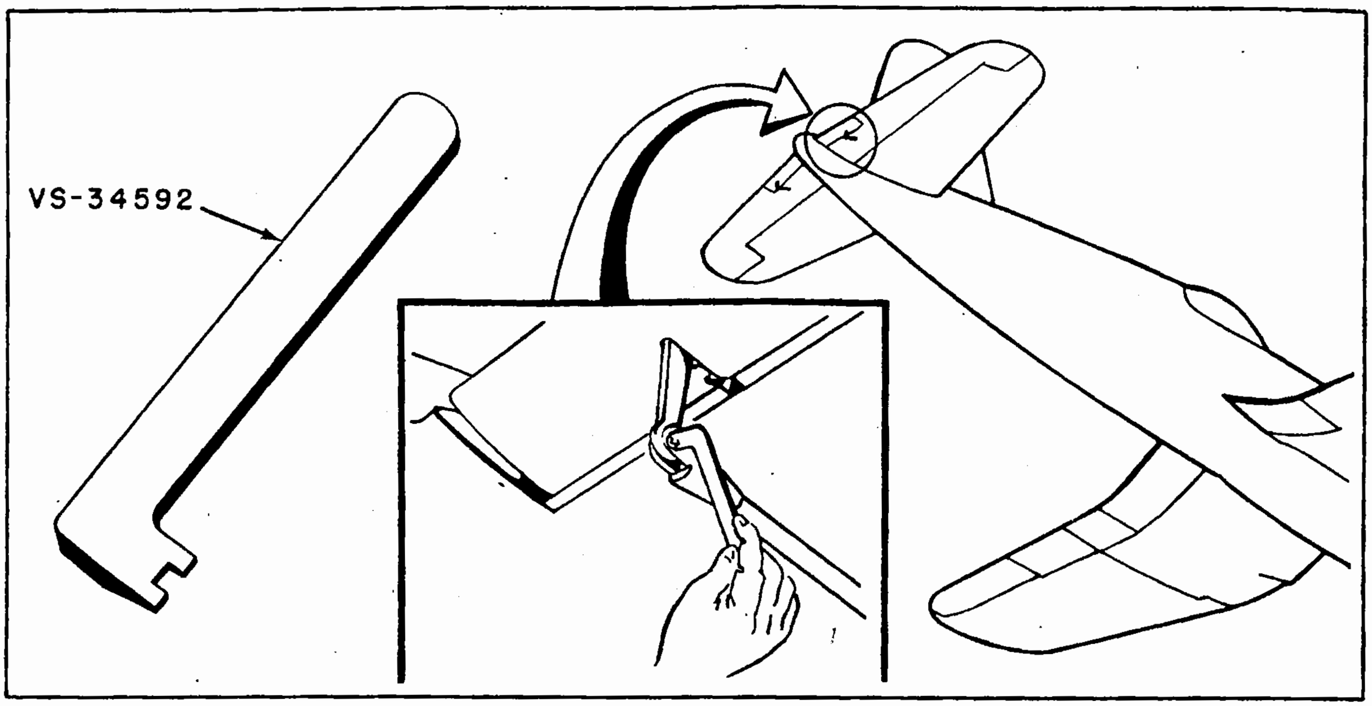


Figure 3—24. Slotted Screwdriver — Used for Removal of Screw on Elevator Tab Control Rod.

3—119. SCREWDRIVER — SLOTTED — ELEVATOR TAB CONTROL ROD. *(See figure 3—24.)* The slotted, elevator tab control rod screwdriver VS-34592 is used for the installation and removal of the screw on the elevator tab control rod VS-12173. (Refer to paragraph 4—104.)

3—120. WRENCH — ENGINE MOUNT PEDESTAL. *(See figure 3—25.)* The engine mount pedestal wrench VS-43789 is used for tightening the engine mount bolts. Remove cup and cotter pins prior to using wrench. (Refer to paragraph 4—502.)

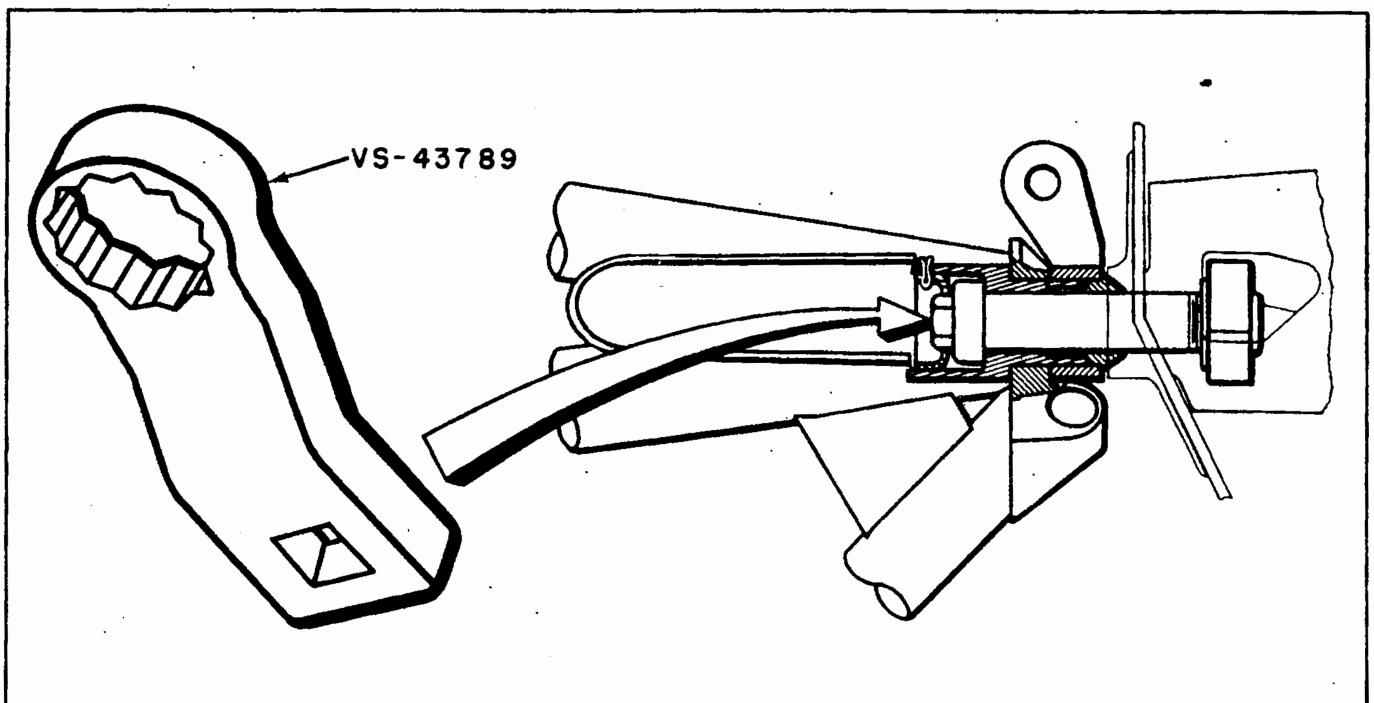


Figure 3—25. Wrench — Used for Tightening Engine Mount Bolts.

SECTION IV

GENERAL MAINTENANCE

4—1. WINGS GROUP.

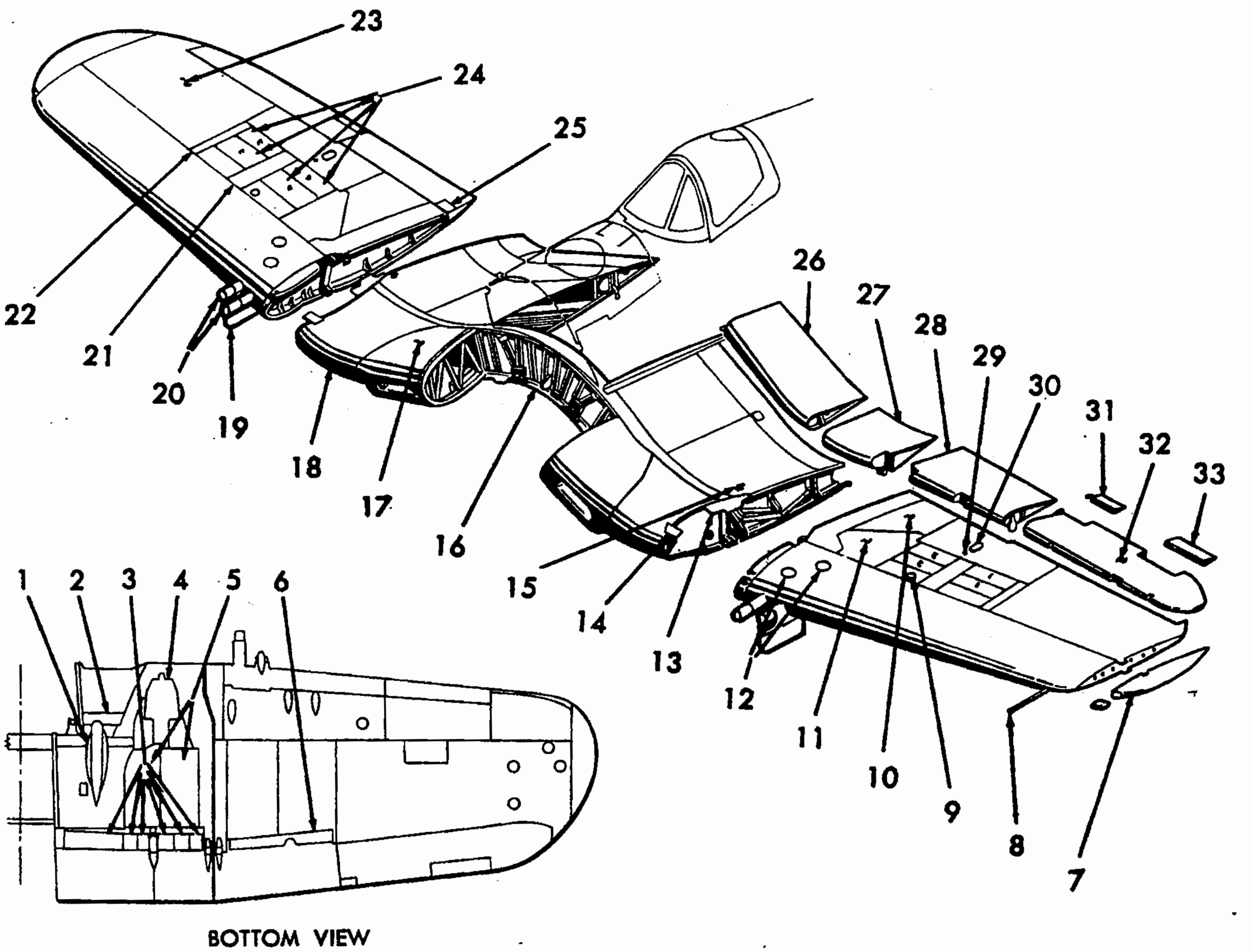
4—2. CENTER SECTION.

4—3. DESCRIPTION. *(See figure 4—1.)* The center section of the wing consists of a large main beam that is continuous through the fuselage, and a rear beam on each side of the fuselage, extending from the fuselage skin line to the center section end rib. The leading edge structure is composed of skin panels, supported by diagonal ribs, a truss type nose rib where the leading edge terminates at the fuselage and an end rib at the center section wing butt. The diagonal ribs transmit loads from the landing gear knuckle fitting to the main beam. The truss type interbeam rib, located inboard of the wheel well, transfers torsion from the leading edge nose section to a torque box composed of the main beam and the rear beam in the region aft of the leading edge air entrance ducts. Loads from the outer panel are transmitted to the center section by means of an upper and lower hinge at the end of the main beam, and a single smaller hinge at the forward part of the center section end rib. The wing fold gap door provides clearance for the upper main hinge of the outer panel during folding of the wings and in addition, gives a visible indication of proper engagement of the lower hinge bolt when the wings are spread. Refer to paragraphs 4—20 through 4—25 for detailed information on the wing folding gap doors and door mechanisms. The oil coolers (one in each wing) and the air intake for the oil coolers are located between the nose rib and the inboard diagonal rib. A socket has been provided in the outboard side of the upper panel of the center section air duct for the insertion of the rear support tube of the engine service platform. Automatically operated oil cooler doors, located on the underside of the center section wing, directly behind the oil coolers, control the flow of air through the coolers. Refer to paragraph 4—700 through 4—705 for information on the oil cooler doors. The catapult hooks are located between the air duct ribs and the intercooler support ribs. The hooks are attached to forgings, mounted on the forward face of the main beam so that only a small portion of the hooks protrudes below the lower skin line of the wing. A dished fairing extends over and around the hook throat. The centerline of the hook throat is approximately eight inches forward of the main beam, and the location of the hooks permits catapult launching when full external stores are carried. Fairings at the right and left inboard leading edge of the lower surface of the center section and fuselage protect the electric and hydraulic lines and fair the catapult hooks. Cutouts in the center section ribs make provision for future installation of radar equipment in the wing. The under side of the center section contains the wheel wells which house the landing gear in the retracted position. The wheel wells are covered in flight by the landing gear doors and fairings. Refer to paragraph 4—330 for information on landing gear doors and fairings. External auxiliary fuel tanks and bombs are carried beneath the wing, inboard of the landing gear, by twin external Mark 51, Mod. 12 pylons. The pylons are attached by a single large bolt to an internal cantilever bracket-type fitting which transfers the load to the main beam. Refer to paragraphs 4—1665 through 4—1676 for further information on the center section pylons. Access to control rods, wiring, and cables in the center section is provided by an access door in the inboard interbeam rib. This door, which is large enough to admit a man's head and shoulders is reached through the wheel well, and is closed by a cloth cover provided with zipper fasteners. In order to enter the access door after the cover has been opened, remove the two trusses and the stiffener by taking out the taper pins and bolts.

WARNING

It is imperative that the above-mentioned stiffener and trusses be replaced before the airplane is flown, since failure to do so might result in collapse of the inboard interbeam rib. It is also important that the zippers be kept in place except during maintenance operations, as a precaution against the entrance of carbon monoxide.

The inboard and outboard center section flaps extend along the trailing edge of each side of the center section from the fuselage to the wing fold. The center section flap doors on the underside of the wing, just aft of the rear beam, operate to close the gap on the underside of the wing between the rear beam and the flaps, when the flaps are up.



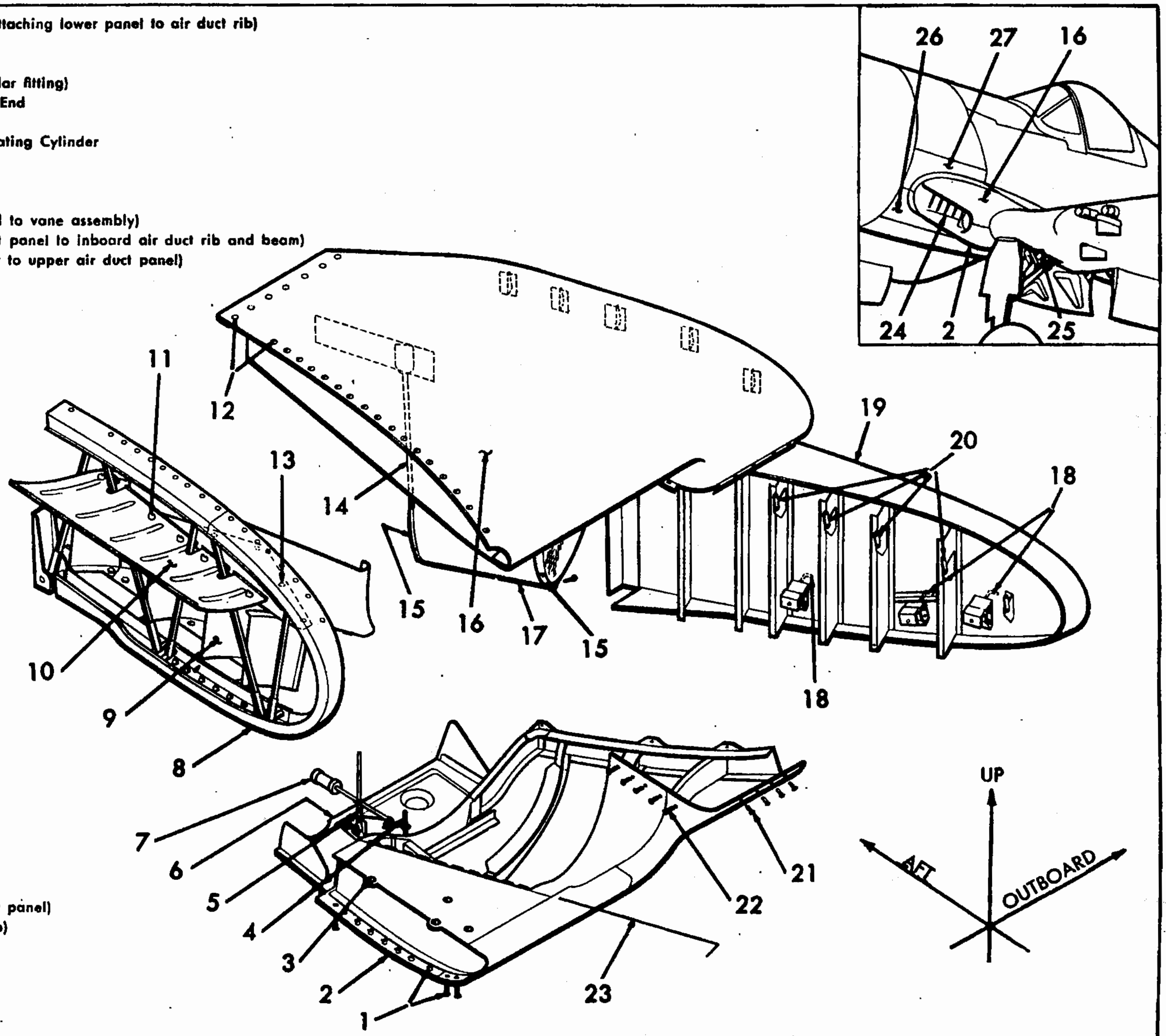
1. Center Section Pylon
2. Oil Cooler Door
3. Center Section Flap Doors
4. Movable Fairing
5. Landing Gear Doors
6. Outer Panel Flap Door
7. Removable Metal Wing Tip
8. Pitot Tube
9. Jury Strut Attachment Point
10. Rear Gun Bay Door
11. Front Gun Bay Door
12. Access to Vent Plug (Gun)
13. Wing Fold Gap Door
14. Auxiliary Hinge Gap Door
15. Wing Pin Lock Indicator
16. Main Beam
17. Upper Air Duct Panel
18. Center Section
19. Mark 9 Rocket Launcher and Mount
20. Front Gun Mount Tubes
21. Inboard Ammunition Box Retaining Door
22. Outboard Ammunition Box Retaining Door
23. Outer Panel Complete
24. Ammunition Boxes
25. Access to Flap Disconnect Mechanism
26. Center Section Inboard Flap
27. Center Section Outboard Flap
28. Outer Panel Flap
29. Release Indicator Rod (red)—Outer Panel Flap
30. Flap Downlock Mechanism Access
31. Aileron Balance Tab
32. Aileron
33. Aileron Trim Tab

Figure 4—1. Exploded View of Wing Group.

4—4. UPPER AND LOWER AIR DUCT PANELS.

4—5. DESCRIPTION. *(See figure 4—2.)* The oil coolers (right and left) are housed in the center section leading edge between the inboard diagonal rib and the air duct rib. The housings are composed of upper and lower "clamshell" panels. The air duct vanes are attached to both upper and lower panels. The oil cooler fairing is attached to the lower panel. The oil cooler is suspended from the upper panel by clamp straps. The inboard and aft edges of the upper panel are attached to the air duct rib and main beam with screws, while the outboard edge is attached to the inboard diagonal rib by a series of five flexible links. The lower panel is attached along its inboard edge by screws and Camloc fasteners, and to the partition by means of a hinge pin. The outboard edge is attached to the inboard diagonal rib by three L-shaped shear pins, extending from the forward inboard side of the wheel well through the inboard diagonal rib into

1. Camloc Fasteners and Screws (attaching lower panel to air duct rib)
2. Lower Air Duct Panel
3. Camloc Fasteners
4. Special Bolt (threaded into tubular fitting)
5. Oil Cooler Door Control Swivel End
6. Oil Cooler Door
7. Oil Cooler Door Hydraulic Actuating Cylinder
8. Air Duct Rib
9. Vane Assembly
10. Seal
11. Camloc Fasteners (attaching seal to vane assembly)
12. Screws (attaching upper air duct panel to inboard air duct rib and beam)
13. Screws (attaching vane assembly to upper air duct panel)



14. Tubular Fitting
15. Oil Cooler Clamp Straps
16. Upper Air Duct Panel
17. Oil Cooler
18. Shear Pins
19. Inboard Diagonal Rib
20. Links
21. Screws (outboard edge of lower panel)
22. Screws (outboard edge of scoop)
23. Hinge Pin
24. Air Scoop
25. Wheel Well
26. Lower Wing Gap Cover
27. Upper Wing Gap Cover

Figure 4–2. Upper and Lower Air Duct Panels.

brackets on the panel. The upper and lower panels are tied together by means of a special bolt located in the lower panel just forward of the oil cooler door, which threads into a vertical tubular fitting on the upper panel.

4–6. REMOVING. *(Parenthesized numbers below refer to callouts on figure 4–2.)* To remove upper and lower air duct panels, proceed as follows:

a. Disconnect hydraulic actuating cylinder (7) from oil cooler door. On left hand oil cooler door only, disconnect the oil cooler door control swivel end (5); on right hand oil cooler door only, disconnect oil cooler door position transmitter.

b. Reaching through the air scoop (24), disengage four Camloc fasteners (3) attaching the lower panel (2) to the vanes (9).

c. Working through oil cooler door (6), loosen the check nut on the special bolt (4) in the vertical tubular fitting (14) just forward of the oil cooler door hinge. Unscrew the special bolt (4) until free of the fitting. The bolt remains in the lower panel.

d. Disconnect camloc fasteners, screws and nuts (1) from the lower panel along the air duct rib (8).

e. Remove four screws (21) from forward outboard edge of the lower panel, and five screws (22) from outboard edge of scoop of the lower panel.

f. Remove hinge pin (23) located just forward of the oil cooler (17) on the aft inboard edge of the air scoop.

g. Reaching through the forward section of the wheel well (25), disengage the three L-shaped shear pins (18) on the inboard diagonal rib (19) by turning them counterclockwise and pulling them out. Remove the lower panel (2).

h. Drain the oil cooler (17) by detaching the hose connections at the oil cooler.

i. Unfasten clamp straps (15) supporting oil cooler and remove cooler.

j. Remove upper and lower wing gap covers (27) and (26) for access to seal (10), by removing screws.

k. Disconnect the seal from the vane assembly by loosening the Camloc fasteners (11); seal remains attached to intercooler support rib. Access to these Camloc fasteners may be gained by using a long screwdriver through the opening between the intercooler rib and the air duct rib.

l. Remove the vane assembly (9) from the inboard side of the upper air duct panel (16) by removing attaching screws (13).

m. Remove the upper panel (16) by disconnecting the links (20) from the inboard diagonal rib fittings and removing the attaching screws (12) from the panel.

4–7. INSTALLING. To install upper and lower air duct panels, reverse removal procedure. Upon completing the installation, check the oil cooler connections for tightness.

4–8. CENTER SECTION FLAPS.

4–9. DESCRIPTION. *(See figures 4–1 and 4–3.)* Two center section flaps, extending along the trailing edge of each side of the center section from the fuselage to the wing fold are of all-metal construction, the reinforced metal skin being riveted to the ribs and to the formed trailing edge. Two flaps are necessary because of the curvature of the center section. The outboard flap is connected by a pushrod and lever to the hydraulic actuating cylinder mounted on the center section wing butt. A rigid adjustable link connects the inboard flap to the outboard flap, causing them to deflect simultaneously. A reinforced metal panel, hinged to the outboard flap and free to slide into the inboard one, bridges the gap created between the two flaps when they are deflected. The deflection of the flaps is controlled by means of the flap control lever located outboard of the engine control unit on the left hand cockpit control shelf. The selector valve is connected by linkage to both the left hand inboard flap and the flap control lever, and if the engine driven hydraulic pump is in operation, the flap selector valve will actuate the flap until the flap deflection corresponds to the setting of the control lever. In order to protect the structure of the flaps from damage due to excessive air loads, a relief valve is provided on the spring-loaded right hand flap pushrod which will release the pressure in the hydraulic strut and allow the flaps to blow up, i.e., to decrease their deflection. Refer to paragraphs 4–191 through 4–201 for further information on flap control system. Wing flap hydraulic information will be found in paragraphs 4–1058 through 4–1102.

4–10. REMOVING. *(See figure 4–3.)*

a. Fold the outer panel and attach the jury strut. Lower the flaps to full deflection.

b. Remove the bolt (1) attaching actuating pushrod (13) to outboard end of the outboard center section flap, reaching the head of the connecting bolt through the lightening hole in the end rib. Disconnect the bonding wire.

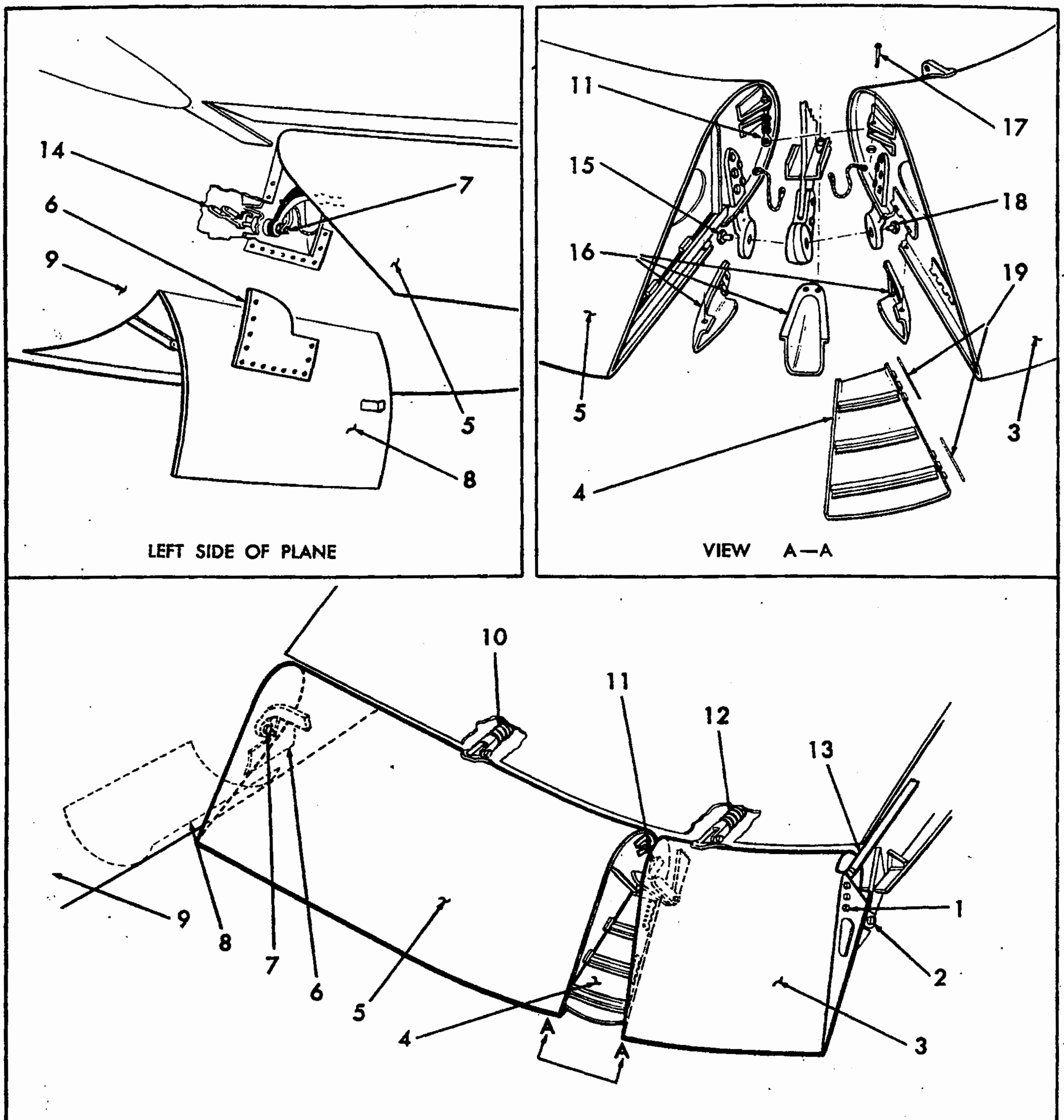
c. Disconnect the outboard center section flap door actuating rod (12) at the inboard end of the outboard center section flap.

d. Remove the bolt (17) attaching the turnbuckle link (11) to the fitting and remove bonding between the outboard and inboard flaps.

e. Remove one forward fairing and two aft pieces of fairing (16) at the hinge support located between inboard and outboard center section flaps on the underside of the wing; remove the outboard center section flap attaching bolt (18) from the hinge support.

f. At the outboard end of the outboard center section flap, remove the hinge bolt (2) and withdraw the outboard center section flap with the flap gap closure plate (4) attached.

g. If necessary, the flap gap closure plate (4) may be removed from the outboard center section flap by pulling out the piano hinge wires (19).



1. Bolt
2. Outboard Hinge Attaching Bolt (C. S. Outboard Flap)
3. Center Section Outboard Flap
4. Flap Gap Closure Plate
5. Center Section Inboard Flap
6. Fuselage Access Door (right and left)
7. Inboard Hinge Attaching Bolt (C. S. Inboard Flap)
8. Lower Cockpit Access Door (ref.)
9. Fuselage (ref.)
10. Inboard C. S. Flap Door Actuating Rod
11. Turnbuckle Link
12. Outboard C. S. Flap Door Actuating Rod
13. C. S. Flaps Actuating Pushrod
14. Flap Selector Linkage (left hand only)
15. Outboard Hinge Attaching Bolt (C. S. Inboard Flap)
16. Fairing
17. Turnbuckle Link Attaching Bolt
18. Inboard Hinge Attaching Bolt (C. S. Outboard Flap)
19. Piano Hinge Wires

Figure 4—3. Inboard and Outboard Center Section Flaps.

h. The inboard center section flap is now accessible for removal. Remove the small fuselage access door (6) at the inboard hinge by removing thirteen screws.

i. Disconnect the inboard hinge by removing the bolt (7). The lower cockpit access door (8) between stations 138.6 and 160 may be used for access to the inboard hinge and linkage. The flap selector linkage (14) (left hand side only) will be disconnected by the removal of the inboard hinge bolt (7).

j. Disconnect the inboard center section flap door actuating rod (10) at the leading edge of the inboard flap.

k. Disconnect the remaining hinge bolt (15) at the outboard end of the inboard flap, and remove the flap.

4–11. LUBRICATING. If lubricant has been removed in disassembly, coat the flap gap closure stiffeners by hand with Dixon's No. 1924 Quick Drying Lubricant, and oil the flap gap closure plate hinges with general purposes low temperature oil, Spec. AN-O-6.

4–12. INSTALLING. To install the flaps, reverse the removal procedure. When flaps are installed, the maximum spanwise gap between flaps is 3/4 inch. Allowable gap between fuselage and center section inboard flap is as follows:

a. From beam to leading edge of flap–5/16 in. (+ or –1/8 in.).

b. From beam aft on upper skin–7/32 in. (+ 5/32, –1/16 in.).

c. From beam aft on lower skin–7/32 in. (+ 3/32, –1/32 in.).

If these tolerances cannot be met, remove and substitute another flap.

4–13. ADJUSTING.

a. Adjust the link between the outboard and inboard center section flaps so that the two flaps align exactly in the zero deflection position.

b. Refer to paragraph 4–201 for other flap adjustments.

4–14. CENTER SECTION FLAP DOORS.

4–15. DESCRIPTION. *(See figure 4–4.)* The center section flap doors are located on the underside of the wing aft of the rear beam. The doors operate as two units: a group of three door panels connected to a common shaft which is actuated through linkage by the outboard center section flap, and a second group of three door panels similarly connected and actuated by the in-

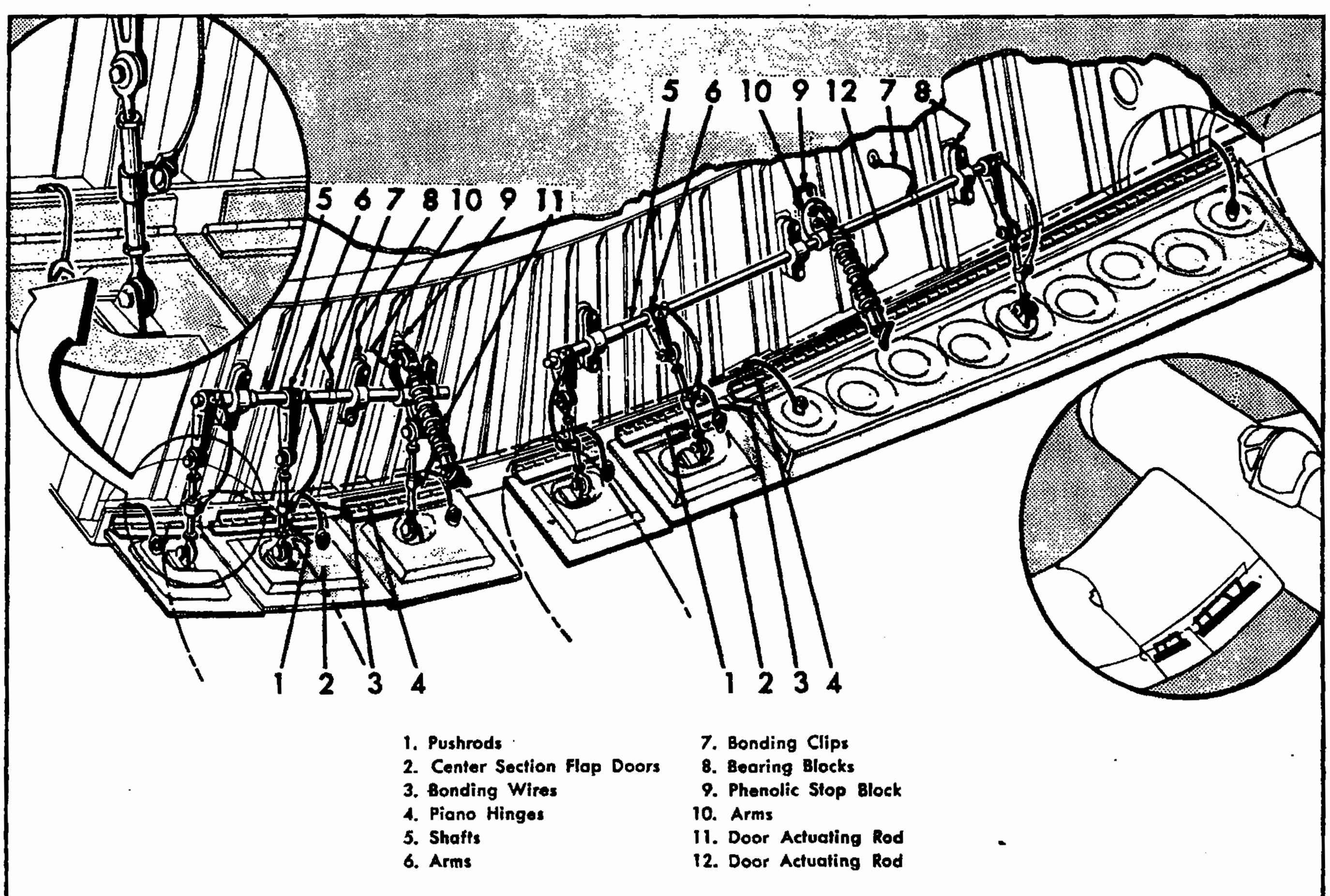


Figure 4–4. Center Section Flap Doors Installation.

board flap. The doors operate so as to close the gap on the underside of the wing between the rear beam and the flaps when the flaps are up, thereby reducing drag. As the flaps are deflected downward, the flap doors revolve upward, permitting a flow of air to pass through the slot for maximum effectivity of the flaps.

4—16. REMOVING. *(See figure 4—4.)* With the outer panel folded, proceed as follows to remove the center section flap doors:

a. Remove the center section flap doors after the flaps have been removed (see paragraph 4—10) by disconnecting the pushrods (1) from the individual doors (2), disconnecting the bonding wires (3) and then removing the hinge wire at the attaching piano hinges (4).

b. Remove the shafts (5) to which the flap doors are all linked by loosening all the members which clamp around the shafts, removing the bearing blocks (8) and the bonding clips (7) and passing the shafts outboard.

4—17. LUBRICATING. Lubricate the piano hinges with general purpose, low temperature oil, Spec. AN-O-6, and wipe free of excess oil before reinstalling the center section flap doors.

4—18. INSTALLING. Install the center section flap doors by reversing the removal proceedure given in paragraph 4—16.

4—19. ADJUSTING. *(See figure 4—4.)*

a. Align all the arms (6) with the flap door pushrods (1) and clamp them to their respective shafts (5).

b. Adjust the pushrods (1) to the doors (2) so that the doors lie along the wing contour between the wing and the flap.

c. Adjust the arms (10) to the door actuating rods (11), (12) which connect to the flaps, so that when the arm stops against the phenolic stop block (9) on the rear beam, the gap doors clear the flaps by 1/8 inch.

d. After installation of the inboard and outboard center section flaps, the individual door links are aligned so that the doors match the contour of the underside of the flaps when the flaps are in their neutral position.

4—20. WING FOLDING GAP DOORS AND DOOR MECHANISMS.

4—21. DESCRIPTION. *(See figures 4—5 and 4—1.)* The main wing folding gap doors which provide clearance for the upper hinges of the outer panels during folding of the wings, furnish in addition, a visible indication of the proper engagement of the lower hinge bolt. Each door is hinged to the center section directly over the upper main hinge. It is connected by means of a pushrod to a series of levers and pushrods which lead to the lower center section hinge fitting opposite the wing hinge pin. The linkage is spring-loaded to hold the door in a vertical position readily visible from the cockpit. When the wing is in the spread position, a bumper on the outer panel depresses a pin protruding from the gap door mechanism, which engages the mechanism with a small latch near the lower hinge fitting. When the hinge pin extends through the hinge flanges, the face of the pin pushes the latch and closes the door. The operation of the latch at the hinge pin can be observed through the access panel and the underside of the wing butt. The spring-loaded auxiliary hinge gap door automatically acts to close the gap area forward of the main gap door at the leading edge.

4—22. REMOVING. *(Refer to figure 4—5.)*

a. Fold the wings and attach jury struts.

b. If it is necessary to remove auxiliary hinge door (12), unhook the spring from the door, knock the hinge pin from the door hinge and remove the door.

c. Disconnect the pushrod (1) at the bracket on the main wing folding gap door and remove the two hinge wires. Remove the door.

d. Disengage the spring (2) from the idler (3).

e. Disconnect the pushrod (1) from the idler (3).

f. Disconnect the link (5) and universals (4) and (11) as a unit by removing the attaching bolts at the idler (3) and the lever (6).

g. Remove the link (7) by disconnecting it from the levers (6) and (8).

h. Remove the bolt which attaches idler (3) to the support bracket, freeing spring (2) and its bushing and spacer.

i. Remove lever (6) from its support.

j. Remove the attaching bolts at the support brackets mounted on the hinge lug, thereby freeing the lever (8) with spring and spacer, and the actuator (10).

k. Unscrew the retainer (9), which houses the engaging pin, from lever (8) to complete the disassembly.

4—23. LUBRICATING. Lubricate the wing folding gap door mechanism with general purpose low temperature oil, Spec. AN-O-6.

4—24. INSTALLING. Install the main wing fold gap door and mechanism and the auxiliary hinge gap door by reversing the removal procedure.

4—25. ADJUSTING. *(See figure 4—5.)*

a. If the gap door is replaced or a new outer panel is installed, it may be necessary to refit the door to the wing contour by bumping, grinding excess material off the outer panel, or shimming the gap door hinges if the door is undersize.

b. Adjust the main gap door pushrod (1) at its upper end so that with wing spread and pin engaged, the door lies snug against the wing.

c. If necessary, shim the bumper on the outer panel which depresses the engaging pin when the wing is spread, by means of washers under the attaching screws so that the engaging pin just projects beyond the latch. This adjustment is observed by removing the access panel on the underside of the center section wing butt.

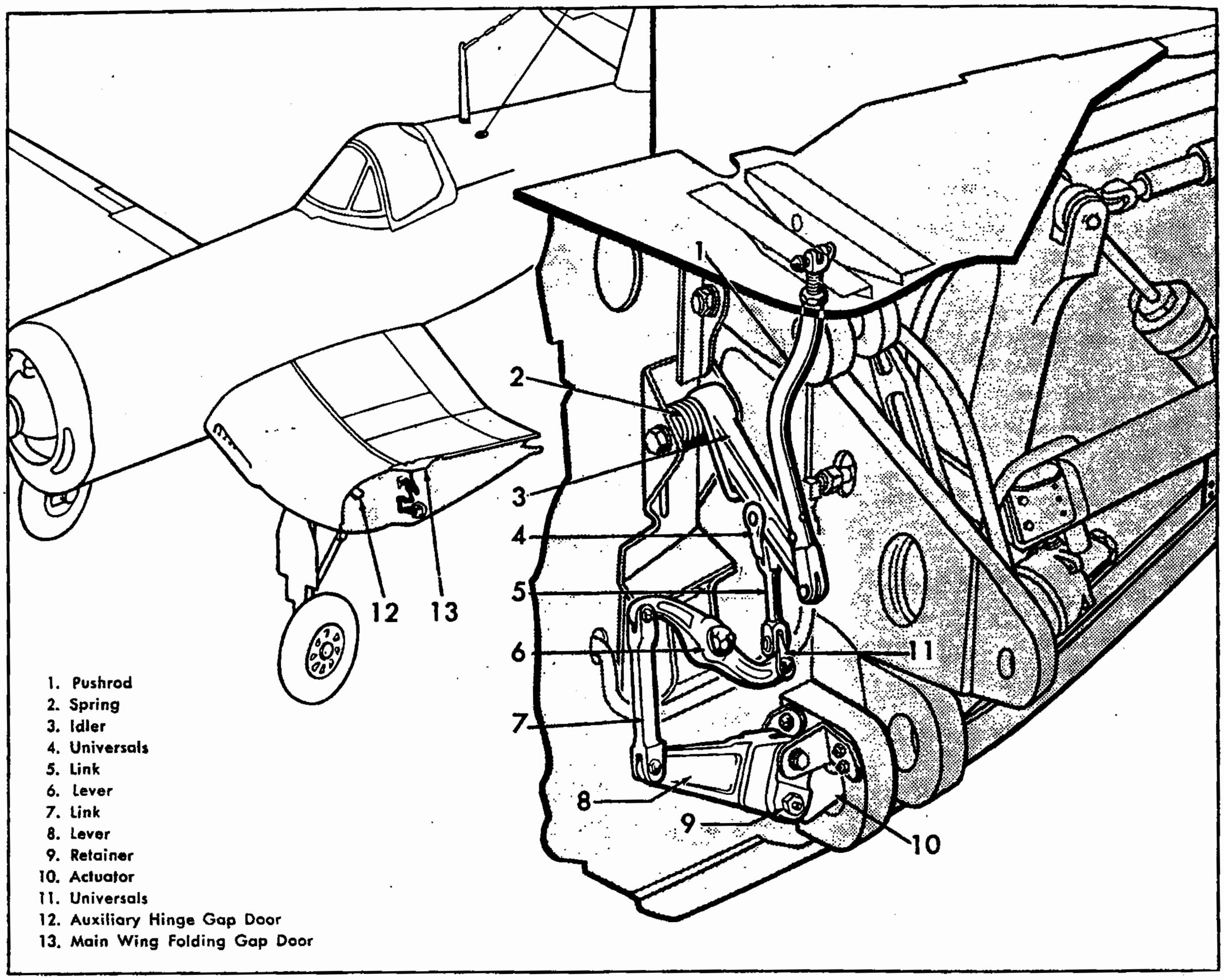
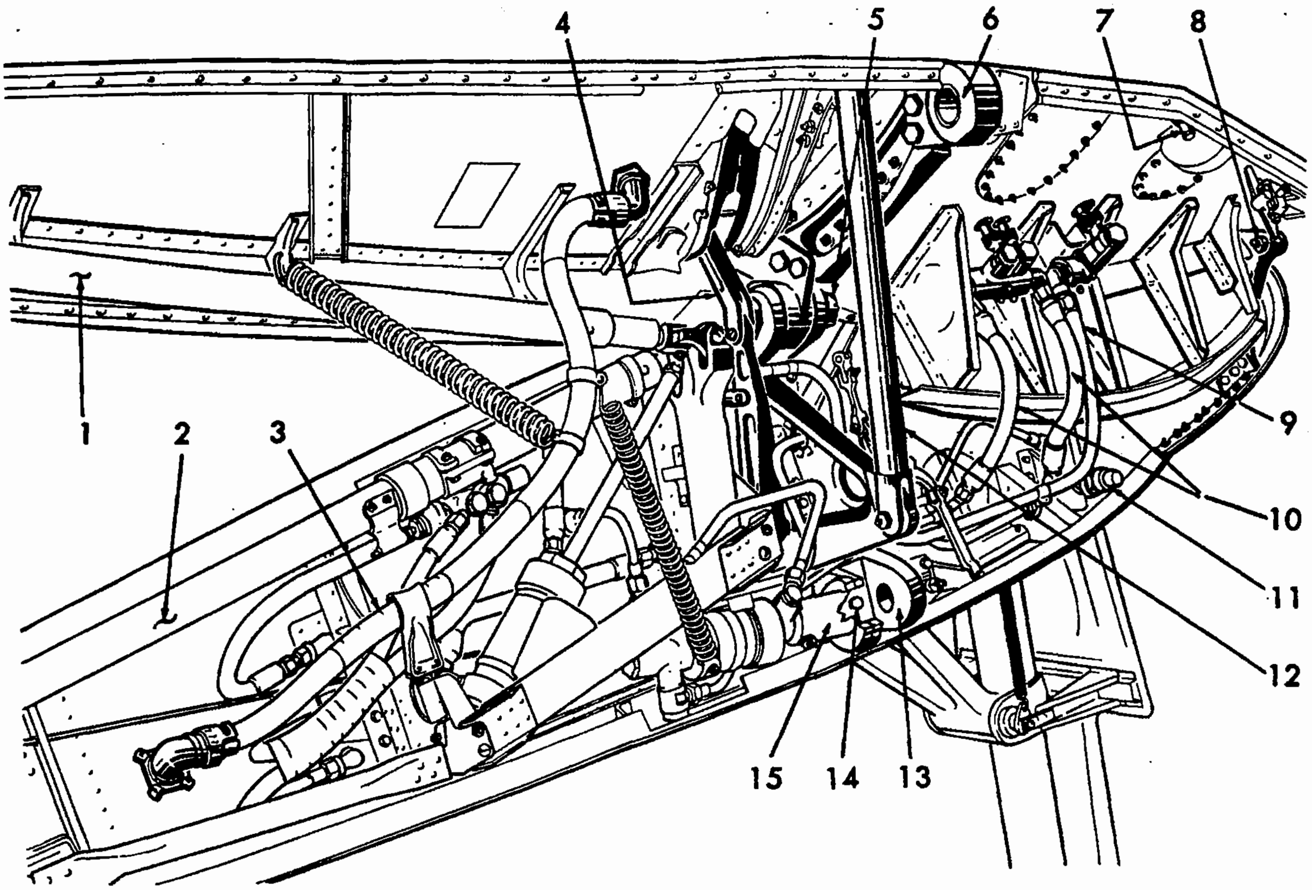


Figure 4–5. Main Wing Folding Gap Door and Mechanism.

4–26. OUTER PANELS.

4–27. DESCRIPTION. *(See figure 4–1.)* The outer panel is constructed entirely of metal, with a stressed skin leading edge structure forward of the main beam. Pressed aluminum alloy, web type ribs, provide for a tie-in with the trailing edge metal skin. Holes are provided in the ribs of the right hand leading edge for installation of a radar cable. Four channel supports in the trailing edge of the right hand center panel and between ribs provide support for the installation of a radar nacelle. A radar cable access door is located on the lower right hand panel. The outer panel is attached to the center section at the wing fold by means of two hinges on the main beam, and an auxiliary hinge at the leading edge. The wing outer panel is hydraulically folded by the cockpit control located on the aft end of the right hand console panel; see paragraphs 4–1103 through 1-106. The wing folding cylinder track in which the accessory pushrod rides, is bolted to the inboard side of the outer panel main beam. The hydraulic actuating cylinder is located in the outer panel; the wing hinge pin and locking mechanism are on the center section wing butt. Reinforcing ribs and two castings forward of the main beam provide for mounting in each wing of two 20-mm, M3 (T-31) gun tubes and front gun mounts. Four ammunition boxes are installed in each outer panel. Two gas cylinder access doors are provided on the upper surface of the leading edge above each cannon. Fixtures with adjustable set screws are provided fore and aft in each wing for the installation of boresight posts. Structural reinforcement is provided in the outer panel for the installation of four Mark 9, Mod. 2 launchers, in order to carry rockets or 100 pound bombs. One rocket launcher is carried below the outboard gun, while the other three are located near the main beam. The right hand panel contains provisions for radar equipment. A rigid mounting is provided for the gun camera. A spoiler on the leading edge right hand outer panel minimizes the tend-



1. Outer Panel Flap Control Rod
2. Center Section Flap Rod
3. Electrical Conduit Cable
4. Aileron Control Link
5. Upper Hinge Bolt
6. Lower Outer Panel Main Hinge
7. Adjusting Bolt and Outer Panel Bumper
8. Pin
9. Gun Charging Hydraulic Line
10. Wing Folding Hydraulic Lines
11. Sequence Valve
12. Wing Folding Rod
13. Lower Center Section Main Hinge
14. Outer Panel Adjusting Stop Screw
15. Center Section Main Hinge Pin Assembly

Figure 4–6. Wing Hinge Detail.

ency of the plane to drop the left wing. Rib reinforcements are provided in the left hand outer panel for mounting an electric motor which operates the aileron trim tab. The pitot tube is located on the left hand outer panel; the static vent is located on the left side of the fuselage. A formation light is located on the outer surface of each outer panel and a running light provided in each of the removable metal wing tips. The trailing edge of the outer panel consists of an aileron and a flap, the flap being actuated by means of a connecting rod to the flap actuating mechanism on the butt of the center section. Bulkhead ribs are located at all points where flap or aileron hinges attach. Flap doors on the underside of the wing automatically act to cover the gap between the flap and the trailing edge of the outer panel. A flap disconnect and flap lock mechanism permit the flap to be pushed down and automatically locked in the down position, if desired. Jury strut sockets are located in each wing on the walkway along the main beam. The jury strut socket is also used as a lift point for hoist attachment. A decal notes this attaching point for both the outer panel hoist and the jury strut.

4–28. REMOVING. *(See figure 4–6.)*

a. With the airplane in either the three-point or thrust line level attitude and the outer panel folded, proceed to remove the wing outer panel as follows:

a. Disconnect the aileron control link (4) at the outer panel control rod, and fold the link down clear of the upper hinge bolt (5).

b. Disconnect the outer panel flap control rod (1) at the inboard end of the outer panel flap, and tie the rod to the center section flap rod (2).

c. Disconnect the pushrod to the wing folding gap door at the pushrod and idler *(references (1) and (3) on figure 4–5).*

d. Disconnect the following lines from both the center section and the outer panel and remove them to avoid

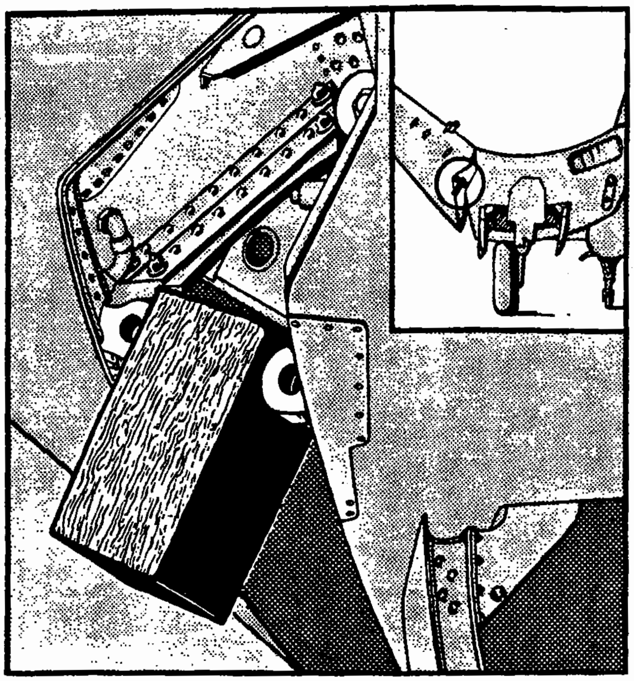


Figure 4–7. Hardwood Block.

damage during removal of the panel *(see figure 4–6)* gun charging hydraulic line (9), electrical conduit cable (3), and airspeed line (left hand side only).

Note

Plug all lines to keep out foreign material.

e. Lower the panel from the folded position to approximately a 45° position, and insert a hardwood block about 4 x 6 x 8 inches between the outer panel and the center section at the lower hinge fittings. *(See figure 4–7.)*

f. *Refer to figure 4–6.* Disconnect the wing folding rod (12) at the center section support bracket, and then retract the hydraulic actuating cylinder up into the outer panel. Remove the wing folding hydraulic lines (10) and plug the lines.

g. Unsafety and remove the pin (8) through the leading edge auxiliary hinge.

h. Using the special lift assembly VS-54614, *(see figure 4–8)* having a capacity suitable for handling the outer panel which weighs 630 pounds when empty, and the jury strut socket as the lift point, unsafety the main upper hinge bolt and remove the nut. A decal on the outer panel indicates the point of attachment of the outer panel lift.

i. Standing on platforms, several men must place their shoulders under the main beam of the outer panel and lift the panel sufficiently to allow removal of the wood block at the lower hinge. Then lower the panel to the spread position.

j. Supporting the outer panel at the wing tip, and with the hoisting cable at the inboard end, force the upper hinge bolt out of the hinge joint and swing the outer panel clear of the airplane. Rotate the outer panel 90°, and lower onto suitable support cradles.

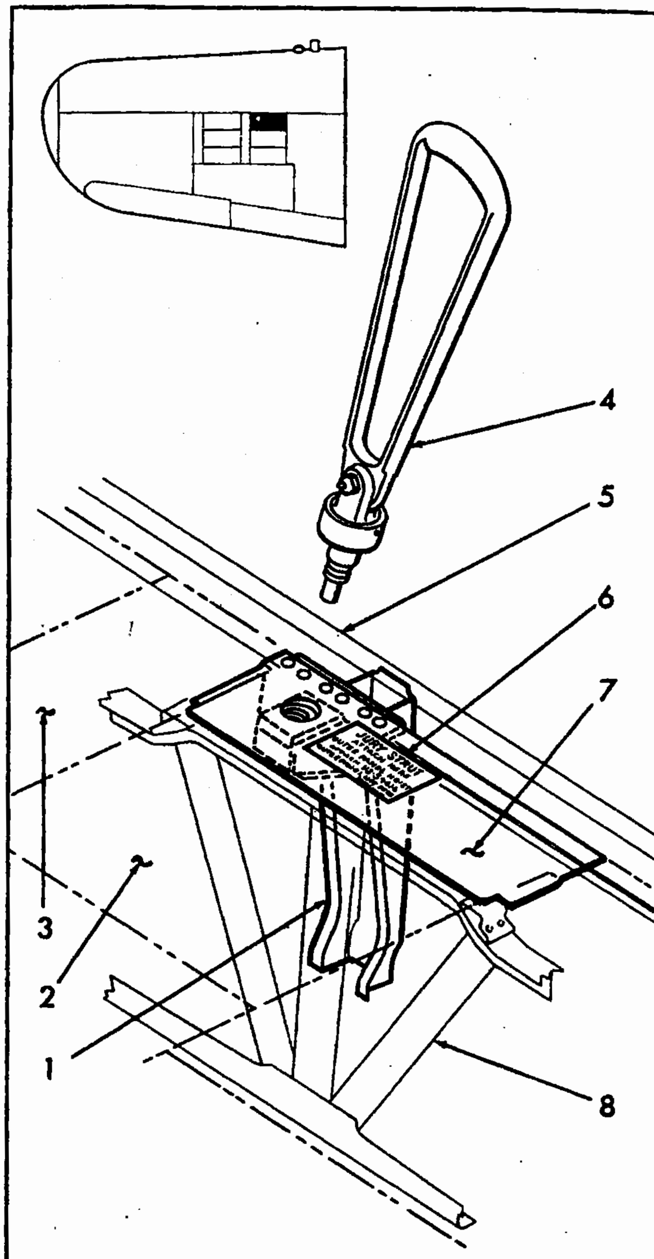


Figure 4–8. Outer Panel Lift Assembly.

4–29. LUBRICATING. Refer to paragraph 4–1732 for lubrication of the gun installation. Refer to figure 3–14 for additional lubrication information.

4—30. INSTALLING. Install the outer panel by reversing the removal procedure. Observe these special points.

a. To facilitate installation, the airplane should be in the thrust line level attitude.

b. Completely retract the wing folding hydraulic actuating cylinder into the outer panel before attempting to install the outer panel. Failure to observe this precaution may result in serious damage.

c. Insert the wing hinge bolts with their heads aft, utilizing special bolt pilot VS-34581 (see figure 3-22) for inserting the upper main hinge bolt. Use a taper pin to secure alignment of the upper hinge fittings before driving the main bolt with a mallet.

4—31. ADJUSTING.

a. Maximum permissible spanwise gap between outer panel flap and outboard center section flap is 3/4 inch. If this tolerance cannot be met, remove and substitute another flap.

b. In order to achieve the desired characteristics, the airfoil contour of the outer panel should coincide with that of the center section wing butt within the tolerance of 1/16 inch from the leading edge to 30 percent of chord, and within the tolerance of 1/8 inch aft of the 30 percent line. The skin joint line over the main beam may be taken as the 30 percent of chord line.

c. Bring the outer panel skin into alignment with that of the center section by bumping the edges.

d. Eliminate any gap between the rubber seals on the edges of the outer panel and center section by removing the retaining strips which hold the rubber seal to the outer panel wing butt and inserting phenolic shims of the required thickness.

e. Adjust the bumper that depresses the engaging pin on the wing fold gap door mechanism as described in paragraph 4—25 c.

4—31A. The following procedure is set forth for adjusting the top screw (14), on the lower center section main hinge (13) to properly line up the holes in the bushings in the lower main hinges of the center section (13) and the outer panel (6) while the outer panel is in the spread position, and to adjust the setting of the outer panel adjusting bolt (7) which strikes the sequence valve (11), to obtain the correct timing for the release of the pin in the lower main hinge pin assembly (15).

Note

In order to prevent any damage to the wing hinge pin due to early firing of the sequence valve it is necessary that this procedure be carefully followed.

a. Remove the adjusting bolt (7), on the outer panel bumper.

b. Spread and fold the outer panel twice in order to get an impression of where the set screw (14), in the lower center section main hinge (13) on the lower outer panel hinge (6), hits the firing pin on the sequence valve.

c. Take a micrometer measurement on the lower outer panel hinge (6), from the inside diameter of the bushing in the hinge to the impression on the outer surface of the hinge. Set adjustable parallel blocks to the dimension found with the micrometer.

d. With the wings folded, fire the lower main hinge pin assembly (15) and insert the parallel blocks between the pin and the set screw (14). Adjust the set screw so that it is flush with the parallel blocks and then tighten the small lock screw that holds the set screw in place.

Note

Safety wiring of the lock screw is not recommended at this point since small changes of adjustments may be necessary after the adjusting bolt (7) is set.

e. Retract the lower main hinge pin.

f. Insert the adjusting bolt (7) into the outer panel bumper. Turn the bolt in so that its head will bottom, and the sequence valve will not be fired the first time the outer panel is spread.

g. Mark a vertical or horizontal arrow with pencil on the head of the outer panel adjusting bolt (7) so that the adjustments can be made with some accuracy. Loosen the outer panel adjusting bolt one-half turn and spread the panel slowly. If the main hinge pin does not fire, continue to spread and fold the outer panel; also loosen the adjusting bolt one-half turn each time, until the pin is fired. When the point is reached at which the pin fires, the adjusting bolt must be tightened somewhere between a small fraction of a turn to one-half turn since somewhere along the last one-half turn lies the exact point of control which will fire the pin when the outer panel and center section pin holes are directly in line. The final adjustments from this point on will consist of small changes, and it is necessary that extreme care be exercised in making them. Just before the final adjustment is made, a "squealing" noise may be heard at the sequence valve. This indicates that only a slight amount of adjustment is necessary to make a satisfactory setting. The final setting should not be accompanied by this "squealing" noise.

Note

One-half turn of the adjusting bolt (7) in the bumper fitting changes the position of the head approximately .020", one-quarter turn approximately .010", etc.; one-half turn on the center section set screw (14) changes the position of the head approximately .0459", one-quarter turn approximately .022", etc.

h. Safety wire the lock screw on the center section main hinge (13).

i. Spread and fold the panels slowly about 10 cycles, firing the wing hinge pin each time. On the last cycle inspect with a feeler gage the gap between the outer panel hinge (6) and the center section set screw (14) in the "spread" position. The gap should be .001″ minimum and .003″ maximum.

j. Fold and spread the panels slowly. While spreading, place a feeler gage of a thickness .002″ greater than the gap found in step i, between the outer panel hinge (6) and the center section set screw (14). If the panel is spread slowly enough the outer panel hinge will first contact the feeler gage, hold it against the center section set screw, and immediately after the wing hinge pin will fire. This will indicate a satisfactory adjustment on the sequence valve.

k. The wing hinge pin should extend at a maximum hydraulic pressure of 700 psi when the wing is fully loaded. If it is found impossible to adjust the stop so that the pin extends within the 700 psi allowable, the hydraulic mechanism should be checked. See paragraphs 4—1103 through 4—1149.

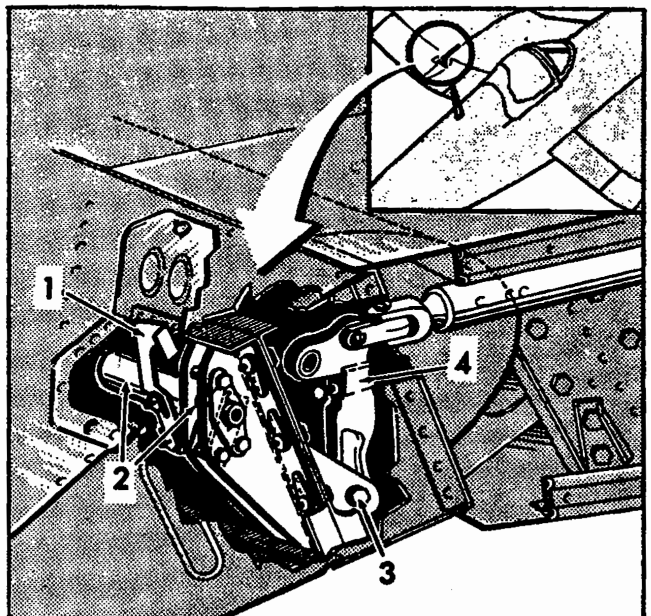
l. Adjust the wing fold cylinder by loosening the lock nut and turning the rod assembly with the special VS-34583 wrench to complete wing adjustment to tolerances given in paragraph 4—31, step b.

4—32. OUTER PANEL FLAPS.

4—33. DESCRIPTION. *(See figure 4—1.)* Each all metal outer panel flap extends along the trailing edge from the aileron inboard to the wing fold and is attached to the rear beam of the outer panel at two hinge points. A flap disconnect mechanism permits the outer panel flap to be easily swung to a vertical position, if desired, and the flap downlock locks the flap in the down position after it has been released by the disconnect mechanism. A cutout in the nose section of the flap permits gun clearance during firing. The outer panel flap is actuated simultaneously with the inboard flaps, being connected by a pushrod to their common actuating lever on the center section wing butt.

4—34. REMOVING. *(Refer to figures 4—9 and 4—10.)*

a. Open the flap disconnect access door (reference (25) on figure 4—1) on the inboard edge of the flap by disengaging the single Camloc fastener.



1. Flap Disconnect Lever
2. Spring-loaded Pin and Housing
3. Fixed Pivot
4. Horn Fitting

Figure 4—9. Flap Disconnect Mechanism.

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b. Lift the flap disconnect lever (reference (1) on figure 4—9), and press down on the flap. This will disconnect the pin (2) which locks the horn fitting (4) to the flap, and permit the flap to be pushed downward. *(See figure 4—9)*; the flap is automatically locked in this position by the flap downlock mechanism within the outer panel.

c. Disconnect the pushrod (reference (8) on figure 4—10), to the flap downlock mechanism located at the outboard end of the flap.

d. Disconnect the pushrod and bonding wire at the inboard end of the flap.

e. Remove the hinge bolt at the outboard hinge.

f. Remove the hinge bolt at the inboard hinge and lift the flap from the airplane.

4—35. INSTALLING. Install the outer panel flap by reversing the steps outlined in the removal procedure. Take care to replace the 63/64 inch diameter washer under the outboard hing bolt in order to prevent the ball bearing from pulling loose due to heavy landing loads.

4—36. ADJUSTING. Refer to paragraph 4—201 for flap adjustment procedure.

4—37. OUTER PANEL FLAP DISCONNECT MECHANISM.

4—38. DESCRIPTION. *(See figure 4—9.)* The pushrod which actuates the outer panel flap is connected to the inboard end of the flap by means of a special horn fitting (4). The lower part of this fitting is attached to the flap at a fixed pivot (3) while the upper part is secured in place by the spring-loaded pin and housing (2) of the disconnect mechanism. Withdrawal of the pin permits the flap to swing down, revolving about the horn fitting, thereby providing clearance for removal of the outboard gun. The disconnect mechanism consists of a spring-loaded pin and housing (2) and a lever (1) for disengaging the pin. To operate the disconnect mechanism, the access door is unfastened by opening the single Camloc screw, the door is opened, and the lever is lifted up, allowing the flap to be rotated to a 90° down position. As this point is reached, the flap downlock mechanism at the outboard end of the flap engages and the indicator plunger, located in the outer panel forward of the lock mechanism, emerges from the outer panel skin. Upon depressing the flap lock indicator, the flap may be revolved upward until the control horn contacts the disconnect mechanism, automatically allowing the spring-loaded pin to engage.

4—39. REMOVING.

a. Remove the disconnect mechanism as a unit by placing the flap in the locked-down position, removing the hinge bolt at the bottom of the horn, and removing the bolts which attach the disconnect assembly to the beam of the flap.

b. The disconnect mechanism may be readily disassembled on the bench.

4—40. LUBRICATING. Apply low temperature grease, Spec. AN-G-25 to the sliding surfaces of flap disconnect mechanism and the flap release indicator, if necessary. Apply general purpose low temperature oil, Spec. AN-O-6 to miscellaneous friction points other than seal bearings.

4—41. INSTALLING. Install the disconnect mechanism by reversing the removal procedure.

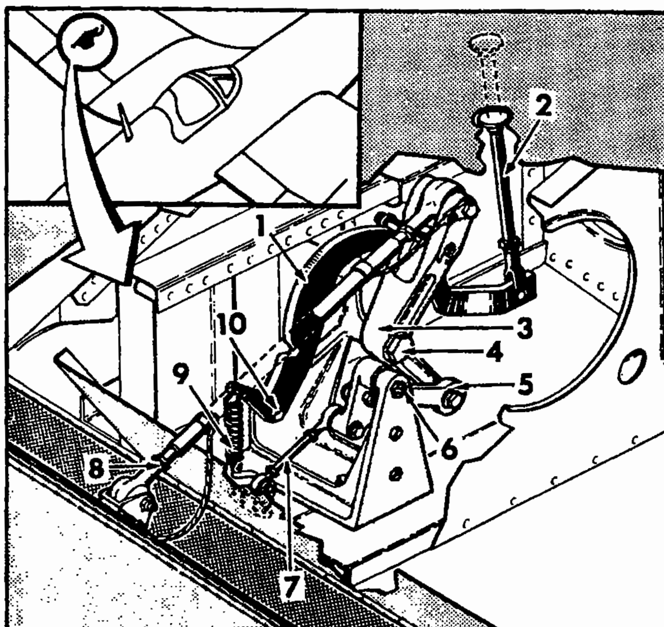
4—42. TESTING. Test by checking the mechanism for positive action and freedom from play caused by wear of the pin or enlargement of the hole in the horn.

4—43. OUTER PANEL FLAP DOWNLOCK.

4—44. DESCRIPTION. *(See figure 4—10.)* The outer panel flap downlock acts to lock the outer panel flap in the down position after the flap has been released by the disconnect mechanism. A pushrod attached to the flap near its outboard end runs forward to a cam and indicator assembly within the outer panel. When the flap has been dropped to a vertical position, the latching cam (1) locks the flap in that position, and the indicator rod (2) is forced upward so that it protrudes about 2-1/2 inches above the wing contour. To release the flap, the indicator must be pushed down.

4—45. REMOVING. *(See figure 4—10.)*

a. Remove the inboard ammunition boxes. (Refer to paragraph 4—1780.)



1. Latching Cam
2. Indicator Rod
3. Bellcrank
4. Bolt
5. Idler
6. Bolt
7. Door Link
8. Downlock Pushrod
9. Latch Spring
10. Pivot Bolt

Figure 4—10. Flap Downlock Mechanism.

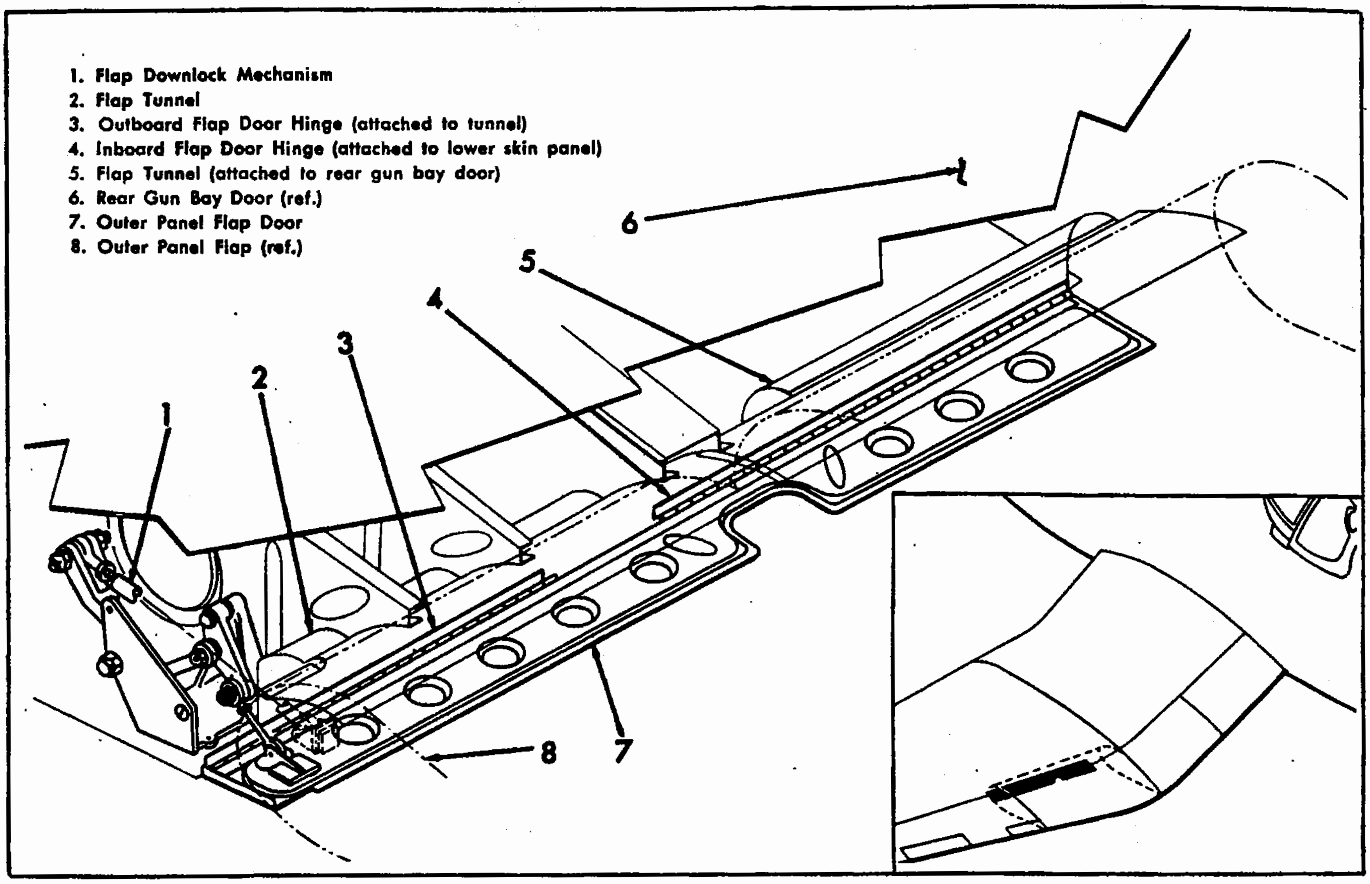


Figure 4—11. Outer Panel Flap Door Installation.

b. Remove the access panel to the flap downlock mechanism located just aft of the indicator plunger.

c. Disconnect the downlock pushrod (8) at the flap.

d. Disconnect the link (7) to outer panel flap door at the door.

e. Remove the bolt (4) which attaches the bellcrank (3) to its support. Reach up through the ammunition box compartment to obtain access to the head of the bolt.

f. Remove the upper bolt (6) from the idler (5), freeing the door link (7), idler (5), link, bellcrank (3), and pushrod (8) as a unit.

g. Unhook the latch spring (9).

h. Remove the pivot bolt (10), thus freeing the latching cam (1).

4—46. LUBRICATING. Apply general all purpose low temperature oil. Spec. AN-O-6, to friction points other than seal bearings on reinstallation.

4—47. INSTALLING. Install the downlock by reversing the removal procedure given in paragraph 4—45.

4—48. ADJUSTING.

a. Set the flap at 90° (plus or minus 5°) down and adjust the pushrod to lock position; i.e., indicator plunger out.

b. Set the flap at 50° down and adjust the flap door link so as to get maximum door opening.

c. Set the flap at 0° and adjust the pushrod so that the gap door matches the wing contour.

4—49. TESTING.

a. Check for positive locking action of the flap.

b. Check for complete disengagement of the lock when the indicator rod is depressed.

4—50. OUTER PANEL FLAP DOOR.

4—51. DESCRIPTION. *(See figure 4—11.)* Each outer panel flap gap closing door consists of a single panel, extending along the lower aft edge of each outer panel. The door (7) is actuated by linkage connected with the flap downlock mechanism (1) which is, in turn, connected with the flap (8). As the outer panel flap is deflected downward, the flap doors rotate upward, permitting a flow of air to pass through the slot.

4—52. REMOVING. *(See figure 4—11.)*

a. With wings folded and outer panel flap removed, (see paragraph 4—34) disconnect the pushrod to the outer panel flap door (7).

b. Remove the hinge wires at the attaching piano hinges (3) and (4) and remove the flap.

4—53. LUBRICATING. Oil the piano hinges with general purpose low temperature oil, Spec. AN-O-6, and wipe free of excess oil before reinstalling the outer panel flap doors.

4—54. INSTALLING. Install the outer panel flap doors by reversing the removal procedure.

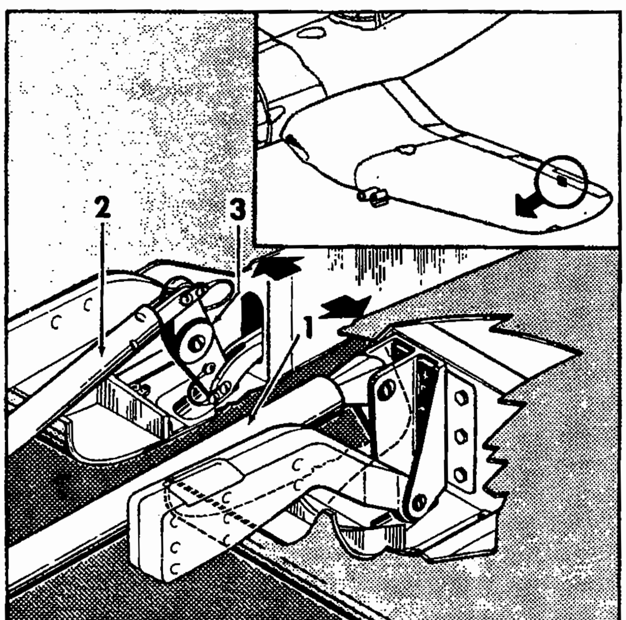
4—55. ADJUSTING. *(See figure 4—11.)*

a. Adjust the pushrod to the door (7) so that the door follows the wing contour when the door is horizontal.

b. After installation of the inboard and outboard center section flaps, the individual door links are aligned so that the doors match the contour of the underside of the flaps when the flaps are in their neutral position; see paragraph 4—19.

4—56. AILERONS.

4—57. DESCRIPTION. *(See figure 4—1.)* Each aileron is an all wood frame assembly with plywood skin. The plywood is covered with fabric for protection against deteriorating influences such as moisture. Its structural framework consists of a conventional main beam with attached leading and trailing edge ribs, and it attaches to the outer panel by means of three hinges. Three cover plates on the bottom surface of the aileron provide access to the hinges. Attached to the inboard end of both ailerons are small balance tabs which are automatically actuated by the deflection of the ailerons and act to reduce the stick forces required to operate them. The left hand aileron also incorporates a trim tab which can be set in flight by means of an electric motor to correct lateral trim. See paragraphs 4—123 through 4—131 for complete information on aileron control system.



1. Aileron Pushrod
2. Aileron Tab Actuating Rod (left hand only)
3. Idler

Figure 4—12. Aileron Attachment Detail.

4—58. REMOVING. *(See figure 4—12.)*

a. Remove the three cover plates on the bottom of the aileron under each hinge.

b. On the center hinge, remove the two hinge bolts and disconnect the pushrod (1) from the aileron.

c. Disconnect the balance tab control rod from the tab.

d. On the left hand panel only, disconnect the trim tab actuating rod (2) from the idler (3).

e. Remove the remaining hinge bolts and lower the aileron to the ground.

4—59. INSTALLING. Install the ailerons by reversing the removal procedure.

4—60. ADJUSTING. Refer to paragraph 4—131 for adjustment of aileron travel.

4—61. TESTING. Test ailerons for freedom of operation and security of hinge attachment.

4—62. AILERON TRIM TAB.

4—63. DESCRIPTION. *(See figure 4—1.)* The aileron trim tab, located on the trailing edge near the center hinge of the left aileron only, is actuated from a toggle switch in the cockpit by means of an electric motor in the left hand outer panel. The aileron trim tab acts to trim the airplane by counteracting engine torque and wing heaviness. Refer to paragraphs 4—132 through 4—141 for complete information on aileron trim tab control system.

4—64. REMOVING. Remove the aileron trim tab by disconnecting the pushrod at the tab. Deflect the tab sufficiently to allow removal of the mounting brackets attached to the aileron.

4—65. LUBRICATING. Lubricate the hinge points of the aileron trim tab with general purpose low temperature oil, Spec. AN-O-6, before installation.

4—66. INSTALLING. Install the tab by mounting the two brackets simultaneously with the trim tab between them. Connect the pushrod to the tab.

4—67. ADJUSTING. Refer to paragraphs 4—136 and 4—141 for adjustment of the aileron trim tab.

4—68. AILERON BALANCE TABS.

4—69. DESCRIPTION. *(See figure 4—1.)* The aileron balance tabs are located on the inboard trailing edge of both ailerons. The aileron balance tabs are mechanically linked to the outboard fixed outer panel flap support and deflect in a direction opposite to the motion of the aileron in order to reduce the stick force necessary to deflect the ailerons.

4—70. REMOVING. Remove the balance tab by disconnecting the link at the flap support and removing one of the two small brackets on the aileron which support the tab hinge.

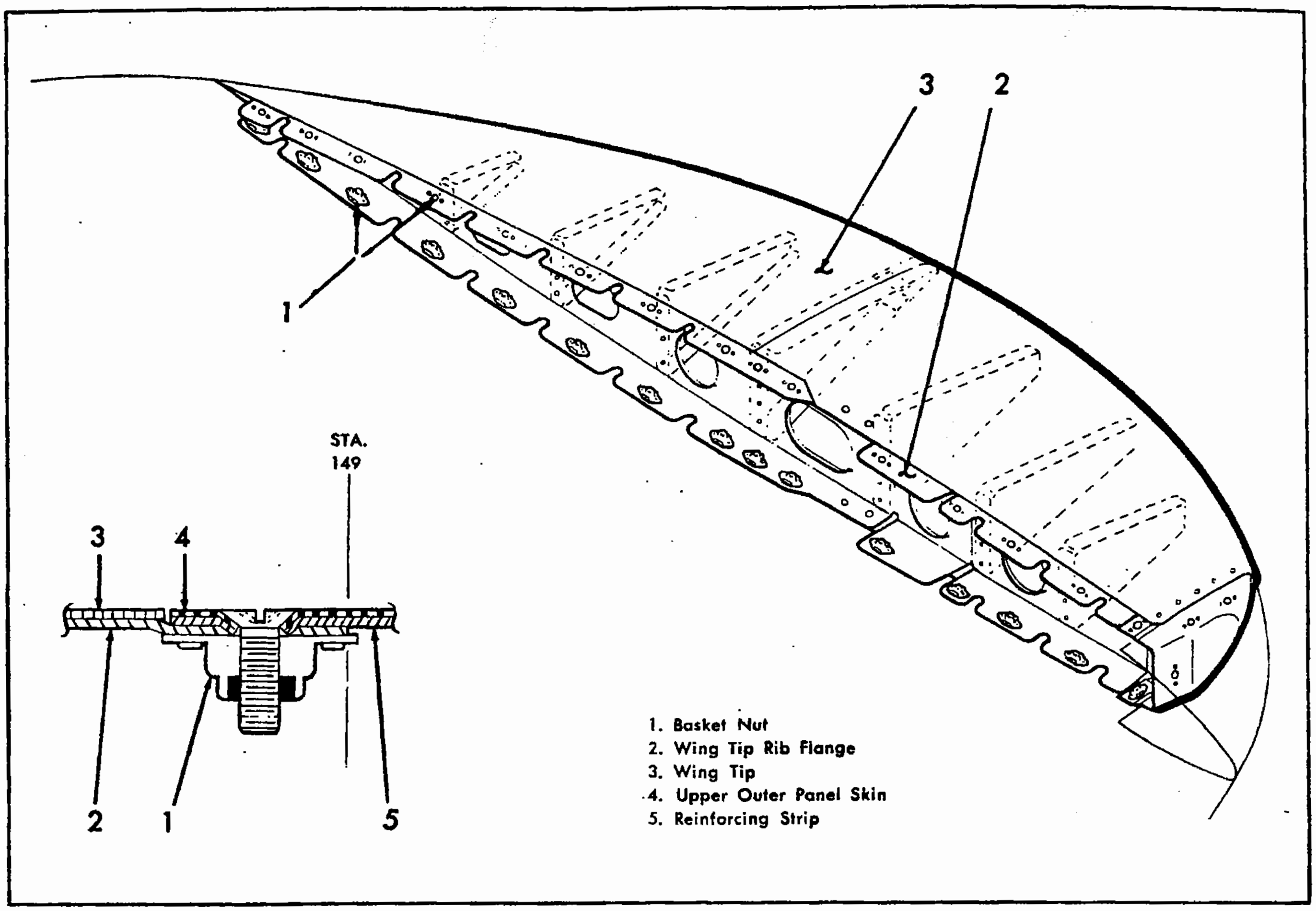


Figure 4–13. Removable Wing Tip.

4–71. LUBRICATING. Lubricate the hinge points of the balance tab with general purpose low temperature oil, Spec. AN-O-6, before installing.

4–72. INSTALLING. Install the aileron balance tab by mounting the detached tab support bracket with the tab between the brackets.

4–73. ADJUSTING. The aileron balance tab push-rods should be adjusted so that the tabs align with the trailing edge of the aileron, with the ailerons in the neutral position.

4–74. WING TIP.

4–75. DESCRIPTION. *(See figure 4–13.)* The all metal wing tip is composed of formers, a rib along the inboard edge, and metal skin. The wing tip is inserted inside the outer panel wing skin at the end rib and is attached by means of screws and basket nuts. A small plexiglas nosepiece attaches over the running light at the leading edge.

4–76. REMOVING.

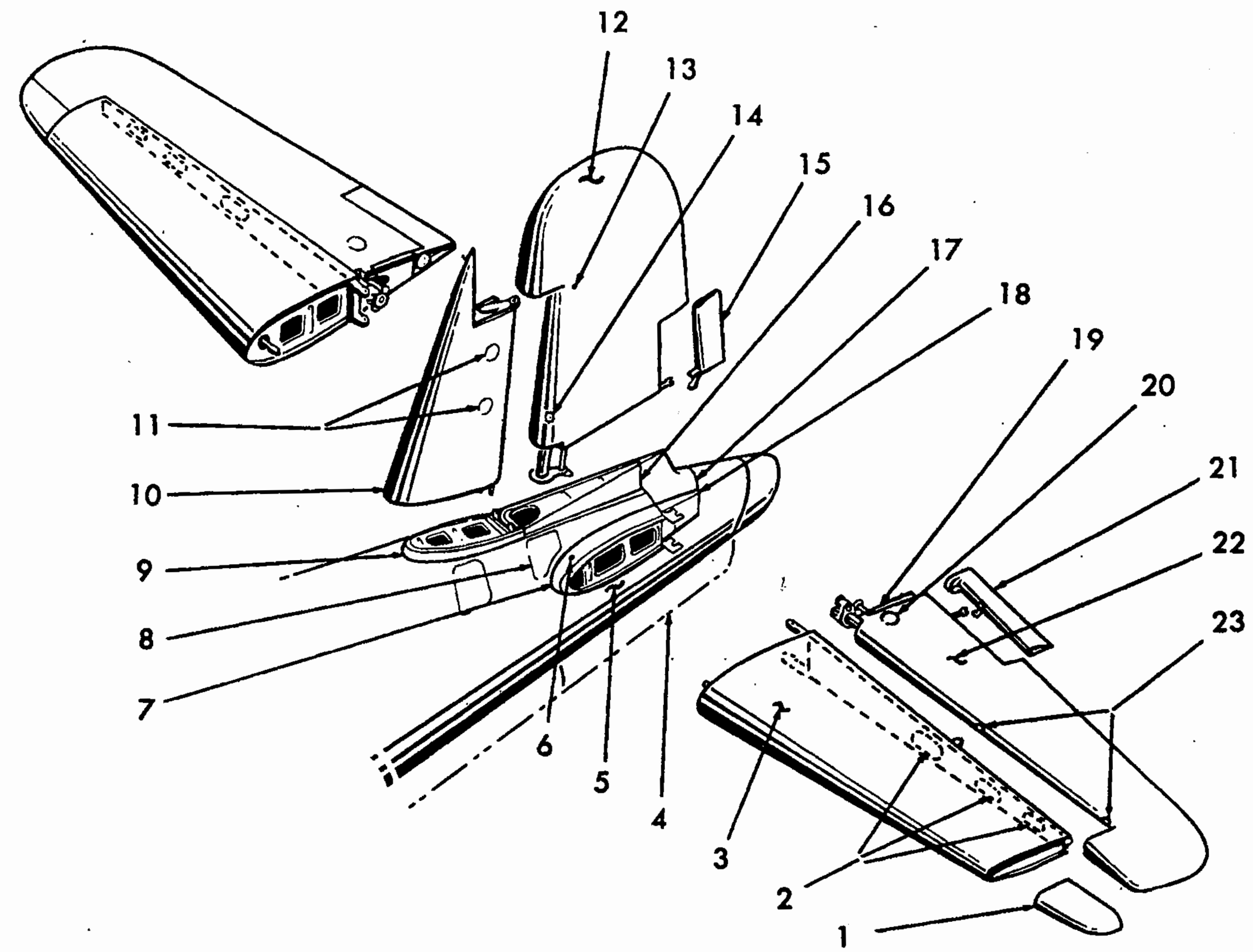
a. Remove the fabric strip at the wing tip joints.

b. Remove the attaching screws around the periphery of the wing tip at the outer panel end rib. Pull out the wing tip.

4–77. INSTALLING.

a. Insert the tip inside the wing skin, align the screw holes, and insert the screws.

b. Cover the joint with fabric and dope in accordance with instructions in paragraphs 4–1905 through 4–1907.



1. Removable Stabilizer Tip
2. Access to Interior of Stabilizer
3. Stabilizer
4. Tail Wheel Doors (ref.)
5. Fuselage (ref.)
6. Access to Forward Stabilizer Attaching Bolts
7. Stabilizer Fairing
8. Access to Rudder Torque Tube and Fin Attaching Fittings
9. Fin Fairing
10. Fin
11. Access to Interior of Fin
12. Rudder
13. Access to Upper Rudder Hinge Bolt
14. Fabric Covered Access to Rudder Torque Tube Bolt
15. Rudder Tab
16. Fixed Rudder Fairing
17. Removable Rudder Fairing
18. Removable Elevator Fairing
19. Fixed Elevator Fairing
20. Access to Elevator Tab Push Rod and Jackshaft Fitting
21. Elevator Tab
22. Elevator
23. Access to Elevator Hinge Fittings

Figure 4—14. Exploded View of Empennage.

4—78. EMPENNAGE.

4—79. DESCRIPTION. *(See figure 4—14.)* The tail group is of full cantilever design, consisting of a rudder with combination spring and trim balance tab, a vertical fin, non-interchangeable right and left hand elevators, right and left hand elevator spring and trim balance tabs, and interchangeable right and left hand stabilizers. The spring and balance action of both rudder and elevator tabs is automatic; the tabs are electrically controlled by an actuator for trimming purposes. The fin, rudder tab, and elevator tabs have aluminum alloy skins. The rudder and elevators have outer surfaces of doped fabric. The stabilizers are constructed of Metalite with removable metal tips.

4—80. RUDDER.

4—81. DESCRIPTION. *(See figure 4—14.)* The rudder is constructed of a skeleton frame consisting of a main beam, horizontal ribs extending from the main beam to the trailing edge, and an aluminum alloy covered leading edge which terminates at its lower end in a torque tube. The rudder is balanced by a lead antimony counterweight mass balance which is bolted to a bulkhead in the balance assembly forward of the rudder beam at the upper rudder leading edge. The entire rudder (leading edge and skeleton frame) is covered with doped fabric. The lower end of the torque tube, to which is attached a bearing assembly, is bolted to the rudder control horn in the fuselage and serves as the lower rudder hinge point. Access to the torque tube fittings on the control horn is provided by Camloc fastened doors located on both sides of the aft fuselage at station 315.5. The upper end of the rudder leading edge is attached to the fin by a hinge fitting located beneath the rudder balance and on the rudder beam. The upper hinge nut and bolt can be reached through the 3/4 inch holes located on both sides of the rudder surface. At its lower trailing edge, the rudder incorporates a spring and trim balance tab (see paragraph 4—86) which is secured to the rudder by a stud fitting at its upper end and a hinge fitting at its lower end. To reduce drag, a fixed rudder fairing is provided on the top surface of the aft fuselage. It extends from the aft end of the fin fairing to fuselage station 346. The removable rudder fairing, which provides access to the stabilizer and elevator attachment fittings, is located aft of the fixed rudder fairing and extends from fuselage station 346 to station 358. Philips head screws secure the removable rudder fairing to bulkhead 346, to the aft inboard ends of the stabilizer fairing, to the sides of the aft fuselage and to bulkhead 358. When actuated by the rudder pedals in the cockpit, the rudder will normally deflect 25 degrees to the right or left. However, a right or left rudder deflection of 21.75 degrees is possible with the aid of the torque spring. For information on rudder controls, see paragraphs 4—171 through 4—179.

4—82. REMOVING. *(See figure 4—15.)* To remove the rudder, observe the following procedure:

Note

In the following procedure, the rudder tab is removed with the rudder. To remove the rudder tab only, refer to paragraph 4—88.

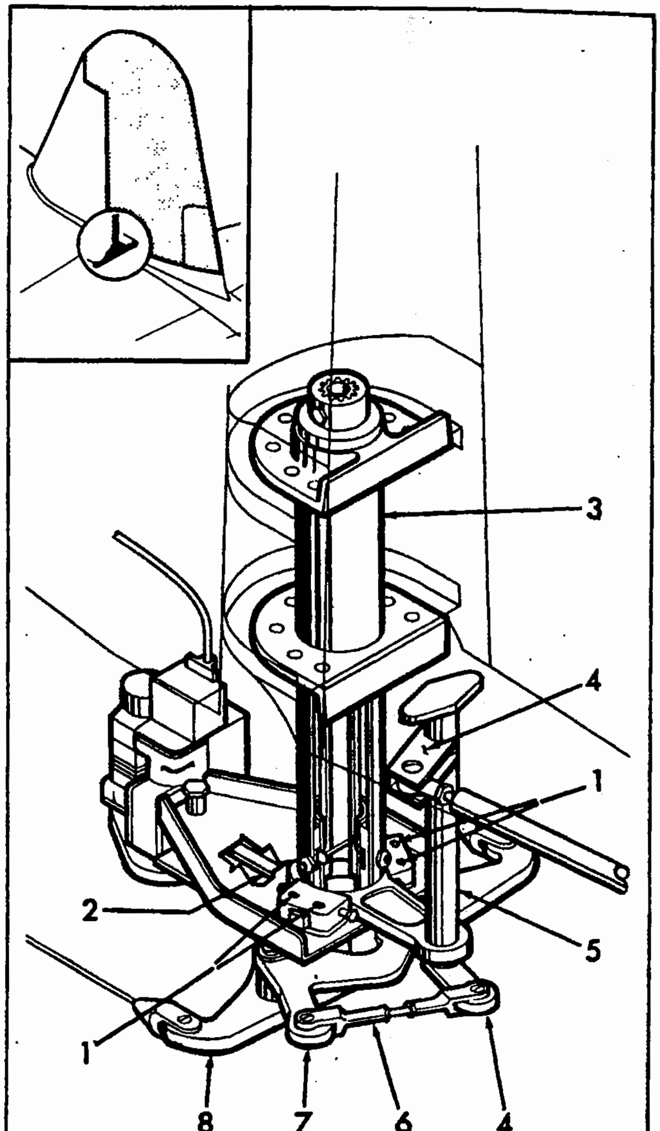
a. With a screw driver, open the Camloc-fastened access doors on both sides of the fuselage at station 315.5 to provide access to the rudder torque tube fittings.

b. Remove the four cotter pins, nuts, washers and bolts (1) which secure the rudder torque tube (3) to the horn fitting (8).

c. Disconnect the turnbuckle link rod (6) from the jackshaft (5) at the arm (4) by removing the cotter pin, nut and bolt.

d. Working through the upper fin access handhole on the left side of the fin remove the six self-locking nuts, washers and bolts which secure the forked hinge assembly to the fin.

e. Remove the rudder by lifting it from the airplane.



1. Cotter Pins, Nuts, Washers and Bolts Attaching Torque Tube to Horn
2. Trim Tab Linear Actuator Rod
3. Torque Tube
4. Arm
5. Tab Jackshaft
6. Link Rod
7. Bellcrank
8. Rudder Horn

Figure 4—15. Rudder Attachment.

4—83. LUBRICATING. Prior to rudder assembly, lubricate the upper rudder hinge bolt with AN-G-10 grease. Refer to figure 3—14 for additional lubrication information.

4—84. INSTALLING. To install the rudder and tab as a unit, reverse the removing procedure given in paragraph 4—82.

4—85. ADJUSTING. To adjust the rudder for proper right and left deflection, refer to paragraph 4—179.

4—86. RUDDER TAB.

4—87. DESCRIPTION. *(See figure 4—14.)* The rudder tab is of aluminum alloy construction reinforced by horizontal ribs and a vertical beam. The tab trailing edge is reinforced by a phenolic filler to which the tab skin is riveted. A stud fitting at the top of the tab beam serves as a hinge point for attaching the upper tab end to the rudder. The stud is secured in position by a supporting bracket which is riveted to the top tab rib. The hinge fitting for the lower end of the tab is bolted to the rudder. A pivot bolt passes through a mass balance fitting secured to the tab through the hinge fitting, and into a fitting secured to the tab beam. The mass balance fitting is secured to the bottom rib of the tab, and carries, as an integral part, the tab horn. The rudder tab is actuated by a push rod which is attached to the horn assembly on the right hand side of the tab. The other end of the push rod is secured by a nut and screw to an arm on the upper end of tab jackshaft which is supported by the bottom rib of the rudder. The lower end of the jackshaft is mounted on an arm which extends aft from the bottom end of the rudder torque tube. The rudder tab is designed to function both as a spring tab and a trim tab. For trimming the airplane, the rudder tab is electrically actuated by a linear actuator which applies motion to the jackshaft through a bellcrank and a link. For detailed information on operation of the rudder tab, see paragraph 4—180. Operating as a spring tab, the rudder tab will deflect 3°45′ to the right or left. When electrically controlled, the normal deflection is 10° right or left.

4—88. REMOVING. To remove the rudder tab, observe the following procedure:

a. Remove the cotter pin and with a special VS-34592 screwdriver, remove the screw and nut from the horn fitting and push rod connection on the right hand side of the tube.

b. Deflect the rudder tab slightly to the right or left and remove the cotter pin, nut, washers, and bolt from the lower hinge fitting.

c. With rudder deflected to clear the fixed rudder fairing, free the stud at the upper end of the tab from its fitting and remove the rudder tab.

4—89. LUBRICATING. Prior to installation of the rudder tab, lubricate the hinge fittings with AN-G-25 lubricant grease. For additional lubrication information, see figure 3—14.

4—90. INSTALLING. To install the rudder tab, reverse the removing procedure given in paragraph 4—88.

4—91. ADJUSTING. For information on adjusting the rudder tab to obtain proper right and left deflection, refer to paragraph 4—185.

4—92. FIN.

4—93. DESCRIPTION. *(See figure 4—14.)* The fin is of full cantilever construction with an outer stressed skin surface, and a skeleton frame consisting of a vertical beam, horizontal ribs, and reinforcing stiffeners. The lower aft end of the fin is attached to bulkhead 310 21/32 by two bolt fittings. The base of the fin is secured by Phillips head screws and lock nuts to the fixed fin fairing which is riveted to the top of the aft fuselage between stations 288 and 313. The leading edge of the fin is offset two degrees to the left hand side of the airplane to counteract the tendency of the airplane to turn toward the left. An antenna hook with threaded bolt end is fastened with a washer and nut to the leading edge of the fin tip. On the left hand side of the outer fin skin, two flanged inspection holes provide access to the interior of the fin. They are covered with discs which are attached by screws and locknuts to spider fittings inside the fin. At the upper end of the fin trailing edge, a hinge bracket with an attached trunnion fitting is bolted to the fin beam to provide an attaching point for the rudder.

4—94. REMOVING. *(See figure 4—16.)* To remove the fin, observe the following procedure:

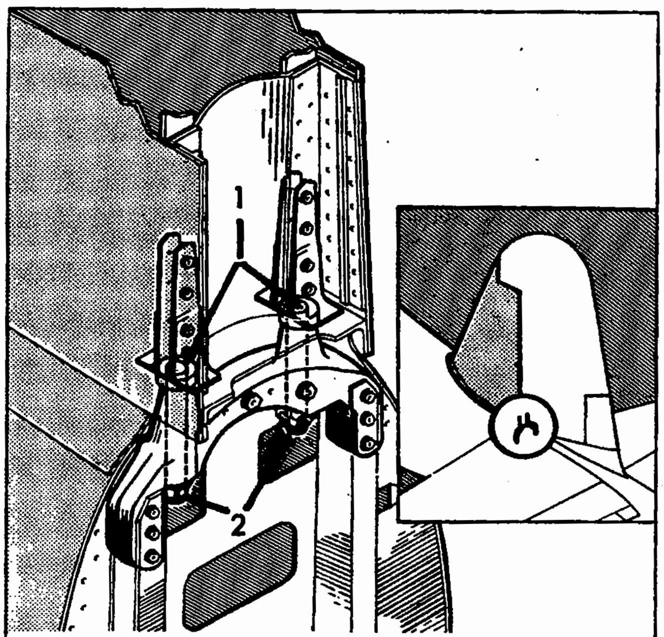
a. Disconnect the antenna from the antenna hook.

b. Remove the rudder; see paragraph 4—82.

c. Remove the cover of the right hand access hole by taking out the attaching screws.

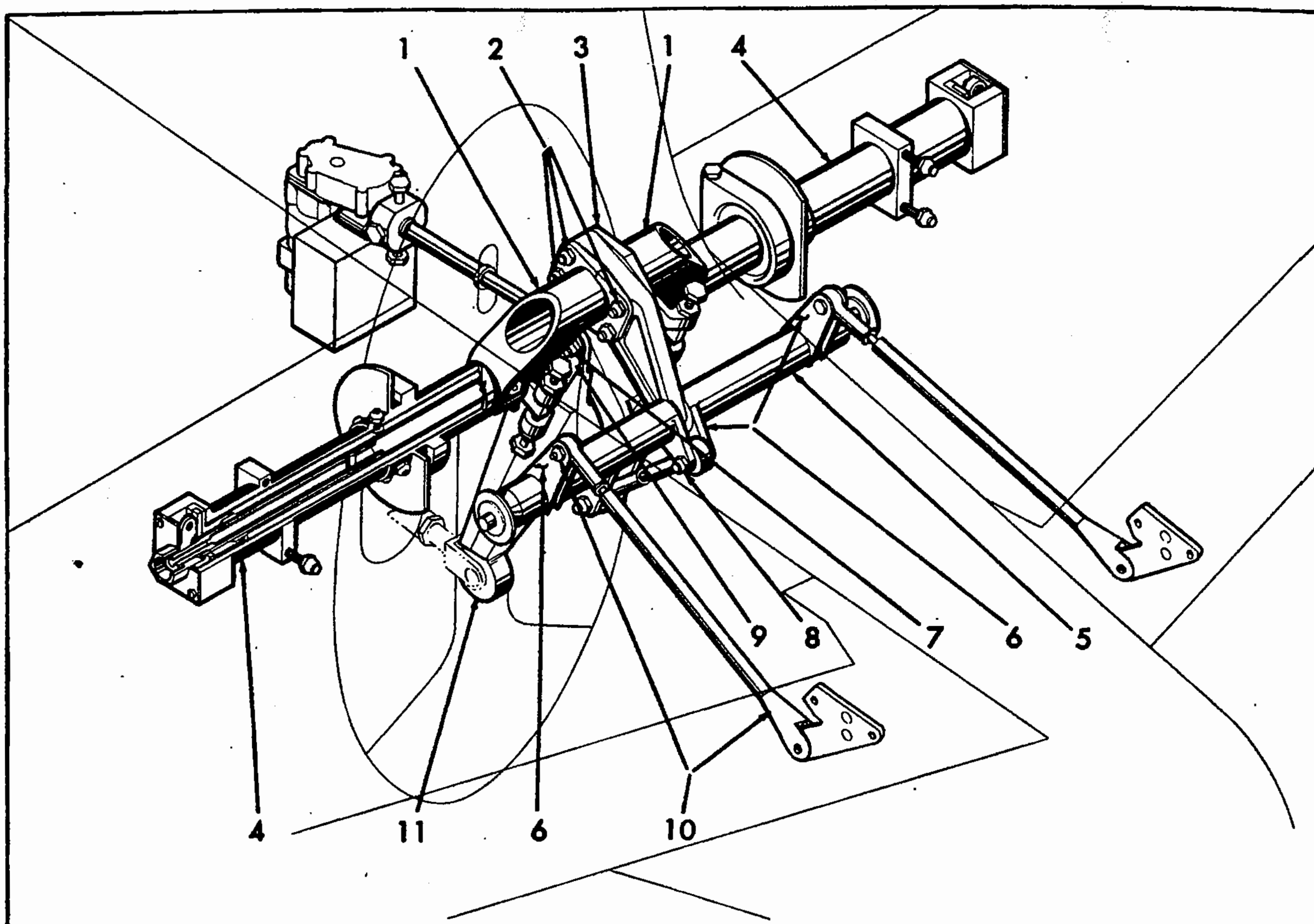
d. Take out the Phillips head screws which secure the base of the fin to the fin fairing.

e. Loosen the Camloc fasteners and open the fin-rudder torque tube access doors which are located on both sides of the fuselage at station 315.5.



1. Fin Fitting Attaching Bolts
2. Cotter Pins, Nuts and Washers

Figure 4—16. Fin Attachment.



1. Overarms
2. Bolts Attaching Overarm to Jackshaft Support
3. Elevator Tab Jackshaft Support
4. Elevator Torque Tube (right and left)
5. Elevator Tab Jackshaft
6. Arms
7. Bolts Attaching Torque Tube Collar to Horn Assembly
8. Bolt Attaching Inboard Ends of Tab Jackshaft
9. Elevator Torque Tube Collars
10. Tab Pushrod Attachments
11. Elevator Horn

Figure 4—17. Elevator and Jackshaft Attachments.

f. Remove the cotter pins, nuts, and washers (2) from the fin bolt fittings (1).

g. Lift and remove the fin from the airplane.

4—95. INSTALLING. To install the fin, reverse the removing procedure given in paragraph 4—94.

4—96. ELEVATORS.

4—97. DESCRIPTION. *(See figure 4—14.)* The right and left hand non-interchangeable elevators consist of a main leading edge beam terminating in a torque tube, and longitudinal ribs which extend from the main beam to the preformed metal trailing edge. The entire elevator assembly aft of the main beam is fabric-covered. Each elevator is mass balanced by a lead antimony counterweight which is bolted to the balance assembly extending forward of the beam at the outboard end of the elevator. At its inboard trailing edge, each elevator incorporates a spring and trim balance tab; see paragraph 4—102. In addition to the torque tube which rotates to provide up and down elevator deflections, each elevator is provided with a tab actuating jackshaft which moves the tab in the opposite direction to that of the elevator. For information on elevator controls, refer to paragraph 4—143 through 4—151. Each elevator is attached to the stabilizer at three hinge points, two on the stabilizer beam and one on the inboard end of the stabilizer beam fitting. A fixed fairing, which is riveted to the inboard end rib of each elevator, extends aft from the elevator leading edge to the counterbalance weight on the elevator tab. In up and down elevator deflections, the fairing clears another fixed elevator fairing which is riveted to the side of the aft fuselage between stations 358 and 371.5. Access to the elevator torque tube and tab torque tube fittings is provided by a removable fairing which is secured by Phillips head screws and lock nuts to the top and sides of the aft fuselage between stations 346-5/32 and 358. The forward right and left hand sides of the rudder fairing are also secured by screws to the aft ends of the right and left hand stabilizer fairings. Access to the forward end of the tab push rod is provided by a round hole which is covered with a metal disc secured by three screws to an inner spider fitting. Normal elevator deflection is 23.5 degrees up and 21 degrees down.

4—98. REMOVING. *(See figure 4—17.)* To remove the elevator, observe the following procedure:

Note

In the following procedure, the elevator tab is removed with the elevator. Removing procedures for the elevator tab only are given in paragraph 4—104.

a. Remove the rudder fairing by taking out the screws which attach it to the fuselage and to the inboard aft ends of the right and left hand stabilizers.

b. Remove the four nuts and bolts (2) which secure the overarms (1) of the elevator torque tubes (4) to the jackshaft aft support (3).

c. Disconnect the elevator torque tube collar (9) from the horn assembly (11) by removing the four nuts and bolts (7).

d. Free the inboard ends of the tab jackshafts (5) by removing the nut and bolt (8) which secure the arms (6).

Note

A VS-34592 slotted screwdriver is required to remove the elevator hinge attaching bolts.

e. Unsafety and remove the nuts from the hinge attaching bolts. The bolts are then driven upward with a small drift pin. The bolts which attach the torque tube bearing to the inboard stabilizer fitting are likewise removed.

f. With the hinge bolts free, pull and remove the elevator from the stabilizer.

4—99. LUBRICATING. Prior to installing the elevators, lubricate all hinge fittings with AN-G-25 lubricant grease. Refer to figure 3—14 for additional lubrication information.

4—100. INSTALLING. To install the elevators, reverse the removing procedure given in paragraph 4—98, and note the following additional information:

a. The elevator hinge attaching bolts are close tolerance bolts of different sizes; inboard bolts (right and left hand) are NAS 54-30; outboard bolts (right and left hand) are NAS 54-26.

b. When inserting the hinge bolts, be certain that the bonding jumpers between elevator and stabilizer are attached.

c. The bolts securing the inboard ends of the elevator torque tubes should be installed with the heads inboard.

d. If a new elevator is installed, be sure that the drain holes on the underside of the elevator are open. If they are not, open them by piercing with a sharp pointed tool.

4—101. ADJUSTING. For information on the adjusting procedure for proper up and down elevator deflections, refer to paragraph 4—151.

4—102. ELEVATOR TABS.

4—103. DESCRIPTION. *(See figure 4—14.)* A combination spring and trim balance tab is incorporated at the inboard trailing edge of each elevator. The tab consits of a beam and longitudinal ribs extending from the beam to the tab trailing edge. The entire tab assembly is covered with an aluminum alloy skin. The tab is attached to the elevator at three points, one outboard and one center stud fitting, and an inboard hinge fitting. A counterweight mass balance projects forward of the inboard leading edge of the tab. A horn fitting, extending from the underside of the tab at the center hinge stud fitting, serves as an attaching point for the aft end of the controlling tab push rod. The forward end of the push rod is fastened by a nut and screw to a horn fitting on the outboard end of the jackshaft which is located in the elevator to provide for automatic spring action of the tab. For trimming purposes, the tab is electrically operated by an actuator in the aft fuselage. For information on operation and control of the automatic spring and trim balance tab, refer to paragraph 4—152.

4—104. REMOVING. To remove the elevator tab, observe the following procedure:

a. Disconnect aft end of push rod from the tab horn fitting by removing the attaching nut and screw, using special slotted screwdriver, VS-34592.

b. Remove the nut from the inboard hinge fitting.

c. With tab deflected, pull the tab slightly inboard to free the stud fittings from the elevator hinge fittings and remove tab.

4—105. LUBRICATING. Prior to installing the elevator tabs, lubricate the hinge points with AN-G-25 lubricant grease. Refer to figure 3—14 for additional lubrication information.

4—106. INSTALLING. To install the elevator tabs, reverse the removing procedure given in paragraph 4—104.

4—107. ADJUSTING. To adjust the elevator tab for permissible up and down deflections, refer to the procedure given in paragraphs 4—156 and 4—162.

4—108. STABILIZERS.

4—109. DESCRIPTION. *(See figure 4—14.)* Each ininterchangeable right and left hand stabilizer consists of a beam, ribs, and stiffeners covered with a Metalite skin; refer to paragraphs 4—1886 through 4—1896 for Metalite information. The removable all-metal tip is attached to the stabilizer by screws and locknuts. The inboard end of each stabilizer is secured to the fuselage through fittings, two of which are bolted to the stabilizer beam and fit into an "H" fitting, bolted to fuselage bulkhead 349-5/32. A forward fitting, located near the stabilizer leading edge, is secured to a fitting located on the stabilizer-fuselage fairing by long Dzus bolts. The inboard end of the stabilizer skin is attached by screws and locknuts to the fixed stabilizer fairing which is fitted under the stabilizer. At the outboard and center trailing edge of the stabilizer, two hinge fittings with trunnion attachments extend aft for securing the elevator to the stabilizer. A bracket is bolted to the inboard stabilizer beam for attaching the bearing support of the elevator torque tube. On the web of the stabilizer beam, three access doors are provided for interior inspection. The doors are secured by screws fastened in locknuts, and are accessible for interior stabilizer inspection when the elevators have been removed. Access to the aft stabilizer fittings is provided through the removable rudder fairing and the tail wheel doors. The front fitting attaching bolt is accessible on the top surface of the stabilizer fairing.

CAUTION

Due to the special construction and the resulting smooth surfaces of the Metalite stabilizers, extreme care should be exercised in their handling to prevent damaging their excellent aerodynamic properties. Dropping tools, tool boxes, etc. on the shell should be avoided. If damage does occur, refer to the Handbook of Instructions for Structural Repair (AN 01-45HB-3) for repair information.

4–110. REMOVING. To remove the stabilizers, observe the following procedure:

a. Remove the elevators as outlined in paragraph 4–98.

b. Remove all the screws which attach the stabilizer skin to the fairing.

c. Unsafety and remove the nuts on the four taper pins securing inboard ends of the stabilizer to the fuselage bulkhead fitting.

CAUTION

Make sure stabilizer is supported while removing retaining pins and bolts.

d. Install washers and nuts (removed from bottom of taper pins) on threaded studs protruding from large upper ends of taper pins, and using nuts as pullers, turn down nuts until taper pins are loosened. If necessary, use a soft drift pin to aid in removing taper pins.

e. After removing taper pins, take out the split bushings from the stabilizer fittings.

f. Working through access hole in stabilizer fairing, unsafety and disengage the special Dzus bolt that attaches the forward stabilizer fitting to the fuselage. Then pull the stabilizer free of the airplane.

4–111. DISASSEMBLY. To remove a stabilizer tip for replacement in case of damage, take out the twenty screws which secure the tip of the stabilizer and pull the tip free of the stabilizer.

4–112. ASSEMBLING. To assemble the stabilizer tip to the stabilizer, reverse the disassembly procedure given in paragraph 4–111.

4–113. LUBRICATING. No lubrication is required, although the fittings may be greased to facilitate installation of the stabilizer.

4–114. INSTALLING. To install the stabilizer, reverse the removing procedure given in paragraph 4–110. When mounting a stabilizer, insert a drift pin through the aligned front fitting to provide a pivot point. Then apply a force on the outboard portion of the stabilizer to align the stabilizer beam fittings prior to installing the bushings and taper pins. A well greased, 5/8 inch diameter "bullet" should be driven ahead of the split bushing before proceeding to drive the bushing into place. After securing the beam fittings, engage the special Dzus bolt at the forward stabilizer fitting. The bolt engagement should be checked visually through the holes provided for that purpose on the underside of the stabilizer fairing. When the stabilizer is attached, apply a coat of Paralketone, AN-C-52, Type I to the attachment fittings.

4–115. CHECK AFTER INSTALLATION.

a. The stabilizer angle of incidence is positive and should be 1-1/4 degrees, plus or minus 1/2 degree, upon installation. The difference in angle between the two stabilizers must not exceed 1/4 degree.

b. The angle of incidence is built into the airplane and is not adjustable. However, the angle of incidence may be checked by leveling the airplane (refer to paragraph 3–28) and measuring the angle with a protractor and a contour board.

c. If the angle exceeds the allowable tolerance, the stabilizer must be replaced. In the case of a new stabilizer which fails to meet the angular tolerance, a careful check should be made of the alignment of the fittings on the stabilizer and in the tail section. Check that the stabilizer fitting is mounted on the bulkhead with the end stamped "TOP" uppermost.

4–116. SURFACE CONTROLS.

4–117. GENERAL DESCRIPTION. *(See figure 4–18.)* The surface controls consist of mechanical and electrical systems which operate the control surfaces. The ailerons and elevators are operated by the conventional cockpit control stick, the movement of which is transmitted to the control surfaces by a series of pushrods, bellcranks and levers. The rudder is controlled by a cable system operated by rudder pedals which are of the hanging and folding type, having a fore and aft adjustment operated by a single control. The rudder and elevators are provided with combination spring and trim tabs, the trim displacement obtained electrically, the spring reaction displacing the tab automatically. The ailerons have balance tabs operated automatically and one electrically operated trim tab located on the left hand aileron. The position indicator for the tabs is located on the left hand cockpit console as are the tab actuating switches. Hydraulically actuated flaps are provided in the center section and outer panels. The flap control handle is located outboard of the engine control unit on the left hand side of the cockpit. The flap position indicator is also mounted on the left hand console. A surface control lock is furnished for the purpose of securing the control stick and hence the ailerons, elevators, and rudder surfaces. The following table covers the maximum throws of the control surfaces, tolerance permitted, and cable tension allowed.

TABLE OF SURFACE MOVEMENTS

	From Neutral Position		
	MAXIMUM UP	MAXIMUM DOWN	TOLERANCES
Aileron	19°	14°	±1°
Aileron Trim Tab	15°	15°	+4°—1°
Flaps	0°	50°	Within 7° except for full up position
Elevator—normal travel without spring tab deflection	23.5°	21°	±1°
Elevator—maximum travel with full deflection of spring tab	18.5°	14.5°	±1°
Elevator Spring Tab	20°	15°	±1°
Elevator Trim Tab	+4°—1°	+4°—0°	
	MAXIMUM LEFT	MAXIMUM RIGHT	
Rudder—normal travel without spring tab deflection	25°	25°	±1°
Rudder—maximum travel with full deflection of spring tab	21.75°	21.75°	±1°
Rudder Spring Tab	3°45′	3°45′	±1°
Rudder Trim Tab	10°	10°	+4°—1°

a. Tension in rudder cables to be . . . . 50 pounds (+ or −10 pounds)
b. Maximum play permissible at top of control stick . . . . 1/4 inch
c. Maximum tolerance on neutral position of control stick:
  Fore or Aft . . . . 1/4 inch
  Left or Right . . . . 1/8 inch
d. Maximum tolerance alignment of rudder pedals in fore and aft positions . . . . 1/4 inch

4–118. CONTROL STICK AND TORQUE TUBE.

4–119. DESCRIPTION. *(See figure 4–19.)* The control stick which actuates the ailerons and elevators is a heat-treated aluminum alloy tubular assembly located in the center of the cockpit. The control stick is connected to and straddles a torque tube mounted longitudinally beneath the cockpit floor. The forward end of the torque tube when rotated laterally, through an extension, actuates the aileron linkage. The bottom of the stick is connected to the elevator actuating push rod system. A protective boot encases the control stick at cockpit floor level. A pistol-grip type handle is installed on the upper end of the control stick and contains three electric switches which operate the gun, bomb release, and rocket firing circuits. The electrical lead from the control stick is plugged into the pilot's distribution box.

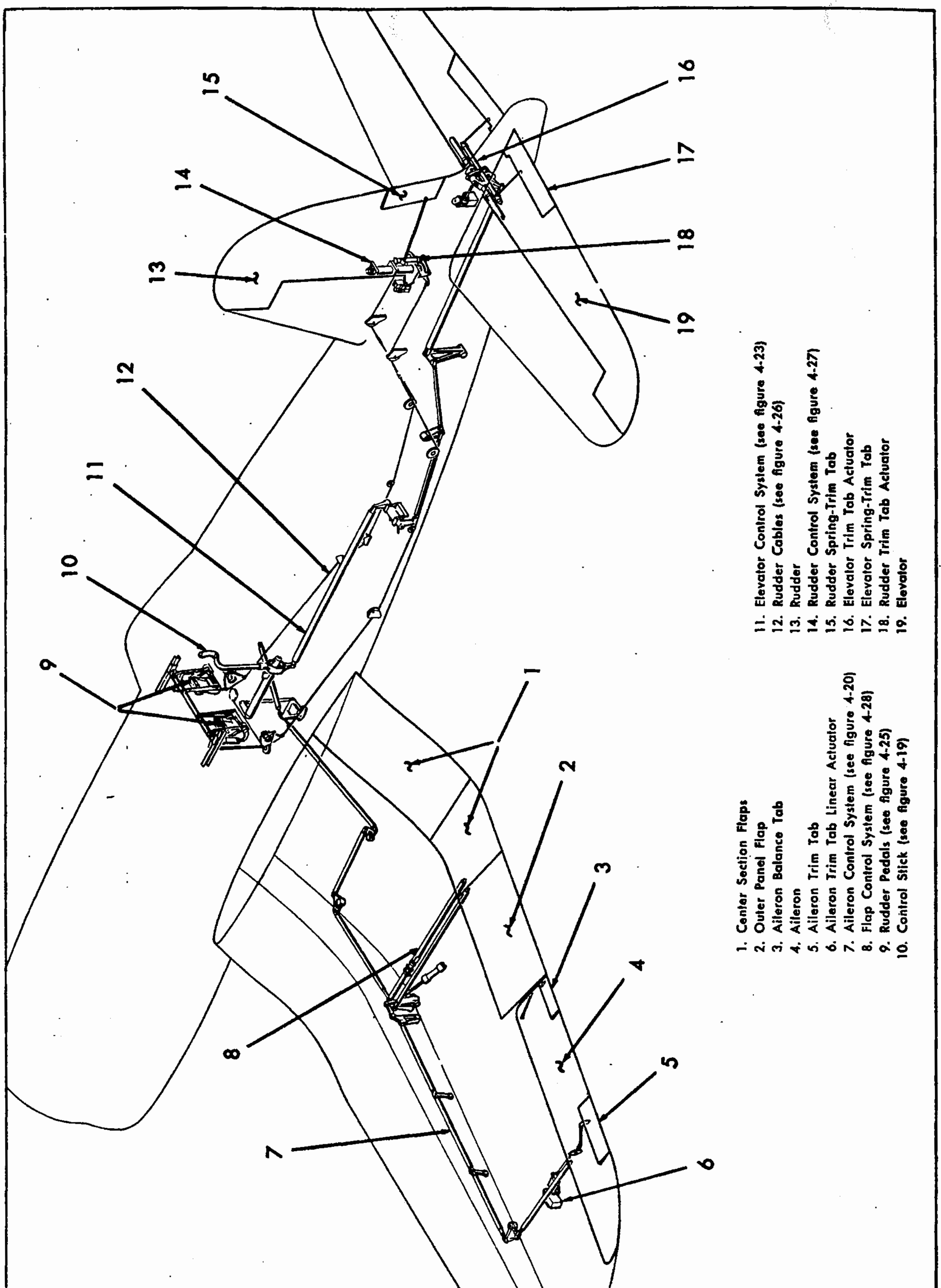
4–120. Lateral rotation of the control stick and torque is limited by stops located under the cockpit floor and in the outer panels. The stops are adjusted to permit lateral stick movement of nine and one-eighth inches to either side of the neutral position. Fore and aft movement of the stick is limited by stops on the torque tube, to eight inches forward and eight and one-half inches aft of the neutral position.

4–121. REMOVING. *(See figure 4–19.)* For complete removal of the control stick and torque tube, proceed as follows:

a. Remove clamp securing relief tube to control stick.

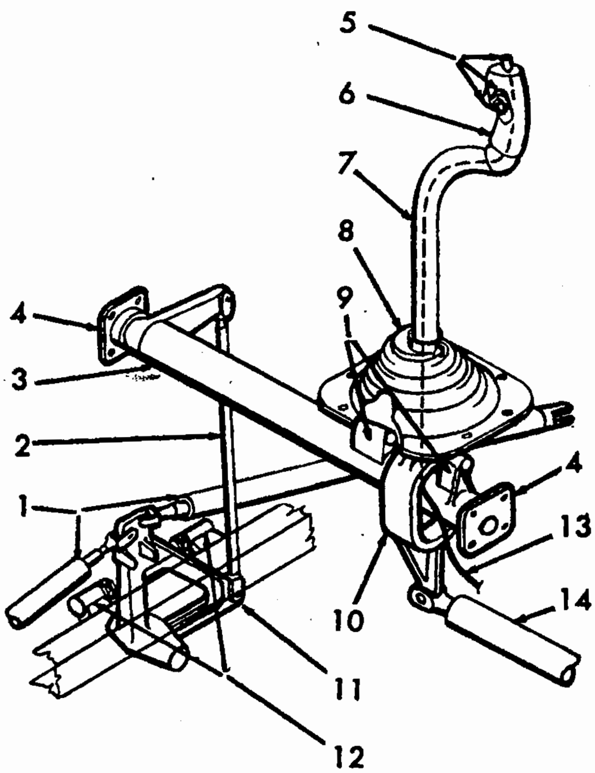
b. Remove protective boot (8).

c. Disconnect armament electrical lead (13) from pilot's distribution box.



1. Center Section Flaps
2. Outer Panel Flap
3. Aileron Balance Tab
4. Aileron
5. Aileron Trim Tab
6. Aileron Trim Tab Linear Actuator
7. Aileron Control System (see figure 4-20)
8. Flap Control System (see figure 4-28)
9. Rudder Pedals (see figure 4-25)
10. Control Stick (see figure 4-19)
11. Elevator Control System (see figure 4-23)
12. Rudder Cables (see figure 4-26)
13. Rudder
14. Rudder Control System (see figure 4-27)
15. Rudder Spring-Trim Tab
16. Elevator Trim Tab Actuator
17. Elevator Spring-Trim Tab
18. Rudder Trim Tab Actuator
19. Elevator

Figure 4—18. Surface Controls Reference Diagram.



1. Aileron Actuating Rods	8. Boot
2. Aileron Link Rod	9. Elevator Stops
3. Torque Tube	10. Socket
4. Torque Tube Bearing Support	11. Aileron Bellcrank
5. Armament Switches	12. Aileron Stops
6. Grip	13. Electrical Cable
7. Control Stick	14. Elevator Pushrod

Figure 4—19. Control Stick and Torque Tube.

d. Disconnect aileron link rod (2) leading from torque tube (3) to bellcrank (11).

e. Disconnect elevator pushrod (14) from bottom of control stick (7).

f. Remove bolt securing control stick (7) to torque tube (3).

g. Remove bearing supports (4) securing torque tube (3) to bulkheads.

h. Remove control stick (7) from torque tube (3) and remove torque tube through belly access door.

i. Remove control stick grip (6) by removing screw securing grip to control stick.

j. Disconnect wiring from switches in grip (2) and remove cable from stick.

4—122. INSTALLING. Assemble and install the control stick and torque tube by reversing the removal procedure. Assemble threaded parts with anti-seize compound. Check control stick and torque tube for freedom of motion; no binding should occur.

4—123. AILERON CONTROL SYSTEM.

4—124. DESCRIPTION. *(See figure 4—20.)* The lower end of the control stick straddles the torque tube which actuates the aileron linkage consisting of pushrods, bellcranks, and idlers extending through the center section and outer panels to the aileron. By differential linkage in the system, a difference is created between the "up" throw of one aileron and the "down" throw of the opposite aileron. When the upward displacement of one aileron is 19 degrees, the downward displacement of the opposite aileron is 14 degrees, the difference being required for aerodynamic reasons. One balance tab is incorporated in each aileron and it automatically moves in the opposite direction to that in which the aileron is rotated, to aid in reduction of stick forces. One trim tab, located in the left hand aileron, provides lateral trim of the airplane when required. It is operated electrically by a linear actuator energized through a toggle switch in the cockpit. The following table gives maximum aileron and aileron trim tab deflections:

From Neutral Position

	MAXIMUM UP	MAXIMUM DOWN	TOLERANCE
Aileron	19°	14°	±1°
Aileron Trim Tab	15°	15°	+4°—1°

4—125. LOCATION AND ACCESS. *(See figure 4—20.)* Access to the control stick and torque tube is through the cockpit and through the belly access door. The center section aileron control rods are also accessible from the cockpit, and from the outboard ends of the center section when the wings are folded. The aileron control rods located in the outer panels are accessible when the gun bay doors and ammunition box doors on the upper surface of the wing are opened, and through access doors located on the lower outboard surfaces of the wings. A door is located in the upper wing skin at approximately station 100 to provide access to the aileron bellcrank bolts.

4—126. TROUBLE SHOOTING.

a. Check bearings for binding, looseness, and end play, particularly self-aligning bearings. All bearings are low temperature grease-packed bearings and need no lubrication.

b. Inspect safetying of all nuts and bolts.

c. Inspect check nuts at push rod ends for tightness.

d. Check security of bonding jumpers and see that no restriction of rotating parts occurs.

e. Make certain that levers, push rods, and bellcranks do not foul any parts of the structure.

f. Hold control stick rigidly and check play in ailerons. Motion of the surfaces in excess of 1/16 inch deflection at their trailing edges indicates excessive play in the control system.

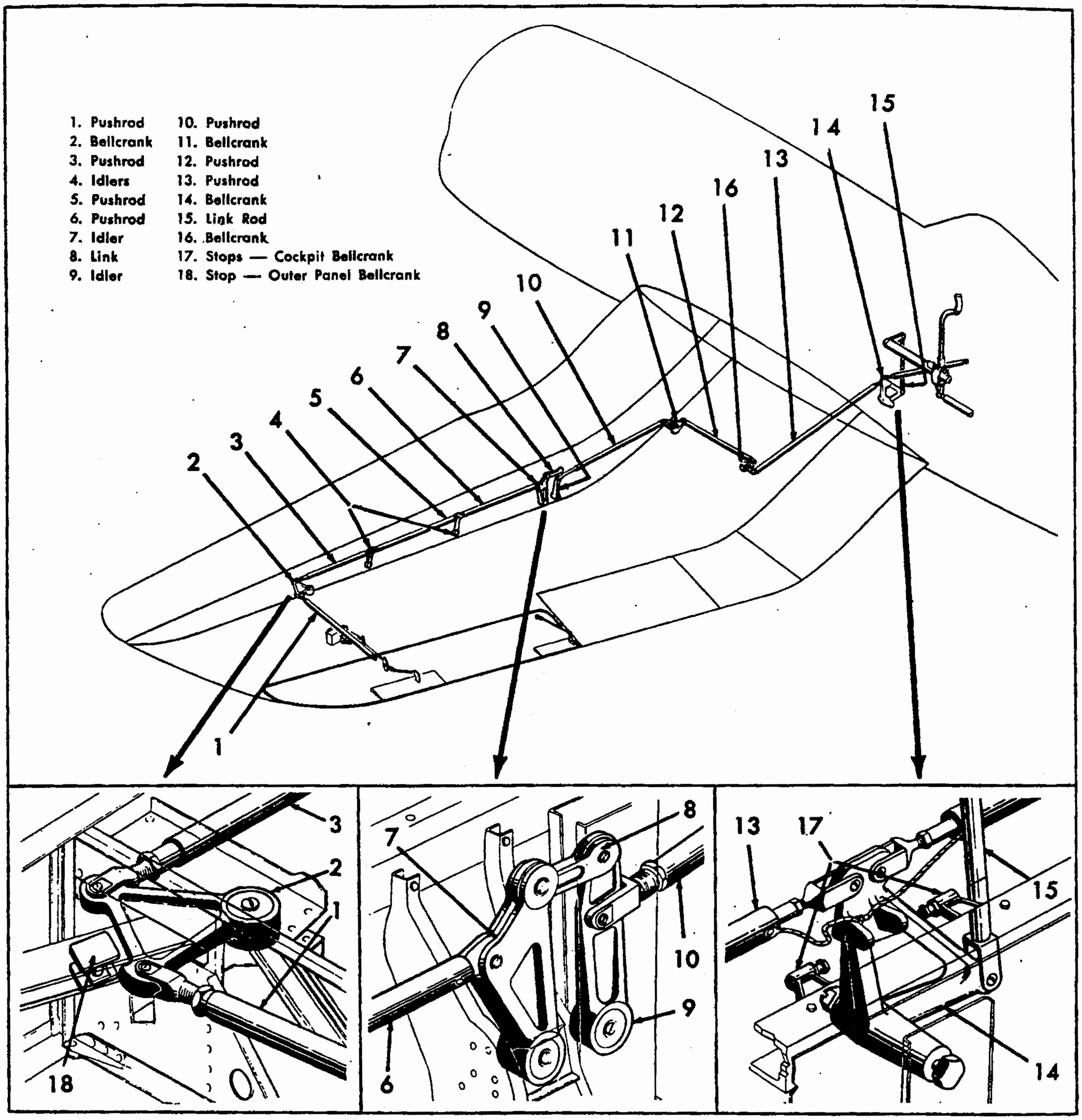


Figure 4—20. Aileron Control System.

Trouble	Probable Cause	Suggested Remedy
Stick will not maintain neutral position.	*a.* Improper installation of torque tube.	*a.* Install torque tube properly.
	b. Maladjustment of actuating control rods.	*b.* Readjust control rods.
Too much or too little angular displacement on ailerons.	*a.* Maladjustment of control rods.	*a.* Readjust control rods.
	b. Stops not adjusted equally.	*b.* Reset stops.

Trouble	Probable Cause	Suggested Remedy
Restriction of control stick movement.	*a.* Binding occurring in system.	*a.* No. 1 elevator torque rod installed improperly; short fork in rod should be installed facing forward.
	b. Excessive tightness of rotating parts of system.	*b.* Check system and loosen pivot bolts of rod, bellcranks, or idlers which are too tight.
	c. Rotating parts foul structure.	*c.* Realign control rods, if necessary.
	d. Accumulation of dirt in bearings.	*d.* Replace bearings.
	e. Bearing misaligned in actuating members.	*e.* Align or replace bearing.
	f. Bent members.	*f.* Remove and replace.
Looseness in system.	*a.* Supporting members in system loosened.	*a.* Tighten loose members.
	b. Check nuts, on control rods not tightened.	*b.* Tighten check nuts.
	c. Pivot bolts not secured.	*c.* Tighten and safety pivot bolts.
	d. Bearings loosened.	*d.* Replace or restake.
Trim tab operating control inoperative.	*a.* Malfunctioning of trim tab linear actuator.	*a.* Test actuator and electrical wiring. If actuator is defective, replace.
	b. Defective control switch.	*b.* Test switch.
	c. Loose connections.	*c.* Tighten connections.
	d. Power source disconnected.	*d.* Check circuit; see paragraph 5–95.
Tab does not deflect properly.	*a.* Stops in actuator control box not adjusted.	*a.* Adjust stops.
	b. Actuator rod maladjusted.	*b.* Adjust actuator rod.

4–127. REMOVING. *(See figure 4–20.)*

a. Open gun bay and ammunition box compartment access doors.

b. Open tie-down shackle access doors located in bottom of wing outer panel.

c. Disconnect bonding cables from members of the aileron control system as they are removed.

d. Open zipper on the inboard side of landing gear wheel well, and remove the interbeam diagonals for access into the interior of the center section.

e. Disconnect center section pushrod (10) from idler (9) and bellcrank (11) and remove by passing the rod outboard through the center section wing butt. (The wings must be folded for this operation.)

f. Disconnect pushrod (12) from bellcrank (16) and remove through wheel well. If both right and left control assemblies are being removed, label each pushrod (12) to facilitate reinstallation as they are not interchangeable.

g. Disconnect pushrod (13) from bellcrank (16) in center section and bellcrank (14) located forward underneath the cockpit floor and remove by passing the pushrod outboard through opening in wing butt.

h. Remove bellcranks (11), (14) and (16) and idler (9), if necessary, by removing their pivot bolts.

i. Working in the outer panel, remove pushrod (6) from idlers (7) and (4).

j. Disconnect pushrod (5) from idlers (4).

k. Disconnect pushrod (3) from idler (4) and bellcrank (2). Remove this rod through the gun bay opening.

l. Disconnect pushrod (1) from bellcrank (2) and aileron, after aileron has been removed. See paragraph 4–58 for removal of ailerons.

m. Disconnect bellcrank (14) and link rod (15) and remove through lower cockpit access door.

4–128. LUBRICATING. See figure 3–14 for lubrication of aileron control system.

4–129. REPAIRING.

a. Replace worn or damaged parts.

b. Eliminate side play between clevis fittings and bearings by the use of washers, after determining that side play is not due to a loose or defective bearing.

4–130. INSTALLING. *(See figure 4–20.)* Installation of the aileron control system is the reverse of the procedure described in removal; see paragraph 4–127. To facilitate reinstallation and rigging of the ailerons, it is advisable to hold aileron control rods to dimensions indicated in the following paragraphs. Rods (6) and (12) installed in the left hand wing are not interchangeable with rods (6) and (12) installed in the right hand wing and should be marked accordingly.

a. Clamp control stick in neutral position by means of surface control lock. Stick should be equidistant between the right and left canopy tracks, measuring from the highest point on the control stick.

b. Install and adjust pushrod (1) to bellcrank (2), so that the rod length is 34 5/8 inches long as measured from the centers of the rod end bolt holes. This is the normal adjustment length.

c. Install and adjust pushrod (3) on bellcrank (2) and idler (4) so that its length is 28 13/16 inches, the normal adjustment length.

d. Install pushrod (5) on idlers (4). This rod is 30 inches in length and is non-adjustable.

e. Install right and left pushrods (6) which are non-adjustable on idlers (4) and (7). Pushrods (6) are 29 15/16 inches in length. Right and left hand rods are not interchangeable.

f. Install link (8) if removed, and install pushrod (10) which is adjustable, and is normally 39 1/4 inches in length, to idler (9) and bellcrank (11).

g. Install right and left pushrods (12) which are non-adjustable and 25 1/4 inches long, on bellcranks (11) and (16). Right and left hand rods are not interchangeable.

h. Install adjustable pushrod (13), whose normal length is 47 13/16 inches, on bellcranks (16) and (14).

i. Install and adjust link rod (15) whose normal length is 18 3/16 inches.

j. The adjustment of the center section pushrod assembly is accelerated by the following:

The bolt which attaches pushrod (13) to the center section aft bellcrank (16) must line up with the pivot bolt of bellcrank (11) when the control stick is locked in neutral. Adjust pushrod (13) at bellcrank (14) until the alignment is accomplished; see figure 4–20.

k. Adjust the outboard end of pushrod (10) which attaches to idler (9) on the center section wing butt, so that when the pushrod is attached, the center of the bolt lies 3/4 inch inboard of the center of the upper hinge bolt. Scribe a line on the upper hinge fitting 3/4 inch inboard at the center of the hinge bolt to aid in making this adjustment.

l. Connect idler (7) on the center section wing butt lever to pushrod (6) of the outer panel.

m. Connect idler (9) to pushrod (10) of the center section.

n. Install link (8) connecting idlers (7) and (9).

o. Adjust pushrod (1) so that the ailerons align with the wing contour with the stick locked in neutral.

4–131. ADJUSTING. *(See figure 4–20.)* The special tools required are a protractor, a checking board and a surface control lock. See figures 4–30 and 4–31. Remove the locking device from the control stick and rudder pedals.

a. Adjust the aileron control stop (18) at the outer panel bellcrank so that maximum deflection of the aileron being adjusted is 19° plus or minus 1°, "up." After both ailerons have been adjusted for their maximum "up" throws, the "down" throws should check at 14°, plus or minus 1°. If this adjustment is not obtained, check over the entire linkage to make certain that it has been installed properly.

b. The aileron stops (17), (see figure 4–20) underneath the cockpit floor at the bellcrank (14) are adjusted so that they act simultaneously with the outer panel stops (18). This is checked with the aid of slips of paper between the stop screws and bellcranks (14) and (2) in the cockpit and in the outer panel respectively. When both pieces of the paper are torn simultaneously as the control stick reaches its extreme left or right hand position, the stops are satisfactorily adjusted.

4–132. AILERON TRIM TAB.

4–133. DESCRIPTION. *(See figure 4–21.)* The aileron trim tab used in maintaining lateral trim is located in the left hand aileron and is actuated electrically through a toggle switch (10) located on the left hand console in the cockpit. The position indicator (9) is also located on the console just forward of the tab operating switch. Movement of the aileron trim tab toggle switch to the right or left will raise or lower the wing as desired, the degree of movement being indicated on the tab indicator. For further information on the indicator refer to paragraphs 4–1532 through 4–1537. The tab linear actuator (1) is located between wing stations 100 and 106.944 and is accessible through an access door on the bottom of the wing. The actuator rod (2) is connected to lever (3) which when rotated pushes or pulls rod (4) connected to the aileron tab idler (5) and actuates rod (6) connected to the aileron tab horn (7) displacing the tab (8).

4–134. REMOVING. *(See figure 4–21.)* Working through the access door for the tie-down and aileron control, and also the access door for the linear actuator, remove the aileron tab control linkage as follows:

a. Disconnect actuator rod (2) from lever (3).

b. Disconnect adjustable rod (4) from lever (3) and idler (5).

c. Remove lever (3).

d. Disconnect adjustable rod (6) from idler (5) and aileron tab horn (7).

e. Remove idler (5).

4–135. INSTALLING. Installation of the trim tab actuating mechanism is the reverse of the procedure described in removal. Rods (4) and (6) are adjustable, the normal lengths as measured from the centers of bolt holes being 9 3/16 inches and 10 31/32 inches respectively.

4–136. ADJUSTING. The special tools required during rigging of the tab are a protractor or checking board.

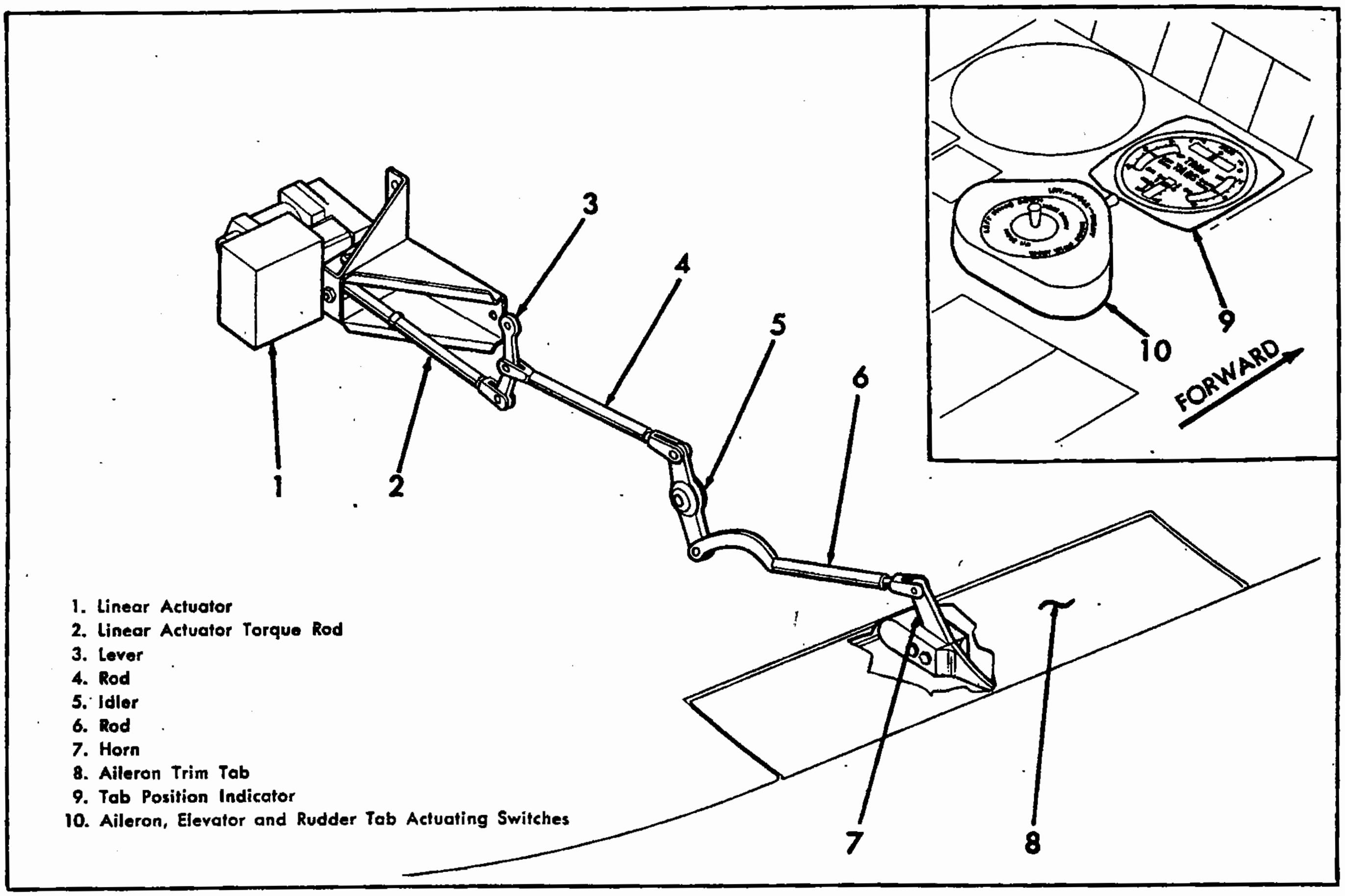


Figure 4–21. Aileron Trim Tab Control System.

With the aileron tab actuator in the neutral position, adjust the two aileron tab rods so that the aileron trim tabs are in the neutral position. Then operate the aileron tab control switch in the cockpit and check to see that tab deflects 15° "up" and "down" from the neutral position. The length of the linear actuator rod when in the neutral position is 7 5/8 inches.

4–137. AILERON TAB LINEAR ACTUATOR.

4–138. DESCRIPTION. *(See figure 4–22.)* The aileron tab actuator, manufactured by Lear, Inc., their part number 401-V, is an electrically operated mechanism which deflects the aileron tab in the direction required to raise or lower an aileron in flight. The actuator is energized through a toggle switch located on the left hand console in the cockpit. The actuator itself is located in the left hand outer panel between stations 100 and 106, adjacent to the aileron actuating rod, approximately midway between the outer panel aileron actuating bellcrank and the aileron leading edge. An access door in the bottom of the wing permits access to the actuator. Basically, the actuator is an electric motor (1) (Lear A100V2), 24 volt series wound, split field, reversible, intermittent duty motor, with a "Faststop" electromagnetic clutch and brake. It furnishes power to a gear train which in turn drives a coarse threaded screwjack. The screwjack in rotating, causes a torque tube and an internally threaded nut assembly to move fore and aft linearly. Tab linkage connected to exposed end (4) of the torque tubes moves in accordance with the tube travel and deflects the tab. The electric motor is energized by the airplane's power source through the toggle switch. At the same time, a clutch coil and its clutch drive disc are also energized. This overcomes a spring-loaded brake and attracts the clutch-driven disc from the restraining brake. In doing so, the rotational energy of the electric motor and its clutch drive disc is transferred to the reduction gear train via the driven disc which is connected to a shaft ending in a small pinion gear. Thus, the electric motor torque is transferred to the gear train through the friction of the two clutch plates. The driving clutch, (being part of the electric motor circuit) opening the circuit will break the magnetic field of the clutch coil, releasing the driven disc, which is then retracted by the spring, to the braking surface, leaving no driving contact between the motor and stops gear rotation. When the gearing ceases to rotate, the actuator rod remains stationary, the motor being free to rotate. The gear train drives a coarse threaded screwjack which drives a torque tube and nut assembly fore and aft depending on the direction of

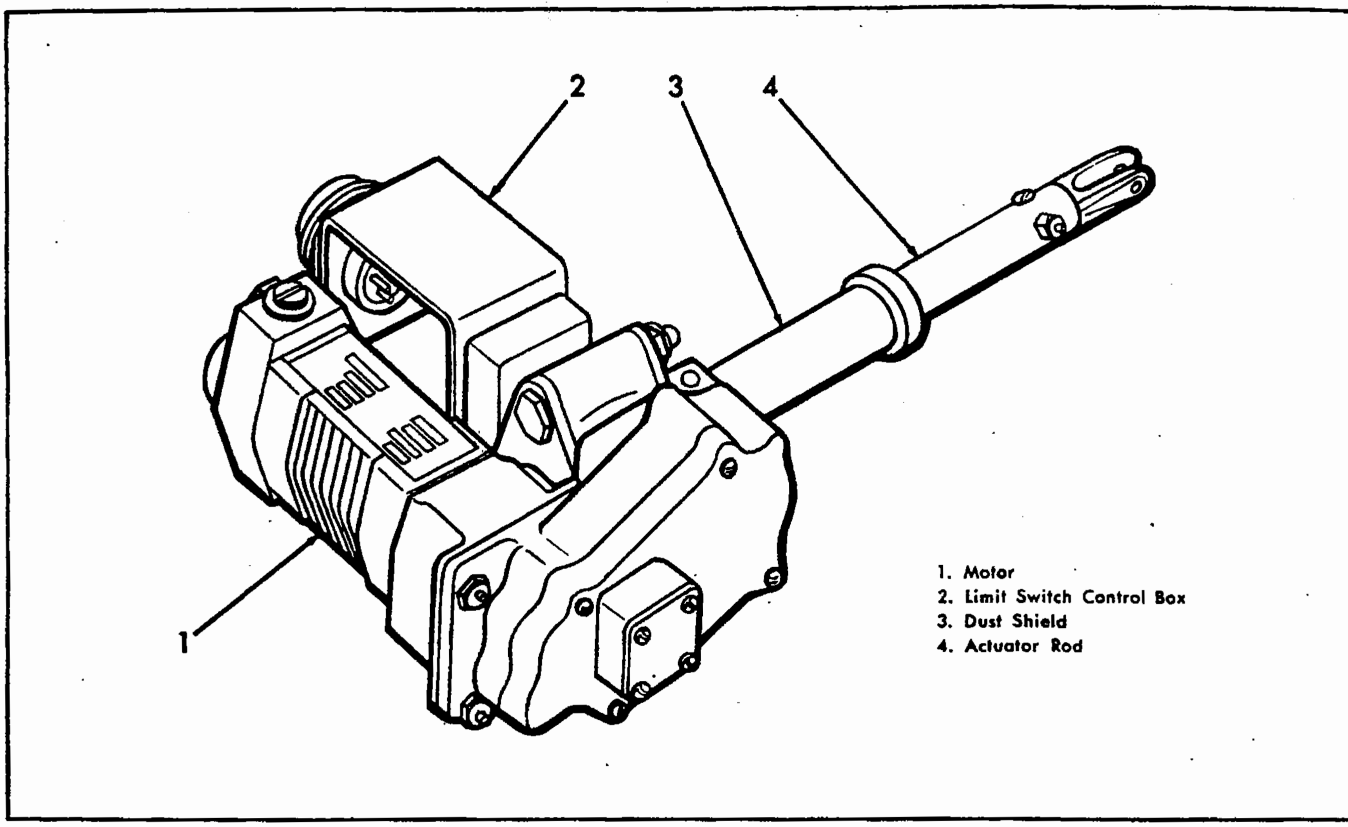


Figure 4—22. Trim Tab Linear Actuator.

rotation of the screwjack. The free end of the torque tube and nut is connected through linkage to the surface to be deflected. In addition to effecting linear torque tube movement, screwjack rotation also actuates a control shaft located within the control box (2). This shaft carries adjustable limit switch cams which open the motor circuit at either extreme of tab travel. To select any wing attitude, it is only necessary that the toggle switch in the cockpit be held toward the position desired and released when the attitude required is reached. See paragraph 5—95 for electrical information.

4—139. REMOVING. Access for removal of the tab actuator is obtained through the aileron control access doors on the bottom of the wing.

a. Disconnect wiring from actuator at quick-disconnect plug on wing rib at station 100.

b. Disconnect actuator rod from tab operating linkage.

c. Remove four screws securing actuator to retaining bracket on rib at station 100.

4—140. INSTALLING. Reverse removal procedure.

4—141. ADJUSTING. Detailed information covering the adjustment of the linear actuator is not available. The actuator is regulated at the place of manufacture to agree with the requirements of the airplane. The following general procedure for checking tab travel applies to the aileron, elevator, and rudder trim tabs.

Note

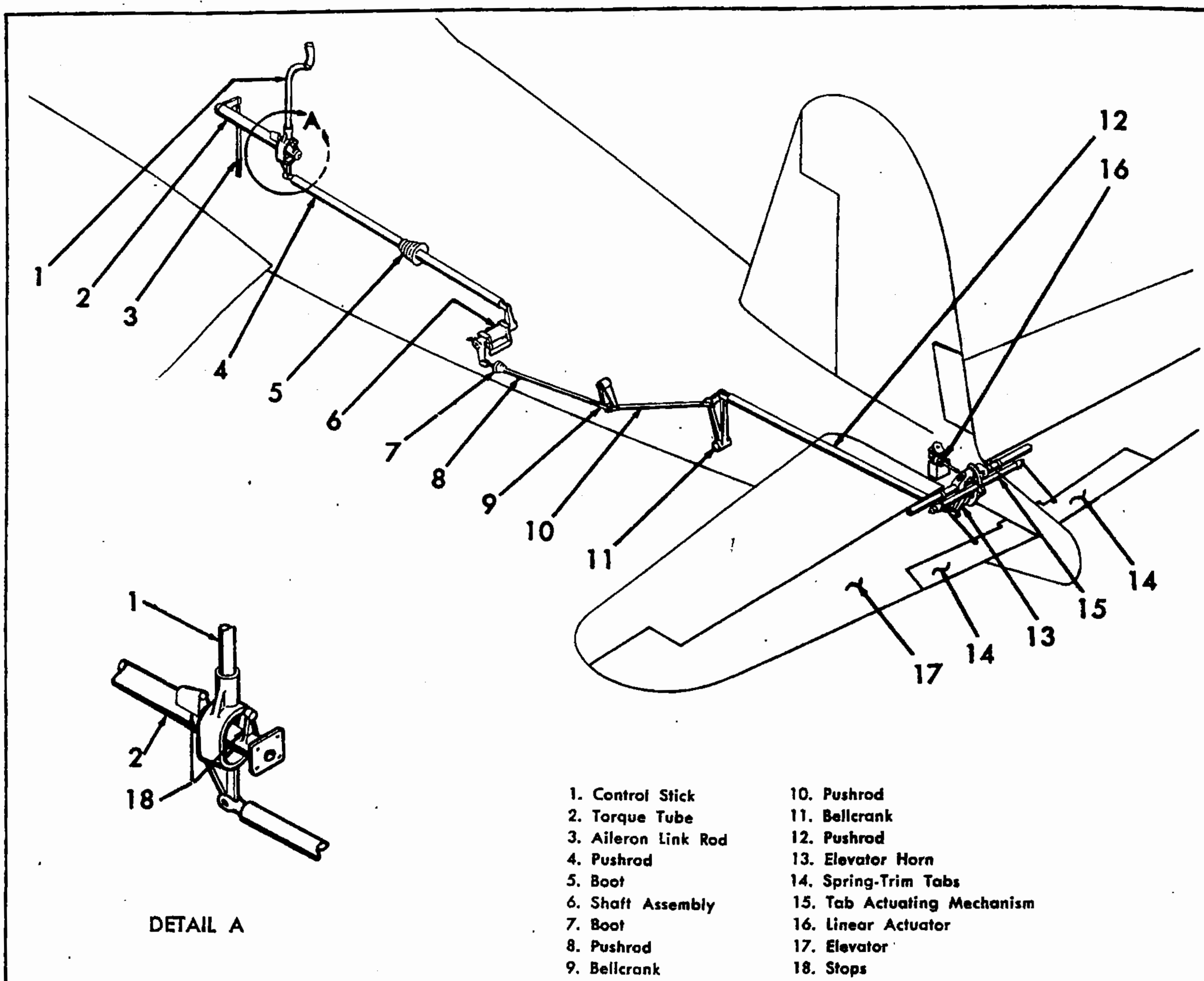
Retracted, extended and neutral linear actuator rod lengths for elevator and rudder tabs are given in paragraphs 4—159 to 4—185a.

a. Run actuator rod (electrically) all the way in. Check tab position. Adjust accordingly. Retracted length of actuator rod should be 6 7/8 inches for aileron trim tab.

b. Run actuator rod all the way out and again check tab position. Adjust accordingly. Extended length of actuator rod for aileron trim tab should be 8 3/8 inches.

c. Check neutral position of actuator and tab and adjust. Neutral length of aileron tab actuator rod should be 7 5/8", or 3/4" from retracted position.

4—142. AILERON BALANCE TABS. *(See figure 4—18.)* Aileron balance tabs are located at the inboard ends of each aileron for the purpose of relieving stick forces ordinarily required to displace the ailerons. The tabs are automatically deflected by aileron movement. This is accomplished by installing adjustable rods of approximately 11 5/32 inches in length on the tab horns and in fittings located on the wing trailing edge. Since the rods are of constant length and attached to a fixed surface at one end and to the tab at the other end, rotation of the aileron (in which the tab is incorporated) causes tab deflection in the direction opposite to that in which the aileron is moved, thus aiding aileron movement. For



1. Control Stick
2. Torque Tube
3. Aileron Link Rod
4. Pushrod
5. Boot
6. Shaft Assembly
7. Boot
8. Pushrod
9. Bellcrank
10. Pushrod
11. Bellcrank
12. Pushrod
13. Elevator Horn
14. Spring-Trim Tabs
15. Tab Actuating Mechanism
16. Linear Actuator
17. Elevator
18. Stops

Figure 4—23. Elevator Control System.

further details covering the aileron balance tab, see paragraphs 4—68 through 4—70.

4—143. ELEVATOR CONTROL SYSTEM.

4—144. DESCRIPTION. *(See figure 4—23.)* The elevators are operated by the fore and aft motion of the control stick, the motion being transmitted by means of pushrods and levers to the control horn on the elevators. The control stick is mounted on a torque tube underneath the cockpit floor which provides a fulcrum for the stick in its fore and aft motion in addition to lateral motions. There are four pushrods between the control stick and the elevator horn and they are connected by bellcranks on the bottom of the fuselage. Three protective boots are installed in the system, one at the bottom of the control stick on the cockpit floor, one on the control floor, one on the control rod (4) which passes through the bulkhead 186, and the third on the control rod (8) leading aft from bulkhead 218. The purpose of the boots is to complete the sealing off of the forward portion of the airplane from fumes. The following table gives maximum elevator deflections:

	From Neutral Position		
	UP	DOWN	TOLERANCE
Elevator—normal travel without spring deflection	23.5°	21°	±1°
Elevator—maximum travel with full deflection of spring tab	18.5°	14.5°	±1°

4—145. A single elevator trim and spring tab is incorporated in each elevator. Trim is obtained electrically through a toggle switch located on the left hand console in company with the aileron and rudder tab actuating switches. An indicator showing elevator tab position is just forward of the toggle switches. A linear actuator located in the tail of the airplane at station 342 5/32, when energized electrically, actuates a pushrod which rotates a bellcrank linked to the tab operating jackshaft. Movement of the linkage rotates the jackshaft and, through a pushrod secured to the tab, displaces the tab. Automatic tab deflection takes place when the airloads on the elevators are excessive. Deflection of the elevator horn which is secured to collars bolted to spring-tube assemblies takes place through the spring-tubes and causes the tab linkages to displace the tabs. Deplacement of the tab results in elevator deflection.

4–146. LOCATION AND ACCESS. Access to the control stick and its torque tube and pushrod, is through the cockpit and the belly access door. Access to the elevator shaft assembly, to the connecting rod leading from the control stick and to the pushrod leading aft is through the radio compartment access door on the right hand side of the fuselage. Access to the remainder of the control rods is through the tail wheel doors. A covered access hole for visual inspection is provided on the elevator pushrod and bellcrank housing at station 220 1/2.

4–147. TROUBLE SHOOTING.

a. Check bearings for binding, looseness and end play, particularly self-aligning bearings. All bearings are low temperature, grease packed bearings and need no further lubrication.

b. All attaching bolts, nuts, cotter pins, and boot clamps should be secured.

c. Checknuts at adjustable pushrod ends should be tight.

d. Check security of bonding jumpers and see that jumpers do not restrict control movement.

e. Make certain that pushrods, levers, or bellcranks do not foul structural parts.

f. Hold control stick firm and attempt to move the elevators. Motion of the elevators in excess of 1/16 inch deflection at their trailing edge indicates excessive play in the control system.

g. Check elevators for alignment with respect to each other. The vertical distance from level ground to corresponding points on the two elevators should be equal within 1/4 inch.

Trouble	Probable Cause	Suggested Remedy
Insufficient elevator throw.	*a.* Distorted control rods. *b.* Improper control system adjustment.	*a.* Replace distorted rods. *b.* Make necessary adjustment.
Elevator stiff.	*a.* Hinges fouled. *b.* Lack of lubrication.	*a.* Clean hinges. *b.* Replace bearings having an accumulation of dirt.

4–148. REMOVING. *(See figure 4–23.)*

a. Remove elevator, observing procedure given in paragraph 4–98.

b. Disconnect pushrod (4) from bottom of control stick (1).

c. Disconnect link rod (3) from torque tube (2).

d. Disconnect torque tube (2) from supports.

e. Remove control stick (1).

f. Loosen clamp securing forward end of boot (5) and disconnect aft end of boot from bulkhead 186.

g. Disconnect pushrod (4) from shaft assembly (6) on bottom of fuselage.

h. Loosen clamp securing boot (7) to pushrod (8) and disconnect forward end of boot from bulkhead.

i. Disconnect pushrod (8) from shaft assembly (6) and from bellcrank (9).

j. Disconnect pushrod (10) from bellcranks (9), (11).

k. Disconnect pushrod (12) from bellcrank (11) and from elevator horn (13).

4–149. LUBRICATING. Bearings used in the system are packed with grease and need no lubrication. Replace bearings if dirt has accumulated. See figure 3–14.

4–150. INSTALLING. Reverse procedure given in paragraph 4–148.

4–151. ADJUSTING. *(See figure 4–23.)*

Note

The special tools required for adjusting are a protractor, a checking board and a surface control lock. See figure 4–32.

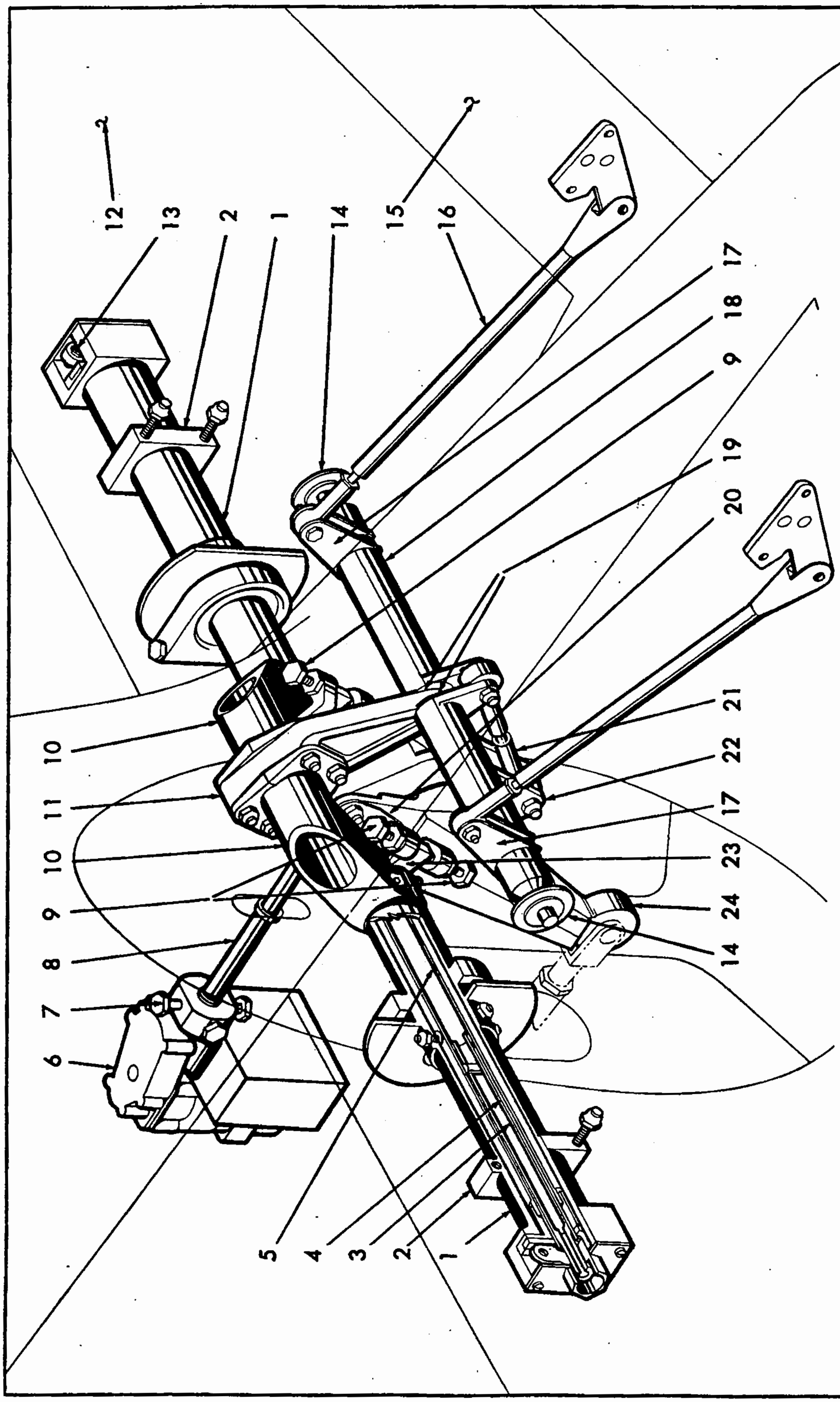
a. Secure the stick in the neutral position midway between the cabin tracks and 25 13/16 inches forward of forward face of bulkhead 186, or 10 23/32 inches from the aft face of the instrument panel.

b. Adjust pushrod (8) so that distance from center to center of bolt holes in rod ends is 33 9/16 inches.

c. Adjust pushrod (12) so that distance between centers of rod end bolt holes is 65 11/16 inches.

d. Measure the distance from center of bolts (attaching pushrod (12) to elevator horn), to station 349.84. The distance should be 7/16 inches from the neutral position of the elevator horn if pushrod and control stick positions are properly adjusted.

e. Remove clamp securing control stick in the neutral position and adjust stops (18) on the elevator torque tube (2) so that elevator deflections from the neutral positions are 23.5° "up" and 21° "down." Control stick movement should be eight inches forward and eight and one-half inches aft from neutral position. The stick movement can be measured using a rule or a protractor. If a rule is used, measure from highest point on control stick grip either forward to the instrument board or aft to the forward face of bulkhead 186, holding the distance specified in paragraph 151a. If a protractor is used, place



1. Elevator Torque Tube
2. Elevator Bearing Support
3. Preloaded Spring Tube #1
4. Preloaded Spring Tube #2
5. Preloaded Spring Tube (attached to collar)
6. Linear Actuator
7. Linear Actuator Mounting Bolts
8. Linear Actuator Torque Rod
9. Collar Stop Lugs and Adjusting Screws
10. Overarms
11. Support
12. Elevator (ref.)
13. Set Screw
14. Jackshaft Outboard Bearings
15. Elevator Tab (ref.)
16. Tab Actuating Rod
17. Arms
18. Jackshaft
19. Jackshaft Inboard Bearings
20. Torque Tube Collar
21. Link Rod
22. Bellcrank
23. Overarm Stop Lug
24. Elevator Horn

Figure 4–24. Elevator Spring-Trim Tab Control System.

it on control stick just above the location for the clamp securing the boot. Stick travel should be 15° 48′ forward and 16° 54′ aft. The deflections of the elevators should be measured with a protractor or checking board.

4–152. ELEVATOR SPRING-TRIM TABS.

4–153. DESCRIPTION. *(See figure 4–24.)* An elevator trim and spring tab is located in each elevator inboard trailing edge for the purpose of maintaining longitudinal trim of the airplane. The trim displacement of the elevator tabs is obtained electrically through a linear actuator. Note that the aileron trim tab is similarly actuated; see paragraph 4–132. In addition to this feature, balance or "helper" tab displacement is provided through the incorporation of spring tubes in each elevator torque tube. The automatic or spring reaction decreases the stick loads required to move the surfaces when the air loads are excessive. The following table gives maximum elevator trim and spring tab deflections:

	From Neutral Position		
Elevator Tab:	MAXIMUM UP	MAXIMUM DOWN	TOLERANCE
Spring Deflection	20°	15°	±1°
Trim Deflection	5° (+4° −1°)	15° (+4° −0°)	

4–154. FUNCTION. *(See figure 4–24.)* The action during spring tab displacement is as follows. During the time of high air loading, displacement of the elevator is resisted by the air loading. However, the elevator horn (24) is still free to move and because of this, the tab linkage is actuated and tab displacement is made with elevator rotation resulting. The elevator torque tubes (1) are attached to the beam of the elevators and rotate with the elevators. At each inboard end of the torque tube is a collar (20) bolted to an internal spring tube (5) which is secured to the outboard end of the torque tube (1). The collars have two lugs (9) with adjusting screws passing through the lugs. Immediately outboard of the collars (20) on each torque tube (1) are two overarms (10) bolted at one end to the torque tube (1) and at the other end to a support (11). This support secures both overarms (10) and also the inboard bearings for the tab jackshafts (18). The outboard bearings are secured to the elevator structure. The elevator horn (24) is bolted to both collars (20). Movement of the elevator horn (24) is transmitted to the spring tube (5) via the collars (20) which permits horn (24) rotation. The twisting of the tube is transferred during "down" elevator movement to preloaded spring tubes (3) and (4) to obtain "down" elevator (up tab) during high load conditions. The amount of preloading is held to 325 pound inches (±25) torque by setscrews (13) at the outboard ends of each torque tube. Since the horn (24) is bolted to the collar (20) and the collar is bolted to spring tube (5), the horn can move in relation to the torque tube and its attached elevator surface. Movement of the horn (24) then will cause rotation of bellcrank (22), pivoted to the horn at one point and to the actuating rod (8) of the linear actuator (6). The bellcrank then, through a link rod (21), causes rotation of the tab jackshaft (18) with consequent tab movement. Each overarm (10) has a stop lug (23) and as the collars rotate, the adjusting screws (9) contact the stop lug of the overarm (10) restraining further displacement of the horn (24) in relation to the elevator torque tube. The tab actuating mechanism then rotates with the elevator.

4–155. REMOVING. *(See figure 4–24.)* Removal of the torque tube and internal spring tubes is not recommended in the field. If any malfunctioning is suspected, the elevators should be removed and forwarded to a major repair base. If it is necessary to remove the torque tube, proceed as follows:

a. Remove link (21) from bellcrank (22) and jackshaft (18).

b. Remove bellcrank (22) from horn (24) and actuator rod (8).

c. Remove bolts securing overarm (10) to support (11).

d. Remove horn (24) from collars (20).

e. Remove elevators; see paragraph 4–98.

f. Remove fabric covering the access hole in leading edge of elevator at station 12 13/16.

g. Remove bolts securing elevator bearing support (2) to elevator.

h. Through access hole, remove bolts securing torque tube to beam of elevator.

i. Remove torque tube (1).

j. Remove bolts securing collar (20) to spring tube (5).

k. Remove screws holding plate at outboard end of tube.

l. Loosen preloading screws.

m. Remove spring tubes.

4–156. INSTALLING AND ADJUSTING. *(See figure 4–27.)* Installation of the torque tube and internal spring tubes is the reverse of the procedure described in paragraph 4–155. Work through removable rudder fairing at the elevator hinge line to make the following adjustment:

a. After adjustment of the control rods is made, and neutral position is found, the centerline of the lug (23) on the overarm (10) should be equidistant from the opposite faces of the collar lugs (9) which hold the setscrews. This will be the neutral position for the spring tabs.

b. To adjust for "UP" tab throw, turn down the two upper forward setscrews and turn up the two lower aft setscrews until the clearances between the overarm lugs (23) and the setscrews are .130 (plus or minus .001) inches. Use a feeler gage to check the clearances. This allows the collar (20) to rotate forward 5°.

c. For "DOWN" tab, adjust the two upper aft setscrews and the two lower forward setscrews until the clearances are .175 (plus or minus .001) inches. This allows the collar (20) and its attached elevator horn (24) to rotate aft 6° 42′.

d. The set screws should be adjusted so that the four lugs (23) of the overarms (10) strike the stop screws (9) at the same time.

e. Upon completion of this adjustment, adjust rod (16) leading from the tab operating jackshaft (18) to the tab horn. The length of the rod should be 11.75 inches.

4—157. LUBRICATING. *(See figure 3—14.)*

4—158. ELEVATOR TAB LINEAR ACTUATOR.

4—159. DESCRIPTION. An electrically controlled linear actuator manufactured by Lear, Inc., their part number 401-T (see paragraph 4—138) and operated from the cockpit deflects the elevator tabs in the direction required to raise or lower the elevators to maintain the desired trim. The actuator is energized through a toggle switch located on the left hand console in the cockpit in company with the aileron and rudder trim tab operating switches. The actuator is located on fuselage bulkhead 342 5/32 and is accessible through the tail wheel doors. This actuator is not interchangeable with those operating the ailerons and rudder because of the difference in the stroke of its actuating rod. The length of the linear actuator rod as measured from the center of the actuator retaining bolts to the bolt securing the actuator rod to the bellcrank should be:

RETRACTED	NEUTRAL	EXTENDED
6 7/8″	7 27/32″	8 3/16″

For details of operation, see paragraph 4—137; in addition see paragraph 5—95 for electrical information.

4—160 REMOVING. The elevator linear tab actuator is located on a bracket installed on the forward side of fuselage bulkhead 346 5/32 and can be removed working through the tail wheel doors. Four special bolts support the actuator in a universal ring mounted in the bracket. Special note should be made to reinstall these bolts in the same place in which they were formerly installed. To remove the actuator, proceed as follows:

a. Disconnect actuator rod from bellcrank secured to elevator horn.

b Remove two special bolts from bracket supporting universal ring.

c. Remove two special bolts from universal ring supporting the linear actuator.

4—161. INSTALLING. Reverse removal procedure.

4—162. ADJUSTING. See paragraph 4—141, observing elevator tab actuator rod lengths in paragraph 4—159.

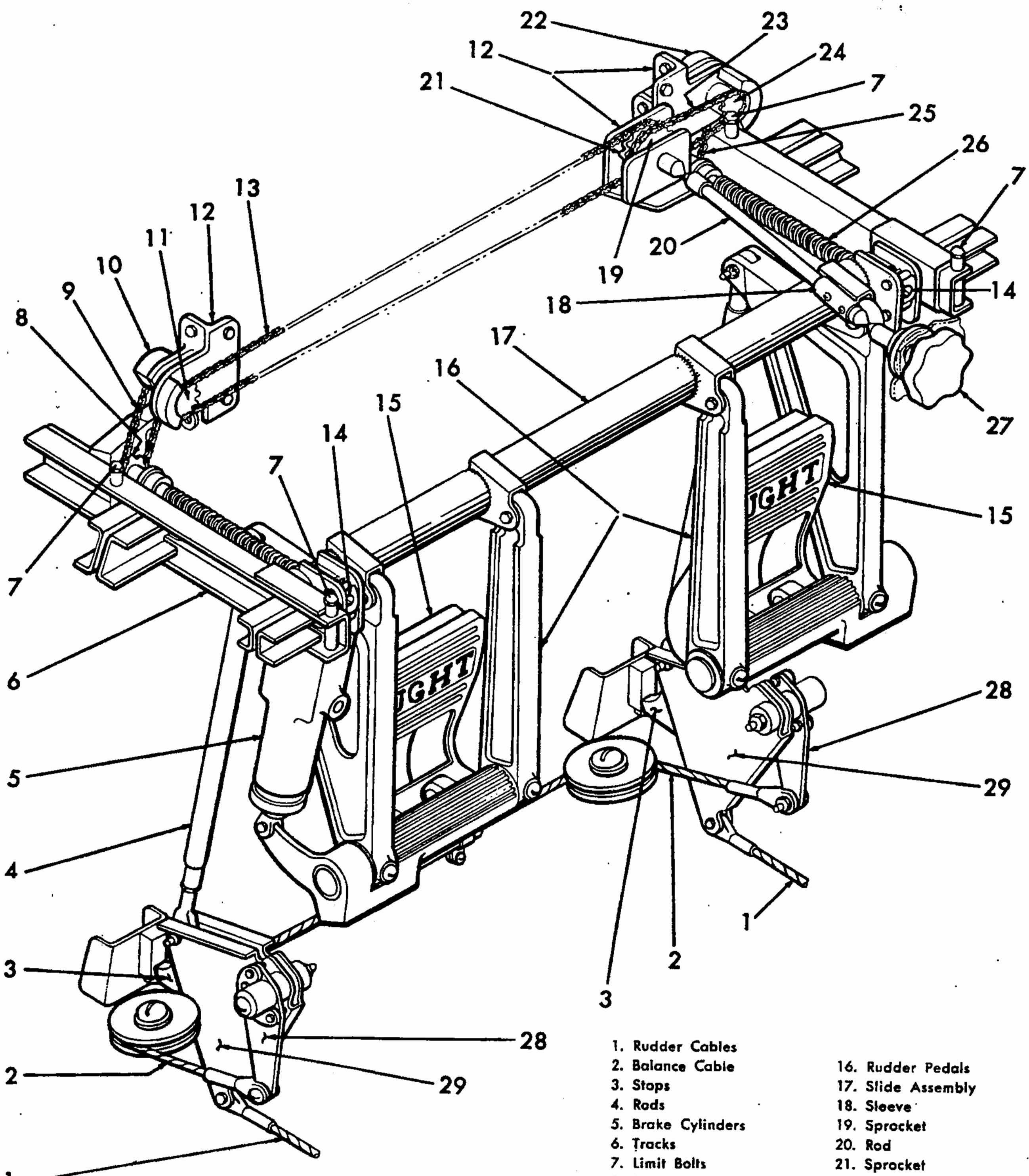
4—163. RUDDER PEDALS AND ADJUSTING MECHANISM.

4—164. DESCRIPTION. *(See figure 4—25.)* Two rudder pedals are mounted forward of, and below the instrument panel. They are provided with a fore and aft adjustment of a total distance of six inches and move parallel to the floor. The pedals are of the hanging and folding type supported on a carriage which rides in tracks extending fore and aft. Both pedals are adjusted in unison by a single control located on the instrument panel. A pedal and slide assembly (17) extending laterally across the cockpit carries both rudder pedals (16) and their wheel brake hydraulic actuating cylinders (5). At the lateral extremities of the pedal and slide assembly are channels which ride on tracks (6) running fore and aft. Extending forward through the lateral ends of the slide (17) are threaded jackshafts (26) which are supported at their forward ends by thrust bearings mounted in brackets, and at their aft ends by special nuts (14) which are carried by the support brackets for the brake cylinders. These nuts are prevented from turning by two bolts which pass through the brackets and over grooves cut on the exterior of the special nuts. Two bolts (7) mounted vertically pass through the track (6) limiting the fore and aft travel of the pedal and slide assembly (17). At the foremost end of each jackshaft (26) is mounted a sprocket (8) which when rotated causes the special nut (14) attached to the slide (17) to travel fore or aft.

4—165. Mounted on a shelf and over the jackshafts are brackets supporting sprockets and chain drives which regulate the travel of the pedal and slide. A knob (27) mounted on the right hand lower side of the instrument panel (just below the clock) is provided to adjust the fore and aft position of the pedals. Rotation of the knob actuates two sprockets (21) and (19) mounted in brackets on the shelf aft of station 134. The aft sprocket (19) through a connecting chain drive (23) rotates the sprockets (24), (22) and (8) driving the right hand jackshaft (26). The forward sprocket (21) actuates the left hand jackshaft (26) through chains (9) and (13), and sprockets (11), (10) and (8).

4—166. A wheel brake hydraulic actuating cylinder (5) is located on the outboard side of each brake pedal (15), the cylinder being attached to the slide (17) and the piston secured to the brake pedal (15). Depressing the brake pedal forces hydraulic fluid from the brake cylinder into the brake unit contained in the landing gear wheels causing the brake discs to be squeezed together, stopping rotation of the landing gear wheels. See paragraphs 4—415 through 4—430 for details of brake cylinder and wheel brake operation.

4—167. The rudder pedals (16) are connected to the rudder control system by two adjustable rods (4) which lead from the top of each pedal to a bellcrank (29) below the cockpit floor between stations 134 and 140.5. From the bellcranks, attached rudder actuating cables (1) run aft and are secured to the rudder horn at the rear of the fuselage. A rudder balance cable (2) extends across the cockpit forward of the rudder pedals and is connected to each pedal at an arm (28) extending from the bellcrank (29). Two adjustable stops (3) are located



1. Rudder Cables
2. Balance Cable
3. Stops
4. Rods
5. Brake Cylinders
6. Tracks
7. Limit Bolts
8. Sprockets (right and left)
9. Chain
10. Sprocket
11. Sprocket
12. Brackets
13. Chain
14. Special Nuts
15. Brake Pedals
16. Rudder Pedals
17. Slide Assembly
18. Sleeve
19. Sprocket
20. Rod
21. Sprocket
22. Sprocket
23. Chain
24. Sprocket
25. Chain
26. Jackshafts
27. Adjusting Knob
28. Arms
29. Bellcranks

Figure 4—25. Rudder Pedal Control Mechanism.

on the right and left hand sides of the cockpit underneath the cockpit floor at station 134 for the purpose of equalizing rudder pedal movement. The stop should be adjusted to permit a three inch movement of the pedals fore and aft of the neutral position.

4—168. REMOVING. *(See figure 4—25.)* Working through cockpit, remove rudder pedals as follows:

a. Remove brake cylinder (5) from pedals (15) and slide (17), first draining fluid from the braking system at the wheel brake housing, afterward plugging the hydraulic lines at the brake cylinders.

b. Disconnect rod (4) from rudder pedals (16) and bellcranks (29).

c. Remove four bolts securing rudder pedals (16) in brackets on slide (17) and remove pedals.

d. Remove slide limiting bolts (7).

e. Working through access doors in windshield cowl panel, and inside cockpit, remove chain (9) from sprockets (8), (10) and chain (25) from sprockets (22), (8).

f. Remove jackshafts (26) and slide (17) by removing nut securing jackshaft in bearing and moving jackshaft and slide aft and off the track.

g. Disconnect sleeve (18) of rod (20).

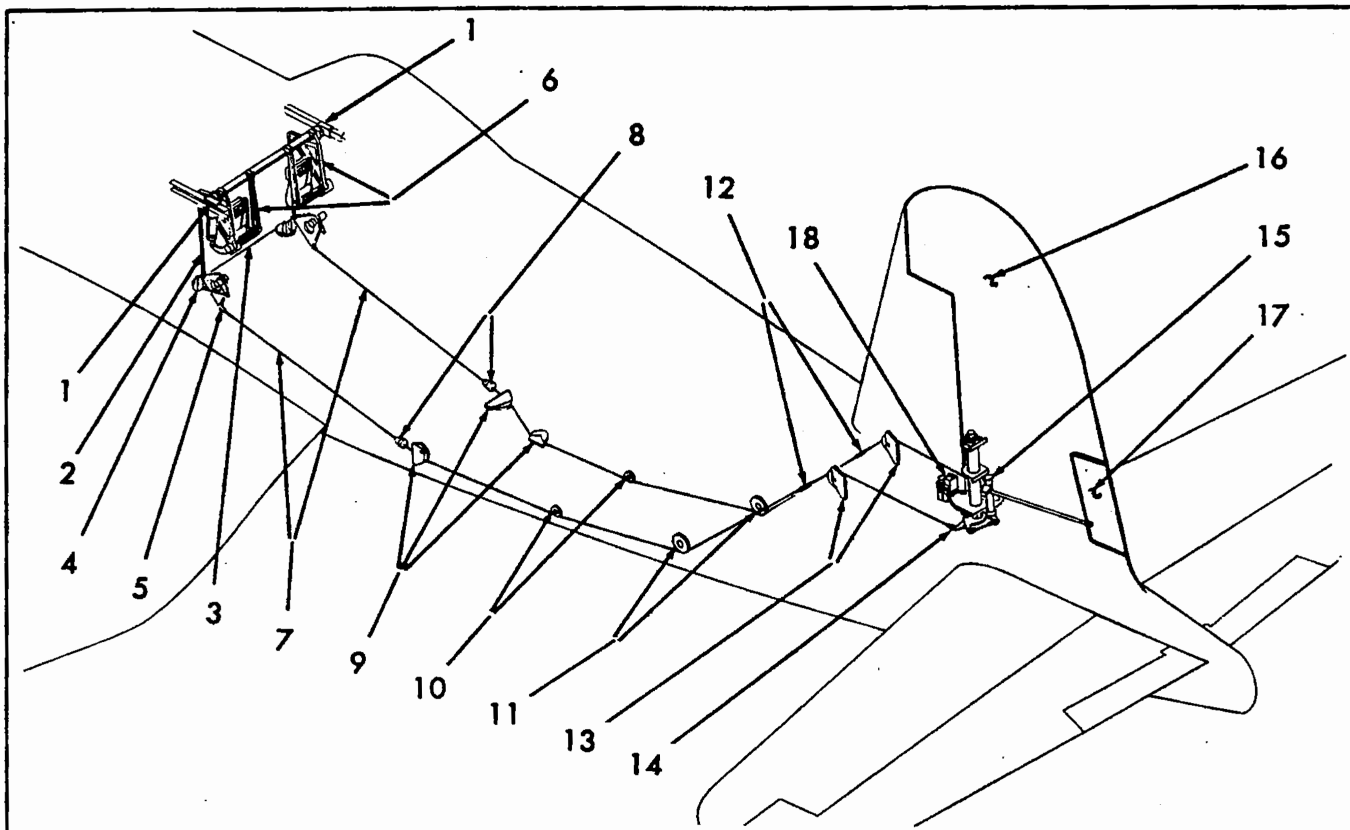
h. Disconnect chain (13) and (23) from sprockets (11), (21), (19) and (24) respectively.

i. Remove brackets (12) which support the sprockets.

j. Remove track (6).

4—169. LUBRICATING. During assembly, the jackshafts should be lubricated with AN-G-25 grease. The slides are lubricated with AN-G-6 grease. For further details see figure 3—14.

4—170. INSTALLING. *(See figure 4—25.)* Installation of the rudder pedals and adjusting mechanism is the reverse procedure of that described in removal. During installation it is essential that the slide assembly (17) is against either the forward or aft limiting bolts (7) in order that the installation is made parallel to the lateral axis of the airplane; otherwise misalignment of the rudder pedals will occur, and in addition, binding of the adjusting mechanism will result in faulty operation.



1. Rudder Pedal Adjustment Mechanism
2. Rod
3. Return Cable
4. Rudder Pedal Stops
5. Bellcrank
6. Rudder Pedals
7. Rudder Cables
8. Boots
9. Pulleys
10. Pulleys
11. Pulleys
12. Turnbuckles
13. Pulleys
14. Rudder Horn
15. Rudder Tab Mechanism
16. Rudder
17. Rudder Tab
18. Linear Actuator

Figure 4—26. Rudder Control System.

The maximum tolerance on alignment of the rudder pedals fore and aft is 1/4 inch.

4—171. RUDDER CONTROL SYSTEM.

4—172. DESCRIPTION. *(See figure 4—26.)* The rudder is controlled by a cable and pulley system extending from the rudder pedals (6) in the cockpit to the rudder horn (14) at the rear of the fuselage. A return cable extension (3) runs forward from the rudder pedals around pulleys, forming a continuous circuit. Pushing on either pedal (6) causes it to swing forward and pull up on rod (2) which transmits motion to a bellcrank (5) applying tension to the rudder cables (7) attached to rudder actuating horn (14) resulting in displacement of the rudder (16). The rudder tab (17) is actuated electrically through a linear actuator (18) to obtain trim displacement, as in the case of the aileron and elevator trim tabs. For a description of operation of the linear actuator see paragraph 4—137. Balance or "helper" tab reaction is obtained automatically through a spring tube installed in the rudder torque tube which is linked to the tab actuating mechanism. The following table gives maximum rudder and rudder tab deflections:

	From Neutral Position		
	MAXIMUM RIGHT	MAXIMUM LEFT	TOLERANCE
Rudder—normal	25°	25°	±1°
Rudder—plus spring action	21.75°	21.75°	±1°
Rudder Tab			
Spring Deflection	3° 45′	3° 45′	±1°
Trim Deflection	10°	10°	+4° −1°

4—173. LOCATION AND ACCESS. Access to the rudder pedals is through the cockpit, as is access to the adjusting mechanism. Access to the balance cable, forward rudder actuating cable terminals, rudder pedal stops, and pulleys and brackets aft of station 186, is through the cockpit access door. The rudder cable pulley brackets located at station 218, and between stations 247.5 and 253 are accessible through the radio compartment access door on the right hand side of the airplane. The rudder cable pulley brackets located on the uppermost sides of the bulkhead 288 are accessible through the radio compartment door or through the tail wheel doors. Access to the linear actuator, rudder horn, tab actuating mechanism and aft rudder cable terminals is obtained through the tail wheel doors and access doors located on each side of the fuselage beneath the rudder and fin. Access to the adjusting turnbuckles is through the radio compartment door.

4—174. TROUBLE SHOOTING.

a. Inspect cables, especially near pulleys and swaged-on terminals.

b. Check pulleys for wear and ball bearings for binding or looseness.

c. Check that cables do not rub excessively against pulleys and fairleads.

d. Check that bolts at cable end terminals are not drawn up so tightly as to prevent terminals from rotating, causing the cable to bend sharply at the terminals.

e. Check that cable guards and fairleads are installed.

f. Check cables to see that they do not rub on foreign parts and that they are tensioned to 50 pounds, plus or minus 10 pounds.

g. Check pedal assembly for full throw.

h. Check alignment of rudder pedals. Rudder pedal slide mechanism should touch stops simultaneously.

i. Check security of attachment of operating parts.

j. Check safetying of all turnbuckles.

4—175. REMOVING. *(See figure 4—26.)* For removal of the rudder, see paragraph 4—82. Removal procedure for the tab actuating mechanism is covered in paragraph 4—182 and that for the rudder pedals and adjusting mechanism in paragraph 4—168. Removal of the remainder of the control system is as follows;

a. Disconnect rods (2) from rudder pedals (6) and bellcranks (5).

b. Disconnect return cable (3) from arms of bellcranks (5).

c. Disconnect rudder cables (7) from links on bellcranks (5).

d. Remove boots (8) from bulkhead at station 186 and rubber cables (7).

e. Remove pulleys (9) from their brackets located between stations 186 and 199.5 at the fuselage floor.

f. Remove pulleys (10) and (11) located at approximately stations 218 and 253.

g. Disconnect turnbuckles (12) and remove rudder cables (7) from the airplane.

h. Remove pulleys (13) near top of bulkhead at station 288.

i. Disconnect aft section of rudder cables (7) from rudder horn (14).

4—176. LUBRICATING. All pulley bearings are packed with low-temperature grease and afterward sealed against entry of dirt. They should be replaced if dirt has entered. See figure 3—14.

4—177. REPAIRING. Bent or broken parts should be replaced. Frayed or broken strands in cables are cause for replacement. In an emergency, cables may be repaired temporarily by cutting out the worn or damaged area and splicing in a new cable and applicable end terminals. The cables should be spliced, using the standard Army and Navy tuck splice, and not soldered.

4—178. INSTALLING. Installation is the reverse of the procedure described in paragraph 4—175.

4—179. ADJUSTING. *(See figure 4—26.)* The special tools required for checking the rudder are a protractor or a rudder travel checking board; *(See figure 4—33)*. After installation of this section of rudder control system, rudder should be rigged to neutral position as follows:

a. Locate the rudder pedals (6) in the neutral position by installing the surface control lock (see paragraph

4—202) in the rudder pedals and on the control stick.

b. Rotate the rudder pedal adjusting knob on instrument panel to bring the pedals full aft. This will center the pedals at station 143.815, (13.375 inches aft of bulkhead 130.5) and at the same time locate the control stick in the neutral position securing the elevators and ailerons in neutral.

c. Adjust turnbuckle of rudder return cable (3) to proper tension.

d. Align centers of cable attaching points in rudder horn (14) with centerline of rudder torque tube (station 314 1/4).

e. Attach fore and aft sections of right and left hand rudder cables (7).

f. Adjust tension of rudder cables (7) to 50 pounds, plus or minus 10 pounds.

g. Adjust rudder pedal stops (4) to allow full throw of rudder pedals (6) and required rudder displacement. The required surface deflection is 25 degrees right and left, plus or minus one degree.

h. Safety turnbuckles and bolts.

Note

Should it be necessary to check rudder using a protractor and measuring deflections relative to fin, it should be noted that leading edge of fin is offset at an angle of incidence of 2 degrees to the left relative to centerline of airplane.

4—180. RUDDER SPRING-TRIM TAB.

4—181. DESCRIPTION. *(See figure 4—27.)* A combination trim and spring tab is incorporated in the rudder control system as in the elevator control system. Trimming action is obtained electrically through the surface control trim tab switch located on the left hand console, aft of the tab position indicator. (For information on trim tab position indicator, refer to paragraphs 4—1532 through 4—1537.) Moving the toggle switch toward the side desired energizes a linear actuator (7) located in the aft end of the fuselage forward of bulkhead 310 21/32. The actuator rod (5) either extends or retracts the tab through rotation of bellcrank (3) which pivots on the rudder horn (4) moving link rod (2) which rotates the jackshaft (15) and its attached arm (14) through arm (18). Tab actuating rod (16) attached to the upper arm (14) moves fore or aft according to jackshaft movement and displaces the attached tab (11). The balance or "helper" tab reaction is obtained automatically through the spring tube and rudder tab operating linkage of the torque tube assembly. When air loads resist rudder movement and the rudder horn (4) is deflected through rudder pedal operation, the rudder horn is free to rotate in relation to the rudder and its attached fitting (8), both of which are secured to the lower end of the splined spring tube (13). The rudder horn (4) twists the spring tube against its attaching fitting (10) at its upper end which is bolted to the rudder beam. When this torsion occurs, the bellcrank (3) pivots on its point of attachment to the linear actuator rod (5), moving link rod (2) connected to the lower arm (18) of the jackshaft (15). This rotates the jackshaft and its upper arm (14), pushing or pulling the attached tab actuating rod (16), moving the tab (11) in the opposite direction to that of the desired rudder movement. Stop screws (17) secured to the rudder horn (4) limit the amount of spring tube rotation and the amount of tab movement. Once the tab (11) is deflected, the rudder (9) rotates in the opposite direction and in doing so, the rudder horn (4) and attached stops (17) are aligned with the bearing fitting and lugs (1), resulting in the tab aligning itself with the trailing edge of the rudder when the excessive loading has ceased; otherwise there is some deviation from the alignment. The following table gives maximum rudder spring-trim tab deflection.

	From Neutral Position		
	MAXIMUM RIGHT	MAXIMUM LEFT	TOLERANCE
Rudder Tab			
Spring Deflection	3° 45′	3° 45′	±1°
Trim Deflection	10°	10°	+4° −1°

4—182. REMOVING. *(See figure 4—27.)* Removal of the trim and spring tab assembly is as follows:

a. Remove rudder as directed in paragraph 4—82.

b. Working through access hole in rudder, disconnect tab actuating rod (16) from jackshaft (15). Remove rod from tab horn.

c. Remove bolt passing through upper torque fitting (10). This bolt secures the uppermost end of the spring tube (13). Two access holes for this bolt are located on the rudder leading edge approximately 9 3/8 inches up from the bottom of the rudder.

d. Remove spring tube (13) and attached fitting (10).

e. Remove bearing fitting (1).

f. Remove fitting securing upper end of jackshaft to rudder.

g. Working in fuselage, remove link rod (2) from bellcrank (3).

h. Remove linear actuator (7) by removing special bolts securing actuator in fuselage.

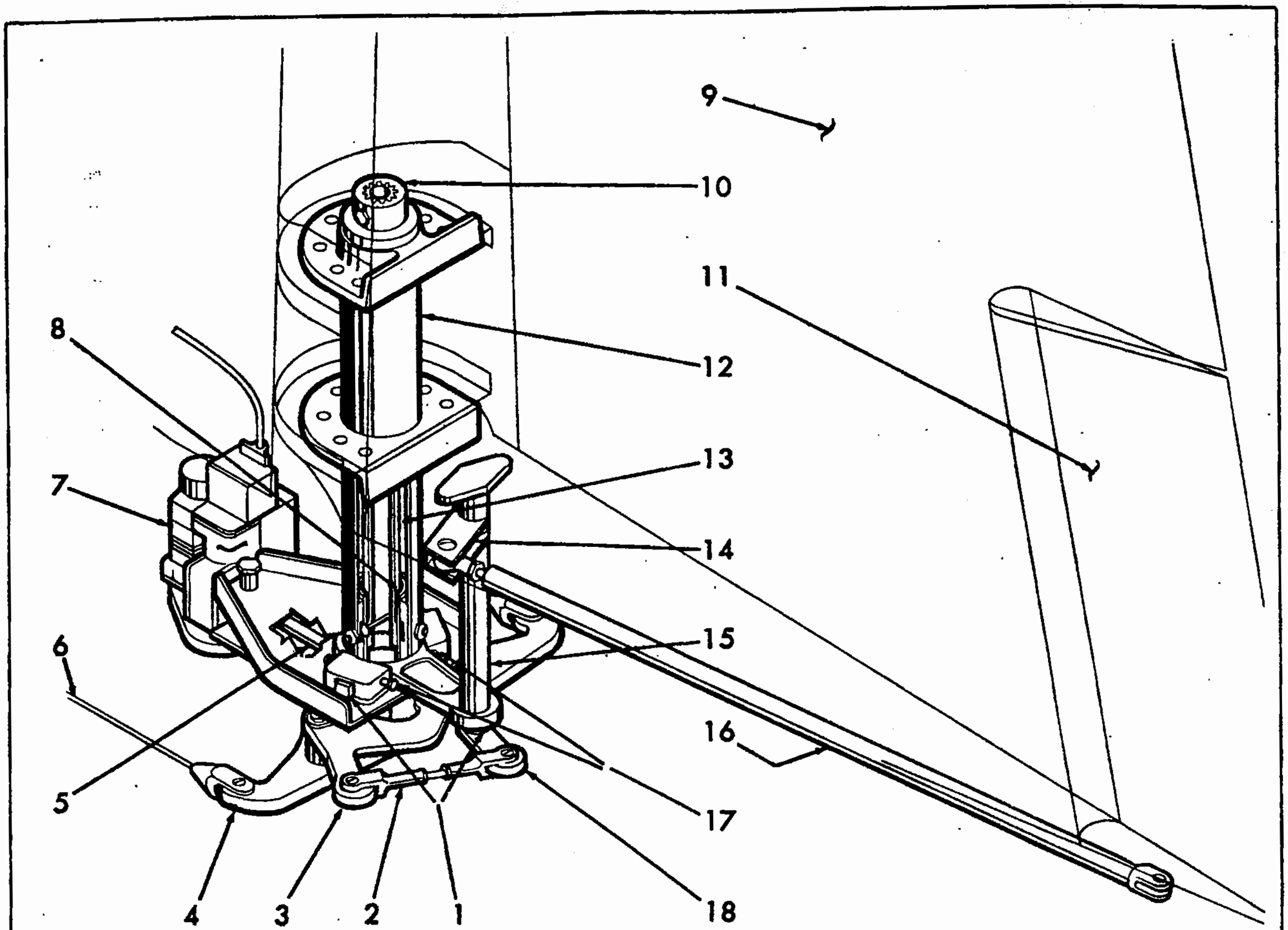
i. Remove rudder horn (4) from bracket in fuselage.

4—183. LUBRICATING. See figure 3—14 for lubrication information.

4—184. INSTALLING. Installation of the trim and spring tab assembly is the reverse procedure of that described in paragraph 4—182.

4—185. ADJUSTING. *(See figure 4—27.)* For information governing adjustment of linear actuator see paragraph 4—141.

a. Align centerlines of cable attaching bolts in rudder horn (4) with centerlines of torque tube at station 314 1/4.



1. Bearings and Lugs
2. Link Rod
3. Bellcrank
4. Rudder Horn
5. Actuator Torque Rod
6. Rudder Cable
7. Linear Actuator
8. Lower Torque Tube Fitting
9. Rudder
10. Upper Torque Tube Fitting
11. Rudder Tab
12. Torque Tube
13. Spring Tube
14. Upper Jackshaft Arm
15. Jackshaft
16. Tab Actuating Rod
17. Stop Screws
18. Lower Jackshaft Arm

Figure 4—27. Rudder Spring-trim Tab Control System.

b. The length of linear actuator rod as measured from center of actuator retaining bolts to bolt securing actuator rod (5) to bellcrank (3) should be:

RETRACTED	NEUTRAL	EXTENDED
6 15/16″	7 5/16″	7 11/16″

4—185A. Working through access door at base of rudder torque tube adjust rudder spring tab system.

CAUTION

The strength of the airplane for certain maneuvers is significantly affected by the adjustment of the rudder spring tab system. The proper adjustments with permissible tolerances for this system are as follows:

a. Adjust stop screws (17) (two left, two right) until the clearances between the screws and the lugs are .055 (plus or minus .001) inches. Use a feeler gage to check clearances. This allows lugs on bearing assembly (1) of torque tube (12) to rotate 1° 36′ fore and 1° 36′ aft. This adjustment allows a tab movement of 3° 45′ right and left.

b. Adjust rudder tab rod (16) from center of attaching bolt holes to a distance of 25 1/32 inches.

c. Adjust link rod (2) from center to center of attaching bolt holes to a distance of 4 13/32 inches.

4–186. RUDDER TAB LINEAR ACTUATOR.

4–187. DESCRIPTION. See paragraph 4–137 for a description of the principles of operation of the linear actuator. The model number used in this system is Lear, Inc., 401S and differs from the actuators used in the aileron and elevator systems in that the stroke of the actuator rod is shorter; see paragraph 4–185a. for rudder tab actuator rod lengths.

4–188. REMOVING. *(See figure 4–27.)* Through access doors at base of fin in rear of fuselage remove special bolts securing linear actuator in bracket.

4–189. INSTALLING. *(See figure 4–27.)* Installation of linear actuator is reverse of procedure described for removing. With rudder tab and tab operating linkage in neutral, adjust linear actuator rod (5) to a length of 7 5/16 inches and attach to bellcrank (3).

4–190. ADJUSTING. See paragraph 4–141.

4–191. WING FLAP CONTROL SYSTEM.

4–192. DESCRIPTION. *(See figure 4–28.)* The wing flap control mechanism operating the center section outer panel flaps is designed so that the flaps can be lowered hydraulically from the full "up" position of 0° to the full "down" position of 50° in steps of ten degrees. A flap positioning handle is located on the outboard side of the engine control unit; the flap positions are visibly indicated in degrees on the housing. In addition, an electrically actuated flap position indicator is provided on the inclined portion of the left hand control panel; see paragraphs 4–1504 through 4–1518. At the lower aft end of the unit an "EMERGENCY DOWN" position is provided. In routine operation, the flap handle moves from the zero degree position to the fifty degree "DOWN" position. In an emergency, such as that due to stoppage of the engine-driven hydraulic pump, the flaps can be lowered by moving the handle into the "EMERGENCY" position by displacing a latch which ordinarily restricts movement of the handle into the "EMERGENCY" position. Movement of the flap handle to "EMERGENCY" actuates a switch contained within the engine control unit which energizes an auxiliary electrically-driven hydraulic pump which feeds hydraulic oil directly to the wing flap selector valve, thus lowering the flaps. At the same time that the auxiliary hydraulic pump is energized, a solenoid shutoff valve in the hydraulic line is also energized, shutting off flow of hydraulic fluid to all systems except wing flap hydraulic system. At full "EMERGENCY" down position of flap control handle, an arm on mechanical follow-up linkage actuates another microswitch which shuts off emergency hydraulic pump.

4–193. WING FLAP BLOW-UP. The system also includes as a safety measure, an automatic hydraulic provision which causes the flaps to "blow-up" from the angle set by the cockpit control when excessive airloads are imposed upon the surfaces. The flaps will return to the angle corresponding to that called for by the control setting when the air speed is reduced. The mechanism is set so that with the flaps full "down" (50 degrees) and power on for level flight, the flaps begin to blow up between 100 and 115 knots indicated air speeds. At lesser flap settings, the "blow-up" speeds will be greater than with the flaps full down. During "blow-up," hydraulic oil from the extension side of the flap actuating cylinders passes through the by-pass valve to the return side of the hydraulic system, due to the compressing of the spring within right hand flap actuating rod at the butt of the center section, which actuates the by-pass valve. After the airspeed has decreased, the flap returns to the angle set by the position of the cockpit handle.

4–194. The flaps are not structurally fitted to withstand loads imposed by speeds in excess of 200 knots for flap deflections above 20 degrees, or for speeds in excess of 110 knots for flap deflection of 50 degrees when the flap "blow-up" is inoperative. See paragraphs 4–1058 through 4–1102 for complete information on the wing flap hydraulic system.

4–195. FUNCTION. *(See figure 4–28.)* When the flap control handle (11) is moved to a selected position, rod (12) moves arm (9) of bellcrank (8) on the cockpit floor. Rotation of this arm moves another arm (13) of the bellcrank (8) moving link (14) attached to arm (15) of the flap selector valve (7) underneath the cockpit floor at station 149. When arm (15) of the selector

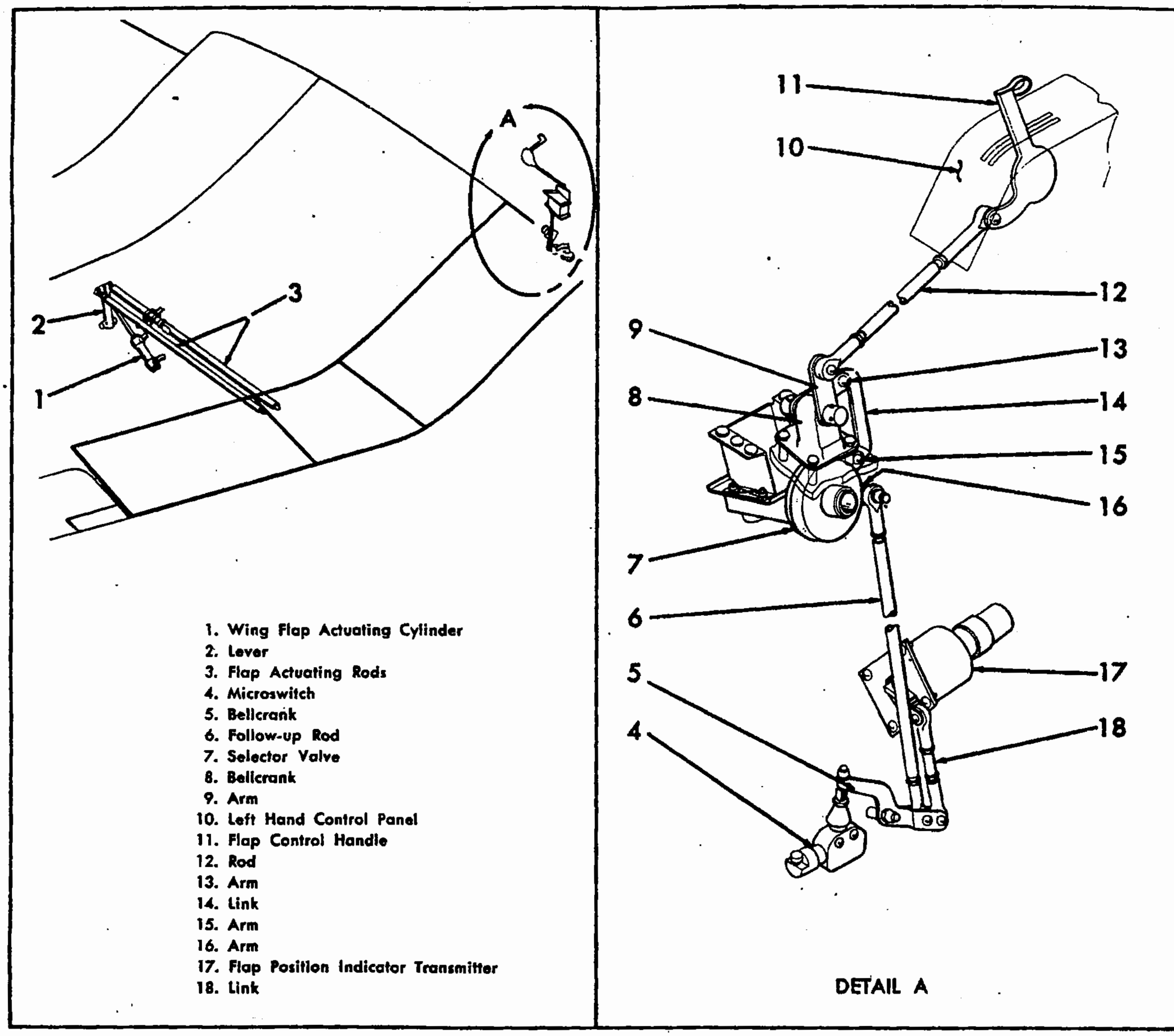


Figure 4—28. Wing Flap Control System.

valve is rotated, hydraulic oil flows from the reservoir, through the solenoid shut-off valve, and selector valve (7) to either the flap extension or retraction side of the operating cylinders, depending upon the flap position desired. See paragraphs 4—1058 through 4—1061 for further hydraulic information. Flap positions are indicated electrically, registering on an indicator located on the forward panel of the left hand console in the cockpit.

4—196. LOCATION AND ACCESS. Access to the flap control system is obtained through the cockpit and through the belly access door.

4—197. TROUBLE SHOOTING.

a. Check security of flap control system.

b. Check operation of system for binding or looseness.

c. Check hydraulic operation of system; see paragraphs 4—1058 through 4—1102.

d. Check positions of flap against flap position indicator; see paragraphs 4—1504 through 4—1518.

e. Check functioning of emergency flap operation.

4—198. REMOVING. *(See figure 4—28.)* With wings folded and working through the cockpit and belly access door, remove the control system as follows:

a. Disconnect rod (12) from flap handle (11) in cockpit, by removing cover plate on side of engine control unit (10).

b. Disconnect end of rod (12) from arm (9) of bellcrank (8); disconnect link (14) from arm (13). Disconnect link (14) from arm (15) of selector valve (7).

c. Break hydraulic connections from selector valve

(7) and plug open ports of valve and hydraulic lines.

d. Disconnect follow-up rod (6) from arm (16) of selector valve (7) and from bellcrank (5).

e. Disconnect link (18) from transmitter (17).

f. For information (including removal procedure) on hydraulic units, see applicable paragraphs 4—1058 through 4—1102.

g. Remove right and left flap actuating rods (3).

Note

Hold rod lengths to same dimensions as when installed on the airplane. The right and left hand center section flap actuating rods are normally 46 1/4 inches in length. The outer panel flap actuating rods are normally 44 19/32 inches in length. These dimensions are measured from the attaching bolt hole centers.

h. Remove right and left hand levers (2).

i. For removal of flaps, see paragraphs 4—10, 4—34.

4—199. LUBRICATING. For lubrication see figure 3—14. All threaded portions of hydraulic fittings should be lubricated with thread-lube before replacing fittings.

Note

On assembly, lubricate the bolt in the lever assembly (reference (2) on figure 4—28) and the shoulder bushing, bolt and spacer on the wing flap actuating cylinder (reference (1) on figure 4—28) with AN-G-10 or AN-G-15 grease.

4—200. INSTALLING. Installation of flap control system is reverse of procedure described in paragraph 4—198.

4—201. ADJUSTING. *(See figure 4—28.)* After installation of cockpit flap operating linkage, adjust the center section flaps in the following manner:

a. Setting the flaps to the match angle of the fuselage, place a 50 pound weight, a sandbag or equivalent, on trailing edge of flap walkway as far aft as possible; adjust piston rod of flap actuating cylinder (1) so that the piston bottoms against cap of the cylinder, and at the same time maintain a gap of approximately 1/64 inch between the flap and the match angle while the 50 pound weight is in place. If this gap is too large, lengthen the piston rod, if too small, shorten the piston rod.

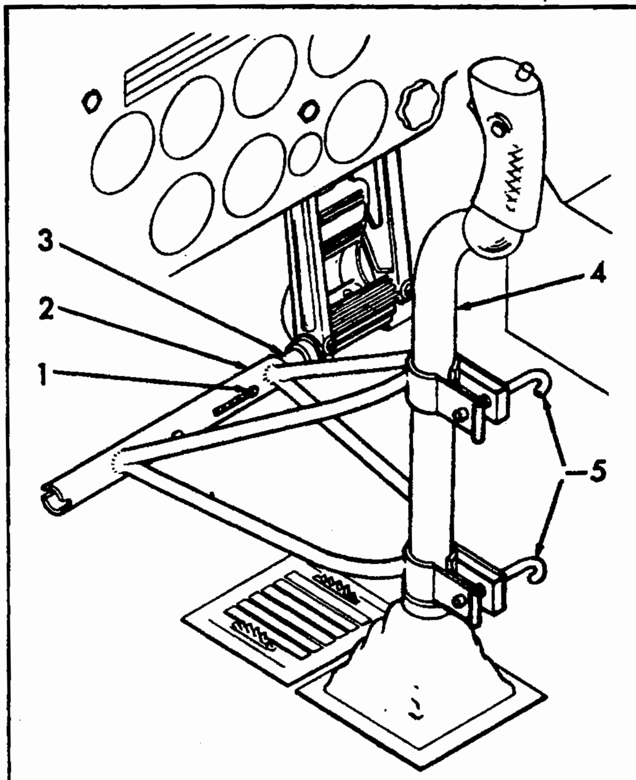
b. To adjust flap selector handle (11) relative to the bellcrank (8), set flap operating handle (11) in mid-position, halfway between 20 and 30 degrees flap "down" and adjust rod (12) so that arm (13) of the bellcrank (8) is parallel to the floor.

c. To adjust the follow-up (with hydraulic system in operation), place cockpit flap control handle (11) in full "DOWN" position (not "EMERGENCY"); disconnect follow-up rod (6) at either end, and by rotating arm (16) a small amount in a clockwise direction, bring flap to full "down" position. Determine the neutral position of the valve by slightly rocking the arm (16) to which the follow-up rod is connected, in either direction. Then adjust the follow-up rod (6) to tht proper length. Move cockpit flap control handle slowly to full "UP" position. The flap should reach full "up" position before the flap cockpit control handle has reached the 0° "UP" position, leaving the selector valve open and permitting hydraulic pressure to act on the piston of the hydraulic cylinder holding the flap in full "up" position.

4—202. SURFACE CONTROL LOCK.

4—203. DESCRIPTION. *(See figure 4—29.)* A surface control lock (VS-58050) is provided with the airplane, and is used to lock the control stick and rudder pedals, when the airplane is parked. The lock consists of a welded steel tube assembly, the forward part of which secures the rudder pedals in neutral. The aft section consists of two "U" shaped tubes, one above the other, securing the control stick in neutral.

4—204. INSTALLING. To install the control lock, move rudder pedal slide full aft and insert forward tubes of lock into the tubes at the lower end of the rudder pedals by telescoping the spring-loaded tubes of the lock into the tube housing the spring; release when aligned with rudder pedal tubes. Rotate control stick into position in the two retaining clamps of the lock and secure by inserting spring-loaded pin into locking position.



1. Lug
2. Surface Control Lock
3. Telescoping Tube
4. Control Stick
5. Locking Pins

Figure 4—29. Surface Control Lock.

4–205. SURFACE CONTROL CHECKING BOARDS.

4–206. DESCRIPTION. *(See figures 4–30 to 4–33 inclusive.)* To check and facilitate inspection of the angular displacement of the control surfaces before "securing" the system, the use of inspection boards (also called checking boards) manufactured in accordance with dimensions indicated in the referenced figures is recommended. The material used in fabrication can be any suitable hardwood or plywood approximately 3/4 inch thick. It should be noted that while the fin is offset 2° to the left at the centerline of the airplane to counteract the effect of propeller slipstream rotation on the vertical tail surface, the rudder neutral position is on the centerline of the airplane, the amount of displacement to the right or left being measured from that point. The amount of rudder displacement to the right and left is 25° off the centerline of the airplane. The movement of the rudder in respect to the fin is 23° right and 27° left, (see figure 4–33) the two degree difference is in effect a "left rudder" to maintain directional stability. To measure rudder deflection, place the forward part of the checking board against rib 25 1/8 on either side of the fin (see figure 1–2 for rib location) and rotate the rudder until it touches the checking board, without disturbing the board. Markings on the checking board indicate which side of the board is to be held against the surface as well as the required amount of deflection. The checking board for the rudder trim tab (see figure 4–33) should be marked to show the amount of tab displacement (ten degrees right and ten degrees left) and to indicate placement of the checking board (rib station 8 9/16) on the rudder. The elevator and elevator tab checking boards (see figure 4–32) are applied in the same manner as are the rudder and the rudder tab checking boards, and should be marked accordingly. The elevator throws are 23.5° up and 21° down. The forward part of the checking board should be placed on the stabilizer at stabilizer station 41.781 (see figure 1–2). The elevator trim tab checking board is placed on elevator rib 12 11/32 to check "up" throw of 5° and "down" throw of 15°. The aileron neutral position checking board (see figure 4–30) is placed on the upper contour of the wing on the centerline of wing rib 86, the foremost edge of the checking board aligned with the aft edge of the wing leading edge skin. The aileron travel checking board (see figure 4–31) is set on rib 86 and measures "up" throw of 19° and "down" throw of 14°. The aileron tab travel checking board should be set on aileron rib station 46 57/64 to measure tab movement of 15° "up" and 15° "down" from neutral.

Note

Elevator spring tab throws of 20° "up" and 15° "down," and the rudder spring tab throws of 3°45′ "right" and "left" should be measured, using a protractor.

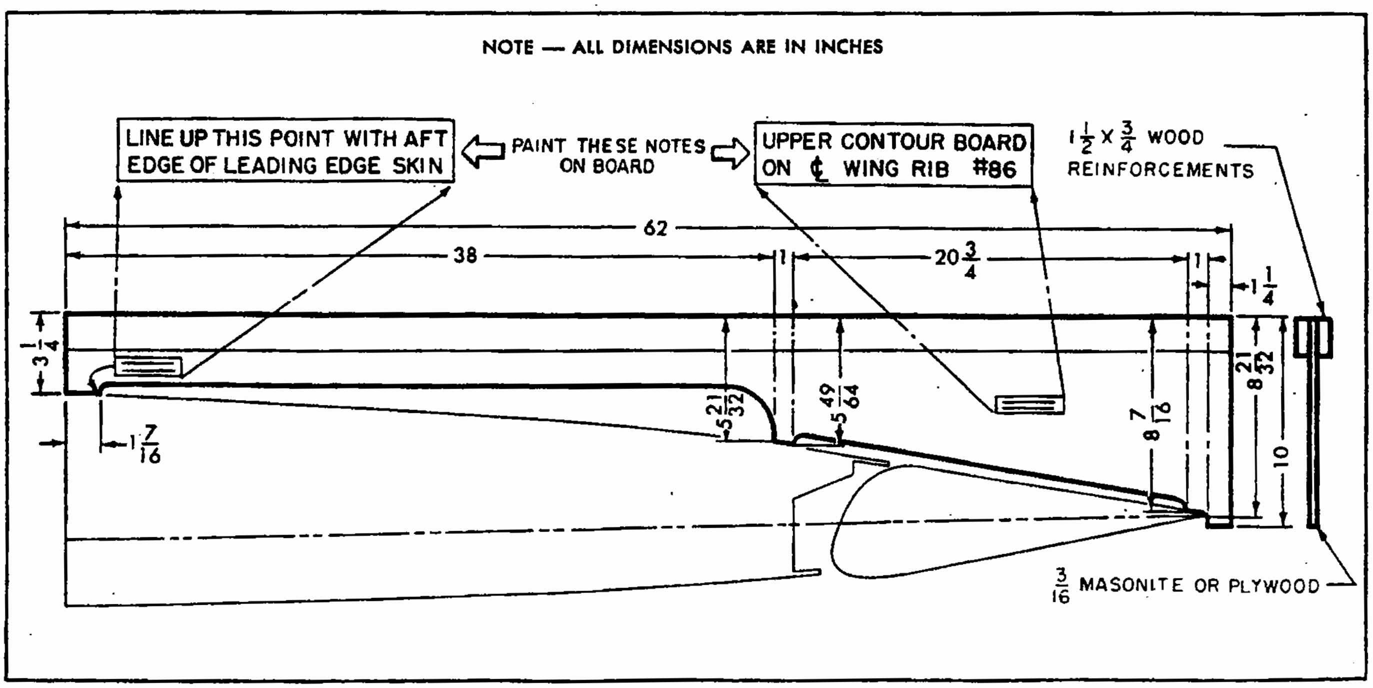


Figure 4–30. Aileron Neutral Position Checking Board.

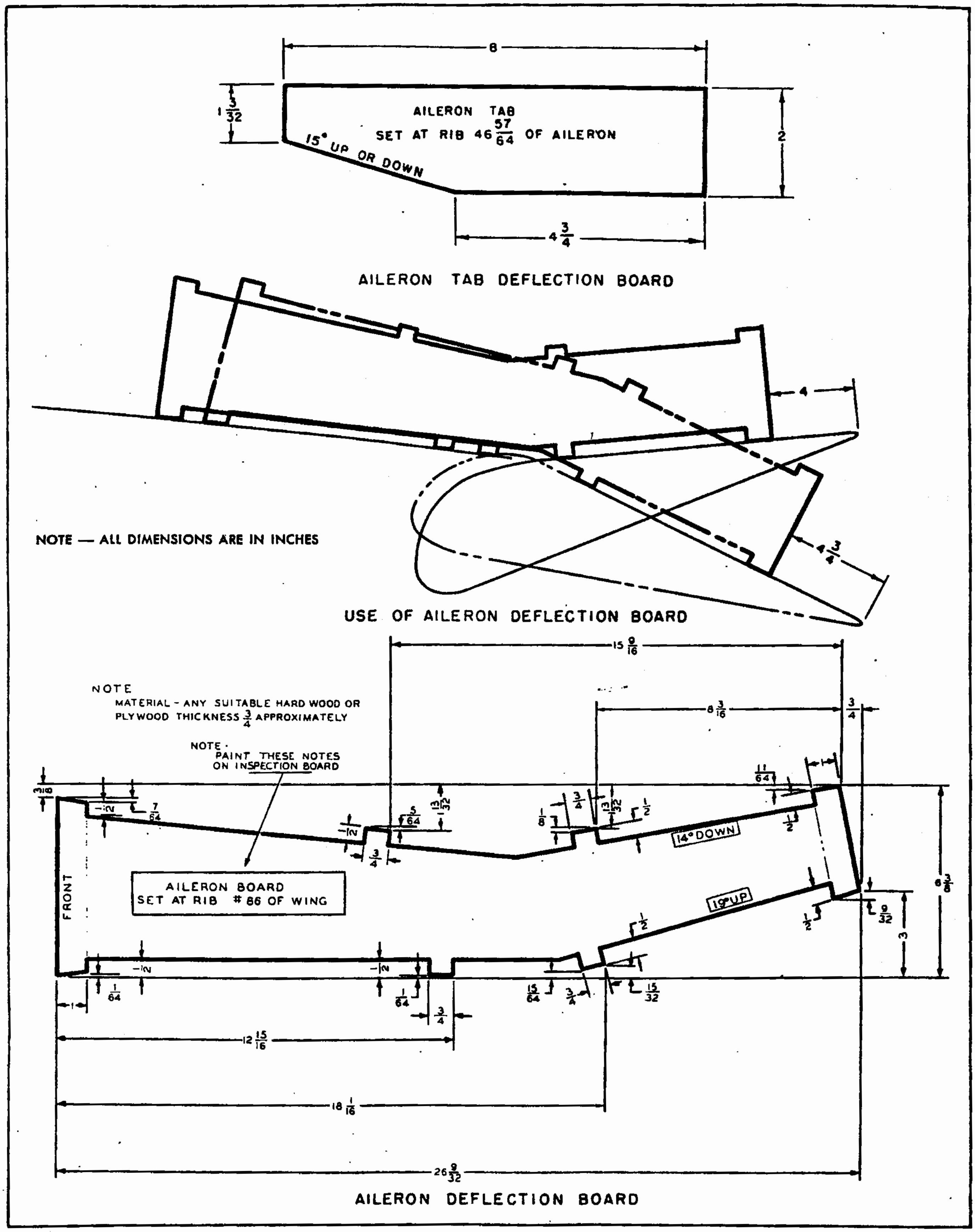


Figure 4—31. Aileron and Aileron Tab Travel Checking Boards.

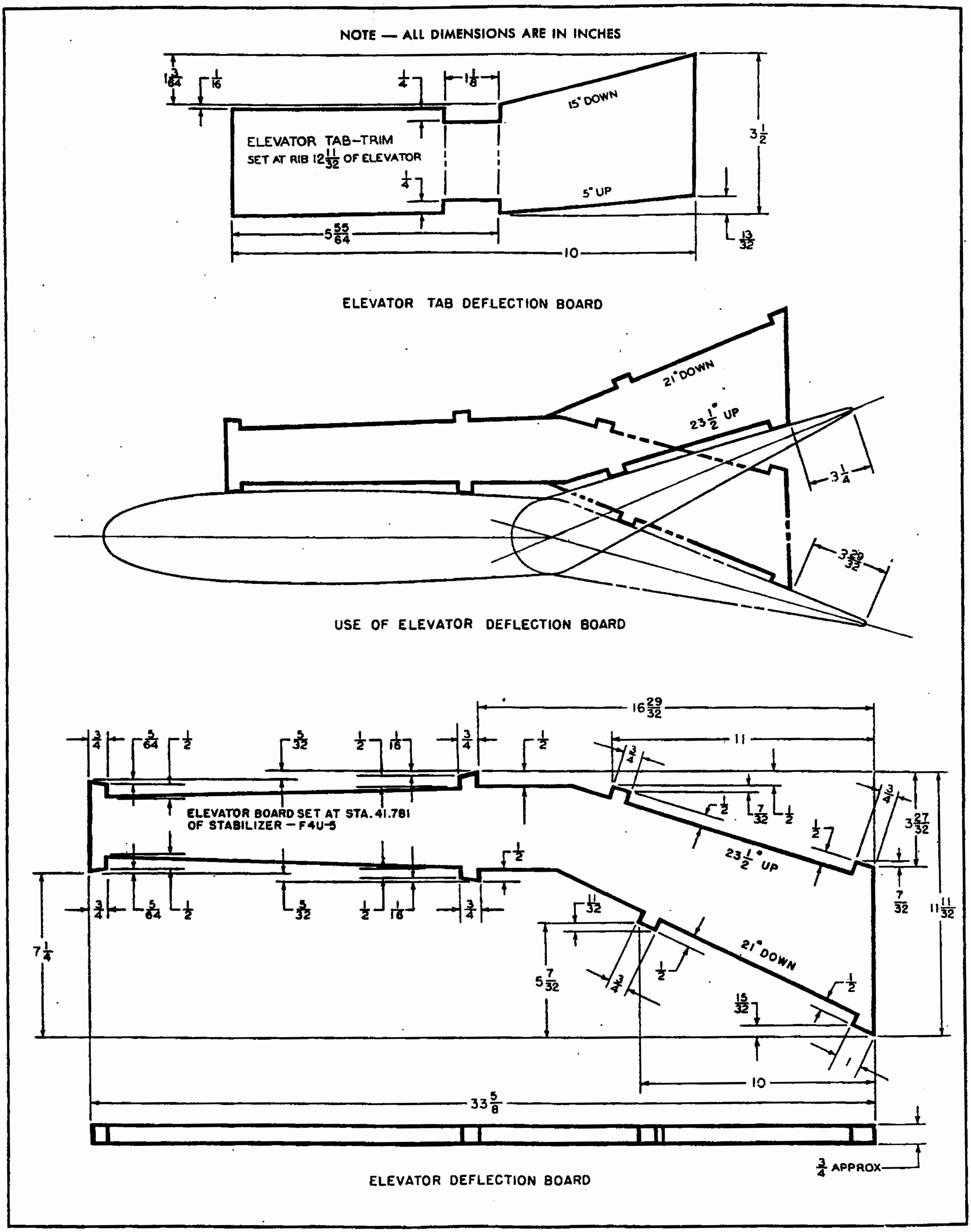


Figure 4—32. Elevator and Elevator Tab Travel Checking Boards.

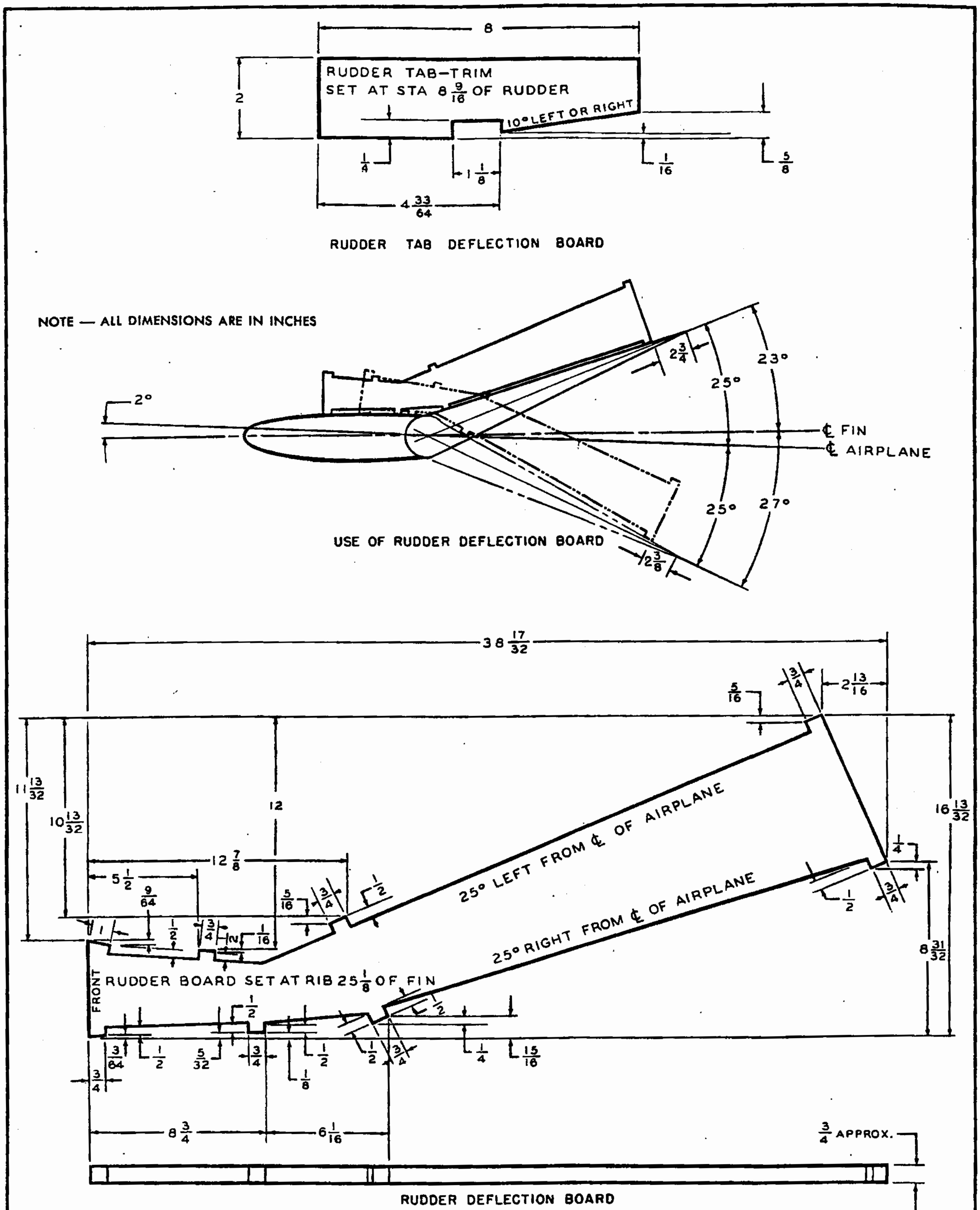
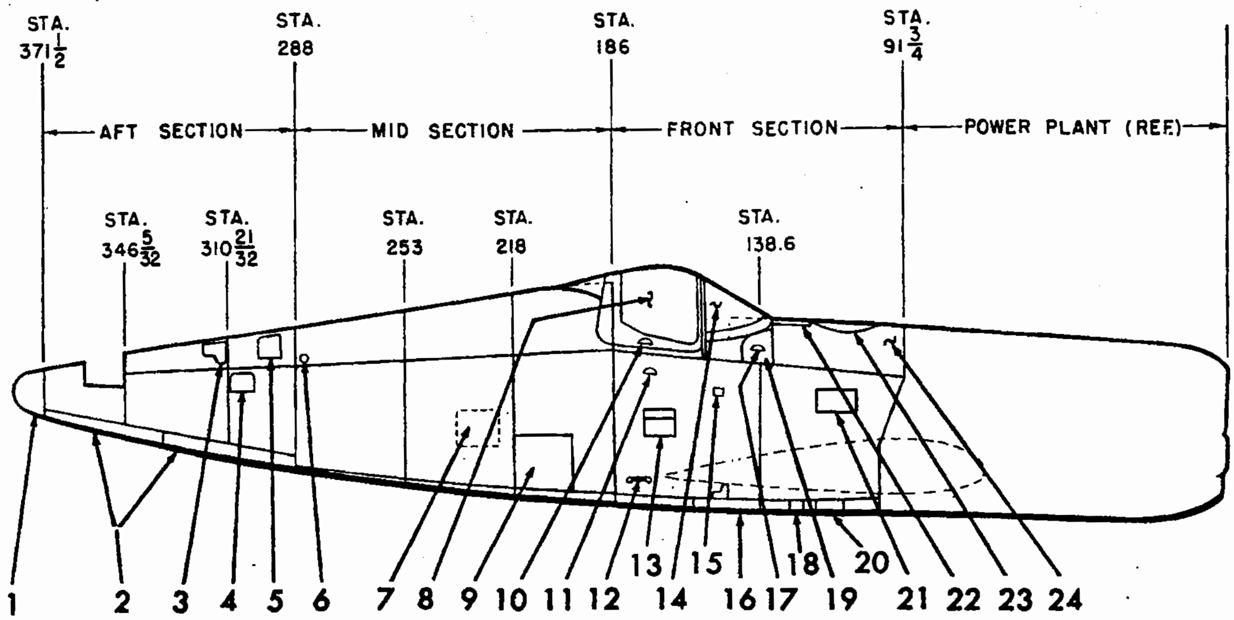


Figure 4–33. Rudder and Rudder Tab Travel Checking Boards.



1. Tail Cone
2. Tail Wheel Doors
3. Access to Fin and Rudder
4. Lower Access Door — Tail Wheel Shock Strut
5. Upper Access Door — Tail Wheel Compression Strut
6. Lift Tube Installation
7. Provision for Camera (ref.)
8. Cockpit Cabin Sliding Section
9. Radio Compartment Access Door
10. Sliding Section Handgrip
11. Handgrip
12. Telescoping Lower Cockpit Access Step
13. Upper Cockpit Access Step
14. Windshield
15. External Sliding Section Release Pullring
16. Lower Cockpit Access Door
17. Handhole
18. Fuel Drain Access Door
19. Access to Instrument Panel
20. Auxiliary (Booster) Fuel Pump Lines Access Door
21. Fuel Cell Hanger Door
22. Access to Liquidometer
23. Fuel Cell Manhole Cover
24. Fuel Cell Access Panel

Figure 4–34. Fuselage Reference Diagram.

4–207. FUSELAGE.

4–208. DESCRIPTION. *(See figure 4–34.)* The fuselage structure, composed primarily of alloys of magnesium and aluminum, is of semi-monocoque construction, reinforced in cross section by stiffened bulkheads and frames, and longitudinally by longerons and stiffeners; refer to figure 1–2 for location of fuselage stations and frames. Primary bending loads are taken by the four longerons, extending the length of the fuselage and consisting of several extruded sections fastened together with fittings and bolts at stations 186 and 288 at the fuselage splice points. A triangular truss, made of square tubing, reinforces the tail wheel and assists in transmitting the tail loads through the aft section. Stiffeners are spotwelded to the skin and provide local reinforcement. The fuselage is assembled in three main sections. The front section, to which the center section is attached, begins at the firewall and includes the fuel tank compartment and the pilot's cockpit, enclosed with Plexiglas sliding section and a flat front windshield with an integral bulletproof glass panel. The mid-section begins at bulkhead 186, immediately aft of the pilot's seat, and includes the radio compartment, and the tail wheel attachment bulkhead. The aft section extends from station 288 to station 371 1/2 and contains the tail wheel installation and attachment fittings for the tail group. The tail cone is attached to the aft end of the aft section. The forward and mid-sections are bolted together, while the mid and aft sections are connected by means of splice plates and rivets. In order to prevent entrance of carbon monoxide into the cockpit, the structure adjacent to the cockpit has been fumeproofed by sealing all holes, joints, and seams.

4–209. FUSELAGE FRONT SECTION.

4–210. DESCRIPTION. *(See figure 4–34.)* The front section of the fuselage extends from the firewall at station 91 3/4 to station 186 with bulkheads at stations 91 3/4–100 and 130 1/2–134. The front section houses the fuel cell, to which access is provided through the filler door, manhole cover, fuel cell hanger access doors (right and left hand) and liquidometer access door. Magnesium panels form the fuel cell access panel (top cowl cover), fuel cell manhole cover, windshield deck cowl, and windshield cowl. Refer to paragraphs 4–1897 through 4–1900 for maintenance of magnesium surfaces.

Instrument panel access doors with integral handholes are located on the left hand and right hand cowl. A hinged fuel drain access door, is provided in the bottom panel under the fuel cell between stations 124 7/8 and 130 1/2. A fuel system lines access door is located on the bottom panel between stations 112 and 120 1/2. The bottom fuselage access door (also called belly access door) between stations 138.6 and 160 provides access to installations in this area, including battery, surface controls, and hydraulic lines.

4—211. COCKPIT FLOOR AND RIGHT AND LEFT HAND CONTROL SHELVES.

4—212. DESCRIPTION. *(See figure 4—35.)* A fixed Metalite floor has been provided in the cockpit forward of the pilot's seat. A removable canvas floor under the pilot's seat between the aft end of the Metalite floor and bulkhead 186, is fastened by means of studs on the structure, which are turned to lock the floor in place.

4—213. The left hand console control panel consists of three main surfaces: an inclined panel at the forward end installed approximately normal to the pilot's line of sight, a forward horizontal panel, and an aft horizontal panel. The left hand inclined panel houses the following controls:

a. Landing Gear Control.

b. Landing Gear and Flap Position Indicator.

c. Oil Cooler Emergency By-Pass Switches and Warning Lights.

d. Landing Check-off List.

The forward horizontal left hand panel houses the following controls:

a. Wing Flap Control.

b. Cowl Flap Control.

c. Intercooler Flap Switch.

d. Oil Cooler Door Switch.

e. Engine Control Unit—including throttle (with twist grip for ranging control of MK-8 sight unit), propeller governor control, and mixture control.

f. Oil Cooler Door and Intercooler Flap Position Indicator.

g. Hydraulic Pressure Gage.

The aft horizontal left hand panel houses the following controls:

a. Emergency Bomb or External Fuel Tank Release.

b. Tail Wheel Lock Control Lever.

c. Anti-blackout Suit Plug and Adjustment Valve.

d. Fuel Selector Handle.

e. Fuel Pump Switch.

f. Fuel Transfer Switch.

g. Gunsight Controls.

h. Oxygen Regulator.

i. Trim Tab Switches and Indicator.

j. Shoulder Harness Release.

k. Tow Target Release (when installed).

4—214. The right hand panel consists of three main surfaces: an inclined panel at the forward end, pilot's right hand electrical and radio console, and an aft auxiliary control panel. The forward inclined panel houses the following controls:

a. Take-off Check List.

b. Arresting Hook Control.

c. Generator Warning Light.

d. Auxiliary Hydraulic Pump Switch.

e. Voltammeter.

f. Starting Switches—Battery, Primer, Starting, Oil Dilution and Pitot Heater.

The pilot's radio and electrical console panel (forward horizontal right hand panel) houses the following controls:

a. Exterior Lights Panel.

b. Interior Lights Rheostat.

c. Interior Lights Selector Switch.

d. Radio Consoles.

The aft horizontal right hand console houses the following controls:

a. Seat Lock.

b. Oxygen Cylinder Handle Access Door.

c. Pilot's Locker.

d. Wing Fold Control and Wing Hinge Pin Lock.

e. Map Case.

The voltmeter test jacks and circuit breaker panel are located on the vertical face of the right hand panel.

4—215. REMOVING FLOOR. The Metalite floor cannot be easily removed for maintenance or access. The canvas floor beneath the pilot's seat will normally provide all necessary access and may be removed as follows:

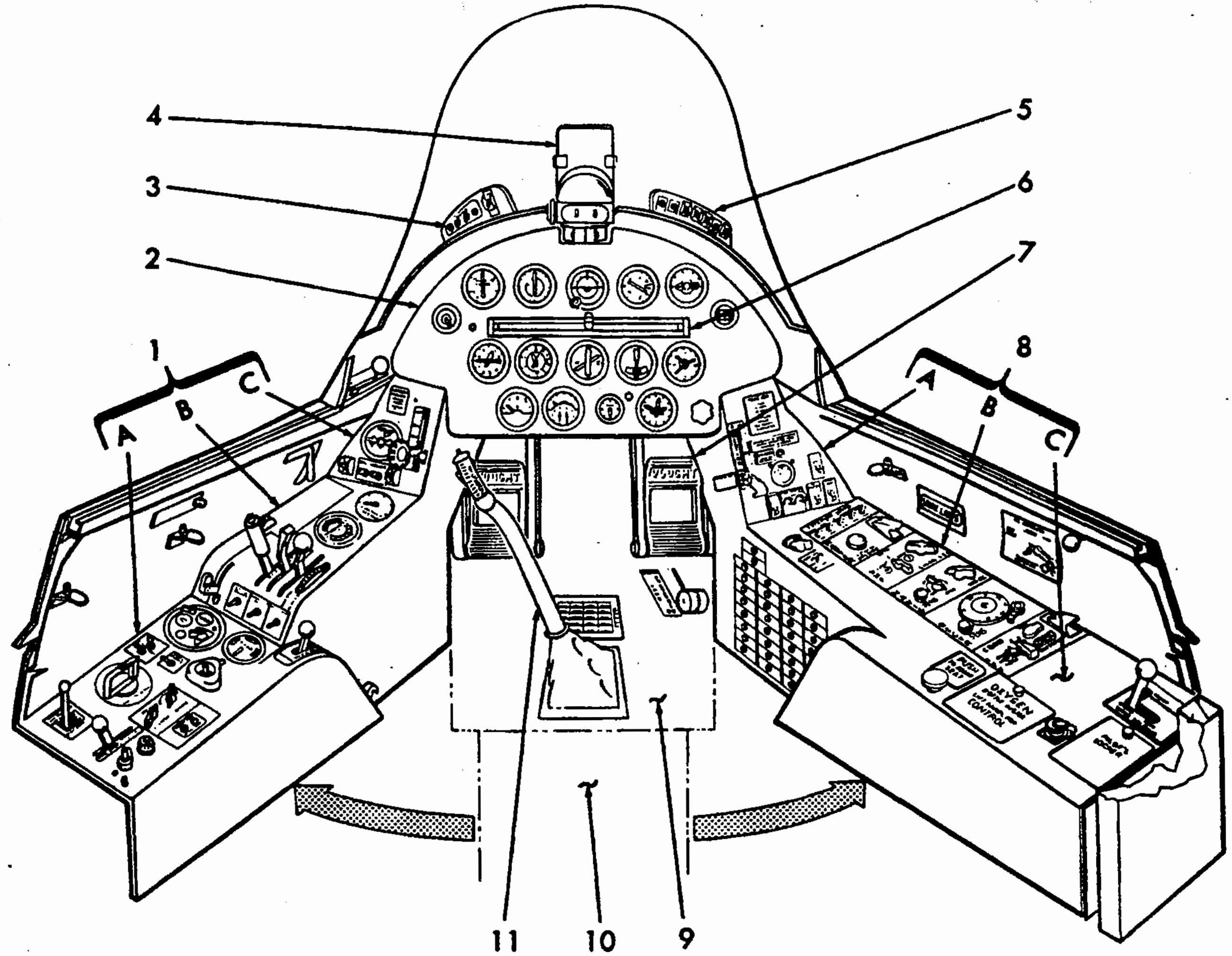
a. Disconnect studs at the forward end of the canvas floor from the angle on the aft end of the Metalite floor.

b. Disconnect studs on the sides of the canvas floor from the lower portion of the left and right hand consoles.

c. Release the tube at the aft end of the canvas floor from the clips on bulkhead 186.

4—216. INSTALLING FLOOR. Install the canvas floor by reversing the removal procedure.

4—217. REMOVING LEFT HAND CONTROL PANEL. *(See figure 4—35.)* The left hand controls are arranged in three units, which are best removed as individual units. The forward horizontal panel in the center of the control installation must be removed first in accordance with paragraph 4—218. The aft horizontal panel may then be removed in accordance with paragraph 4—219, and the inclined panel removed last in accordance with paragraph 4—220. For access, remove the pilot's seat (see paragraph 4—1543), and the canvas floor; open the lower cockpit access door.



1. Left Hand Control Shelf
   A. Aft Horizontal Panel
   B. Forward Horizontal Panel
   C. Inclined Panel
2. Instrument Panel
3. Armament Switch Box — L.H. (Gun Switches and Charging Buttons)
4. MK-23 Gunsight
5. Armament Switch Box — R.H. (Bomb and External Tank Release, Rocket and Bomb Arming)
6. Chart Board Slot
7. Brake and Rudder Pedal Installation
8. Right Hand Control Shelf
   A. Inclined Panel
   B. Pilot's Electrical and Radio Console
   C. Aft Auxiliary Control Console
9. Fixed Metalite Floor
10. Removable Canvas Floor
11. Control Stick

Figure 4—35. Cockpit Arrangement.

4—218. To remove the forward horizontal left hand panel, remove the vertical cover assembly from the inboard side of the forward horizontal panel by removing seven Dzus fasteners.

a. Disconnect all controls to the engine control unit levers.

b. Disconnect all wires from bulkhead on the forward end of aft horizontal panel.

c. Disconnect plug from intercooler flap and oil cooler door position indicator.

d. Disconnect and plug hydraulic line from hydraulic pressure gage.

e. Remove three screws attaching the outboard edge of the forward horizontal panel, to panel just outboard of the engine control unit.

f. Remove three bolts attaching forward horizontal panel to inclined panel and three bolts attaching forward horizontal panel to aft horizontal panel. Remove forward horizontal panel, including ranging throttle grip, from the airplane.

g. Remove three screws, attaching remaining panel to fuselage angle assembly and remove panel.

4—219. To remove the aft horizontal left hand panel, remove inboard vertical cover assembly from aft horizontal panel by removing seventeen screws.

a. Disconnect controls to the tail wheel lock, fuel tank selector, emergency external fuel tank or bomb release, weld assembly of shoulder harness lock, anti-blackout equipment, and tow target handle (when installed).

b. Disconnect plug to the MK-7 relay box, located on bulkhead 186. Remove eight screws and lift panels from the selector-dimmer and MK-3 switch box. Remove screws, as required, to gain access to the selector-dimmer box and disconnect wires from terminals 2, 3, 4, and 5. Remove both boxes.

c. Remove plugs to the trim tab position indicator and to the trim tab switch.

d. Disconnect wires from the fuel pump switch and the fuel transfer switch.

e. Remove the plug to the fuel transfer pressure switch located on bulkhead 134.

f. Remove three bolts attaching aft horizontal panel to fuselage side panel and three bolts attaching assembly to frame 177 1/2.

g. Remove six screws attaching outboard edge of aft horizontal control panel assembly to fuselage side panel attaching angle.

h. Remove three bolts attaching forward end of aft horizontal control panel assembly to attaching angle.

i. Remove five bolts attaching bottom of aft control panel to cockpit floor angle.

j. Remove three screws from fairing and panel.

k. Remove three bolts attaching fairing assembly to aft panel controls unit bulkhead.

l. Remove two bolts attaching fairing assembly to floor gusset and remove aft horizontal control panel assembly and fairing.

4—220. To remove forward left hand inclined panel:

a. Disconnect landing gear control from the forward inclined panel.

b. Disconnect cockpit lining from bracket.

c. Remove the plug from the landing gear and flap position indicator.

d. Remove ground wire from check-off list.

e. Remove two screws attaching inboard edge of inclined panel to fuselage attaching angle and shelf.

f. Remove ten bolts attaching forward bulkhead of forward inclined panel to fuselage frame.

g. Remove five bolts attaching bulkhead to cockpit floor attaching angle, and remove forward inclined control panel assembly.

4—221. INSTALLING LEFT HAND CONTROL PANEL. Install left hand control panel units by reversing procedure given in paragraphs 4—217 through 4—220. Forward horizontal panel must be installed last.

4—222. REMOVING RIGHT HAND CONTROL PANEL. *(See figure 4—35.)* The right hand control panel is arranged in three units which must be removed separately from the airplane. The pilot's right hand electrical and radio console in the middle of the installation should be removed first in accordance with paragraph 4—223. The aft right hand auxiliary control console may then be removed in accordance with paragraph 4—224, and the right hand forward inclined panel removed last in accordance with paragraph 4—225. For access, remove the pilot's seat (see paragraph 4—1543) and canvas floor; open the lower cockpit access door. Disconnect all wires from the main junction box to the right hand control units.

4—223. To remove the right hand electrical and radio console:

a. Remove the four screws holding each of the radio console panels and the exterior lights panel to the box.

b. Raise the panels sufficiently to disconnect the electrical plugs at the bottom of each.

c. Disconnect one wire PL2A18 from the exterior lights panel.

d. Disconnect radio circuit-breakers, wire HF1A14 from the portable equipment circuit-breaker, check list light wire LC8A18 from the terminal block, and wire AG9A18 from the gun charging circuit-breaker.

e. Remove eight screws from the console and remove it from the airplane.

4—224. To remove the right hand aft auxiliary console:

a. Disconnect the seat adjustment linkage and the wing fold mechanism linkage from the aft right hand auxiliary control console.

b. Remove four screws attaching bulkhead to frame at station 177 1/2.

c. Remove four screws attaching the forward end of the console to the supporting brackets.

d. Remove three screws attaching the aft outboard end of panel to angle and remove the aft auxiliary console.

4—225. To remove the right hand inclined panel:

a. Disconnect the arresting hook control cable from the forward inclined panel.

b. Remove three screws attaching forward inclined panel to upper channel; remove two screws attaching panel to lower channel on side panel assembly.

c. Remove five screws from frame 149 and lift the right hand forward inclined panel from the airplane.

4—226. INSTALLING RIGHT HAND CONTROL PANEL. Install the three sections of the right hand control panel by reversing procedures given in paragraphs 4—222 through 4—225. The radio and electrical console must be installed last.

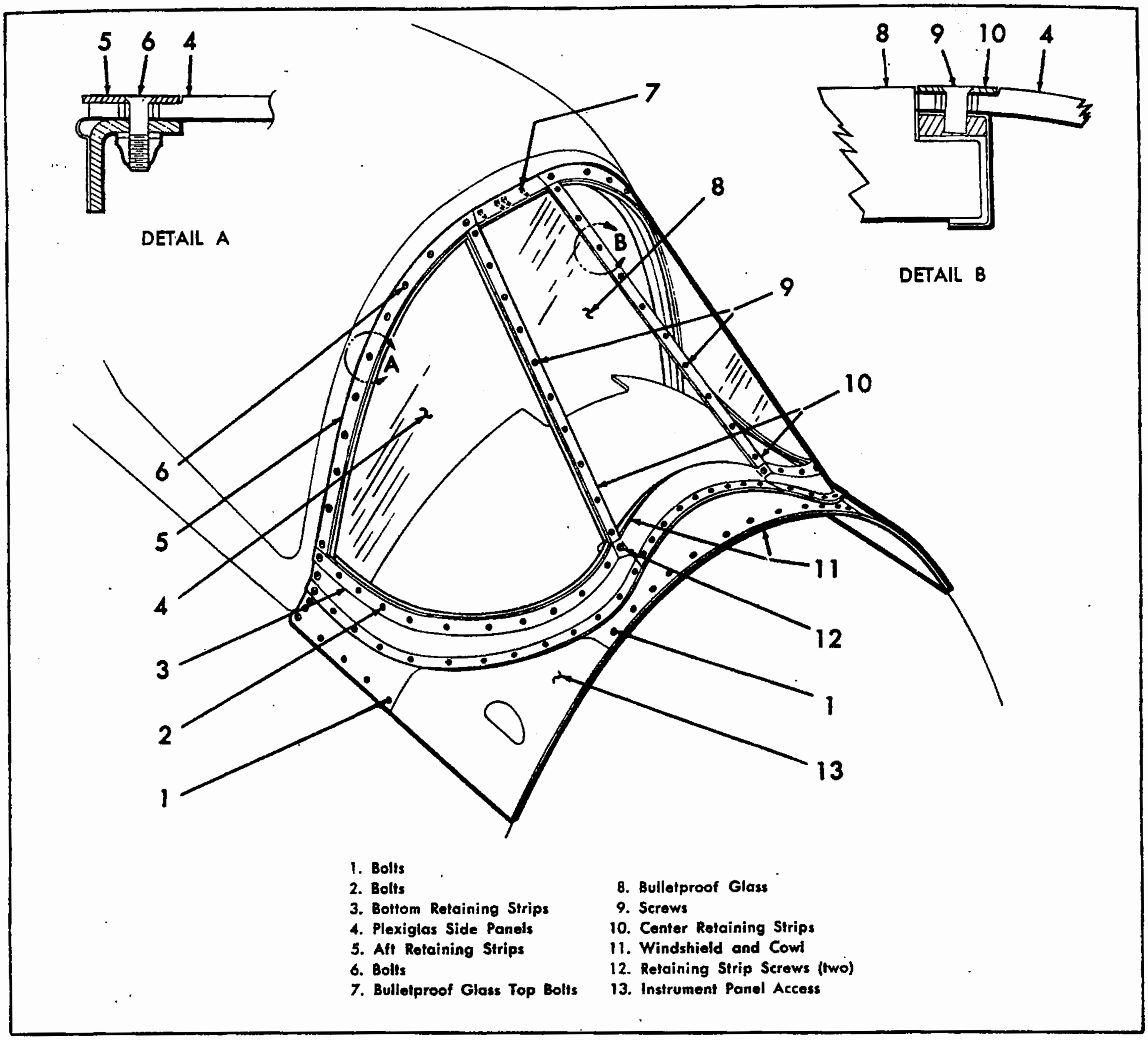


Figure 4—36. Windshield Installation.

4—227. WINDSHIELD.

4—228. DESCRIPTION. *(See figure 4—36.)* The flat-front windshield covers the forward portion of the cockpit; its forward edge is fastened with bolts to the top of the bulkhead just aft of the fuel cell compartment and its side edges are bolted to the upper longerons. The windshield consists of a frame of formers, enclosing three panels; two, one quarter inch transparent plastic side panels attached to the frame by means of retaining strips, and the one and one-quarter inch center bulletproof glass plate. The whole assembly is reinforced near the bottom by a magnesium alloy cowl. To the windshield cowl are attached the instrument panel, the heating and ventilating diffuser, the armament switch boxes, and the gunsight.

4—229. REMOVING. *(Parenthesized numbers refer to callouts on figure 4—36.)*

a. Remove the instrument panel access doors (13) from each side of the fuselage by removing screws.

b. Remove the gunsight (see paragraph 4—1792) and the armament switch boxes from the cowl.

c. Remove the two cockpit lights from their clips at the aft edge of the windshield.

d. Remove the spare gunsight lamp from the clamp at the aft edge of the cowl.

e. Remove the heating and ventilating diffuser assembly from the cowl by removing bolts.

f. Disconnect the instrument panel from the cowl. Refer to paragraph 4—1280 for removal procedure.

g. Remove the bolts (1) which fasten the windshield and cowl (11) to the bulkhead aft of the fuel cell compartment and to the upper longerons. The sides of the windshield are fastened directly to the longerons with bolts except at four points where they are fastened by means of bolts to two brackets and two clips which are in turn fastened to the longerons. The clips are located at the aft corners on the windshield and the brackets at both sides of the instrument panel.

h. Remove the windshield as a unit. Note that windshield assembly weighs approximately 57 pounds.

4–230. REMOVING SIDE PANELS. *(Parenthesized numbers refer to callouts on figure 4–36.)*

Note

If necessary, the glass panes may be removed while the windshield is installed on the airplane.

a. If new side panels are to be installed, place gage marks on the retainers and on adjoining fuselage panels, so that the retainers can be replaced in their original position with all drilled holes properly aligned with the holes in the formers.

b. To remove the side panels, disengage the center retaining strips (10) by removing screws (9).

c. Disengage the aft retaining strips (5) by removing bolts (6).

d. Disengage the bottom retaining strips (3) by removing bolts (2).

e. Remove the outboard screw (12) in the bottom center retaining strip and remove the glass (4).

4–231. REMOVING BULLETPROOF GLASS. *(Parenthesized numbers refer to callouts on figure 4–36.)*

Note

If necessary, the bulletproof glass may be removed while the windshield is installed on the airplane.

a. If the side glass panels have first been removed in accordance with paragraph 4–230, proceed as follows to remove bulletproof glass:

b. Remove screws extending through retainer strips and bulletproof glass.

c. Remove four bolts (7) at the top of the glass (8) and remove glass from frame. Take care to support glass as it weighs approximately 38 pounds.

Note

If it is necessary to remove bulletproof glass only leaving side panels installed, observe procedure given in paragraph 4–1853.

4–232. INSTALLING SIDE PANELS.

a. Scrape the edges of the retainers clear of old "Aluminastic" sealing compound.

b. Hold the new glass panes in proper position, align the retainers by means of the gage marks, and hold them in place; refer to paragraph 4–230a. The gap between the retainer and the plate glass shoulder shall be not more than 3/16 inch and not less than 1/16 inch.

c. Using the retainer holes as jigs, drill pilot holes in the glass panes with a 3/32 inch drill.

d. Remove the panes and redrill 7/16 inch holes through the pilot holes. The holes will actually be larger than the holes in the retainer strips to provide for expansion and contraction of the Plexiglas panes.

e. Install the replacement panels and retainers with screws.

f. Fill the joints between retainers and the glass with "Aluminastic" compound.

4–233. INSTALLING BULLETPROOF GLASS. To install the bulletproof glass, reverse procedure given in paragraph 4–231.

4–234. INSTALLING WINDSHIELD. To install the windshield as a unit, reverse procedure given in paragraph 4–229.

4–235. CLEANING. For cleaning and maintenance of Plexiglas, refer to paragraphs 4–1901 through 4–1904.

4–236. COCKPIT CABIN SLIDING SECTION.

4–237. DESCRIPTION. *(See figures 4–37 and 4–38.)* The cockpit cabin sliding section consists of a fully transparent plastic canopy secured in a metal frame and moving on rollers on two tracks forward of bulkhead 186 and two tracks aft of bulkhead 186. The sliding section is approximately twenty-six inches long, extending in the closed position from station 158 to station 184. In normal operation, the canopy is hydraulically opened and closed by actuating the control handle located on the left hand side of the cockpit; see paragraph 4–1150. Provision is made to open the closed sliding section from the outside through an external manual release pull ring stowed behind a small door on the right hand fuselage; placing the cockpit canopy control handle in the "MANUAL" position permits manual opening from the inside. An emergency compressed air system is provided to open the cabin should normal hydraulic actuation fail. The cabin is held closed by hydraulic pressure. If the hydraulic system fails, a check valve in the pressure line prevents loss of hydraulic fluid and provides an emergency hydraulic lock thus holding the cabin closed until the cabin control handle is moved to the "EMERGENCY" position.

4–238. ACCESS FROM OUTSIDE.

4–239. DESCRIPTION. *(See figure 4–34.)* Entrance to the cockpit is gained from the right hand side by means of the upper and lower cockpit access steps (12) and (13), the cockpit manual release pull ring on the right hand side (15), the handhole (17) in the instrument panel access door and the handgrip in the sliding section frame. The cockpit access steps are normally in

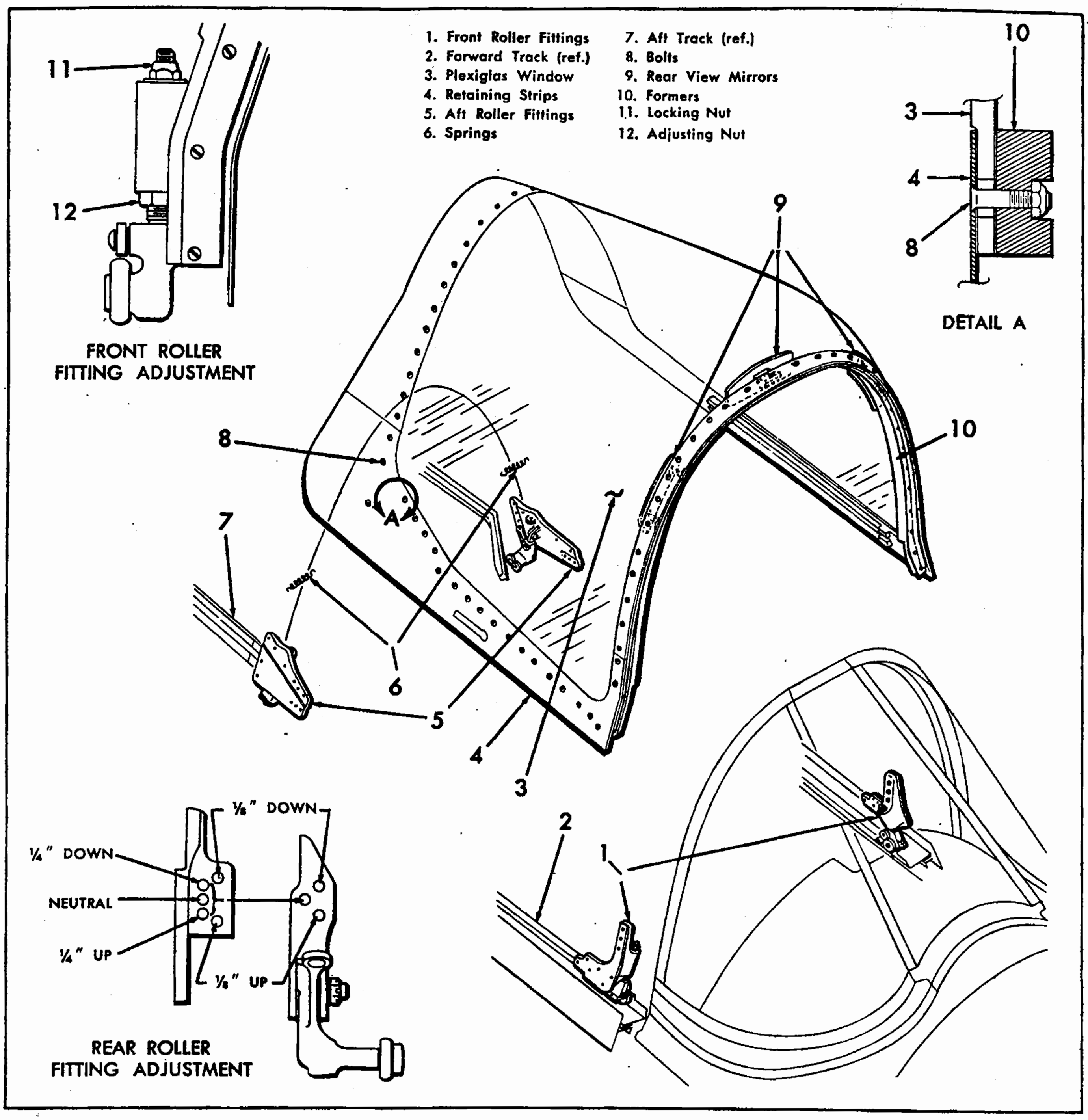


Figure 4–37. Cockpit Cabin Sliding Section.

the down position when the airplane is on the ground, tail wheel extended. If the steps have been manually retracted, however, they may be manually extended by opening the upper folding step (13). Refer to paragraph 4–262 for further information on the cockpit access steps. The use of the external manual release pull ring is necessary only in case of a crash landing when the cockpit control handle has been left in the "CLOSE" position. Normally, when the sliding section has been closed from the outside, the control system is left in "MANUAL" and the sliding section may be opened by pushing it aft, using the external handgrip.

4–240. COCKPIT CABIN SLIDING SECTION FRAME AND PLEXIGLAS INSTALLATION.

4–241. DESCRIPTION. *(See figure 4–37.)* The sliding section (also called the cabin, canopy, or hatch) consists of an aluminum alloy frame of formers in which a formed Plexiglas window is held by retaining strips and bolts. Three small mirrors (9) on the forward part provide vision to the rear. Small rollers, which ride in tracks on the fuselage, are fixed to each corner of the sliding section. The tracks for the front rollers are attached to the upper longerons on each side of the cockpit; the tracks for the rear rollers are slightly higher up on the fuselage and extend aft from bulkhead 186.

4—242. REMOVING. *(Parenthesized numbers refer to callouts on figure 4—37.)*

a. Enter the cockpit and close sliding section.

b. Remove the springs (6) which connect the aft corners of the sliding section to the aft roller fittings (5).

c. Detach aft roller fittings (5) from sliding section fittings by removing bolts. Roller fittings will remain within tracks when sliding section is removed.

d. Detach front roller fittings (1) from sliding section fittings by removing nuts (11). Roller fittings will remain within tracks when sliding section is removed.

e. Lift sliding section from airplane.

4—243. DISASSEMBLY. *(See figure 4—37.)* Remove Plexiglas window (3) from formers (10) by removing bolts (8), detaching retainers (4) and tape. It is not necessary to remove the sliding section from the airplane in order to remove Plexiglas from sliding section frame.

4—244. ASSEMBLING.

a. Place the replacement window over the sliding section formers so that the edges of the window are flush with the bottom edges of the formers.

b. Drill pilot holes through the Plexiglas window from the inside of the sliding section with a 3/32 inch drill, using the formers as jigs. A 3/16 inch fiber bushing with a 3/32 inch hole in it may be inserted into the holes in the formers and used as a drill guide.

c. Remove the Plexiglas and redrill through the pilot holes, using a 5/16 inch drill for all holes.

d. Install the Plexiglas, placing fresh strips of Spec. N-9 Class A or B tape between the replacement Plexiglas and the formers and retainers, so that no metal touches the Plexiglas.

e. Fill the joint between the Plexiglas and retainers with "Aluminastic" compound after installation.

4—245. INSTALLING AND ADJUSTING. *(See figure 4—37.)* Two men will be required to lift the sliding section and to drop it over the roller fittings which remain in the tracks. To adjust the sliding section properly upon installation, proceed as follows:

a. Pin rear rollers in neutral position.

b. Rotate nut (12) at front roller fitting, to move canopy up or down until leading edge of canopy lines up with windshield at top center line.

c. If necessary, move rear end of cabin up or down by means of the vernier adjustment on rear rollers until cabin hoop lies snugly against windshield hoop.

d. Make final adjustment as required at front rollers before tightening nut (11) to secure front roller fitting.

4—246. CLEANING. For cleaning of Plexiglas surfaces, refer to paragraphs 4—1901 through 4—1904.

4—247. COCKPIT CABIN SLIDING SECTION—NORMAL OPERATING MECHANISM.

4—248. DESCRIPTION. *(See figure 4—38.)* The cockpit cabin sliding section normal operating mechanism is actuated by a cockpit control handle (22) located on the forward left hand side of the cockpit. The cockpit control handle has five positions: "CLOSE," "STOP," "OPEN," "MANUAL," and "EMERGENCY." Three lines run from the cockpit control handle levers: one runs to the external control pull ring (1) on the right hand side of the airplane, the second runs to the safety stop lever (6) located in the track on the right hand side of the cockpit, and the third runs to the canopy control valve located aft of bulkhead 186. A connection with the emergency compressed air bottle permits operation of the sliding section in event of failure of the hydraulic system. Refer to paragraphs 4—1168 through 4—1193 for additional information on emergency operation.

4—249. FUNCTION. Pulling the external pull ring (1) on the right side of the airplane actuates a lever inside the airplane which picks up the cockpit control handle (22) and rotates it to the "MANUAL" position. The external pull ring when released will return to its original position, leaving the cockpit control handle in the "MANUAL" position. When the cabin has been closed from the outside, the control system is always left in "MANUAL"; therefore, the use of the external pull ring for opening is necessary only in the case of a crash landing when the cockpit control handle has been left in the "CLOSE" position. To close the cabin from the inside, the control handle is normally placed in the "CLOSE" position. In doing so, the safety stop lever (6) in the track is depressed, clearing the track. To close the cabin from the outside, pull the external pull ring or place cockpit handle in "MANUAL" position and depress the safety stop manually. Pull cabin forward. The cabin is held closed by hydraulic pressure. If the hydraulic system fails, a check valve in the pressure line prevents loss of hydraulic fluid and provides an emergency hydraulic lock. To open the cabin from the inside, the control handle is normally placed in the "OPEN" position. For an intermediate position, the control handle is moved from "OPEN" to "STOP" when the desired position is reached. The actuating cylinder is hydraulically locked in the "STOP" position. For complete hydraulic information, refer to paragraphs 4—1150 through 4—1194.

4—250. TROUBLE SHOOTING. *(See figure 4—38.)*

1. External Pullring
2. External Release Housing
3. R. H. Forward Cable Assembly
4. Idler Pulley
5. Safety Stop
6. Safety Stop Lever
7. Front Roller Fitting
8. Fairlead
9. Pulley (R. H. lower)
10. R. H. Aft Cable Assembly
11. Drum and Pinion
12. Rack
13. Hydraulic Actuating Cylinder
14. Pully (L. H. upper)
15. Jackshaft Lever (center)
16. Rod End
17. Telescopic Unit
18. Conduit
19. Telescopic Unit
20. Rod End (Hydraulic Actuating Cylina
21. Sliding Section Control Shelf
22. Cockpit Control Handle
23. Spring
24. Control Unit Levers
25. Rod End (safety stop)
26. L. H. Forward Cable Assembly
27. Cable (External Release L. H.)
28. Pulley
29. Tube
30. Clevis
31. Lever Assembly
32. Pulley
33. Lever
34. Fairleads
35. Lower Cable Assembly
36. Fairlead
37. Cable (External Release No. 1, R.H.)
38 Forward Pulley
39. Pulley
40. Cable
41. Check Nuts
42. Emergency Air Valve Actuating Screw
43. Emergency Air Valve Jackshaft Lever
44. Emergency Air Valve
45. Boot and Plate
46. Lever Bracket
47. Bracket Assembly
48. Bulkhead #186 (ref.)
49. Jackshaft Lever (lower)
50. Lever Assembly — External Release
51. Cable (External Release No. 2, R.H.)
52. Canopy Control Valve
53. Shuttle Valve

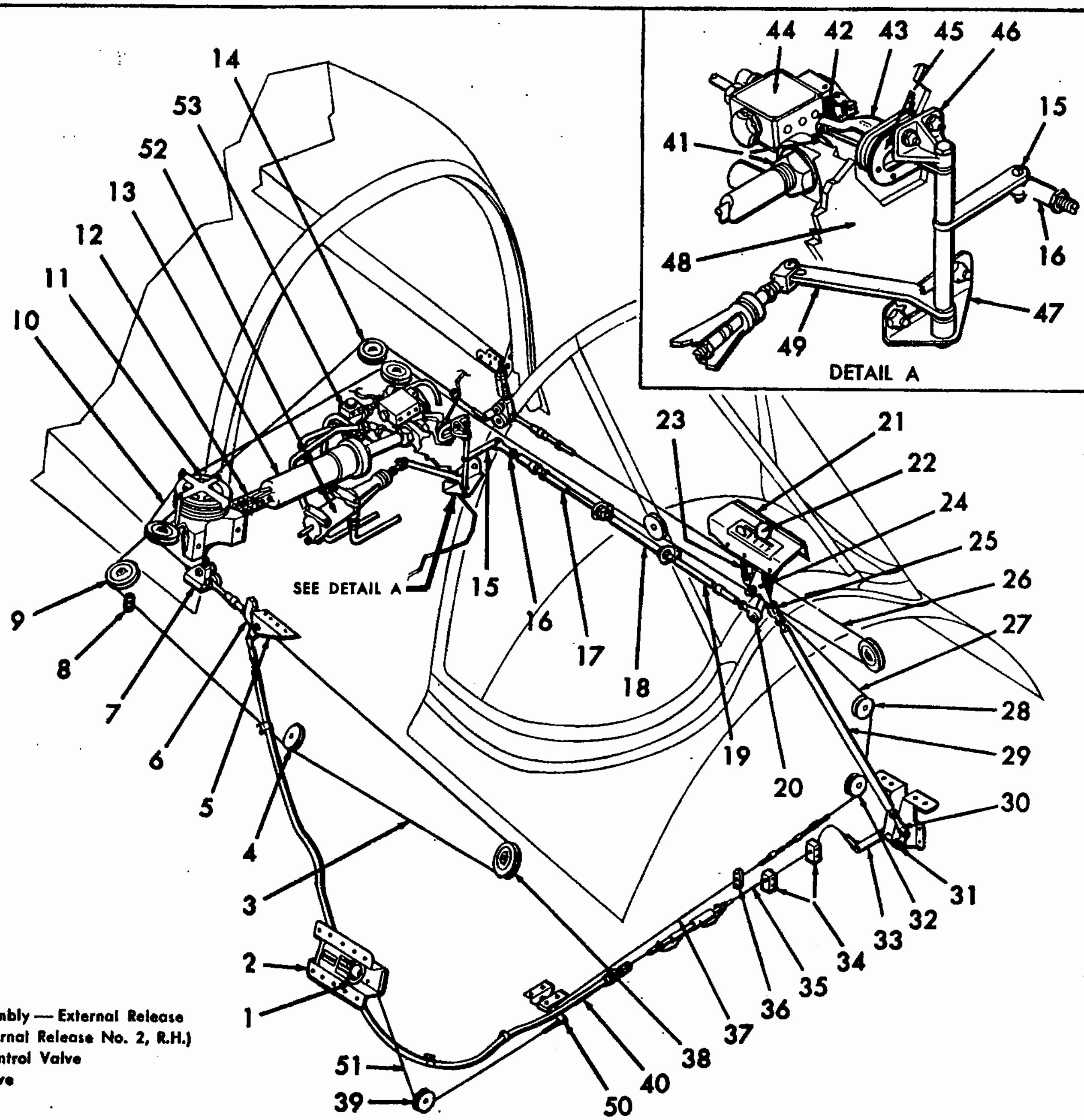


Figure 4—38. Cockpit Cabin Sliding Section — Normal Operating Mechanism.

Trouble	Probable Cause	Suggested Remedy
Cabin control handle cannot be moved to "CLOSE" position.	*a.* Interference between cabin stop and roller.	*a.* Pull handle momentarily to "OPEN" to relieve interference.
Cabin operates slowly or not at all.	*a.* Hydraulic failure.	*a.* Refer to Hydraulic System, paragraphs 4—1150 through 4—1194.
Cabin fails to open or to close completely.	*a.* Check nuts (41) not properly positioned.	*a.* Adjust check nuts (41); refer to paragraph 4—259.
	b. Adjusting screw (44) not properly adjusted.	*b.* Adjust screw (44). Refer to paragraph 4—259.
Cabin fails to operate smoothly.	*a.* Rack needs greasing.	*a.* Grease rack. Refer to paragraph 4—257.
Emergency system fails to operate.	*a.* Screw (42) not adjusted to actuate valve.	*a.* Adjust screw (42). Refer to paragraph 4—259.

4—251. REMOVING AND DISASSEMBLY.

4—252. REMOVING COCKPIT CONTROL. *(See figure 4—38.)*

a. Disconnect rod end (25) leading to the safety stop, spring (23) leading to the external control, and rod end (20) leading to the hydraulic actuating cylinder from the control unit levers (24) located on the left hand side of the cockpit.

b. Remove two screws from the inboard vertical side of sliding section controls shelf (21).

c. Remove shelf from angle by removing four screws.

d. Remove handle assembly (22) from support by removing two bolts. If necessary, remove the cotter pin and nut from the shaft, thereby disassembling the component parts of the cockpit control assembly.

4—253. REMOVING EXTERNAL RELEASE INSTALLATION. *(See figure 4—38.)*

a. Remove spring (23) from cable end by removing bolt.

b. Remove cable (27) from cutout in bracket.

c. Remove two pulleys (28) and (32) from brackets between stations 149 and 154 by removing bolts, and disconnect cables from pulleys. Remove brackets, if necessary.

d. At centerline of airplane approximately, disconnect left hand and right hand sections of cable (27) and (37) respectively, from the barrel.

e. Disconnect cable from fairlead (36) located underneath the floor.

f. Disconnect left hand and right hand sections of cables (37) and (51) respectively, from the lever arm of the lever assembly (50), by removing the bolts. Remove the lever assembly and brackets if necessary.

g. On the right hand side of the airplane, remove pulley (39) from brackets by removing bolt, and disconnect cable. Brackets may be removed, if necessary.

h. Remove cable from external pull ring (1) by disconnecting at the terminal. Remove the external pull ring (1) from the housing (2) on the right hand side of the fuselage, if necessary, by drilling out rivets from support and housing, turning the ring and slipping it from the slot on the inboard side of the housing.

i. The housing (2) and access door are not intended to be removed, but may be removed if necessary, by drilling out attaching rivets.

j. Remove bolt to disconnect the spring from the access door in the housing.

4—254. REMOVING SLIDING SECTION SAFETY STOP. *(See figure 4—38.)*

a. Remove clevis (30) on lower end of tube (29) from lever assembly (31) on bracket by removing bolt, the upper end having been previously disconnected in paragraph 4—252.

b. Disconnect lever assemblies by removing bolt and spacer.

c. Disconnect lower cable assembly (35) from lever (33) by removing bolt.

d. Disconnect cable assemblies at turnbuckle near the centerline of the airplane and remove cable from two fairleads (34).

e. Disconnect cable assembly from channel under floor by removing nuts beneath the right hand console, and from frames by removing screws and clamps.

f. Remove upper end of cable from safety stop lever (6) by removing bolt.

g. Remove lever assembly (5), (6) from the longeron and track by removing four bolts and four screws.

4—255. REMOVING CANOPY CONTROL VALVE —EMERGENCY AIR VALVE CABLE AND JACKSHAFT INSTALLATION. *(See figure 4—38.)*

a. Remove rod end (20) from the cockpit control end of the telescopic unit (19), leading from cockpit handle to cylinder. The rod end was disconnected from the cockpit control in paragraph 4—252.

b. Remove telescopic unit (19) from the forward side of bracket at station 162 and disconnect conduit (18) attached to the aft end of telescopic unit.

c. Remove conduit from bracket at station 174 and disconnect the second telescopic unit (17).

d. Brackets may be removed, if necessary, by removing screws.

e. Remove the rod end (16) from the center jackshaft lever (15) just forward of bulkhead 186 by removing bolt.

f. Disconnect lower jackshaft lever (49) from canopy control valve by removing bolt which secures lever to fork-end fitting on valve.

g. Remove center and lower jackshaft levers (15,49) from lever bracket (46) and bracket assembly (47) by removing shaft bolt.

h. Remove lever bracket (46) and bracket assembly (47) from bulkhead 186 by removing the two bolts which secure each unit in place.

i. Remove clamp and screw from emergency air valve jackshaft lever (43) where it passes into boot (45). Remove lever.

j. Remove boot and plate (45) by removing six screws.

4—256. REMOVING DRUM AND PINION AND CABLE ASSEMBLIES. *(See figure 4—38.)*

a. Remove canopy actuating cylinder as directed in paragraph 4—1154.

b. Remove bolt from separating bearing, and slip rack (12) from drum and pinion (11).

c. Disconnect left forward cable assembly and stop (26) and right aft cable assembly and stop (10) from the drum.

d. Remove drum and pinion assembly (11) from bulkhead 186 by removing two bolts.

e. Remove right forward cable assembly (3) from fairlead (8) from right lower pulley (9) and from left upper pulley (14) on bulkhead 186.

f. Remove pulleys, if necessary, by removing bolts. Brackets may be removed from bulkhead 186 if necessary, by removing bolts.

g. Disconnect right hand control cable (3) from idler pulley (4) located in brackets on the frame at station 165. Pulley and brackets may be removed by removing their attaching bolts, if necessary.

h. Remove cable (3) from forward pulley (38) and spacers located on the longeron at approximately station 152 1/2. Pulley and spacers may be removed, if necessary, by removing bolt.

i. Remove cable (3) from forward end of aft roller fitting (7) by removing bolt.

j. Remove cable (10) from aft end of roller fitting (7) by removing bolt.

k. Remove left hand cable in the same manner by disconnecting it from two pulleys on bulkhead 186, from pulley at station 165, from forward pulley, and from rollers.

4—257. LUBRICATING.

a. Grease the sliding section operating rack by hand with low temperature grease, Spec. AN-G-25.

b. Oil all friction points on the sliding section operating mechanism with general purpose low temperature oil, Spec. AN-0-6.

c. Do not oil or grease the cabin track. Clean daily with kerosene.

4—258. ASSEMBLING AND INSTALLING. Assemble and install the cockpit cabin sliding section normal operating mechanism by reversing the procedure given in paragraphs 4—251 through 4—256.

CAUTION

In installing Teleflex controls the procedure given in paragraphs 4—602 through 4—604G must be followed exactly. Also see paragraph 6—65.

4—259. ADJUSTING. *(See figure 4—38.)*

WARNING

Paragraphs 4-247 through 4-259 contain cockpit cabin sliding section information applicable to airplanes Bu. Nos. 121793 through 121902. DO NOT ATTEMPT ADJUSTMENT ON SUBSEQUENT AIRPLANES PER INSTRUCTIONS IN PARAGRAPH 4-259. Information concerning revised cockpit cabin sliding section installation on subsequent airplanes will be contained in a forthcoming revision.

a. Prior to adjustment make certain that hydraulic power is off and that the emergency air bottle is disconnected from system. The jackshaft lever (49) which actuates the canopy control valve should also be disconnected.

b. Adjust canopy restrictor valve to a minimum opening to prevent excessively quick opening and closing of canopy when hydraulic power is turned on. To do this, bottom adjusting screw on side of restrictor, then turn out very slightly. The restrictor valve is located just below the canopy control valve in the return line.

c. Position actuating cylinder check nuts (41) to provide equal adjustment in either direction of cylinder. Rack (12) at opposite end of cylinder should be detached from drum and pinion.

d. Set drum (11) so that index mark on drum is positioned approximately aft with canopy fully open. Rig drum actuated cables to 100 pounds tension.

e. Attach rack (12) to drum (11) with actuating cylinder bottomed in retract position. Adjust check nuts (41) if necessary.

f. Using 500 psi hydraulic pressure supplied by an external power source, close the canopy by actuating the canopy control valve slider rod by hand. A good windshield to canopy joint should be obtained. The actuating cylinder should be completely extended and bottomed. In event that the piston does not bottom after all possible adjustment of the check nuts (41) has been made, refer to paragraph 4–1160 for internal cylinder adjustment.

g. After adjustments are completed, open and close the canopy hydraulically for a final check, making certain that the actuating cylinder bottoms in both the retract and extend positions. Failure of the cylinder to bottom in either position will cause severe loads to be transmitted to the cables.

h. Turn off hydraulic power and proceed to adjust the canopy control valve cables in the following steps. Jackshaft lever (49) must be detached from the control valve slider rod.

i. Place control handle in "CLOSE" position. Adjust Teleflex cables leading from control handle to jackshaft so that LOWER jackshaft lever (15) is parallel to bulkhead 186. To accomplish this, lengthen or shorten Teleflex cable as required at telescopic end fittings which connect to the control handle (22) and to jackshaft lever (15).

WARNING

To attach telescopic units to end fittings and to insure that Teleflex cables are properly locked, observe procedure in figure 4–72.

j. Connect rod end at end of control valve slider to lower jackshaft lever (49).

The control valve slider arm must be bottomed in the "CLOSE" (fully in) position. If adjustment is required, disconnect rod end of slider from jackshaft lever (49) and thread rod end in or out as required.

k. Using 500 psi hydraulic pressure supplied by an external source, move cockpit control handle to the "OPEN" position. Canopy should open in 3 to 5 seconds. Adjust the restrictor located below the control valve in the return line if necessary.

l. Bring control handle back until it touches tab. The emergency air valve actuating screw (42) should barely touch contact point on emergency air valve. Screw may be adjusted if required to accomplish this.

m. Place control handle in the "EMERGENCY" position and check to see that actuating screw (42) on jackshaft lever actuates the emergency air valve arm. Bring control handle to "OPEN" position and make certain that air valve arm returns to normal position (air valve closed). Turn off hydraulic power. Emergency air bottle may now be connected into system.

4–260. COCKPIT CABIN SLIDING SECTION EMERGENCY OPERATION.

4–261. DESCRIPTION. For emergency operation of the canopy, the latch adjacent to the control handle is released and the control pulled aft to the "EMERGENCY" position. This action, places the canopy control valve in the "EMERGENCY" position and at the same time actuates the air valve. Refer to paragraph 4–1168 through 4–1193 for additional information on the cockpit cabin sliding section emergency compressed air system.

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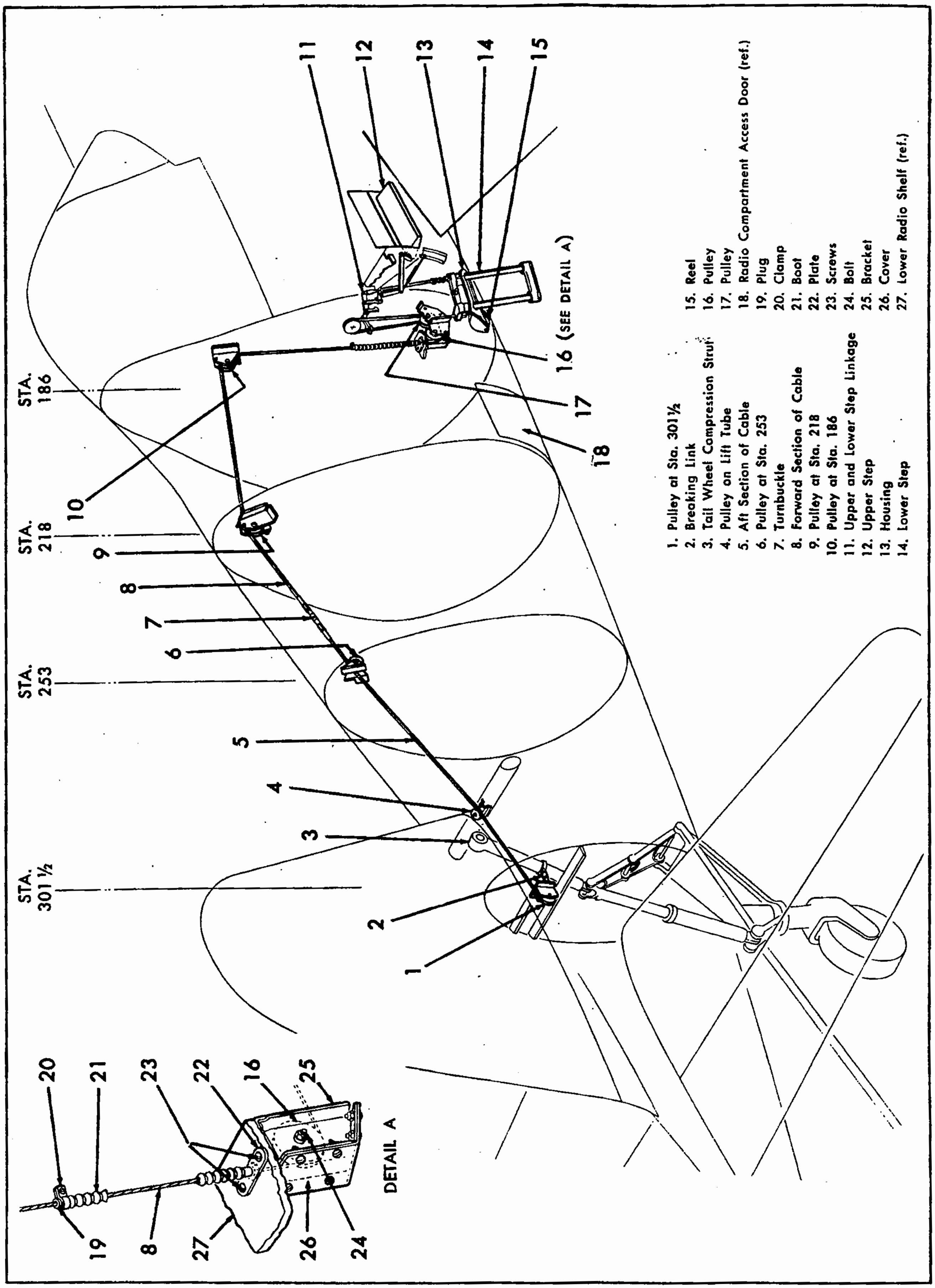


1. Pulley at Sta. 301½
2. Breaking Link
3. Tail Wheel Compression Strut
4. Pulley on Lift Tube
5. Aft Section of Cable
6. Pulley at Sta. 253
7. Turnbuckle
8. Forward Section of Cable
9. Pulley at Sta. 218
10. Pulley at Sta. 186
11. Upper and Lower Step Linkage
12. Upper Step
13. Housing
14. Lower Step
15. Reel
16. Pulley
17. Pulley
18. Radio Compartment Access Door (ref.)
19. Plug
20. Clamp
21. Boot
22. Plate
23. Screws
24. Bolt
25. Bracket
26. Cover
27. Lower Radio Shelf (ref.)

Figure 4—39. Cockpit Access Steps Reference Diagram.

4–262. COCKPIT ACCESS STEPS.

4–263. DESCRIPTION. *(See figure 4–39.)* Two steps are provided on the right hand side of the fuselage for access to the cockpit. The action of the steps is controlled by the tail gear. When the tail wheel is retracted, the steps are retracted; when the tail wheel is extended, the steps are extended. With the tail wheel extended, it is possible to push the bottom step manually to the stowed position from outside the cockpit. This action automatically closes the top step. Likewise, it is possible to operate the top step by hand or by foot, thus automatically dropping the bottom step. A mechanic's step is provided on the left hand side of the fuselage at approximately station 170, to permit the mechanic to leave the cockpit while the pilot enters from the right hand side. A spring-loaded door, directly above the step is depressed by the mechanic's toe and the step pushed to the horizontal position by the mechanic's foot. A spring-loaded lever returns the step to the closed position when it is not in use.

4–264. FUNCTION.

4–265. FUNCTION–TAIL WHEEL RETRACTED. When the landing gear is retracted, a cable attached to the tail wheel compression strut is pulled aft, a split clamp on the cable raises and holds the lower step up, and a sleeve on the cable engages the lock lever, thus preventing the lock from engaging the step. The upper step is closed by the interconnecting linkage, actuated by the lower ladder step through the ejector spring.

4–266. FUNCTION – TAIL WHEEL EXTENDED. When the landing gear extends, the cable slackens and the lower ladder step is ejected for a short distance, gravity and use extending it fully. The upper step is sprung open. The slack in the cable is taken up by a spring-loaded drum.

4–267. MANUAL EXTENSION AND RETRACTION. With the tail wheel extended, the steps may be retracted by hand by pushing the lower step up. This action retracts the upper step and engages the spring-loaded latch. The steps may be extended after manual retraction by pulling the upper step out, thereby disengaging the latch and ejecting the lower step. A spring holds the upper step open. Should the airplane take off with the step manually extended, retraction of the tail wheel will automatically retract both steps.

4–268. TROUBLE SHOOTING.

Trouble	Probable Cause	Suggested Remedy
Steps fail to open.	*a.* Reel is jammed.	*a.* Replace or reload reel. Refer to paragraph 4–275 for reel loading procedure.
Upper step fails to close.	*a.* Turnbuckle fork improperly adjusted.	*a.* Lengthen or shorten turnbuckle fork as required.
Sliding step rung extends below housing in "up" position.	a. Set screw improperly adjusted. *b.* Cable clamp located incorrectly.	*a.* Adjust set screw in housing. *b.* Adjust clamp on cable.

4–269. REMOVING FORWARD SECTION OF CABLE. *(Parenthesized numbers in steps a. through f. refer to callouts on figure 4–39.)* With tail wheel extended and access steps in down position, work through tail wheel door and proceed as follows to remove the forward section of the cable:

a. Disconnect forward and aft sections of the cable (8), (5) at the turnbuckle (7). Access may be gained through the radio compartment access door (18).

b. Remove pulleys (9), (10) from brackets at station 218 and from the upper part of bulkhead 186 by removing the screws. If necessary, pulley brackets may be removed by removing screws and rivets. Free cable from pulleys.

c. Remove the clamp (20) and plug (19) from the upper end of the boot (21) and cable (8) by removing screw. Disconnect boot by removing screws (23) and plate (22).

d. Remove cover (26) from bracket (25) on bulkhead 186 by removing screws. Remove pulley (16) from cover by removing the bolt (24).

e. Pull cable through boot and through bulkhead to the cockpit section.

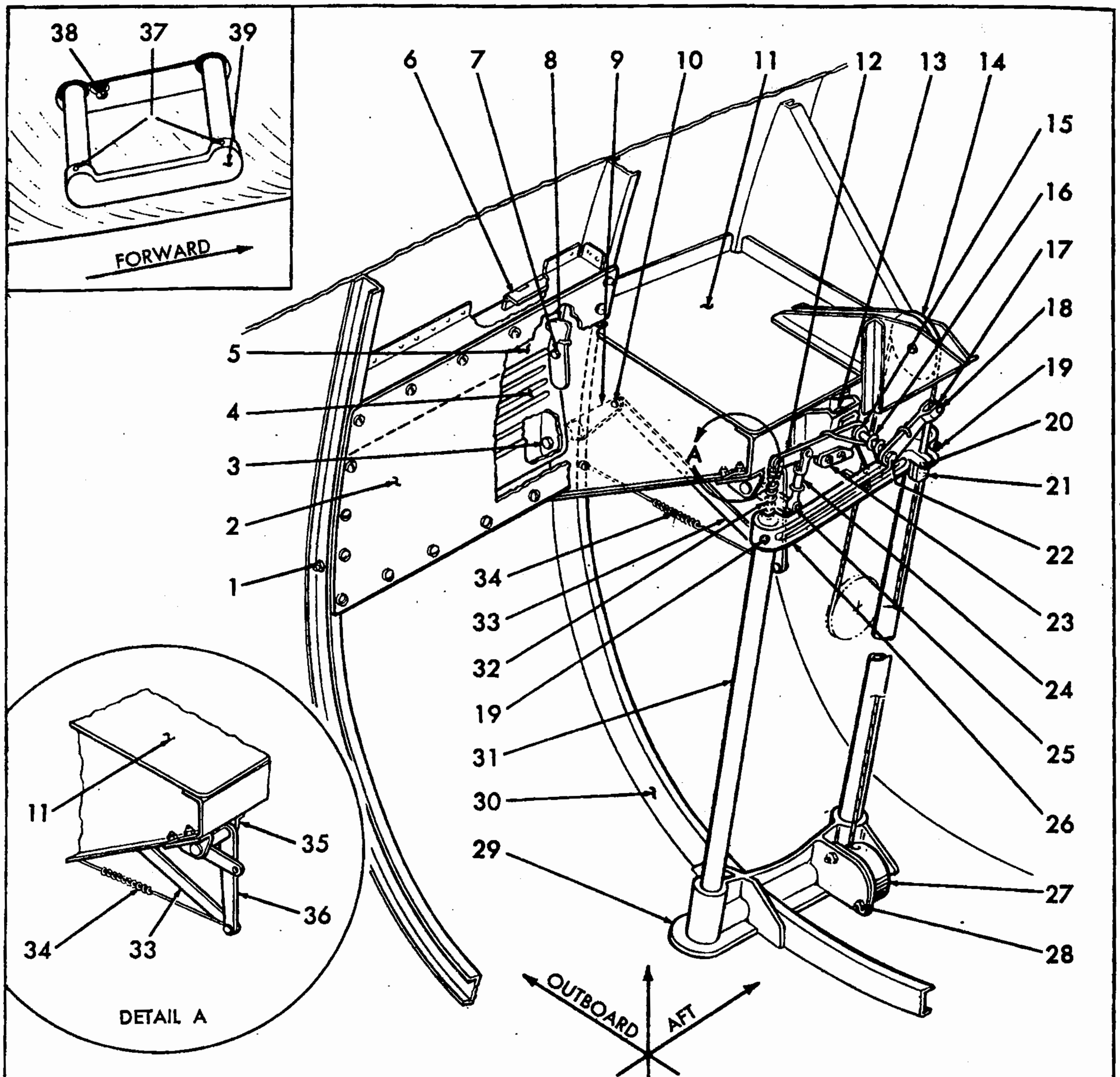
f. Remove pulley (17) just forward of bulkhead 186 from bracket by removing bolt. Free cable from pulley. Access may be gained by removing pilot's seat (see paragraph 4–1543) and the canvas floor.

g. If necessary, disconnect pulley and guide (14) by removing bolt. Remove cable from pulley. (Refer to figure 4–40 for identification of callouts in steps g. through i.)

h. Remove pins (18), (20) from lever assembly (17) and from tie bar (26) in order to free cable.

i. Remove spring-loaded reel assembly (27) from housing (29) by removing two nuts and washers (28). Do not remove bolts. Replace nuts and washers after removing reel from housing to prevent accidental unloading of reel. Refer to paragraphs 4–274 and 4–275 for disassembly and loading of reel in case of jamming or fraying of the cable.

j. Withdraw forward section of cable, together with reel, from airplane.



1. Bolt	14. Pulley and Guide	27. Reel Assembly
2. Fumeproofed Cover Plate	15. Hook	28. Nuts and Washers
3. Nut	16. Spring	29. Housing
4. Upper Step Assembly	17. Lever Assembly	30. Frame
5. Upper Step Door	18. Pin	31. Slide Tube
6. Piano Hinge	19. Bolts	32. Tube Assembly
7. Bolt	20. Pin	33. Link
8. Ejector Lever Assembly and Spring	21. Clamp	34. Spring
9. Lever	22. Bolt	35. Angles
10. Pin	23. Stop	36. Lever Assembly
11. Support	24. Clevis	37. Pins
12. Lever	25. Fork	38. Set Screw
13. Nut, Washer, Plates and Spacer	26. Tie Bar	39. Rung

Figure 4—40. Cockpit Access Step Mechanism and Linkage.

4—270. REMOVING UPPER STEP. *(Parenthesized numbers refer to callouts on figure 4—40.)*

a. Remove fumeproofed cover plate (2) from inside of upper step by removing screws.

b. Remove upper step door (5) by pulling out piano hinge wire (6).

c. Disconnect lever (9) of upper step assembly (4) from linkage by removing pin (10).

d. Remove lever (9) from aft end of step and frame by removing nut (3) and pulling out shaft and key.

e. Remove bolt (1) attaching the forward end of step to frame and remove step.

f. Ejector lever assembly and spring (8) may be removed, if necessary, by removing bolt (7).

4—271. REMOVING LINKAGE. *(Parenthesized numbers refer to callouts on figure 4—40.)*

a. Remove fork (25) from lever assembly (36), and clevis (24) from lever (12) by removing pins. Disassemble fork and clevis, if necessary.

b. Disconnect spring (34) from frame (30) by removing screw, and from lever assembly (36) by removing pin.

c. Disconnect link (33) from lever assembly (36) by removing pin.

d. Disconnect lever assembly (36) from support (11) by removing bolts from angles (35).

e. Disconnect lever (12) of linkage assembly from tube assembly (32) by removing pin.

f. Remove nut, washer, plates and spacer (13) from support (11), in order to remove lever (12), stop (23), lever assembly (17), and spring (16), as a unit.

g. Pull bolt (22) in order to disassemble parts removed as a unit in preceding step.

4—272. REMOVING LOWER STEP. *(Parenthesized numbers refer to callouts on figure 4—40.)*

a. Remove tube and spring (32) from slide tube (31).

b. Remove two bolts (19) from tie bar (26). Slip tubes from airplane. Remove pins (37) to disconnect rung.

c. The housing (29) may be removed, if necessary, from the fuselage panel, by removing rivets and bolts.

4—273. REMOVING AFT SECTION OF CABLE. *(Parenthesized numbers refer to callouts on figure 4—39.)*

a. Release the aft end of the cable by disconnecting the cable at the breaking link (2) on the tail wheel compression strut (3).

b. Remove pulleys (1), (4) and (6) from the support bracket at station 301 1/2, from fitting on the upper surface of the lift tube and from bracket at station 253 by removing the attaching bolts. The brackets may be removed, if necessary.

c. Withdraw the aft section of the cable (5) from the airplane.

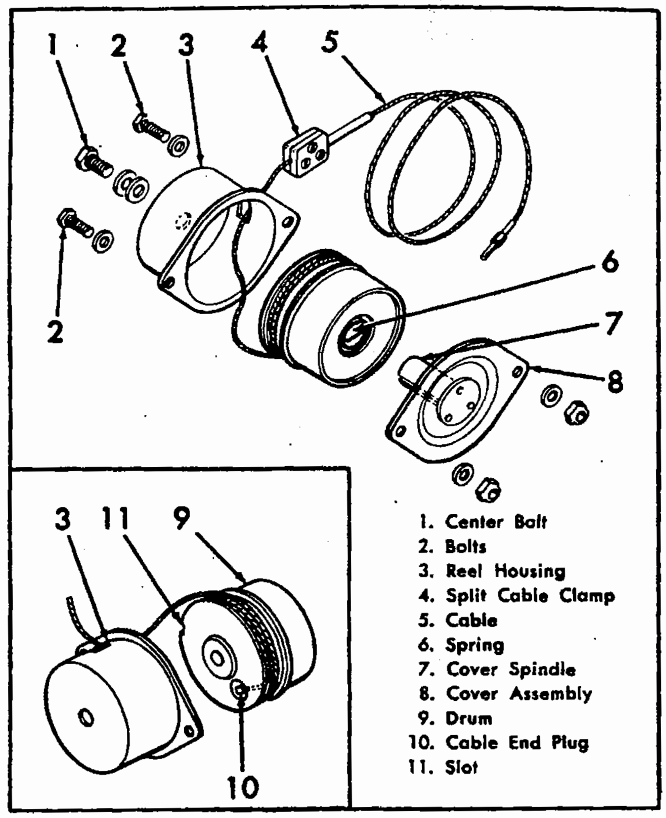


Figure 4—41. Loading Reel — Step Mechanism.

4—274. DISASSEMBLY OF REEL. *(Refer to callouts on figure 4—41, except as noted.)*

Note

Disassemble reel, only if reel is jammed or cable frayed, and no preloaded reel is available for replacement.

a. Remove reel (27) from housing (29) by removing nuts and washers (28). (Refer to figure 4—40.)

b. Remove bolts (2) from reel housing (3), holding housing and drum (9) firmly to prevent spring-loaded reel from unwinding during removal.

c. Carefully unwind spring-loaded reel.

d. Remove drum from housing by removing center bolt (1).

e. Remove cable (5) from drum by disconnecting cable end plug (10).

4—275. LOADING REEL. *(Parenthesized numbers below refer to callouts on figure 4—41.)*

a. Install and stake cable end plug (10) at three points in drum assembly (9).

b. Wrap cable around drum and pass cable through 3/16 inch slot (11) in drum wall ridge prior to sliding drum assembly into housing (3).

c. Assemble cover assembly (8) to drum and housing, inserting inner end of spring (6) into slot of cover spindle (7). Secure with center bolt (1) only.

d. Wind up cable two and one-half turns by rotating cover counterclockwise when facing cover. At required two-and-one-half turns, 3/16 inch slot (11) shall be visible through cable cutout in housing.

e. Secure split cable clamp (4) to cable in contact with housing.

f. Wind up spring (6) by continuing motion started in step d. until spring bottoms (approximately five and three-quarter turns); then back off two-and-one-half turns (plus 3/8 minus 1/8 turns).

g. Install two bolts (2), securing cover to housing. Bolts have excess length to accommodate installation in airplane.

4—276. LUBRICATING.

a. Do not oil or grease slide tubes.

b. Grease all other pivot points with Spec. AN-G-25 grease as necessary on installation.

4—277. INSTALLING AFT SECTION OF CABLE. *(See figure 4—39.)*

a. Install pulleys (1), (4), (6) and cable (5) on the support bracket at station 301 1/2, on the fitting on the upper surface of the lift tube, and on bracket at station 253 by inserting bolts.

b. Connect aft end of cable at the breaking link (2) to clamp on the tail wheel compression strut (3) by means of bolt.

4—278. INSTALLING LOWER STEP. *(See figure 4—40.)*

a. Install rung (39) on slide tubes (31) using pins (37). Install rung in housing (29) and fasten tie bar on tubes using bolts (19).

b. Insert tube and spring (32) in slide tube (31).

4—279. INSTALLING LINKAGE. *(See figure 4—40.)*

a. Assemble lever (12), stop (23), lever assembly (17), spring (16), and spacer and plates (13) as a unit by inserting bolt (22).

b. Install linkage unit on support (11) by securing nut and washers.

c. Install lever (12) of linkage assembly on tube assembly (32) by means of pin.

d. Install lever assembly (36) on support (11) by installing angles (35).

e. Connect link (33) and lever assembly (36) by means of pin.

f. Assemble fork (25) and clevis (24), if previously disconnected, and install fork (25) on lever assembly (36) and clevis (24) on lever by inserting pins.

g. Install spring (34) on frame (30) by means of screw, and on lever (36) by means of pin.

4—280. INSTALLING UPPER STEP. *(See figure 4—40.)*

a. Replace ejector lever assembly and spring (8), if previously removed.

b. Install bolt (1) attaching forward end of step (4) to frame.

c. Install lever assembly (9) on aft end of step and attach step to frame by inserting key and shaft and tightening nut (3).

d. Connect lever (9) of step assembly with linkage by means of pin (10).

e. Install upper step door (5) by inserting piano hinge wire (6).

f. Install cover plate (2) on inside of step by means of screws. Refer to paragraph 4—301 for fumeproofing information.

4—281. INSTALLING FORWARD SECTION OF CABLE. *(Refer to figure 4—40 except as noted.)*

a. Remove nuts and washers (28) from preloaded reel (27) and install reel on housing (29). Do not permit bolts to slip from reel thereby unwinding spring during installation.

b. Pass cable through tie bar (26) of slide assembly (31) and secure with pin (20).

c. Pass cable through lever assembly (17) and secure within linkage by means of pin (18).

d. Install one pulley (14) in guide. Install one pulley (callout 17 on figure 4—39) in bracket just forward of bulkhead 186, using bolts.

e. Pass cable over pulleys installed in preceding step.

f. (Callouts in steps f. through j. refer to figure 4—39). Install cover (26) and bracket (25) on bracket assembly aft of station 186 using screws and pulley bolt (24).

g. Install boot (21) and plate (22) on floor (27) by inserting screws (23). Pass cable (8) through boot. Install clamp (20) and plug (19) on upper end of boot and cable, using screw. Refer to paragraph 4—301 for fumeproofing information.

h. Install pulleys (10) and (9) on brackets located on the upper part of bulkhead 186 and at station 218 by inserting screws.

i. Pass cable over pulleys installed in preceding step.

j. Connect forward and aft sections of cable (8) and (5) at turnbuckle (7) and safety. Adjust cable tension in accordance with paragraph 4—282.

4—282. ADJUSTING. *(See figure 4—40.)*

a. Sliding step rung is adjusted with fuselage skin by means of a set screw (38) in housing.

b. Slide hook (15) up or down as required to hold slide assembly in retracted position, before tightening bolt (22).

c. Adjust stop (23) to touch hook.

d. Adjust turnbuckle fork (25) to insure closing of folding step.

e. Check clearance between clamp (21) and tie bar (26) and if necessary, move clamp along cable, plus or minus three inches from its original position on reel assembly in order to maintain clearance of 1/8 inch between clamp and tie bar. Adjust clamp on compression strut so that sliding step is flush when tail wheel is retracted.

CAUTION

In case of failure of the breaking link (2) at aft end of the cable, do not replace link with one of a different type; (see figure 4—39). The system is designed to withstand stress up to breaking point of this link, and strengthening of the breaking link may result in serious structural failure, since its breakage indicates incorrect operation or adjustment of system.

4—283. FUSELAGE MID-SECTION.

4—284. DESCRIPTION. *(See figure 4—34.)* The fuselage mid-section extends from station 186 to station 288 and is strengthened structurally by four bulkheads located at stations 186, 218, 253, and 288. Bulkhead 186 incorporates armor plating for protection of pilot's head and back and is sealed to prevent entrance of carbon monoxide into cockpit. Refer to paragraph 4—298 for additional information of fumeproofing of bulkhead 186. Steel longerons reinforce top centerline of aft turtledeck. The radio compartment, located between stations 186 and 218, is provided with upper and lower Metalite shelves which accommodate radio equipment and in addition take fore and aft seat loads. The Metalite decks permit addition of mounting holes for new radio equipment without weakening structure. Easy access to mid-section equipment has been provided on right hand side of airplane by a radio compartment access door and step. A small Metalite floor on bottom panel adjacent to door provides additional service accessibility. Provisions are incorporated for possible future installation of an aerial camera aft of station 218. The lift tube is located between stations 281 and 288. The compressed air bottle for emergency operation of sliding canopy is located on frame at station 193 1/2. The static vent installation is located on left hand side of airplane between stations 253 and 260. A special bolt is installed on a plate attached to frames at station 199 1/2 and 205 1/2 for plumb bob level suspension and a target scale is installed directly beneath bolt. The installation is jigged at factory and should not be disturbed. Refer to paragraphs 3—28 through 3—31 for further information on longitudinal and lateral leveling of airplane.

4—285. RADIO COMPARTMENT ACCESS DOOR.

4—286. DESCRIPTION. *(See figure 4—42.)* The radio compartment access door is located on right hand side of airplane between stations 199 1/2 and 218 and provides easy access to radio and baggage compartment, heater installation, surface controls, hydraulic lines and miscellaneous other items. The door is hinged at its lower end to fuselage structure. It is opened by depressing four push button type latches. Two cables are attached to fore and aft step ends of door and to fittings on fuselage structure. When door is in open position, cables provide support for door and Metalite step tread on door. A small Metalite floor is located on fuselage bottom panel adjacent to door to provide a firm footing for service personnel. A decalcomania on exterior of door indicates "ACCESS DOOR" and another decalcomania indicates "STEP." The dome light in turtledeck structure is controlled by a toggle switch adjacent to door which must be turned on by hand for mid-section working light. Should mechanic forget to turn switch off, the actuator on door will automatically turn switch off when door is closed. The door is sealed against fumes and oil with protective and waterproofing tape cemented to the forward, aft and top sides, and strip cemented to the hinge and to the fuselage frame at station 199 1/2.

4—287. REMOVING. *(See figure 4—42.)*

a. Open the radio compartment access door (7) by depressing flush latches (2).

b. Disconnect the cables (3) from the supports (4) on the door. The cables may be disconnected from the fittings on the fuselage mid-section, if necessary.

c. Remove the piano hinge wire (1) and lower the door from the airplane.

4—288. INSTALLING. The radio compartment access door may be installed by reversing removal procedure.

4—289. ADJUSTING. Check, and if necessary, adjust lengths of cable so that they support the door and step when the door is in full open position.

4—290. FUSELAGE AFT SECTION.

4—291. DESCRIPTION. *(See figure 4—34.)* The aft section of the fuselage extends from station 288 to station 371 1/2 where the tail cone is attached. Two doors are provided on the right hand side of the airplane and one on the left hand side for access to upper and lower tail wheel mechanism. A second door is provided on the right and left hand siides for access to the fin and rudder. Bulkheads are located at stations 310 21/32, 346 5/32, and 371 1/2. Heavy fittings are provided in the aft section for attachment of the tail surfaces. Shear truss tubes provide structural reinforcement for the tail wheel and arresting hook; tail wheel and arresting hook are completely housed in the retracted position by the tail wheel doors. For information on the tail wheel, arresting gear, and tail wheel doors refer to paragraph 4—340.

4—292. TAIL CONE.

4—293. DESCRIPTION. The tail cone consists of a one piece magnesium alloy cone, attached to flange of bulkhead 371 1/2 with eighteen screws fastened in locknuts. The tail running light is located on flattened aft end of tail cone. Refer to paragraph 4—1897 through 4—1900 for maintenance of magnesium surfaces.

4—294. REMOVING.

a. Remove two screws from tail running light plate and remove plate and light assembly. Disconnect wire and jumper.

b. Remove eighteen screws from tail cone and flange of bulkhead 371 1/2. Remove tail cone.

4—295. INSTALLING. The tail cone may be installed by reversing the removal procedure.

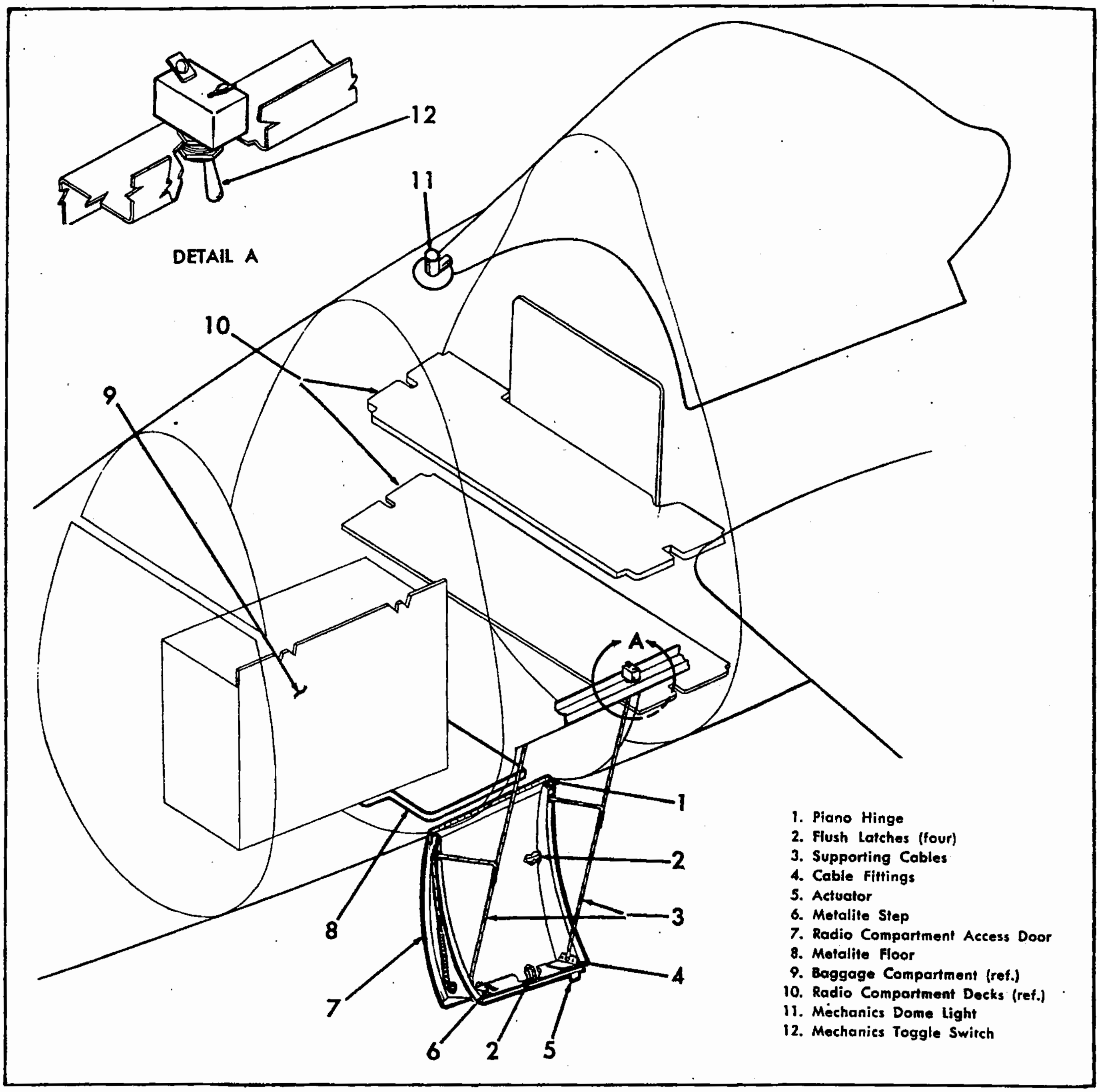


Figure 4–42. Radio Compartment Access Door.

4–296. FUMEPROOFING.

4–297. DESCRIPTION. In order to prevent the entrance of carbon monoxide into the cockpit, the airplane has been fumeproofed by sealing all holes, joints, and seams on bulkhead 186 aft of the cockpit, the firewall, main beam and shoulder, bulkhead 130 1/2–134 forward of the cockpit, and the skin area between these bulkheads.

4–298. On bulkhead 186, the areas around the cockpit access step actuating cable boot, the left and right hand rudder cable boots, the elevator push rod boot, the tail wheel lock cable boot, the arresting gear control cable boot, and the tow target release cable boot (if installed) are sealed with 3M-EC-504 Thiokol cement. The flange relief holes of the cockpit access step control cable bracket are plugged with 3M-EC-612 Thiokol putty. All bolts, nuts, rivets, screws, and areas around brackets, angles, supports, fittings, and electrical receptacles are coated with Thiokol cement. The edge of the sliding section track aft to approximately station 195 is filleted with Thiokol cement. All openings inboard of the track through the bulkhead are plugged with Thiokol putty.

The cabin control cables are fumeproofed with seals. The tail wheel hydraulic line fittings are sealed with Thiokol cement. Joints and crevicees are filleted with Presstite SS-50 bead. Refer to VS-55279 for detailed fumeproofing information on bulkhead 186.

4—299. On the aft side of bulkheads 130 1/2—134, areas around the drop tank inlet lines and the fuel tank vent lines are sealed with 3M-EC-612 Thiokol putty, as are the areas around the upper longeron. The area around the vacuum line and the fuel cell access lines is sealed with Thiokol putty and coated with 3M-EC-504 Thiokol cement on the aft side of the bulkhead. Four sealing pad and plate installations are located on the aft side where controls pass through the bulkhead. On the forward side of the bulkhead, the entire periphery, and all joints and rivets are coated with Thiokol cement. All pin holes are plugged with 3M-APS adhesive tape and a brush coat of Thiokol cement is applied. All neoprene pads and attaching screws and all rivets on the forward side of the bulkhead are coated with Thiokol cement. Presstite SS-50 bead is used around the periphery of the aft side of the web of bulkhead 130 1/2 which then is coated with Thiokol cement. All fuel lines are wrapped with neoprene tape to close the openings, sealed on the forward side of the bulkhead with Thiokol putty and coated with Thiokol cement. The area where the longerons pass through bulkheads 130-1/2—134 is sealed on both sides of the bulkhead with Thiokol putty and coated with Thiokol cement. All lines passing through the pad seals on the aft side, are sealed on the forward side with Thiokol putty and coated with Thiokol cement on both sides of the bulkhead. Refer to VS-55268 for detailed fumeproofing information on bulkhead 130 1/2—134.

4—300. On the aft side of the firewall and main beam, areas between top and bottom angles and the web are sealed with 3M-EC-612 Thiokol putty. Holes in the main beam web are plugged with 3M-EC-APS adhesive tape or equivalent and sealed with 3M-EC-504 Thiokol cement. On the forward side of the firewall and main beam, areas around fittings and blocks are sealed with Thiokol putty and coated with Thiokol cement. Four pin holes are plugged with rivets. Thiokol cement is applied around the lower edge of the firewall. A neoprene block is forced tightly against the fuel line on the left hand side of the airplane. The opening between the flange of the main beam and the former, the opening between longeron and gussets, and the area around the electrical conduit in the shoulder are sealed with Thiokol putty and coated with Thiokol cement. The aft edge of the former is coated with Thiokol cement. Refer to VS-55269 for detailed fumeproofing information on firewall and shoulder.

4—301. The external power receptacle and the front section access steps are coated with 3M-EC-504 Thiokol cement over all seams, rivets, and edges. All large openings are caulked with Presstite SS-50 compound and coated with Thiokol cement. The seams between the center section flap hinge housing and frames and skin are coated from the inside of the airplane with Thiokol cement. Two pin holes in the housing are plugged with rivets. With the housing door removed, the seams are plugged from the outside of the airplane with Thiokol cement. After hydraulic, instrument, and electrical lines have been installed, the holes on both left hand and right hand sides of the airplane are plugged with 3M-EC-612 Thiokol putty. A fillet of Thiokol cement is laid along the seams between the lower longerons and skin from stations 130 1/2 to 186. All rivets fastening longerons to the skin are coated over with Thiokol cement. Before joining front and mid-sections, the flanges of angles attaching to bulkhead 186 are coated with Thiokol cement at the factory. Refer to VS-55267 for fumeproofing information on the front section of the fuselage.

4—302. TESTING.

a. Inspect all seams and joints of bulkheads, angles, skin, and cover plates for security of sealing material. Check the covering of all rivets.

b. Inspection is accomplished with the aid of bright light held by an assistant on the opposite side of the skin or bulkhead being inspected. In the case of the firewall and forward cockpit bulkhead, this procedure is not possible unless the fuel cell is removed; therefore, a very careful visual check from one side should suffice.

4—303. INSTALLING.

CAUTION

Operator must wear gas mask when using 3M-EC-504 Thiokol cement.

a. All surfaces to be sealed must be thoroughly cleaned with clear gasoline or carbon tetrachloride before applying sealing compound.

b. Coat over all applications of 3M-EC-612 Thiokol putty with 3M-EC-505 Thiokol cement.

c. Plug form pinholes with 3M-ES-APS adhesive tape 3/4 inches wide. Coat with Thiokol cement.

d. The forward face of bulkhead 186 and aft flanges of angles attaching to bulkhead should be coated with Thiokol cement, should front and mid-sections of an airplane be joined in the field.

e. Do not cover the following drain holes in bulkhead 130 1/2—134 when sealing around longerons with Thiokol putty: 1/4 inch diameter drain holes in lower longeron web forward of station 130 1/2, 1/4 inch diameter drain holes in upper longeron forward of station 134.

f. Coat over all neoprene pads and attaching screws with 3M-EC-504 Thiokol cement.

Note

Adhesive tape 3M-EC-AFY may be used in place of 3M-EC-APS. CE-9235 fumeproofing cement may be used in place of 3M-EC-504 Thiokol cement and may be purchased from Sherwin Williams Co., Newark, N. J.

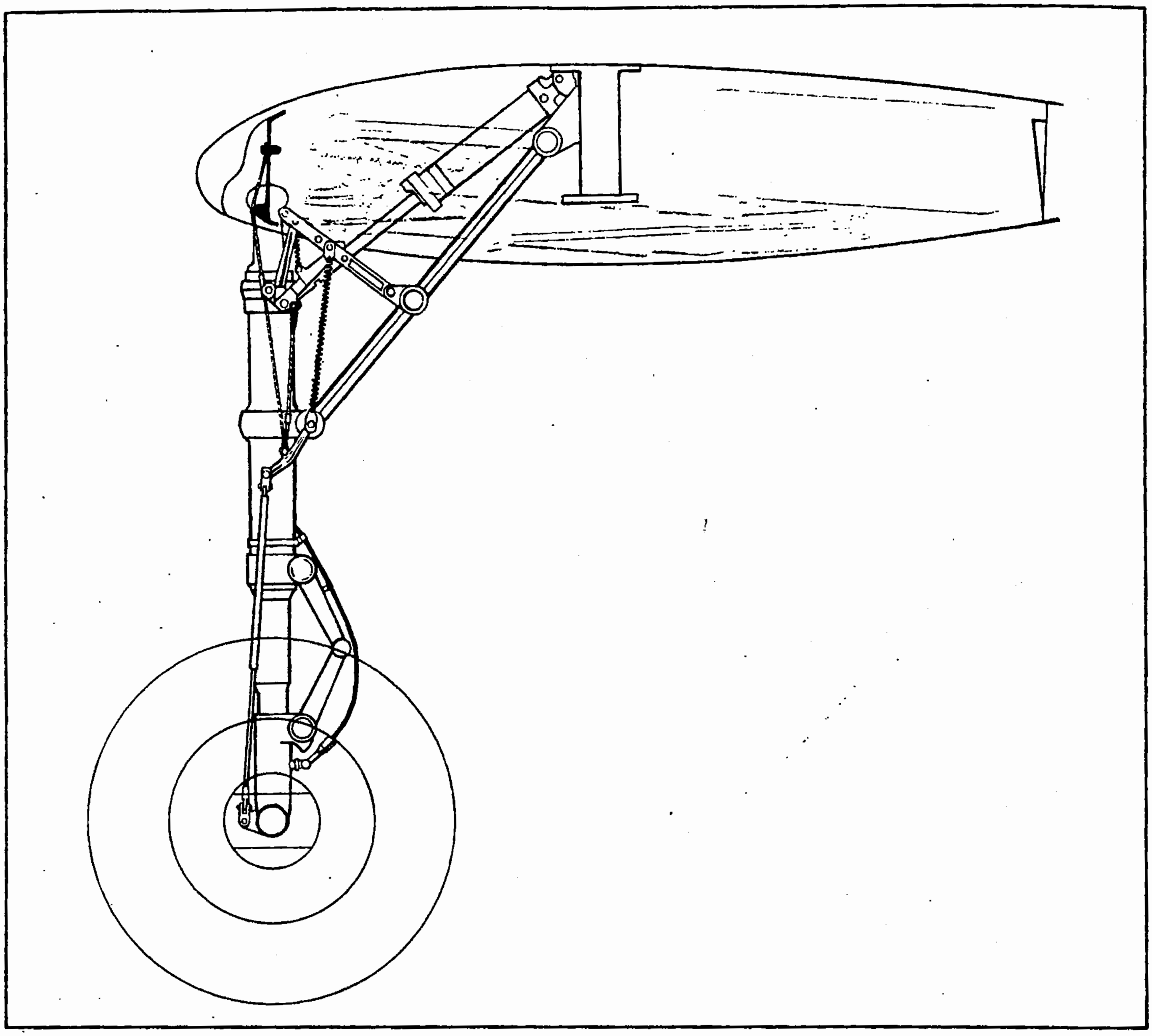


Figure 4—43. Main Landing Gear Motion Diagram.

4—304. MAIN LANDING GEAR.

4—305. DESCRIPTION. *(See figures 4—43 and 4—44.)* The main landing gear assemblies on each side of the airplane consists of a structural skeleton, retracting and locking mechanisms, a shock absorbing strut of the oleo pneumatic type, a scissors device for maintaining wheel alignment between the shock strut and the axle, a hydraulically actuated, Goodyear disc-type brake and a 32 x 8 Goodyear wheel with tire and tube. Under normal conditions, the landing gear is hydraulically actuated. A single control lever, located on the forward vertical panel of the left hand control shelf in the cockpit and connected to the hydraulic system, controls the movement of both main and tail gears. Refer to paragraphs 4—973 through 4—976 for information on normal hydraulic operation. The landing gear is rotated 87° in retraction, so that the wheel lies flat, completely within the wing. Hydraulically operated doors close over the wheel well when the landing gear is retracted, so that the under surface of the wing is not broken by any openings or projections. The landing gear position indicator, actuated by the "down and locked" position indicating microswitch on the guide behind the movable fairing, and the "up" position indicating microswitch mounted on the drag link shaft, registers the full "up" position and full "down" position for each gear. For additional information on the microswitches, refer to paragraph 4—308. In the event of a failure in the hydraulic system, the gear can be extended by moving the cockpit control lever to the "EMERGENCY" down position which is below the normal "DOWN" position. Refer to paragraphs 4—1027 through 4—1029 for information on emergency extension of the landing gear. The landing gear is mounted on a knuckle fitting supported by the inboard and outboard diagonal ribs in the leading edge of the center section, and two slipper fittings attach the drag link mechanism to the main beam. Towing shackles are located on the shock strut; the towing shackles are also used as tie-down points. The base of the landing gear drag links is also used for tie-down purposes. Jacking pad points are located on the landing gear axle.

4—306. MECHANICAL DOWNLOCK. *(See figure 4—44.)* The mechanical downlock on each main landing gear consists of two spring-loaded downlock links, pivoting on each side of the fixed upper portion of the shock strut ring. The downlock links are forced against pins on the lock links by the springs when the shock strut is compressed (airplane on ground). A spring assembly from the downlock links to the movable portion of the shock strut overcomes the locking spring force when the shock strut is extended (after take-off or airplane jacked up) and pivots the downlock links free of the locking links. This permits breaking of the lock links, the drag links, and retraction of the gear. Since tail wheel retraction is accomplished hydraulically through the same sequence valve which retracts the main landing gear, and closes the main gear doors, retraction of the tail wheel cannot be accomplished until the airplane is off the ground and the mechanical downlock on the main gear is unlocked. The main landing gear downlock thus prevents inadvertent retraction of both main gear and tail gear while the airplane is on the ground.

4—307. LIFTING DEVICE. *(See figure 4—44.)* The lifting device consists of a tube which is connected to the towing ring attaching bolt at the centerline of the axle at its lower end, and to a pivoting lever at the shock strut collar at its upper end. The lifting device cable also attaches to the pivoting lever, and its upper end is secured in the knuckle fitting. As the landing gear is retracted, the lifting device cable is snubbed by a rounded projection on the knuckle fitting. This causes the lifting device to pull on the axle stub, compressing the shock strut approximately four inches and allowing the wheel to clear the aft end of the wheel well. The reverse of this process occurs in the extension of the landing gear.

4—308. MICROSWITCHES. *(See figure 4—44.)*

a. The "down-and-locked" position indicating microswitches, actuated by the down-lock links are located on the guide behind the movable fairings. They (right and left) must be adjusted so as to make electrical contact with the downlock links when the main gear is in the "down-and-locked" position.

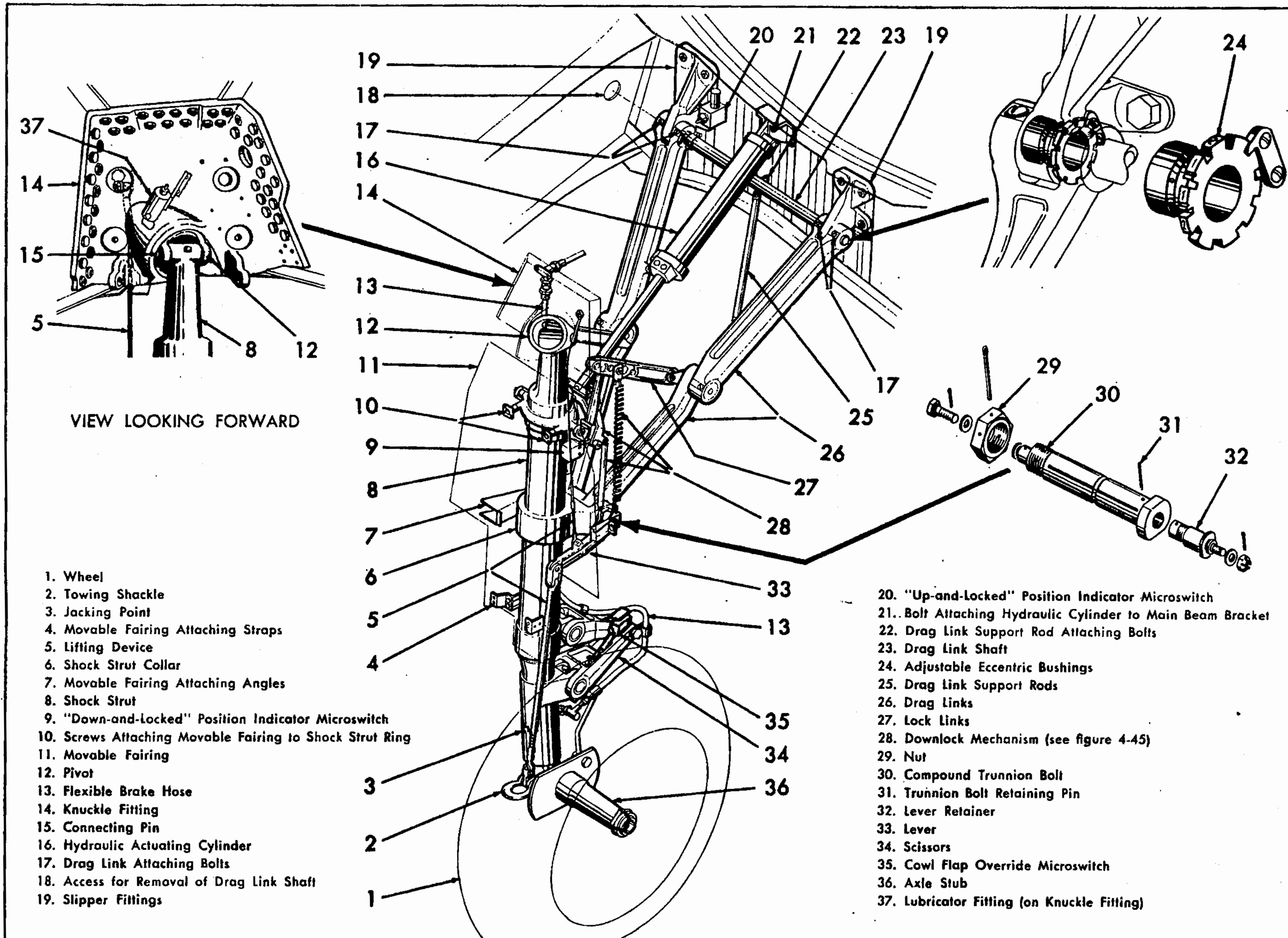
b. The "up" position indicating microswitch actuated by a set screw on the inboard side of the drag links shaft, is mounted on a bracket on the main wing beam in the wheel well. The set screw must be adjusted to move contact point on switch 1/8 inch (plus 1/32, minus 0 inches) beyond free position when the gear is retracted.

c. The "down-and-locked" and the "up" position microswitches are wired to the landing gear position indicator on the forward end of the left hand control panel in the cockpit and indicate the full "up" and full "down" positions of both right and left main gears. Refer to paragraph 5—93 for wiring diagram information, and to paragraphs 4—1504 through 4—1512 for information on the indicator.

d. The cowl flap override switch is located on the lower scissors of the left hand gear only. Its purpose is to open the cowl flaps, thereby overriding the cockpit control whenever the airplane is on the ground. The switch must be adjusted so that electrical contact is made when the shock strut is 2 1/4 inches from the fully compressed position. See paragraph 5—79 for wiring diagram information.

4—309. FUNCTION. The main landing gear, in conjunction with the tail gear, is used to support the airplane on the ground and to protect the structure of the airplane by absorbing the impact of shock during landings. When the airplane is resting on the ground or being taxied, the main gear cannot be retracted until the downlock links have been disengaged from the pin on the upper locking links. The lever in the cockpit that controls the operation of the landing gear can be moved at all times, but it will not operate the gear until the downlock is free. The downlock is free when the piston of the main shock strut is within approximately one inch of full extension. The gear may be retracted on the ground by using wing jacks to raise the airplane until the extension of the shock strut unlocks the downlock. After the airplane takes off, the downlock is automatically freed by the extension of the shock strut.

4—310. To retract the gear, move the landing gear cockpit control lever to the "UP" position. The flow of hydraulic oil which controls the main landing gear may be followed on figure 4—102. When the gear is fully extended, the toggle joints of the drag links are constrained to an in-line or locked position by the pressure of the hydraulic cylinder, and also by the spring-loaded downlock links, so that the gear cannot retract in case of a failure of the hydraulic system. The drag links cannot break upward until the locking links have broken first. In retraction, the hydraulic cylinder, acting through links and connecting rods, causes the locking links to break upward, allowing the drag links to break and the landing gear to be pulled up. The drag links guide the motion of the shock strut upward into the wheel well, but the retracting force is supplied by the hydraulic cylinder. As the gear is retracted, the pivot screw, to which the shock strut is attached, is forced to rotate in the knuckle fitting, turning the shock strut and the wheel assembly so that the latter will lie flat in the wing. During retraction, the lock links double up and then straighten out again, so as to attain an in-line position when the wheel is com-



1. Wheel
2. Towing Shackle
3. Jacking Point
4. Movable Fairing Attaching Straps
5. Lifting Device
6. Shock Strut Collar
7. Movable Fairing Attaching Angles
8. Shock Strut
9. "Down-and-Locked" Position Indicator Microswitch
10. Screws Attaching Movable Fairing to Shock Strut Ring
11. Movable Fairing
12. Pivot
13. Flexible Brake Hose
14. Knuckle Fitting
15. Connecting Pin
16. Hydraulic Actuating Cylinder
17. Drag Link Attaching Bolts
18. Access for Removal of Drag Link Shaft
19. Slipper Fittings
20. "Up-and-Locked" Position Indicator Microswitch
21. Bolt Attaching Hydraulic Cylinder to Main Beam Bracket
22. Drag Link Support Rod Attaching Bolts
23. Drag Link Shaft
24. Adjustable Eccentric Bushings
25. Drag Link Support Rods
26. Drag Links
27. Lock Links
28. Downlock Mechanism (see figure 4-45)
29. Nut
30. Compound Trunnion Bolt
31. Trunnion Bolt Retaining Pin
32. Lever Retainer
33. Lever
34. Scissors
35. Cowl Flap Override Microswitch
36. Axle Stub
37. Lubricator Fitting (on Knuckle Fitting)

Figure 4—44. Main Landing Gear Reference Diagram.

pletely within the well. When this point is reached, the toggle on the lock links locks the landing gear in the raised position. As the landing gear is retracted, the lifting device cable compresses the shock strut approximately four inches and allows the wheel to clear the aft end of the wheel well. A sequence valve controls closing of the landing gear doors after the gear has been fully retracted. In extending the landing gear, the process described above is reversed, the sequence valve first causing extension of the landing gear doors. Force, exerted by the hydraulic cylinder, causes the lock links to break and allows the gear to be extended. The sequence valve controls the motion of the tail wheel simultaneously with the motion of the main gear doors. When either extreme up or down position is reached, microswitches make electrical contact and indicate the landing gear position on the cockpit indicator.

4—311. TROUBLE SHOOTING.

Trouble	Probable Cause	Suggested Remedy
Landing gear fails to extend.	*a.* Freezing of knuckle fitting and pivot or other friction joints due to improper lubrication.	*a.* Lubricate friction joints. Refer to paragraph 4—315.
	b. Binding of drag links or other parts caused by deformation of part.	*b.* Replace deformed parts. Check for deformed parts after hard landings.
	c. Hydraulic failure.	*c.* Refer to hydraulic system, paragraphs 4—973 through 4—1057.
	d. Eccentric bushings improperly adjusted.	*d.* Adjust bushings; see paragraph 4—321.
Landing gear fails to retract.	*a.* Shock strut does not extend sufficiently to unlock mechanical downlock and allow links to break.	*a.* Check the shock strut for internal binding.
	b. Eccentric bushings improperly adjusted.	*b.* Adjust bushings; see paragraph 4—321.
	c. Improper lubrication of friction joints.	*c.* Lubricate friction joints; see paragraph 4—315.
Position of gear fails to register on landing gear position indicator in cockpit.	*a.* Microswitches not sufficiently depressed.	*a.* Make necessary adjustments; see paragraph 4—320c.
	b. Failure in electrical circuit.	*b.* Check circuit; see paragraph 5—93.

4—312. REMOVING. *(See figure 4—44, except as noted.)* The following paragraphs cover the removal of one main landing gear and the disengaging of its various connecting members:

a. Jack the airplane at the center section and tail; see paragraphs 3—23 through 3—26.

b. Remove the movable landing gear fairing (11) as described in paragraph 4—333.

c. Take off the wheel (1) by removing the lock ring, hub cap, and axle nut. Use a special wrench (VS-45678) for removal of axle nut. The washer, bearing, and wheel may now be slipped off the axle.

d. Disconnect the flexible brake hose (13) at the union in the wheel well. Cap the union to prevent subsequent dripping of oil. Cap the hose to keep out dirt.

e. (Callouts in steps e. through j. will be found on figure 4—45.) Disconnect the downlock latch spring (6) of the downlock mechanism from the upper outboard lock link (7). Disconnect the upper end of the two lock link springs (3) from the lugs on the lock link.

f. Disconnect the spring assembly (11) from the downlock link assembly (4) and from the lug on the lever (14) by removing bolts. Disconnect the lower end of the lift cable (13) by removing the bolt on the lever. Do not disturb the safety wiring of the lift cable turnbuckle.

g. Disconnect the lift tube (15) from the towing ring on the axle and from the lever by removing the bolts.

h. Disconnect the lower end of the downlock link assembly (4), the link (5) and the landing gear actuating cylinder (2) by removing their common bolts (10) at the small links near the shock strut ring. The small links (9) on the outboard side remains attached to the ring.

i. Withdraw the downlock link weld assembly.

j. Disconnect the upper end of the lock links by removing the bolt (8) at the knuckle fitting.

k. Remove the nut (29) at the inboard end of the compound trunnion bolt (30) which connects the drag links (26) and lever (33) to the strut collar (6) and withdraw the bolt; refer to figure 4—44.

l. Disconnect wiring to the "up" position microswitch (20), located on the main beam in both right and left wheel wells, and disconnect wiring to the cowl flap override microswitch (35), located on the lower scissors (34) of the left hand gear.

m. With the landing gear control in the "UP" position, retract the actuating cylinder, slowly (using external source of hydraulic power or the electrically-driven auxiliary hydraulic pump), meanwhile guiding the actuating cylinder, lock links, and drag links up into the wheel well.

n. Note the position of the pivot screw in the knuckle fitting; i.e., the exact number of threads showing clear of the fitting when the landing gear is hanging in a vertical position. This will facilitate reinstallation, and reduce the possibility of misalignment. Similarly, note the threads showing above the collar on the shock strut.

o. Remove the shock strut (8) by swinging it into the plane of the pivot screw, and rotate the strut until the pivot screw emerges from the knuckle fitting (14) far enough to allow the connecting pin (15) to be tapped out. The shock strut should be supported as the pin is driven out of the knuckle fitting.

p. Detach the drag links with the lock links by removing the upper ends of the support rods (25) and their attaching lug bolts (22). Remove the four bolts (17) securing the shaft into the ends of the drag links. The panel aft of the oil cooler door is removed, and the drag links shaft (23) passed inboard through the opening (18) leading to the now accessible oil cooler compartment.

q. Further disassemble the drag links and lock links on the bench, if necessary.

r. To detach the upper end of the landing gear actuating cylinder, disconnect and plug the two lines from the cylinder. Remove the bolt (21) which connects the cylinder to the attaching bracket on the main beam.

4—313. DISASSEMBLY. Disassembly of the main landing gear is accomplished in the removing procedures given in paragraph 4—312. For shock strut disassembly, see paragraph 4—326.

4—314. CLEANING. A petroleum distillate, such as kerosene or its equivalent, used in the cleaning of any conventional landing gear is recommended. After using kerosene, wipe surfaces with a clean cloth, soaked in red hydraulic fluid, AN-O-366. Do not use carbon tetrachloride.

4—315. LUBRICATING. Refer to figure 3—14 for maintenance lubrication. On reinstallation of main landing gear, lubricate as follows:

a. Oil felt wipers of the landing gear actuating cylinder by filling oil cups with hydraulic oil, Spec. AN-O-366 red fluid.

b. Wipe exposed piston rod of hydraulic actuating cylinder and shock strut with hydraulic oil, Spec. AN-O-366.

c. Clean shock strut pivot and knuckle thoroughly, using a solvent to remove any grease. Remove all foreign matter with an air jet. Apply general purpose, low temperature oil, Spec. AN-O-6 to shock strut attaching pin.

d. Note position of indicator protruding from top of lubricator on knuckle fitting. If it is all the way up (bottom of knurled nut approximately one inch above top of lubricator body), it does not need filling. If nut is one-half inch or less above top, refill with Spec. AN-G-10, extreme pressure, low temperature grease, using a gun. Wipe Zerk fitting clean before greasing to minimize the amount of foreign material forced into the junction between the knuckle fitting and the pivot.

e. On installation, grease the sixteen grease points requiring Spec. AN-G-10 extreme pressure, low temperature grease every thirty hours; see figure 3—14.

f. Oil the friction points on the towing shackle, locking mechanism and lifting device with general purpose, low temperature oil, Spec. AN-O-6.

g. Refer to paragraph 4—408 for information on greasing the main landing gear wheel bearings on reinstallation.

4—316. REPAIRING. Replace cracked fairing, and all bent or damaged members of the landing gear skeleton. If the looseness of any member is due to wear, replace the worn parts. Replace the bearings, if the tolerance between the drag link pin and link exceeds .004 inch. Replace chafed brake hose. Clean fouled threads on the drag links collar by gently unscrewing the collar and washing the threads with unleaded gasoline or a similar solvent. Apply a fresh coat of Spec. AN-G-10 grease and replace the collar.

4—317. ASSEMBLING. Assembling of the shock strut is covered in paragraph 4—327.

4—318. INSTALLING. *(See figure 4—44.)* To install one main landing gear, proceed as follows:

a. Install the hydraulic actuating cylinder by inserting the bolt from the outboard side of the fitting on the face of the main beam. Do not safety the nut until it is definitely determined that the beam fitting will not require shimming.

b. The drag links and lock links are bench assembled, and the assembly is installed by reversing the removal procedure. Connect only the outboard lock link to the knuckle fitting.

c. The knuckle fitting and pivot are carefully cleaned with undoped gasoline or similar solvent, and any burrs or nicks in the threads are removed, using emery cloth, and then crocus cloth. A new pivot requires lapping, using Clover Grade A No. 280 grit lapping compound. Approximately two minutes of rotation are required. Clean the pivot and the internal threads of the knuckle fitting with Gulf Solvent "B". The cleaned pivot is lubricated with light oil and tested for freedom of rotation in the knuckle fitting. If the fit is satisfactory, wipe off the oil, lubricate the pivot knuckle fitting with Spec. AN-G-10 grease and recheck the fit before proceeding with the installation. Refer to paragraph 4—315 for lubrication procedure.

d. One man lifts the shock strut, and a second guides the top of the strut into the pivot and slips in the pin. A gentle tap with a light hammer should be all that is required to drive the pin home. Extreme caution should be exercised to avoid damaging pivot threads.

e. The shock strut is raised into the plane of the pivot and rotated so that the pivot rises into the knuckle fitting. The pivot should be returned to the exact position it had before it was removed. Generally, the most favorable positions of the pivots which will require the minimum amount of adjustment on the collar and eccentric bushings are with the left hand pivot showing one-half to one pivot thread beyond the knuckle fitting and with the right hand pivot flush, to showing half a thread.

f. Install the downlock mechanism by reversing procedure given in paragraph 4—312.

g. Mount the wheel and tire on the axle. Use the VS-45678 wrench for the main wheel retaining nut. Refer to paragraph 4—409 for additional information.

h. Back down the collar on the shock strut and grease it thoroughly with Spec. AN-G-10 grease. Return the collar to the position which it occupied. Generally, three threads should be visible above the top of the collar, and the collar adjusted so that the shock strut rests firmly against the center of the sequence valve pad. The drag links are attached to the collar by inserting the compound bolt with the attached lever from the outboard side. Place the nut on the inboard end, but do not safety it until the gear has been adjusted for proper retraction.

Note

The retaining pin (31) which holds the lever and the lever retainer (32) to the trunnion bolt (30) comes lightly staked in place. Should this staking have been disturbed by disassembly of the lever, it will be necessary to seal the pin with wax to hold it in place while assembling the bolt through the collar. Refer to figure 4—44.

i. The lift cable assembly is installed by attaching the rod to both the fitting at the centerline of the axle and to the lever. Should a new cable be required, the old cable may be removed by withdrawing it through the hole in the upper portion of the face of the knuckle fitting. To do so, break turnbuckle at lower end of cable, remove the cotter pin and loosen but do not remove the nut at the upper end of cable. Raise the cable fitting assembly slightly turning it to free the tack welded bolt from the notch at the bottom of the hole through the upper portion of the knuckle fitting. The lifting cable may then be withdrawn by pulling it up and aft through the hole in the upper portion of the knuckle fitting. When installing a new cable, use cable of 24 inch length, 3/16 inch diameter.

Note

Before withdrawing the old cable, attach a piece of string or safety wire to the lower cable terminal, that may be used to pilot the new cable back through both holes in the knuckle fitting. Should it be necessary to install a new lift cable without the assistance of a pilot string, the shock strut must be removed, and the new cable guided through the lower hole on the knuckle, working through pivot opening.

j. Upon obtaining satisfactory alignment, of the actuating cylinder, connect the yoke and lock links to the link at the ring. Attach the two springs which extend from the lock links to the trunnion bolt. The landing gear is properly adjusted if the shock strut is snug against the pad on the lower side of the beam when the gear is in the locked-up position. Means of adjustment are provided by the collar and the eccentric bushings between the drag links shaft and the shaft fittings on the center section main beam (see figure 4—44).

Note

This is an important adjustment since proper operation of the landing gear hydraulic system depends on compression of the sequence valve shaft which protrudes through the pad.

4—319. Adjust the position of the shock strut as follows:

a. Raise the gear into the wheel well by hand, check for snugness against the beam pad after both toggles have been pushed into the "locked" position.

b. Check the clearance between the tire and the wedge plate on the aft wall of the wheel well when the gear is in the "locked-up" position. The lift cable should compress the shock strut sufficiently to provide a 5/8 inch clearance, plus or minus 1/8 inch, from the block on the beam. If the proper clearance is not obtained, break the safety wire and adjust the turnbuckle as required. Upon obtaining satisfactory turnbuckle adjustment, safety wire the turnbuckle so that the adjustment will not be disturbed during subsequent cycling operations.

c. Adjust the threaded collar on the shock strut, if necessary. Each full clockwise turn of the collar lowers the position of the shock strut approximately one-half inch when the gear is up. Rotating the eccentric bushings one division alters the gear "up" position approximately .05 inches. When making adjustment, it is generally desirable to make the preliminary position adjustment by means of the threaded collar and utilize the eccentric bushing adjustment for equalization of the toggle action and final locking pressure adjustment as explained in paragraph 4—320 below.

d. After cycling the landing gear by hand to check collar adjustment, connect the hydraulic lines to the actuating cylinder and make final adjustments in accordance with paragraph 4—320.

Note

No one member or joint of the landing gear shall give so much excessive play that it will be a major contributing factor to the maximum permissible play of 1/4 inch at the centerline of the axle.

e. When the landing gear is operating satisfactorily, complete all safety wiring and bonding.

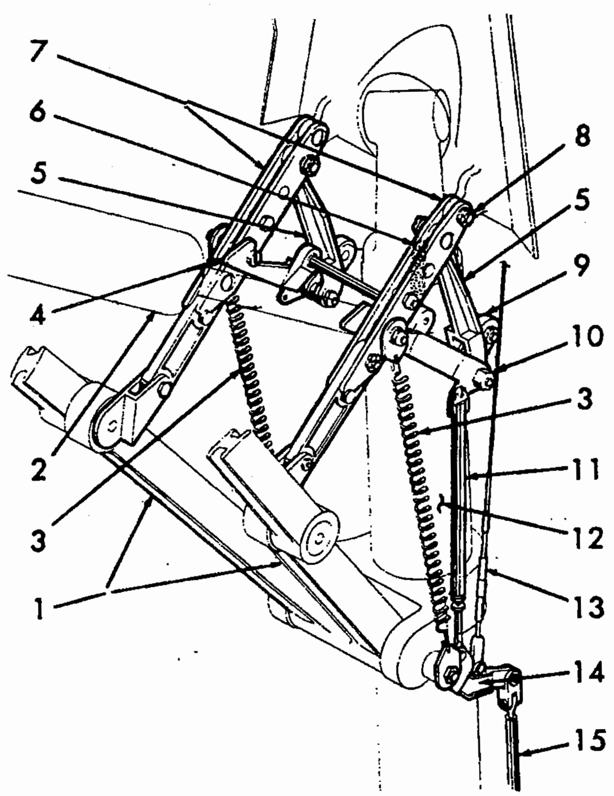
f. Attach the movable fairing by reversing removal procedure. Refer to paragraph 4—333. Replace wiring to the "up" position indicating microswitch on the main beam, to the "down-and-locked" position indicating microswitch behind the movable fairing, and to the cowl flap override microswitch on the lower scissors, left hand only. Check operation of the microswitches. Refer to paragraph 4—320 for adjustment procedure.

4—320. ADJUSTING. *(See figures 4—44 and 4—45.)*

Note

To check adjustment of landing gear in the retracted position, jack up airplane and disconnect door actuating cylinders.

a. Connect an external source of hydraulic power so that locking pressures may be checked slowly.



1. Drag Links (ref.)
2. Landing Gear Hydraulic Actuating Cylinder (ref.)
3. Lock Link Springs
4. Downlock Link Assembly
5. Links
6. Downlock Spring
7. Lock Links
8. Lock Link Attaching Bolts
9. Links
10. Downlock Link Attaching Bolts
11. Downlock Spring Assembly
12. Shock Strut (ref.)
13. Lifting Device Cable
14. Lever
15. Lift Tube

Figure 4—45. Positive Downlock Mechanism.

b. The main gear should lock up against the main beam at a hydraulic pressure of not more than 800 psi and not less than 300 psi. The gear should lock down at a pressure of not more than 300 psi. The locking links of one gear should lock at a pressure within 150 psi of the locking pressure of the other gear. More than 150 psi difference between the respective locking pressures of each gear requires corrective adjustment of the eccentric bushings. See paragraph 4—326.

c. Extend the landing gear; the pressure required to unlock the gear must not exceed 400 psi.

d. The pressure required to lock gear in extended position must not exceed 400 psi. No test is required for unlocking the gear from the extended position.

e. Adjust downlock spring assembly to give 1/16 inch clearance between rod and yoke on the actuating cylinder, with wheels in the fully extended position.

f. Check the operation of the landing gear indicator system. If necessary, adjust the "down" indicator microswitch behind the movable fairing so that electrical contact is made when the downlock links actuate the switch with the gear in the "down-and-locked" position. Adjust tht set screw on the drag link shaft lever assembly so as to move the point of contact on the "up" position microswitch 1/8 inch (plus 1/32, minus zero inches) beyond free position when the landing gear is in the fully retracted position. For further information on adjustment of landing gear position indicating microswitches, refer to paragraph 4—1512. Adjust the cowl flap override microswitch on the lower scissors of the left gear, so that the switch will make electrical contact when the center line of the lubricator fittings are 4 13/16 inches (plus or minus 1/2 inch) apart.

4—321. ADJUSTING ECCENTRIC BUSHINGS. The lugs on eccentric bushings are numbered so that markings are visible from wheel well. To adjust bushings, hoist airplane and proceed as follows. (See figure 4—44.)

a. Kill the pressure in the hydraulic system by actuating the flaps from the cockpit. This will relieve the pressure on the drag links and allow the bushings to be rotated without binding or scoring of their surfaces. Connect an external source of hydraulic power so that locking pressures may be checked slowly.

b. Remove the lockwire from the two screws which attach the locking pawl to the slipper fitting, loosen the lower screw and remove the upper screw.

c. The pawl is then disengaged and the bushing can be rotated by driving the lugs with a screwdriver and a light hammer. Be sure that the pressure in the hydraulic system has been "killed" before rotating these bushings.

CAUTION

Always rotate both bushings in the same direction; i.e. both forward or both aft.

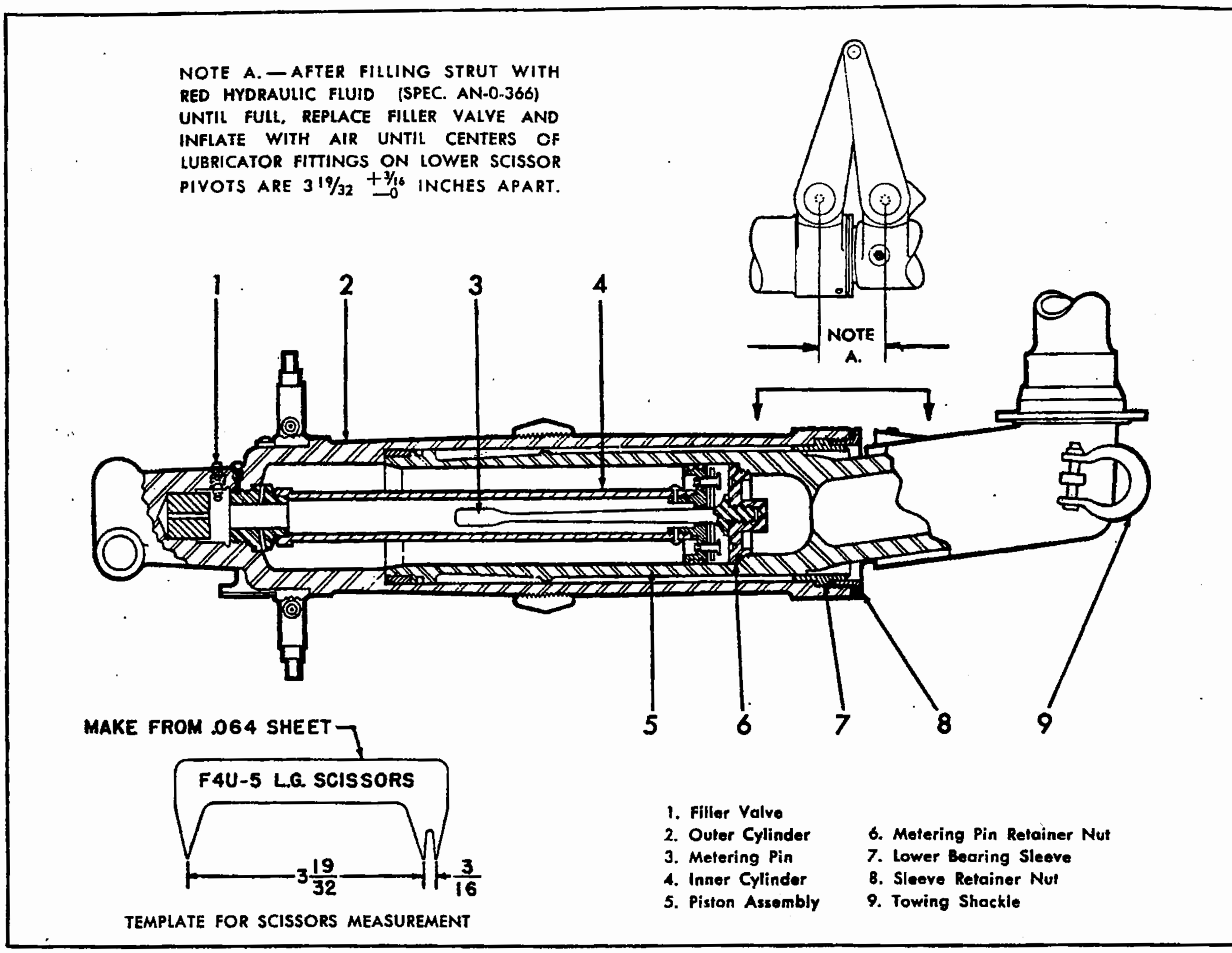


Figure 4—46. Main Landing Gear Shock Strut.

d. If the eccentric bushings *(reference 24 on figure 4—44)* are set initially so that the two notched No. 1 lugs are at the forwardmost position, then the gear is locking at its maximum pressure, and rotation of the bushings will decrease the pressure to the desired locking pressure.

e. Both bushings must always be rotated equal amounts, except that if the toggles do not lock within 150 psi of each other, it is permissible to rotate one bushing a maximum of two numbered lugs farther than the other. If this inequality is exceeded, binding of the drag links shaft may result.

f. Since the adjustment range of the eccentric bushings is only approximately 500 psi, the threaded collar should be readjusted one turn if the gear does not lock initially within the 300 psi to the 800 psi range.

4—322. MAIN LANDING GEAR SHOCK STRUT.

4—323. DESCRIPTION. *(See figures 4—44 and 4—46.)* The shock absorbing landing gear strut is of the oleo-pneumatic type, consisting of a sliding piston between fixed inner and outer cylinders. The wheel is attached to the piston axle stub, wheel alignment being maintained by a scissors link between the shock strut outer cylinder and the axle stub. The hollow piston contains hydraulic fluid and a fixed metering pin which extends upward into the inner cylinder through a metering orifice. The shock of landing is absorbed by the action of the oil which is forced to flow between the metering pin and the inner cylinder orifice as the extended piston is driven upward into the outer cylinder. The upper portion of the inner cylinder contains pressurized air which fulfills a dual purpose. When the airplane is taxiing, the air absorbs the loads and prevents the strut from "bottoming". The pressurized air also aids in extending the strut to its full shock absorbing position by forcing the oil down into the piston. A flapper plate around the metering orifice opens to facilitate the return flow of fluid to the piston. Bleed holes through the inner cylinder permit the addition of hydraulic fluid (Spec. AN-O-366) through the filler plug with the strut in the fully compressed position.

4–324. TROUBLE SHOOTING.

Trouble	Probable Cause	Suggested Remedy
Scoring of the piston rod.	*a.* Failure, before taxiing or take-off, to wipe exposed portion of piston rod free of dirt with a cloth oiled in hydraulic fluid.	*a.* Remove slight scoring by polishing with crocus cloth. Excessive scoring necessitates replacement.
Leakage at air valve.	*a.* Defective or "cut" gasket.	*a.* Replace gasket at air valve and tighten valve with a light wrench so as not to cut gasket.
	b. Worn or defective air valve.	*b.* Replace air valve.

4–325. REMOVING. To remove the shock strut from the airplane, refer to paragraph 4–312.

4–326. DISASSEMBLY. *(Refer to figure 4–46).* Disassembly of main landing gear shock strut may be accomplished on bench or while shock strut is installed on airplane. The following special tools are used:

VS-10517 – Handle for VS-34536 wrench.
VS-16412 – Wrench for shock strut flapper valve.
VS-34536 – Wrench for tail gear and main landing gear metering pin.
VS-34577 – Adjustable spanner wrench.

To disassemble the shock strut while it is installed on the airplane, proceed as follows:

a. With the tail wheel unlocked and chocks at the opposite main landing gear, jack the airplane by means of the high jack and jackpad. There must be a clearance of at least 33 inches between the deck or floor and bottom of the outer cylinder.

b. Pull strut out to full extension and release air pressure at valve (1) by unscrewing valve body a few turns, allowing air to leak out. When all air has escaped, unscrew valve.

c. Remove the wheel (see paragraph 4–406) and detach the lower parts of the lifting device from the axle stud by removing the bolt at the towing shackle.

d. Detach the brake hose support clip below the lower scissors pivot and at the scissors joint. Remove the brake unit from the torque plate by removing the six attaching bolts. The brake is then tied up to the drag links to keep it out of the way during the rest of this operation. Do not detach the brake hose from the brake.

CAUTION

Take care to avoid kinking brake hose.

e. Break the lockwire and remove the sleeve retainer nut (8) from the lower end of the outer cylinder (2), using an adjustable spanner wrench VS-34577. Carefully withdraw the sleeve (7) and piston assembly (5). Pour the oil into a can.

f. If necessary, the metering pin (3) may now be removed from the piston. Use a 14 inch screwdriver to take out the metering pin retaining nut set screw, and then remove the metering pin with the special VS-34536 wrench. The metering pin retainer nut (6) is also removed by using the special VS-34536 wrench.

g. Loosen small set screw at upper part of strut. Using VS-16412 special wrench provided, unscrew eight full turns and withdraw inner cylinder assembly (4).

CAUTION

Great care should be taken to avoid having the tool disengage and score the cylinder walls.

4–327. ASSEMBLING. Assemble the main landing gear shock strut by reversing the disassembly procedure given in paragraph 4–326.

4–328. INSTALLING. If the shock strut has been removed from the airplane prior to disassembly, install it by reversing procedure given in paragraph 4–312.

4–329. FILLING PROCEDURE. *(See figure 4–46.)*

a. With weight of airplane on wheels, remove filler valve and allow the shock strut to compress fully under the weight of the airplane.

b. Fill strut slowly with red hydraulic fluid, Spec. AN-O-366, until no more can be added.

c. Replace filler valve and apply air pressure through the valve until the centers of the lubricator fittings on the lower scissors pivots are 3 19/32 inches (plus 3/16, minus 0 inches) apart; see figure 4–46. In this way, even though the strut is serviced while the airplane is empty, there remains a small air cushion between piston top and cylinder to prevent bottoming during normal taxiing after the airplane has been loaded.

Note

Rock airplane during inflation of shock strut to prevent sticking of the strut.

d. It is recommended that a checking gage similar to that shown on figure 4–46 be fabricated from .064 stock to aid in checking this dimension.

4–330. MAIN LANDING GEAR DOORS AND FAIRINGS.

4–331. DESCRIPTION. *(See figure 4–47.)* The main landing gear doors and fairings, located in the wing center section, consist of a movable fairing, inboard and outboard fixed fairings and a hydraulically actuated inboard and outboard landing gear door on each side of the airplane. The fairings and doors completely cover the retracted landing gear. The inboard and outboard fixed fairings, constructed on reinforced aluminum alloy sheet, cover the area between the movable fairing and the outboard center section skin and are fastened with screws to the center section structure. The movable fairing, a reinforced metal panel, is attached to the shock strut. Its movement is controlled by the movement of the main landing gear. The landing gear doors, located on the underside of the center section between the main and rear wing beams, consist of reinforced panels built up of aluminum alloy sheet. The doors open downward, parting along an axis parallel to the centerline of the airplane, each door being supported by two hinge fittings and actuated by separate hydraulic cylinders. Refer to paragraphs 4—975 and 4—976 for information on hydraulic actuation of the doors.

4—332. TROUBLE SHOOTING.

Trouble	Probable Cause	Suggested Remedy
Landing gear doors fail to open or close.	*a.* Failure of hydraulic system.	*a.* Refer to paragraph 4—937 through 4—1056.
	b. Door or movable fairing deformed or cracked.	*b.* Replace or repair door of fairing.
Doors open or close incompletely.	*a.* Slight distortion of door.	*a.* Bump door.
Main gear retracts; landing gear doors and tail wheel fail to retract.	*a.* Sequence valve insufficiently compressed by main gear shock strut.	*a.* Check landing gear adjustment; see paragraph 4—320.

4—333. REMOVING MOVABLE FAIRING.
(See figure 4—44.)

a. Disconnect wiring to "down-and-locked" position indicator microswitch (9).

b. Disconnect the bonding at the shock strut.

c. Remove the small screws which connect the upper end of the fairing to the attaching strip.

d. Remove the two screws (10) which attach the fairing to the shock strut ring.

e. Remove the bolts which attach the fairing to the angles (7) mounted on the ends of the trunnion bolt (30). Then remove the angles from the trunnion bolt.

f. Remove screws and strap (4) which attach lower end of the fairings to shock strut. Remove fairing.

4—334. REMOVING INBOARD AND OUTBOARD LANDING GEAR DOORS.
(See figure 4—47.)

a. With landing gear and doors extended, detach the bonding from the door hinge fittings.

b. Disconnect the hydraulic actuating cylinder from the door by removing the bolts which connect the pistons to the fittings on the doors.

c. Remove the bolts connecting the hinge brackets to the hinge fittings and lower the doors to the ground.

4—335. LUBRICATING. Oil the felt wipers of the landing gear inboard and outboard door actuating cylinders with hydraulic fluid, Spec. AN-O-366, on reinstallation.

4—336. REPAIRING.

a. Structural damage should be repaired in accordance with approved methods.

b. Correct misalignment and distortion by bumping.

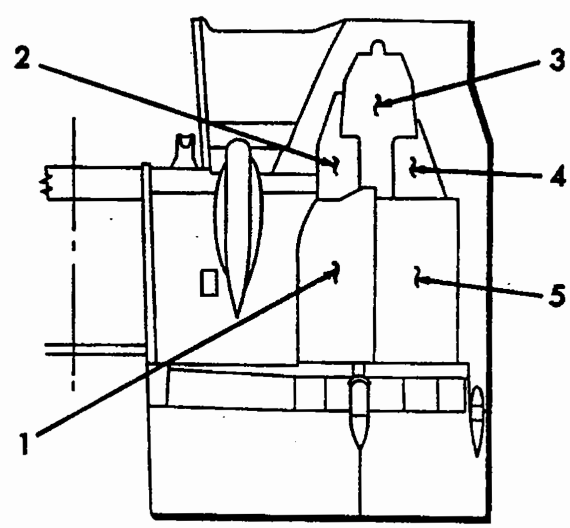
c. Tighten loose rubber seals, replace badly worn seals.

d. Refinish corroded areas in accordance with instructions in paragraphs 4—1908 through 4—1920.

4—337. ADJUSTING. The doors should close snugly and fair with the surrounding skin surface. The threaded piston rod end fitting of the hydraulic actuating cylinders provides necessary adjustment.

4—338. INSTALLING MOVABLE FAIRING. Install the movable fairing by reversing procedure given in paragraph 4—333.

4—339. INSTALLING INBOARD AND OUTBOARD LANDING GEAR DOORS. Install inboard and outboard landing gear doors by reversing procedure given in paragraph 4—334.



1. Inboard Landing Gear Door
2. Inboard Fixed Fairing
3. Movable Fairing
4. Outboard Fixed Fairing
5. Outboard Landing Gear Door

Figure 4—47. Main Landing Gear Doors and Fairings.

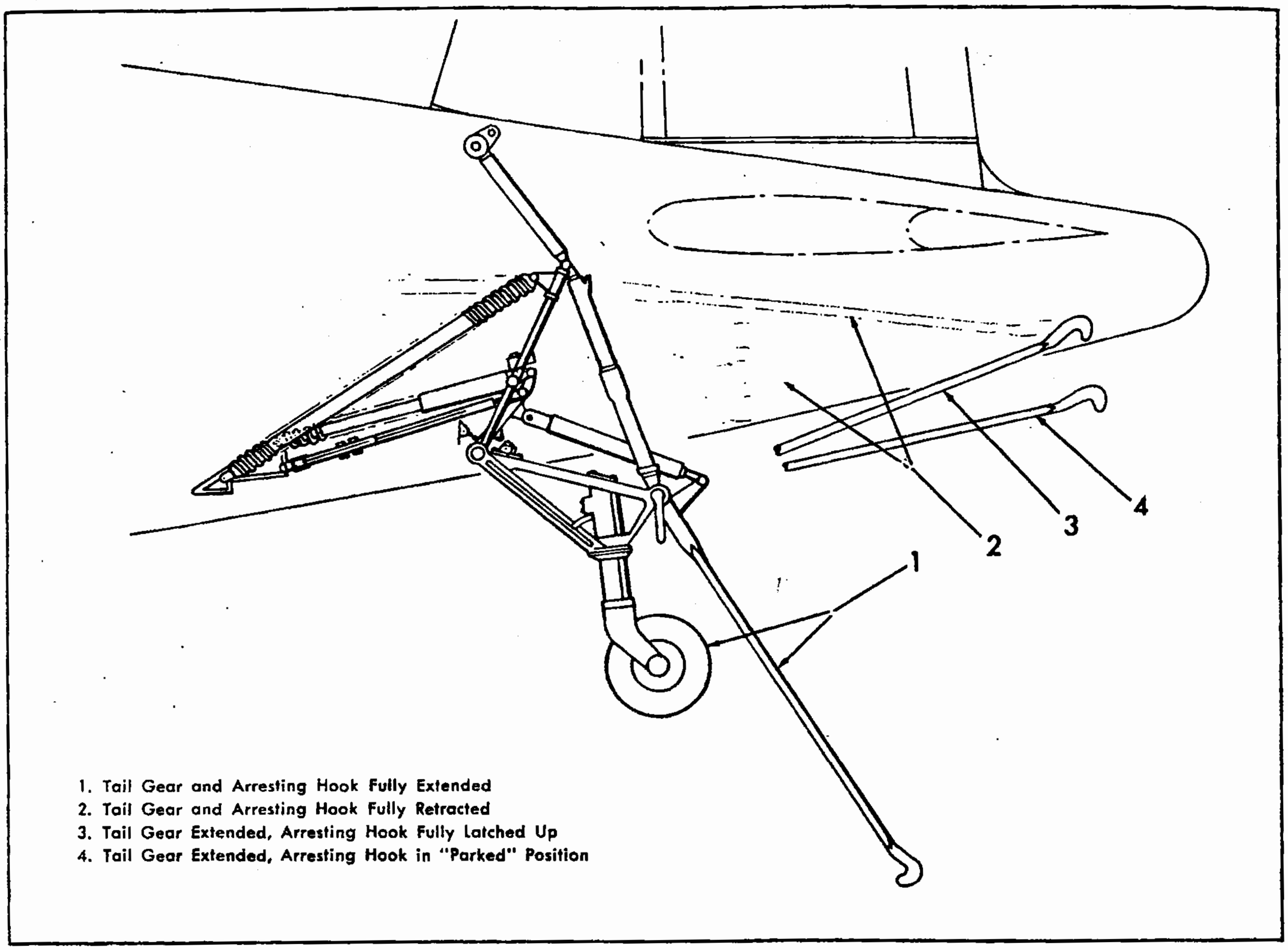


Figure 4—48. Tail Gear and Arresting Hook Motion Diagram.

4—340. TAIL GEAR AND ARRESTING HOOK.

4—341. DESCRIPTION. *(See figure 4—48.)* The tail gear and arresting hook are mounted together in the aft fuselage unit. The tail gear is attached to the fuselage structure through the forward point of the tail-wheel yoke and the lower end of the scissors at station 288, through the upper end of the compression strut at station 288 and through the forward end of the tail wheel hydraulic actuating cylinder between stations 253 and 260. The dashpot and the locking strut of the arresting hook are attached to the fuselage just forward of station 267, and the arresting hook mechanism ties into the tail wheel mechanism at the forward and aft ends of the tail wheel yoke. The tail gear and arresting hook mechanism are so arranged that, although the arresting hook control in the cockpit is moved to the "DOWN" position, the hook will not extend until the tail gear is extended. Refer to figure 3—11 and 3—12 for location of the arresting hook and landing gear controls in the cockpit. The tail gear may be extended independently of the arresting hook, if desired, the hook remaining in the latched up position until movement of the arresting hook control handle in the cockpit to the "DOWN" position unlatches the locking strut and permits the spring-loaded dashpot to extend the hook. The hook cannot, however, be retracted independently of the tail gear, since the single tail gear hydraulic actuating cylinder retracts the tail gear and forces the arresting hook to the "up" position through a roller and cam installation on the arresting hook rocker arm and tail wheel yoke respectively. After extension of the hook and while the tail gear remains extended, the arresting hook may be manually placed in a parked position (about one foot off the deck) by the deck crew, provided the arresting gear control handle in the cockpit is first moved to the "UP" position. If the control handle is not placed in the "UP"position, the hook cannot be parked, but will be subsequently retracted along with the tail gear. Movement of the tail gear also actuates the tail wheel doors through right and left interconnecting linkages attached to the tail wheel yoke and to the forward tail wheel doors. The forward doors are in turn linked to the aft tail wheel doors. See paragraph 4—377 for complete information on the arresting hook mechanism.

4—342. TAIL GEAR.

4—343. DESCRIPTION. *(See figure 4—49.)* The tail wheel installation consists of the following units. A hydraulic actuating cylinder (29), incorporates a spring for the emergency extension of the tail gear should hydraulic pressure fail. The cylinder attaches to a fitting on the centerline in the bottom of the fuselage between stations 260 and 267. Refer to paragraphs 4—973 through 4—976 for hydraulic information on this system. The hydraulic cylinder attaches to the scissors assembly (2) and an interconnecting positive downlock (4) prevents the scissors from inadvertently breaking when the gear is in the extended position. The positive downlock also actuates the tail gear "down-and-locked" position indicator microswitch (3) which is mounted to the scissors. The scissors attach at their top end to the lower end of the compression strut (7) (which transfers loads to the tail wheel bulkhead) and to the upper end of the shock strut (11). The lower end of the scissors and the lower end of the shock strut attach to the forward and aft ends of the tail wheel yoke (21) respectively. A solid tail wheel (24) is installed on the yoke. A shock strut compressing the cable (13), attached to the upper scissors through a link and to the aft end of the yoke, compresses the shock strut sufficiently, when the tail gear is retracted, to enable the tail wheel doors to completely enclose the retracted tail gear and arresting hook. The "up" position microswitch actuator, assembled to the forward tail wheel yoke pivot point, is actuated by a microswitch (27) located on bulkhead 288 just to the left of the centerline of the airplane. The lower cockpit access step actuating cable is attached to the compression strut. The tail wheel lock cable runs from the lock in the yoke forward to the cockpit.

4—344. FUNCTION — RETRACTING. *(See figure 4—49.)* Movement of the main landing gear control handle in the cockpit to the "UP" position, first actuates the selector valve and commences retraction of the main landing gear. Completion of the retraction of the main landing gear opens the sequence valve and directs hydraulic fluid to the retract port of the tail gear hydraulic actuating cylinder. The first slight forward movement of the cylinder slides its rod end attaching bolt forward in a slot. This slight movement permits the torsion spring to free the downlock latch from the fitting which it engages on the upper scissors. The scissors break aft, the hydraulic cylinder continues to retract, and the tail wheel assembly pivots on its attaching point at the forward end of the yoke. The shock strut compressing cable fully compresses the shock strut, as the gear retracts. Retraction of the tail gear also retracts the arresting hook, regardless of the position of the arresting hook control handle in the cockpit (see paragraph 4—377) and closes the tail wheel doors (see paragraph 4—397) in proper sequence. When the tail wheel is fully retracted, the "up" position indicator microswitch on bulkhead 288 is moved by an actuator at the forward end of the yoke to give the pilot positive visual indication on the cockpit indicator that the tail wheel is fully retracted. The tail gear is held in the retracted position by hydraulic pressure only.

4—345. FUNCTION — EXTENDING.
(See figure 4—49.)

a. Movement of the landing gear control handle in the cockpit to the "DOWN" position first extends the main landing gear doors and then the main landing gear and tail gear. The hydraulic cylinder, actuated by the selector valve, exerts force on the bracket at the upper end of the scissors assembly, pushing the compression strut, the shock strut and the scissors assembly joint aft from the retracted position and extending the tail wheel. When the fully extended position is reached, the scissors assembly is completely straightened against its knee joint, providing rigid suspension for the upper part of the shock strut. The downlock has no function when the gear is in the retracted position. It functions at the end of the extension cycle only, snapping over the locking fitting on the upper scissors. The "down-and-locked" position indicator microswitch, mounted to the scissors, is actuated by the downlock to give the pilot visual indication on the cockpit indicator that the tail gear is down and locked.

b. Should the hydraulic system fail, placing the landing gear control handle in the "EMERGENCY" position actuates the emergency valve which releases compressed air to the main landing gear cylinders; see paragraphs 4—1027 through 4—1056. When the landing gear control handle is in the "EMERGENCY" position, the selector valve directs hydraulic fluid from the tail gear actuating cylinder to the reservoir, allowing the spring on the tail gear cylinder to extend the tail gear. Note that emergency extension of the tail gear is automatically accomplished by this spring when hydraulic pressure holding the tail gear actuating cylinder in the retracted position is released.

4—346. TROUBLE SHOOTING.

Trouble	Probable Cause	Suggested Remedy
Cockpit indicator fails to show gear "down-and-locked."	*a.* Electrical failure.	*a.* Refer to electrical system, paragraph 5—93.
	b. Improper adjustment of micro-switch.	*b.* Adjust micro-switch to contact latch when tail wheel is "down-and-locked". Refer to paragraph 4—354.
Cockpit indicator fails to show gear retracted.	*a.* Electrical failure.	*a.* Refer to electrical system, graph 5—93.

Trouble	Probable Cause	Suggested Remedy
	b. Improper adjustment of switch.	*b.* Adjust switch to contact latch when gear is fully retracted. Refer to paragraph 4—354.
Downlock fails to latch or unlatch.	*a.* Incorrect clearance between latch and locking fitting on upper scissors.	*a.* Adjust latch to obtain correct clearance. See paragraph 4—354.
Tail wheel doors fail to open or close correctly.	*a.* Tail wheel door linkage incorrectly adjusted.	*a.* Readjust linkage. Refer to paragraph 4—354.
Gear extends or retracts slowly or not at all.	*a.* Failure of hydraulic system.	*a.* Refer to hydraulic system, paragraphs 4—973 through 4—1057.
	b. Improper lubrication.	*b.* Refer to figure 3—14 for lubrication points.

4—347. REMOVING. *(See figure 4—49.)* This procedure removes the tail wheel and arresting hook installation as a unit because of their interrelationship in the aft section of the airplane, but it should be noted that it is not always necessary to completely remove both assemblies in order to remove some component part. Only the hydraulic actuating cylinder, arresting hook dashpot, and locking strut are left installed in the airplane upon completion of the following procedure.

a. Open right and left access doors to tail wheel shock strut and compression strut; doors are located in aft fuselage below fin. Hoist the airplane with the tail wheel extended and the hook down, by means of a properly counterweighted lift tube, until the tail wheel and the lowered hook clear the ground.

b. Disconnect right and left hand tail wheel door actuating rods (25) from the tail wheel yoke (21).

c. Disconnect the breaking link (8) of the cockpit lower access step actuating cable from the compression strut (7) by removing bolt.

d. Disconnect the tail wheel lock cable (28) from the tail wheel lock rocker arm (23) by removing the bolt. Withdraw cable from pulley at the forward end of the tail wheel yoke.

e. Unhook scissors locking spring (39).

f. Remove bolt (33) connecting downlock latch (34) and fitting (31), thereby removing latch and freeing downlock from scissors.

g. Kill the pressure in the hydraulic system. Remove the bolt (32) connecting the aft end of the hydraulic actuating cylinder (29) to the scissors (2).

h. Remove the bolt (6) attaching the top forward end of the compression strut to the fitting on bulkhead 288. The tail wheel yoke and housing must be supported during this operation.

i. Remove the grease bolt (26) attaching the forward portion of the yoke to the fitting on bulkhead 288, freeing the scissors, rocker arm, and yoke. The tail wheel and arresting gear mechanisms are now freed from the airplane.

4—348. DISASSEMBLY. *(Refer to figure 4—49.)*

a. Remove the hydraulic actuating cylinder (29), if desired, from the airplane by disconnecting and plugging lines and withdrawing the bolt (30) from the cylinder and fitting between stations 253 and 262.

b. Break the safety wiring and remove the shock strut compressing cable (13) from the scissors and yoke by removing bolts. Remove the bolt (18) at the aft end of the tail wheel yoke in order to disassemble the tail wheel yoke (21), tie down shackle (hold-back link) (19), shock strut (11), snubber arm and arresting hook. Refer to paragraph 4—361 for disassembly of the tail wheel yoke.

c. Remove the bolt (9) connecting the compression strut, shock strut, and upper scissors. Refer to paragraph 4—373 for disassembly of the shock strut.

d. Remove the special bolt (5) and four bolts (10) from bracket and upper scissors, and grease bolt (12) connecting upper and lower scissors and spacer, in order to disassemble scissors.

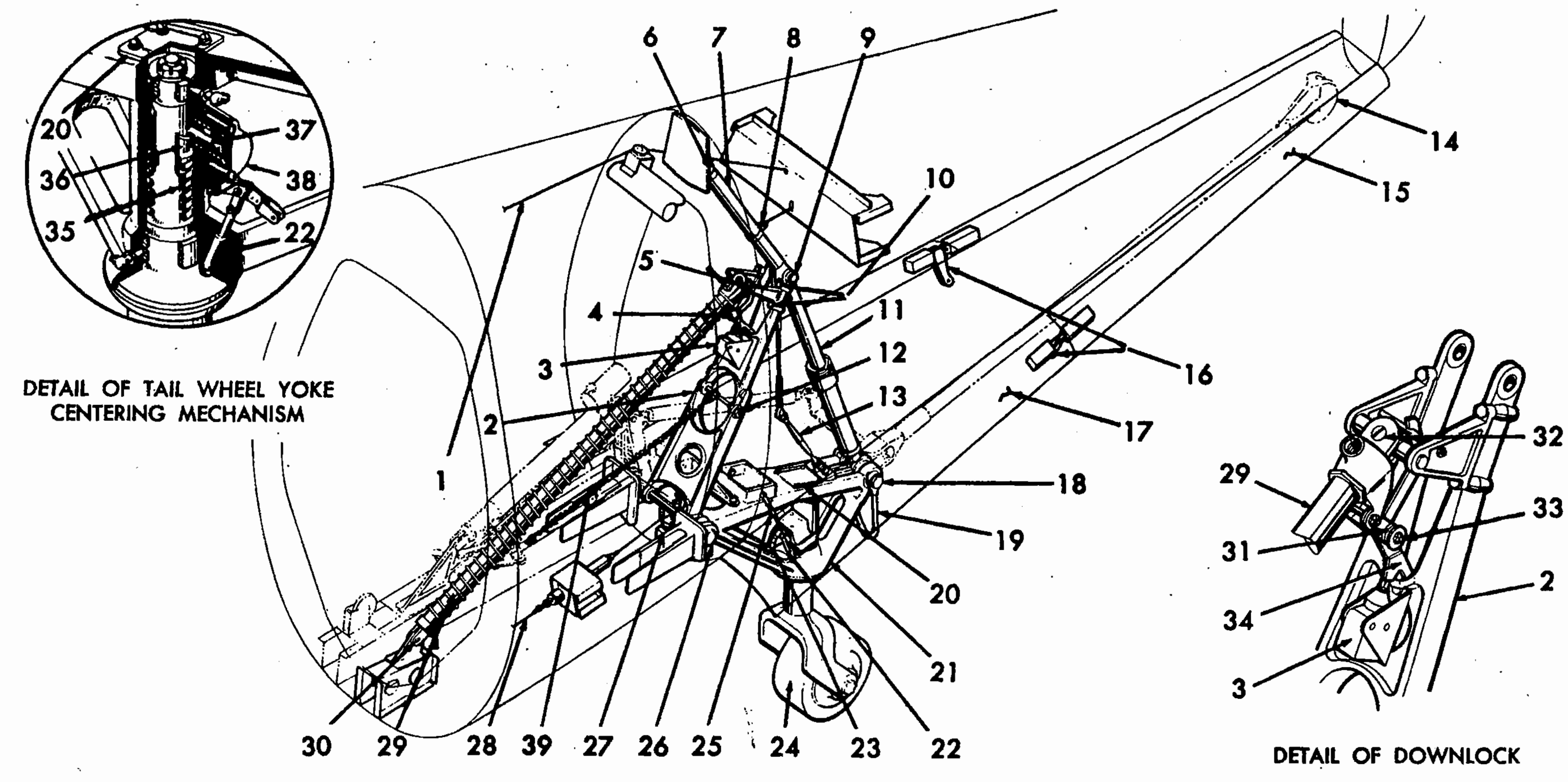
4—349. CLEANING. A petroleum distillate, such as kerosene or its equivalent, used in the cleaning of any conventional landing gear is recommended for the cleaning of the tail wheel and arresting gear. After using kerosene, wipe surfaces with a clean cloth, soaked in red hydraulic fluid, Spec. AN-O-366. Do not use carbon tetrachloride. Clean the faces of the attaching brackets on tail wheel bulkhead 288 until free of all dirt; if necessary refinish chipped paint surfaces as directed in paragraph 4—1916 through 4—1920.

4—350. LUBRICATING. Lubricate all friction points on the tail gear with Spec. AN-G-25 grease prior to installation, or as required. Refer to figure 3—14 for location of lubrication points. If doubt exists as to the adequacy of lubricant remaining in the bearing area, lubrication should be applied.

a. Oil the tail wheel positive downlock latch in three places, using general purpose low temperature oil, Spec. AN-O-6.

b. Oil the felt wipers of the tail gear actuating cylinder with hydraulic oil, Spec. AN-O-366.

4—351. REPAIRING. Replace all bent or otherwise damaged parts.



1. Step Actuating Cable
2. Scissors Assembly
3. "Down-and-Locked" Position Indicator Microswitch
4. Positive Downlock
5. Special Bolt
6. Compression Strut Attaching Bolt
7. Compression Strut
8. Step Cable Breaking Link
9. Shock Strut Attaching Bolt
10. Bolts
11. Shock Strut
12. Scissors Connecting Grease Bolt
13. Shock Strut Compressing Cable
14. Arresting Hook (see figure 4-51)
15. Aft Tail Wheel Doors
16. Aft Tail Wheel Doors Actuating Links
17. Forward Tail Wheel Doors
18. Aft Tail Wheel Yoke Attaching Grease Bolt
19. Tie-down Shackle (Hold Back Link)
20. Seal
21. Tail Wheel Yoke Housing
22. Locking Pin
23. Tail Wheel Lock Rocker Arm
24. Tail Wheel
25. Tail Wheel Door Actuating Rod
26. Forward Tail Wheel Yoke Attaching Grease Bolt
27. "Up" Position Indicator Microswitch
28. Tail Wheel Lock Cable
29. Hydraulic Actuating Cylinder
30. Hydraulic Actuating Cylinder Attaching Bolt
31. Fitting
32. Bolt
33. Bolt
34. Downlock Latch
35. Spring
36. Cam
37. Cam Follower
38. Retainer Plate
39. Scissors Locking Spring

Figure 4—49. Tail Gear Reference Diagram.

4—352. ASSEMBLING. *(See figure 4—49.)* For use of special tools noted below, see figure 3—21.

VS-34580-1	Bolt Pilot
VS-34580-2	Bolt Pilot
VS-34580-3	Bolt Pilot

a. Assemble the upper and lower scissors and spacer by inserting the grease bolt. Lubricate bolt on assembly with Spec. AN-G-25 grease. Assemble the bracket to the upper scissors by inserting the four bolts and special bolt.

b. Assemble the compression strut, shock strut, and upper scissors by inserting the bolt with its head on the right hand side. Use the special VS-34580-2 bolt pilot.

c. Assemble the tie down shackle, shock strut, arresting hook and snubber arm to the aft end of the tail wheel yoke and housing by inserting the bolt from the right hand side. Use the special VS-34580-3 bolt pilot.

d. Attach the assembled shock strut compressing cable to the scissors and yoke by reversing the disassaembly procedure given in paragraph 4—348.

e. Assemble the hydraulic actuating cylinder, if previously removed, on the fuselage fitting between stations 253 and 262 by inserting the bolt. Use the VS-34580-1 bolt pilot.

4—353. INSTALLING. *(See figure 4—49.)* For use of special tools noted below, see figure 3—21.

VS-34580-3	Bolt Pilot
VS-34580-1	Bolt Pilot

a. Install the lower end of the scissors, rocker arm, and forward end of yoke together on the fitting on bulkhead 288 by inserting the grease bolt with its head on the right hand side. Use the special VS-34580-3 bolt pilot. Before the bolt is safetied, the housing should be rotated up and down to check the freedom of the connection at the bulkhead. There should be absolutely no binding. Tighten the nut to finger tightness and safety.

b. Install the top end of the compression strut (previously assembled to the upper end of the scissors and the shock strut) on the fitting on the upper part of bulkhead 288. Install bolt head on the left hand side. The tail wheel yoke and housing must be supported during this operation.

c. Connect the aft end of the hydraulic actuating cylinder to the bracket on the scissors by inserting the bolt. Use the VS-34580-1 bolt pilot. Connect hydraulic extend and retract lines to cylinder.

d. Replace bolt connecting the downlock latch and fitting on the hydraulic cylinder.

e. Pass the tail wheel lock cable through the pulley at the forward end of the tail wheel yoke. Install cable end on the rocker arm by inserting bolt.

f. Connect the breaking link of the cockpit access lower step actuating cable to the compression strut with the bolt.

g. Connect right and left hand tail wheel door actuating rods to the tail wheel housing.

h. Lower the airplane and close the small access doors on the fuselage.

4—354. ADJUSTING.

a. Adjust the downlock latch so that a clearance of 1/16 inch (plus 1/16, minus zero inches) between the latch (34) and the scissors is obtained in the locked position.

b. Adjust the set screw on the "up" position indicating microswitch (27) and move the "down" position microswitch (3) mounting bracket as required, so that the switches are actuated by the lever on the special bolt at station 288 and by the downlock latch, respectively, with the gear in the fully "up" and "down" positions.

c. Adjust the door linkage at the rod and the link between doors so that the doors close completely and open sufficiently. Tighten lock nuts on the links after satisfactory adjustment is reached.

4—355. TESTING. Cycle the gear to see that hydraulic lines are properly connected, that the "up" and "down" position indicating microswitches are operating correctly to shown the position of the tail gear on the cockpit indicator, and to see that the downlock latch is functioning properly.

4—356. TAIL WHEEL LOCK CONTROL AND TAIL WHEEL YOKE.

4—357. DESCRIPTION. *(See figure 4—49.)* The tail wheel housing incorporates a cam and spring centering device and a tail wheel lock. Normally the tail wheel is locked, (the wheel and yoke being aligned parallel to the centerline of the airplane) for field, carrier and catapult take-offs and for field landing. The tail wheel must be unlocked for carrier landing, all taxiing and towing. The centering device aligns the unlocked tail wheel whenever the wheel is off the ground, so that it can be retracted into the fuselage. The tail wheel lock lever is located in the cockpit on the left hand control shelf. When the lock handle is pulled upward and locked in that position by twisting the handle, a cable (28) passing through the lower part of bulkhead 186 and aft on the left hand side of the airplane through pulleys at stations 218, 247 1/2 and 253, through a guide aft of station 274, and a pulley at the forward part of the tail wheel yoke, pulls a pin (22) out of the yoke, permitting the tail wheel to swivel or "castor."

4—358. TROUBLE SHOOTING.

Trouble	Probable Cause	Suggested Remedy
Actuation of handle fails to lock or unlock tail wheel.	*a.* Improper adjustment of cable.	*a.* Adjust cable length at the turnbuckle; see paragraph 4—366.
Locking pin does not seat properly.	*a.* Excessive dirt or grease in lock pin socket.	*a.* Clean drain hole in base of socket with wire.

4—359. REMOVING TAIL WHEEL LOCK CONTROL AND CABLE. *(See figure 4—49.)* Relieve tension in the cable by means of the turnbuckle.

a. Disconnect forward end of tail wheel lock cable from the tail wheel lock control lever on the left hand control panel by removing the bolt.

b. Disconnect knob from the tail wheel lock control lever by removing screw. Disconnect lower end of the lever from bracket by removing bolt. Lever may then be removed through the slot in the left hand control panel.

c. Disconnect forward and aft sections of the tail wheel lock control cable at the turnbuckle.

d. Disconnect aft section of cable from the guide and bracket by removing bolt. Remove cable from pulleys at stations 253, 247 1/2, fairlead at station 237, pulley at station 218, and fairlead at station 211 1/2. Remove cable from pulley just forward of bulkhead 186.

e. Pull cable through boot on the aft side of bulkhead 186 after removing clamp with screw.

f. Disconnect cable assembly from spring by removing bolt. Remove spring from brackets and guides.

g. Remove cable from pulley at the forward end of the tail wheel yoke. Disconnect aft end of cable from the rocker arm by removing bolt.

4—360. REMOVING TAIL WHEEL YOKE. *(See figure 4—49.)* With the tail gear extended, the yoke alone may be removed from the airplane as follows:

a. Disconnect the left and right hand door actuating rod and joint (25) from fitting on tail wheel yoke by removing nut.

b. Disconnect the lower end of the shock strut compressing cable (13) from the yoke (21) by removing the bolt.

c. Disconnect the tail wheel lock cable (28) from the tail wheel lock rocker arm (23) and from the pulley at the forward end of the yoke.

d. Disconnect the jumpers at the forward and aft ends of the yoke by removing screws.

e. While supporting the yoke, remove the bolt (18) attaching the aft portion of the yoke to the arresting hook and chuck strut. Remove the bolt (26) attaching the forward portion of the yoke to the scissors.

4—361. DISASSEMBLY. *(See figure 4—49.)* The tail wheel yoke may be disassembled without removing the yoke from the airplane. Jack or hoist the extended tail wheel clear of the ground, and proceed as follows:

a. Break the safety wire at the top of the housing and obtain access to the top inner recess by removing three of the four screws so as to swing the seal (20) and gasket about the small attached lug on the remaining screw.

b. Reach into the housing, unsafety the nut, and remove the nut, and bushing. The spring (35) will force the yoke shaft down out of the housing. Withdraw the shaft with attached cam (36), spring bushing, and bearing plate. The cam is keyed to the yoke shaft, and upon its removal, the yoke assembly may be completely disassembled.

c. Access to the cam follower (31) may be obtained by removing the screws from the retainer plate (38) at the forward side of the housing. Remove the follower (37) and roller by withdrawing them through the space formerly occupied by the shaft of the yoke.

d. Remove the tail wheel locking pin (22) when the yoke is out, by withdrawing the bolt which connects the pin to the rocker arm. The pin will then drop out of the housing.

4—362. CLEANING. Clean all bushings and springs, and lubricate with Spec. AN-G-25 grease upon assembly.

4—363. LUBRICATING.

a. Grease all bolts before reinstallation, pack tail wheel yoke and grease tail wheel lock plunger with low temperature grease, Spec. AN-G-25.

b. Coat mating surfaces of the bearing plate and the tail wheel yoke with AN-O-8, type 1065 engine lubricating oil before assembling.

4—364. REPAIRING. When the tail wheel yoke is removed from the housing, the pin, cam follower, cam, and bushing are available for close inspection. Bent or otherwise damaged parts must be replaced, and scoring of the yoke facing or shaft should be carefully smoothed out with crocus cloth or the yoke replaced.

4—365. ASSEMBLING. The tail wheel yoke and housing are assembled by reversing the disassembly procedure. Points to be observed are to attach the cam so that the lowest portion of the notch is forward, and to force the yoke up against the spring until the facing on the yoke is flush with the housing facing before tightening the retaining nut. Care must be taken not to over tighten this nut lest the bushing bind.

4—366. ADJUSTING. Adjust the tail wheel lock cable by means of the turnbuckle directly beneath the control handle on the left hand side of the cockpit. Adjust the cable so that it is just taut when the tail wheel lock handle is in the "locked" position.

4—367. INSTALLING. *(See figure 3—21 for use of following special tool.)*

VS-34580-3 Bolt pilot

a. Install the tail wheel yoke and tail wheel lock control by reversing removal procedure given in paragraphs 4—359 and 4—360.

b. Grease all bolts before installing. Refer to paragraph 4—363.

c. Install bolts at the forward and aft ends of the tail wheel yoke with the head on the right hand side. Use the special VS-34580-3 bolt pilot when inserting the bolts.

d. If fumeproofing of cable boot on bulkhead 186 has been disturbed, coat all faying surfaces of boot with 3M-EC-504 Thiokol cement.

4—368. TESTING. Test the tail wheel lock for proper function and adjust, if necessary. Refer to paragraph 4—366.

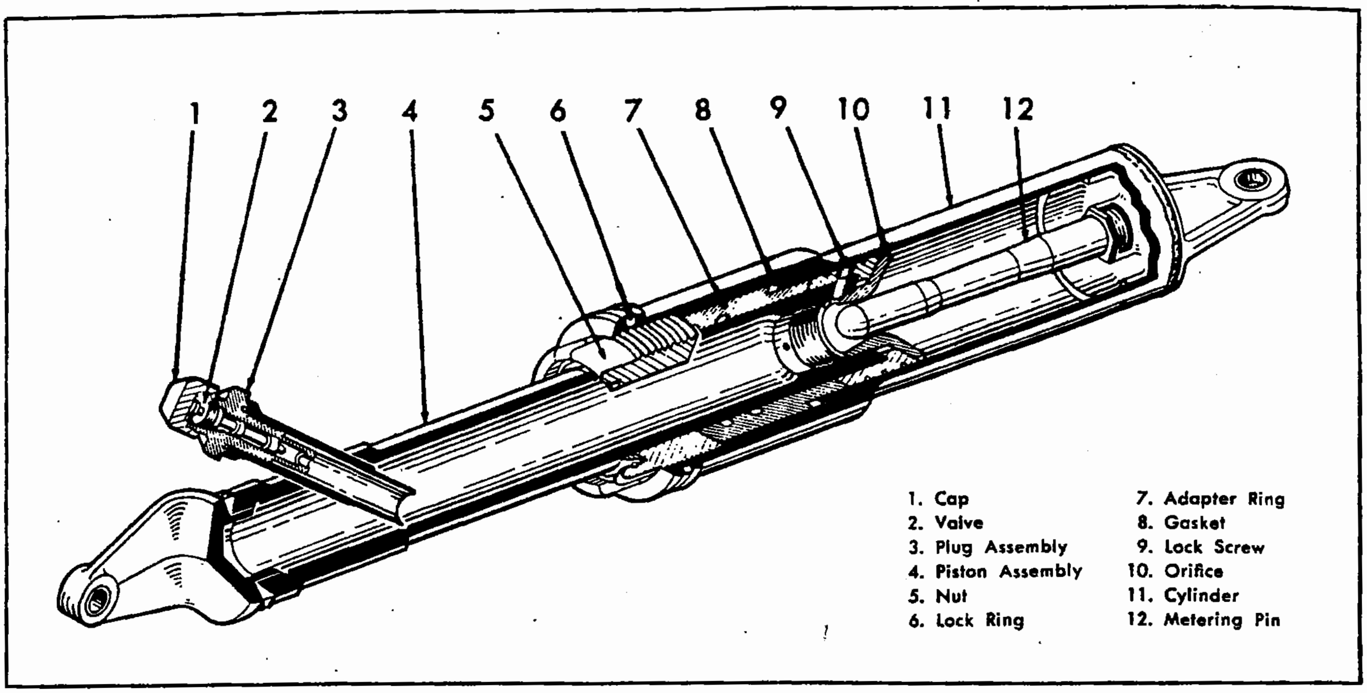


Figure 4–50. Tail Gear Shock Strut.

4–369. TAIL GEAR SHOCK STRUT.

4–370. DESCRIPTION. *(See figure 4–50.)* The tail wheel shock strut is of the oleo-pneumatic type, consisting of a piston assembly (4), an orifice (10), an outer telescoping cylinder (11) and metering pin (12). Shock absorption is accomplished by the combined metering of the oil through the orifice and the cushioning effect of the pressurized air in the upper portion of the strut.

4–371. TROUBLE SHOOTING.

Trouble	Probable Cause	Suggested Remedy
Leakage at the air valve.	*a.* Worn or faulty valve.	*a.* Deflate strut and replace valve or plug as required; see paragraph 4–376.
Strut bottoms with ordinary usage.	*a.* Fluid level low.	*a.* Add fluid; refer to paragraph 4–376.
	b. Worn, torn or frayed packings.	*b.* Replace packings.
Shock strut will not fully bottom.	*a.* Damaged cylinder wall.	*a.* Replace shock strut.
	b. Binding of internal components.	*b.* Disassemble strut, clean all components and reassemble.

4–372. REMOVING. *(See figure 4–49.)*

a. With tail wheel extended, jack the tail of the airplane at the tail wheel bulkhead immediately forward of the tail wheel doors until the tail wheel just clears the ground in the extended position. For jacking procedure, see paragraph 3–26.

b. Open the Camloc-fastened tail wheel shock strut access door located on the right hand side of the fuselage at station 306.

c. Release the air pressure in the shock strut by removing the cap and depressing the valve stem until all air is released.

d. Detach bonding clips and remove the aft bolt at the tail wheel housing, disconnecting the arresting hook, the hold back shackle, the tail wheel housing and the lower end of the shock strut.

e. Detach the bonding clips and remove the bolt at the top of the shock strut, disconnecting the compression strut and scissors and freeing the shock strut, which may now be removed from the airplane.

4–373. DISASSEMBLY. *(See figure 4–50.)* The following special tools are required for the disassembly of the tail gear shock strut; see figure 3–16 for use of special tools.

VS-34536 – Wrench for tail gear and main landing gear metering pin.

VS-10517 – Handle for above wrench.

a. Make certain that the shock strut is completely deflated. Remove the valve plug and empty the fluid.

b. Remove the lock ring (6) and nut (5) from the cylinder. Withdraw the piston (4). This makes VS-12251 gasket accessible.

c. The metering pin (12) is sweat-soldered in place and may be removed by means of the special VS-34536 wrench and VS-10517 handle after heating the lower end of the strut to melt the solder.

CAUTION

If primer and cadmium plate have been damaged by heating operation, the strut shall be stripped, replated and reprimed.

d. Remove the orifice lock screw (9) and then unscrew the orifice (10), using an adjustable hook spanner wrench. The adapter ring (7) can now be slid off the inner cylinder and its packings replaced.

e. For replacement of gaskets and packings, consult the following table.

PART NO.	NAME	LOCATION
CV-44212	Gasket	At the filler valve.
AN6230-5	Gasket	Between cylinder and adapter.
AN6227-30	Packing	Between adapter and piston tube.

4—374. ASSEMBLING. Using special tools noted in paragraph 4—373, assemble the tail wheel shock strut by reversing the disassembly procedure.

Note

Dip the adapter in hydraulic fluid before slipping it onto the inner cylinder.

4—375. INSTALLING. The following special tools are required for installation of tail gear shock strut:

VS-34580-2	Bolt pilot
VS-34580-3	Bolt pilot

a. Install the tail gear shock strut by reversing removal procedure given in paragraph 4—372.

b. Install grease bolt heads on the right hand side.

c. Use VS-34580-2 bolt pilot for installing upper bolt, and VS-34580-3 bolt pilot for installing lower bolt.

4—376. FILLING PROCEDURE. *(See figure 4—50.)* The shock strut has a stroke of 8 1/2 inches from the fully compressed position to the fully extended position. The distances measured between the centerlines of the strut attaching bolts for fully compressed, static and fully extended positions are given below:

Fully Compressed — 20 11/16″	(plus or minus 1/16″)
Static (with airplane loaded) for take-off) — 27″	(plus or minus 1/4″)
Fully extended — 29 3/16″	(plus or minus 1/16″)

Each strut incorporates a decalcomania giving general servicing instructions. The following procedure is intended to amplify the instructions given on the decal.

a. Open the shock strut access door, located on the right hand side of the fuselage at approximately station 300. Remove cap (1) from valve assembly (2) on the strut and depress valve stem until all air is released and the strut is fully compressed.

b. After releasing air, remove plug assembly (3).

c. If strut is in service, refill by adding mineral oil conforming to Spec. AN-O-366 (red fluid) to level of filler plug with strut in fully compressed position.

d. For the first filling of a new strut or after inspection or overhaul, extend strut to maximum length. Fill with approximately one pint of mineral oil, Spec. AN-O-366 (red fluid). Compress and extend slowly two or three times. With strut fully compressed, add oil to bring level up to filler hole with strut in approximately vertical position.

e. Replace plug, valve body and gasket.

f. To inflate strut, attach high pressure air hose to air valve. Inflate to 11 3/4 inches between upper bolt centerline and uppermost lock ring retainer shoulder of the lower cylinder, with airplane loaded for take-off.

g. Seat air valve hex cap lightly with wrench.

h. Check valve and filler plug seat for leaks.

4—377. ARRESTING HOOK.

4—378. DESCRIPTION. *(See figure 4—51.)* The arresting gear is mechanically linked to the tail gear and is of the "latch-up" type. Each hook is provided with a removable hook head and is proof-loaded to 44,000 pounds. The arresting hook shaft embodies a pre-loaded spring and centering cam to maintain the hook in the proper position. A cable runs from the arresting hook control handle, on the right hand control shelf, to a bellcrank on the locking strut in the rear fuselage. When the control handle is placed in the "DOWN" position, the cable slackens, latches are released, and the dashpot spring forces the hook down. After landing, the control handle should be moved to the "UP" position; this resets the locking mechanism and permits the hook to be parked (positioned approximately one foot above the deck) by the deck crew. The arresting hook will remain in this position until a subsequent take-off, since the hook is returned to its fully retracted position only when the landing gear and tail wheel are fully retracted. Moving the arresting hook control handle "DOWN" also actuates two switch buttons beneath the control panel, which make the master armament and gun charging circuit inoperative. This safety feature prevents inadvertent firing of guns, bombs or rockets at any time that the arresting hook control handle is in the "DOWN" position; see paragraph 5—103. When the arresting hook extends, it depresses a switch which automatically turns on the approach light; see paragraph 5—119.

4—379. FUNCTION — EXTENDING. *(See figure 4—51)* Placing the arresting hook control handle in the "DOWN" position slackens the control cable. The torsion spring then forces the bell crank and lock link assembly to break away from the guide assembly, releasing the latches from the sliders and permitting the dashpot to push the rocker arm assembly (to which the locking strut is also attached) aft. This forces the link assembly aft, extending the hook. Should the arresting hook control cable break, the arresting hook is automatically unlatched, and extends when the tail gear is extended. Avoid dropping the arresting hook after the tail gear is extended, to prevent excessive jarring.

4–380. FUNCTION – RETRACTING. *(See figure 4–51.)* Although the arresting hook will not be retracted when the control handle is placed in the "UP" position, subsequent retraction of the main landing gear and tail wheel will retract the hook, and lock it, provided the control handle is in the "UP" position. This is mechanically accomplished as follows. The cam assembly (6) on the upper forward portion of the tail wheel yoke (13) bears against a roller (19) on the rocker arm (5). As the rocker arm is rotated forward, it compresses the dashpot and latches the locking strut.

4–381. TROUBLE SHOOTING.

Trouble	Probable Cause	Suggested Remedy
Hook head does not rest tight against bumper with tail wheel extended.	*a.* Link improperly adjusted.	*a.* Adjust link. Refer to paragraph 4–387.
Approach light fails to be actuated when arresting gear is extended.	*a.* Failure in electrical system.	*a.* Refer to paragraph 5–119.
	b. Improper adjustment of switch screw.	*b.* Adjust screw to contact locking strut assembly in "down" position.
Hook fails to center.	*a.* Centering cam inoperative.	*a.* Back off red-headed bolt.
	b. Hook mechanism out of alignment.	*b.* Adjust spring plunger; see paragraph 4–387A.

4–382. REMOVING. *(See figure 4–51.)*

a. Disconnect the aft section of the arresting hook control cable (16) from the bellcrank of the locking strut assembly (3) by removing bolt.

b. Disconnect the forward section of the arresting hook control cable (24) from the lever (22) of the cockpit control (25) located on the right hand inclined panel, by removing bolt (23).

c. Remove cable from pulleys at stations 149 and 171 on the right hand side of the cockpit. Remove clamp by means of screw from cable where it passes through boot just forward of bulkhead 186. Break cable at turnbuckle located beneath cockpit floor between stations 171 and 186.

d. Remove cable from pulleys at stations 199 1/2, 218, and upper pulley (2) on bulkhead 253.

e. Disconnect cable from spring assembly (1) by removing bolt. Pull cable from pulley (17) on the lower part of bulkhead 253.

f. Disconnect forward end of locking strut (3) from fitting (15) and aft end from rocker arm (5) by removing grease bolts.

g. Remove forward end of dashpot (4) from fitting (15) and aft end from rocker arm (5) by removing grease bolts.

h. Remove forward end of link (7) from rocker arm (5) and aft end of link (7) from the arm (8) of the arresting hook by removing grease bolts.

i. Remove three bolts (18) from cam assembly (6), disconnecting it from the yoke. Release the cam assembly from the airplane by removing the bolt (21) attaching the arm assembly (20) to the fitting on bulkhead 288.

j. Push arresting hook to one side and tighten red-headed bolt at forward end of hook (see figure 4–52), thus locking internal spring in a compressed position.

WARNING

The arresting hook spring is preloaded to 855 pounds. When hook is removed from airplane, do not loosen red-headed bolt at its forward end, since a sudden release of the interior mechanism might cause injury to personnel.

k. Remove grease bolt (11) at aft end of tail wheel yoke and remove arresting hook from airplane.

4–383. DISASSEMBLY. *(See figure 4–52.)* After arresting hook has been removed from airplane, proceed as follows to further disassemble hook:

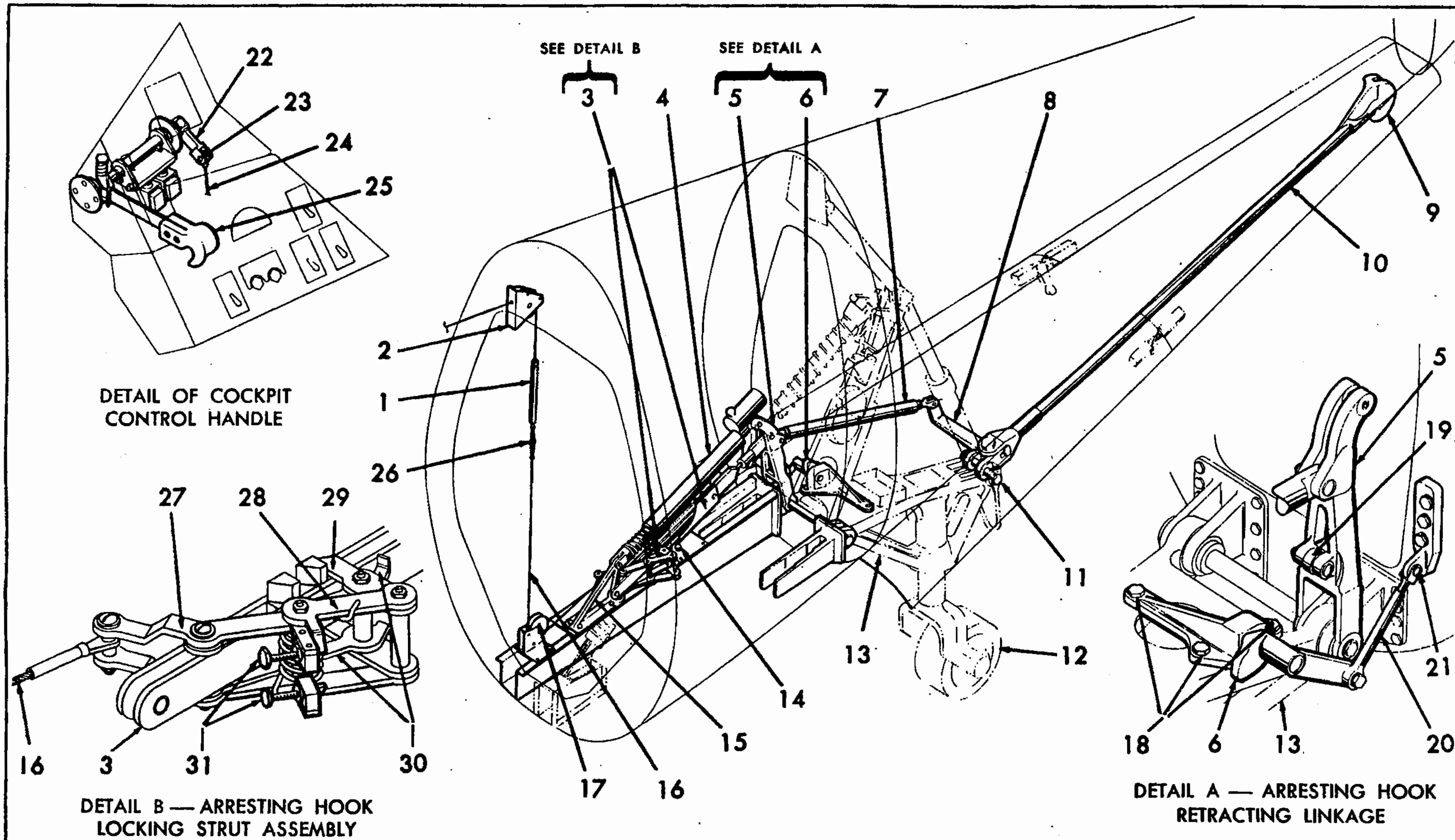
a. Make sure red-headed bolt (3) is securely tightened against spring plunger; see Warning above.

b. Disconnect snubber arm assembly (12) from arresting hook, by removing vertical grease bolt (7).

c. Use a special clamp, such as that shown on figure 4–52, to safely remove centering spring (8). Tighten clamp against spring plunger (10). Then release the red-headed bolt (3), and slowly back off clamp screw, thereby releasing centering spring.

d. The NAF 601121 hook point may be removed from hook by removing attaching bolt (1).

4–384. LUBRICATING. Lubricate arresting hook as follows before installation. Refer to figure 3–14 for location of lubrication points if lubricant remaining on bearing surface is insufficient for proper operation. If



1. Cable Spring Assembly
2. Upper Pulley — Bulkhead 253
3. Locking Strut Assembly
4. Dashpot
5. Rocker Arm
6. Cam Assembly
7. Link Assembly
8. Arm
9. Removable Hook Point
10. Arresting Hook
11. Arresting Hook Attaching Grease Bolt
12. Tail Gear (see figure 4-49)
13. Tail Wheel Yoke (ref.)
14. Approach Light Microswitch
15. Dashpot and Locking Strut Attaching Fitting
16. Arresting Hook Control Cable (aft section)
17. Lower Pulley
18. Cam Assembly Attaching Bolts
19. Rocker Arm Roller
20. Arm Assembly
21. Arm Assembly Attaching Bolt
22. Arresting Hook Control Handle Lever
23. Cable Attaching Bolt
24. Arresting Hook Control Cable (forward section)
25. Arresting Hook Cockpit Control Handle
26. Turnbuckle
27. Bellcrank Assembly
28. Lock Link Assembly
29. Latch
30. Link Assembly
31. Set Screws

Figure 4–51. Arresting Hook Reference Diagram.

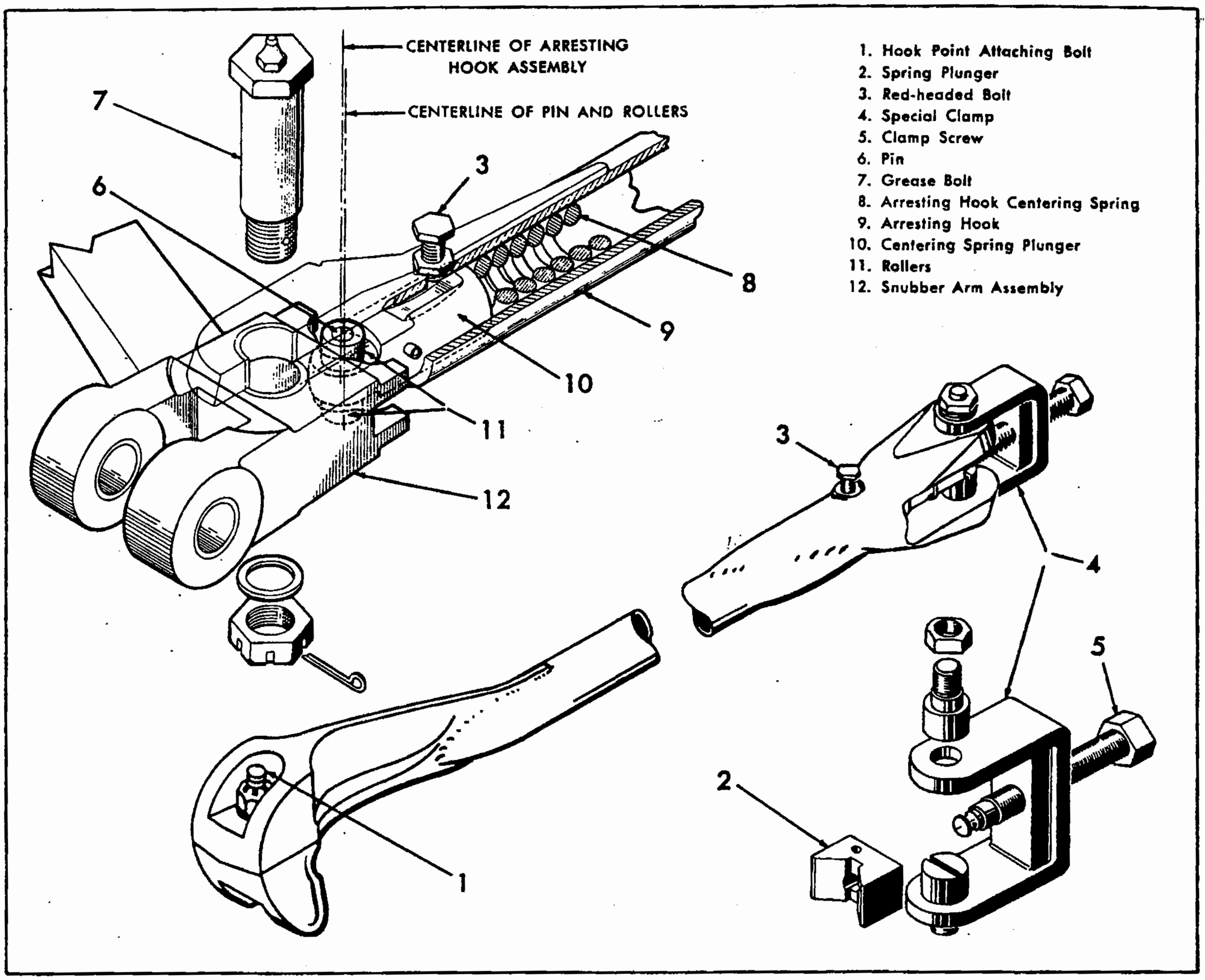


Figure 4—52. Arresting Hook Disassembly.

doubt exists as to adequacy of lubricant remaining on bearing area, lubrication should be applied.

a. Grease all bolts, arresting hook dashpot and locking strut with low temperature grease, Spec. AN-G-25.

4—385. ASSEMBLING. Assemble the arresting hook by reversing the disassembly procedure given in paragraph 4—383. Be sure the red-headed bolt does not bind the spring plunger.

4—386. INSTALLING. Install arresting hook by reversing removal procedure; see paragraph 4—382. Install all grease bolts with heads on right hand side of airplane. Install all other bolts with heads on left hand side.

4—387. ADJUSTING. *(See figure 4—51.)*

a. Adjust arresting hook link (7), with tail wheel extended, arresting hook retracted and locking strut (3) locked, so that hook head remains against bumper with 35 pound weight hanging on hook.

b. Adjust arresting hook to properly clear doors during retraction as follows. Set arm assembly (20) to nominal length of 5 7/32 inches. Adjust length of locking strut (3) at rod end to provide 1/8 inch gap between cam assembly (6) and roller (19) when arresting hook is fully extended.

Note

Further adjustment for door clearance can be obtained by reducing the gap between roller (19) and cam (6). It is recommended that this gap not be reduced below 1/16 inch, so as to prevent damage to cam surface when tail wheel is extended and arresting hook is released.

c. If, in operating the tail gear, the arresting hook cannot be kept locked up, make the following adjustment. Set arresting hook control handle (25) in cockpit in the "UP" position. Next adjust turnbuckle (26) in

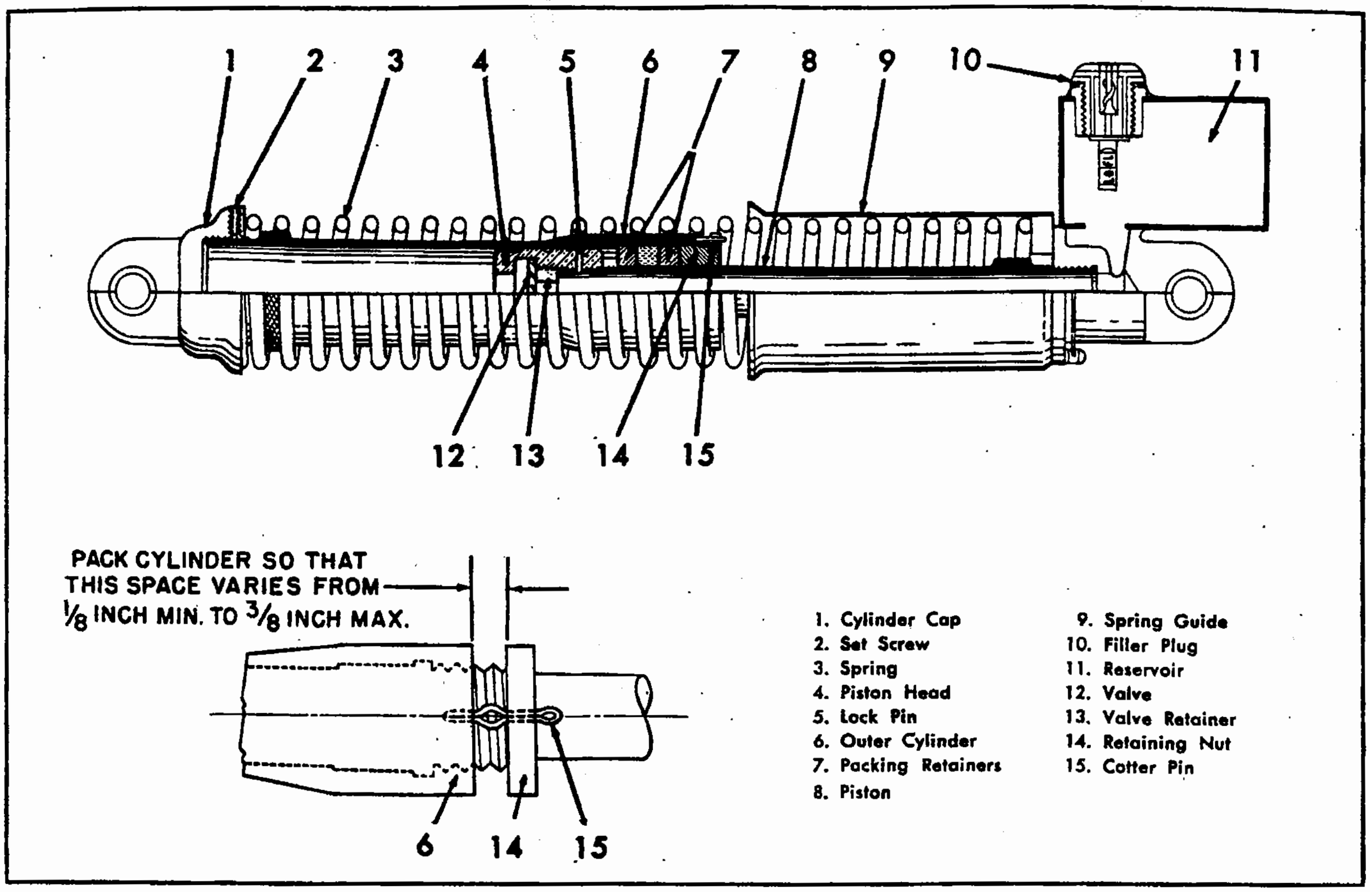


Figure 4—53. Arresting Hook Dashpot.

control cable to close locking links (28). Adjust setscrews (31) on bellcrank assembly (27) so as to provide 1/32 inch gap between bellcrank (27) and link assembly (30), both upper and lower.

Note

If, in cycling the tail wheel, the arresting hook cannot be kept locked in the up position, reduce the gap between the locking links. If, on the other hand, the arresting hook cannot be released at will after the tail wheel is lowered, the gap between the locking links should be increased to a maximum of 3/32 inch.

d. Adjust the approach light microswitch screw (14) so that it is actuated by the locking strut when the hook is lowered.

4—387A. *(See figure 4—52.)* The centerline of the rollers (11) of the centering device is offset from the centerline of the arresting hook. The direction and magnitude of offset on original installation is stamped on the centering spring plunger (10). If the hook is displaced in the same direction as the markings on the plunger indicate that the pin (6) is offset (i e., to the left), the hook may be brought to a more central position as follows:

a. Remove hook; see paragraph 4—382 j. and k.

b. Remove plunger (10) from hook; see paragraph 4—383 a. through c.

c. Rotate spring plunger (10) 180°; reinstall plunger and hook, using reverse procedure.

4—388. TESTING.

a. Check hook shank visually for possible bending.

b. Test the action of the internal spring by flexing the hook 15° to either side of the airplane's centerline.

c. Visually check the operation of the latches in the locking strut.

4—389. ARRESTING HOOK DASHPOT.

4—390. DESCRIPTION. *(See figure 4—53.)* The spring-loaded dashpot consists of two telescoping oil-filled cylinders within a preloaded spring, and hydraulic fluid reservoir. The spring aids in gravity actuated extension of arresting hook, and keeps hook in contact with carrier deck during landings. The function of the dashpot is to dampen out "bouncing" of hook, which it accomplishes by means of a combined flapper valve and metering orifice at lower end of inner cylinder. The flapper valve permits relatively rapid flow of oil when dashpot is extending (i.e., when hook is traveling downward), but forces the oil through a central 3/32 inch orifice when the dashpot is being compressed. The flow to and from the attached reservoir is unrestricted. The reservoir filler plug contains a rod-type gage which can be read when the plug is removed.

4—391. REMOVING. Refer to paragraph 4—382g. for removal of arresting hook dashpot.

4—392. DISASSEMBLY. *(See figure 4—53.)*

a. Secure the forward end of the dashpot in a vise and pull the spring (3), which is preloaded approximately 100 pounds, down sufficiently to allow a small clamp to be inserted between the spring and the cylinder cap (1). Tighten the clamp to the cylinder.

b. Remove set screw (2) from cap and, holding cylinder with a strap wrench, unscrew cylinder cap.

c. Hold back spring while an assistant removes clamp. Carefully allow spring to extend and be removed.

d. Remove cotter pin (15) and nut (14) at upper end of cylinder tube (6) and then withdraw piston (8), with attached packing retainers (7), from cylinder.

e. Knock out the piston head lock pin (5) and unscrew the piston head (4).

f. Remove the valve (12) by unscrewing the valve retainer (13) with a large screwdriver.

g. Remove spring guide (9) by breaking lockwire and removing screws which attach guide below reservoir.

h. Remove the reservoir (11) by unscrewing the set screw, holding the cylinder with a strap wrench and unscrewing the reservoir.

4—393. REPAIRING. The following packings and gaskets must be replaced, as necessary:

PART NO.	NAME	LOCATION
AN6227-21	Packing	Outer cylinder cap
Garlock Beaver No. 117	Twisted packing	Open end of outer cylinder
AN6227-13	Packing	Cap at reservoir end of piston
AN901-8A	Gasket	Under reservoir filler plug

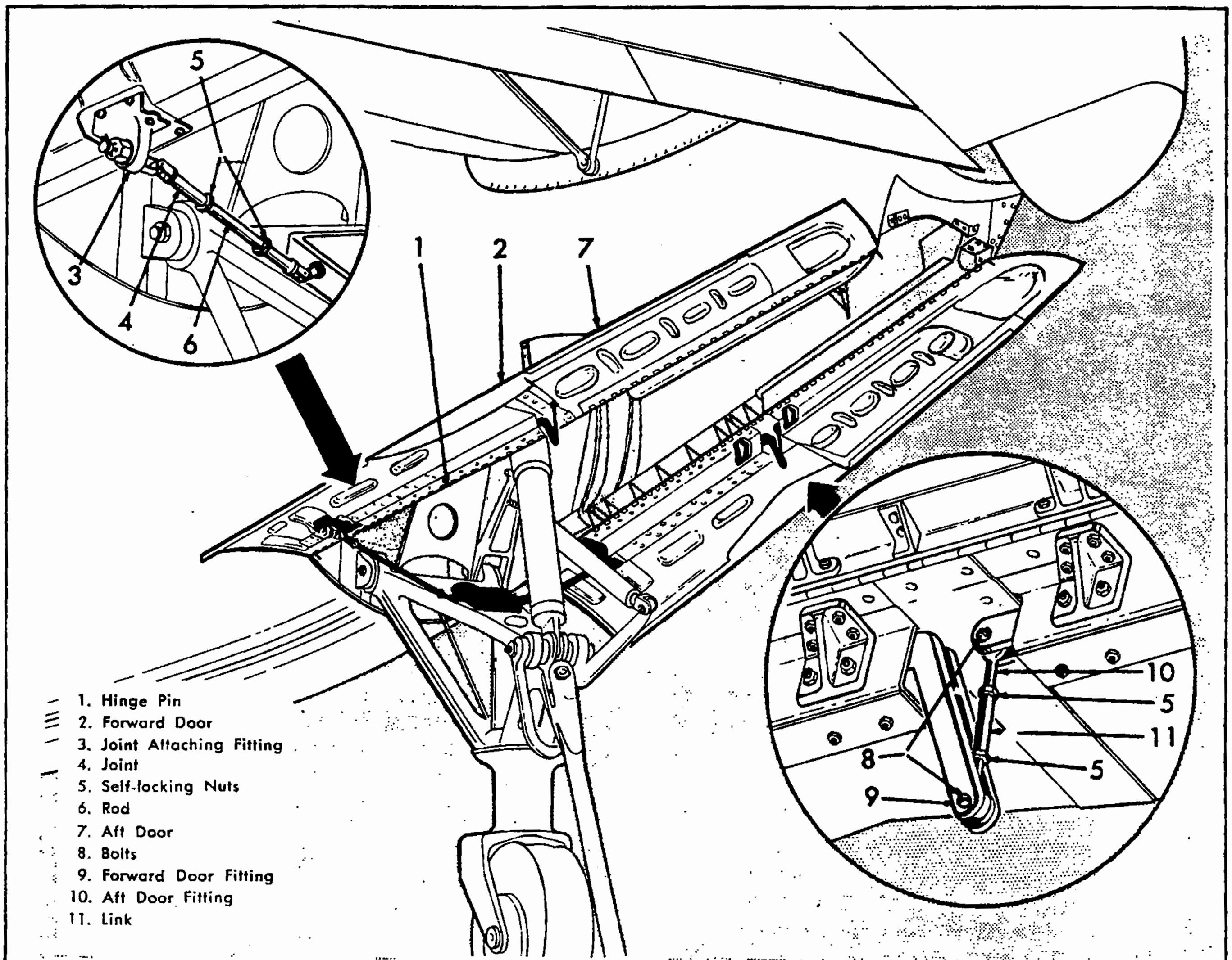


Figure 4—54. Tail Wheel Doors.

4—394. ASSEMBLING.

a. Assemble the arresting gear dashpot by reversing disassembly procedure. Refer to paragraph 4—392.

b. Special attention should be paid to packing outer cylinder. Sufficient packing should be inserted so that after inserting upper retaining ring and tightening retaining nut (14), a clearance of from 1/8 inch to 3/16 inch remains between end of outer cylinder (6) and inside face of nut (14). *(Refer to figure 4—53.)* A cotter pin (15) inserted through nut and cylinder is spread in this gap so as to lock nut and itself in place.

4—395. INSTALLING. Install arresting gear dashpot by reversing removal procedure. See paragraph 4—382g.

4—396. FILLING PROCEDURE. *(See figure 4—53.)* The small reservoir on dashpot requires frequent filling in accordance with decal on side of reservoir. The following procedure gives additional information.

a. Raise the tail of the airplane so the hook in the "down" position clears the deck. Refer to paragraph 3—26 on jacking information.

b. With the hook in full "up" position, remove filler plug (10) and fill reservoir with Spec. AN-O-366.

c. Move hook slowly from full "up" to full "down" several times to remove air from dashpot cylinder.

d. Check the gage in the reservoir with the nut and cap unscrewed. If the oil level is below the "full" mark on the gage, add sufficient oil to bring it only to the full mark and replace filler plug.

e. If position of airplane is such that step a. cannot be accomplished, steps b., c., and d. should be accomplished within limits as defined by position of airplane. This deviation from recommended procedure should be corrected as soon as practicable thereafter.

CAUTION

Do not overfill dashpot by adding fluid to reservoir or strut with the hook in "down" or partially "down" position. This, if done, results in a hydraulic fluid "lock" prior to full bottoming of the strut and will cause excessive leakage or possible physical failure of the strut and/or connecting related parts.

4—397. TAIL WHEEL DOORS.

4—398. DESCRIPTION. *(See figure 4—54.)* The tail wheel doors extend from station 288 to the tail cone and completely enclose the tail gear and arresting hook. The doors are actuated through a simple linkage from the yoke of the tail gear to both right and left hand forward doors. Aft doors are linked to forward ones.

4—399. REMOVING. *(See figure 4—54.)*

a. Detach the rod (6) from the forward door (2) by removing nut from the joint (4) and fitting (3) on the tail wheel housing.

b. Detach forward and aft doors (2) and (7) by removing either of the bolts (8) connecting the link (11) to the forward or aft door fittings (9) or (10).

c. Cut off the forward ends of the wire hinge pins (1) (the parts which are bent over) and pull out the pins from the aft end of the door installation with a pair of vise-grip pliers and a mallet. An alternate method is to grip the ends of the wires with a slow speed drill and pull them out while twisting them.

4—400. INSTALLING. *(See figure 4—54.)*

a. Grease the half hinges on the fuselage and on the forward and aft tail wheel doors (2) and (7) with AN-O-8 engine oil.

b. With the aid of a drill (an air drill is best) insert an 87 inch long (.090 inch diameter) wire hinge pin (1) which is pointed at one end through the piano hinge on the fuselage and the forward and aft doors. Run the wire through each set of half-hinges first before pinning them together in order to clear the openings of any obstructions. If any of the half-hinges are out of alignment, tap them into position with a mallet.

c. Install the rod (6) on the forward tail wheel door and connect the forward and aft tail wheel doors with their link (11) by reversing the removal procedure.

4—401. ADJUSTING.

a. If the tail wheel doors come in contact with tail wheel yoke when closing, make adjustments at the universal swivel fitting which connect the doors and yoke. A final adjustment may be made by filing slightly on the door edges until 1/8 inch clearance is obtained between doors.

b. Adjust the doors to be evenly aligned and to close completely with a 1/8 inch maximum gap by means of the links connecting the two doors, and the rods connecting the doors, to the tail wheel yoke.

Note

Whenever the rods or links are adjusted, do not neglect to lock them in position with the lock nuts (reference 5 on figure 4—54). Do not over-tighten the links as this might cause shearing of rivets or distortion of the doors.

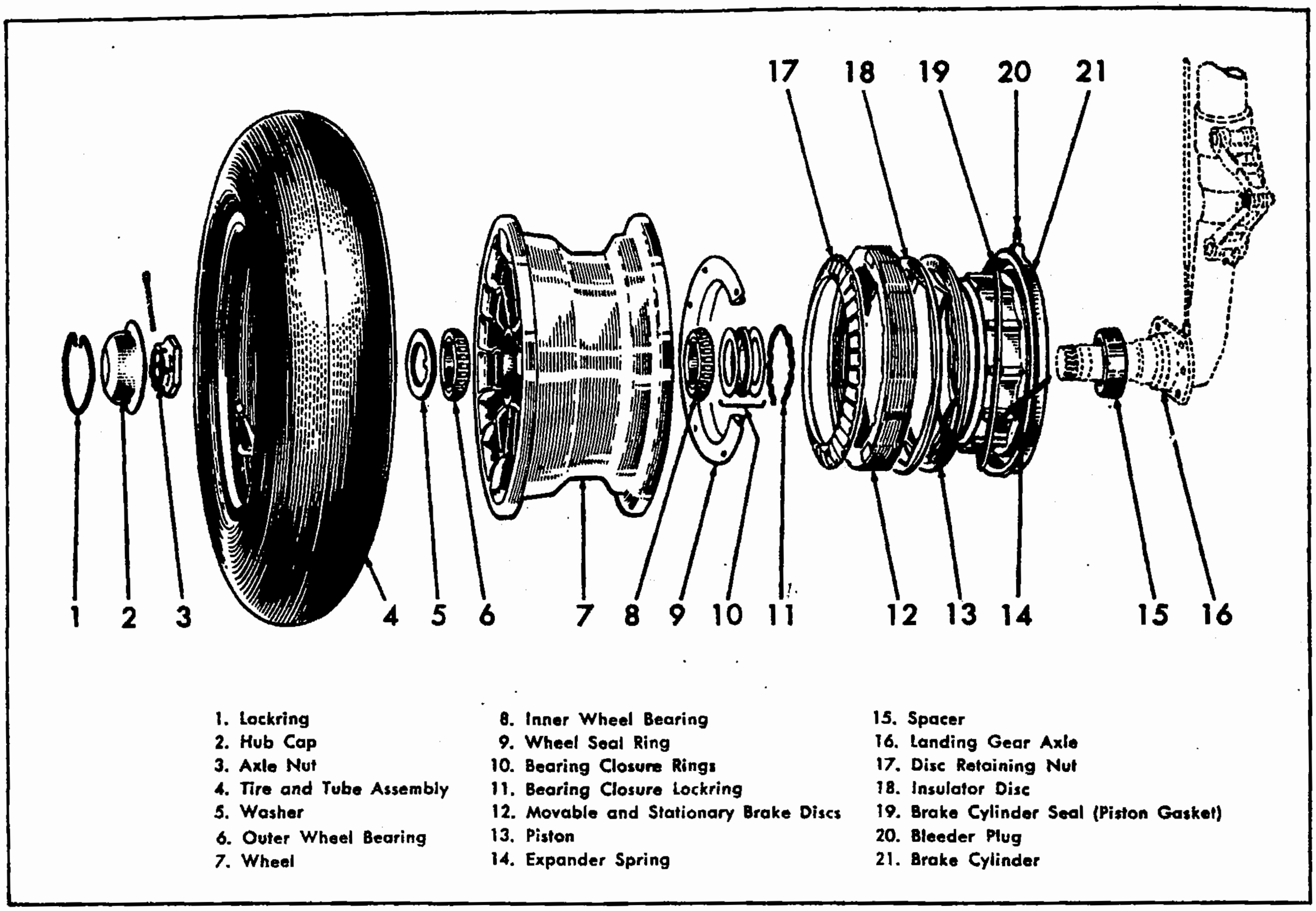


Figure 4—55. Wheel, Tire and Brake Assembly.

4—402. WHEELS, TIRES AND BRAKES.

4—403. WHEELS – MAIN LANDING GEAR.

4—404. DESCRIPTION. *(See figure 4—55.)* The main landing gear wheels are drop center wheels, each consisting of a Goodyear 32″ x 8″ magnesium alloy, single cast, fixed flange rim, with a single brake cavity, two tapered Timken roller bearings, and provisions for mounting a cover plate over the flange.

4—405. TROUBLE SHOOTING. Inspect the condition of the protective coating; inspect for evidence of corrosion. At no time should corroded wheels be used. Refinish chipped protective coating immediately in accordance with instructions in paragraph 4—1900. Apply two coats of zinc chromate primer and two coats of aluminized lacquer.

Trouble	Probable Cause	Suggested Remedy
Flange or rib damaged, wheel cracked.	*a.* Landing with flat tire. Hitting rock or other hard object during landing.	*a.* Replace wheel. Such wheel condition is dangerous.
Damaged bearing.	*a.* Dirt or frozen material in bearing, or maladjustment.	*a.* Remove bearing cone. Replace with new bearing, making sure that bearing cup has not been damaged.
Cracked webs.	*a.* Hard landing.	*a.* Drill stop holes at end of cracks.
Worn or damaged felts or closure rings.	*a.* Wear or lack of lubrication.	*a.* Replace bent or damaged closure rings. Replace worn felts. Before installing felts, dip into light machine oil.

4—406. REMOVING. *(See figure 4—55.)* Jack up airplane as directed in paragraph 3—27.

a. Remove lockring, hub cap and cotter pin, and unscrew the axle nut. Use special wrench VS-45678 for removal of axle nut; see paragraph 3—115.

b. The wheel is then carefully lifted off the axle stub.

4—407. CLEANING. Replace felt grease retainers that have become worn or grease soaked. Wash the roller bearings in gasoline, and lubricate as directed in paragraph 4—408. Wash wheel with mild soap and fresh water. Gasoline or naphtha may also be used for cleaning the wheels.

4—408. LUBRICATING: Lubricate Timken roller bearings with Spec. AN-G-5 medium grease, whenever bearings are removed, and also after 120 hours of service; apply by hand. Grease retaining felt should be oiled sparingly with light machine oil.

4—409. INSTALLING. Before installing the wheel, make sure the brake is properly installed and adjusted; see paragraph 4—423.

a. Align tangs on brake discs with straight-edge and apply brake pressure to hold discs in position.

b. Slip wheel on axle and slide it over the brake, making sure that keyways in wheel line up with keys of discs and that wheel engages last disc.

c. Release brake and screw up axle nut until the wheel will not turn freely. Use special wrench VS-45678. Then back off one adjustment slot in lock nut and safety. Do not damage axle threads when bending cotter pin.

d. Check above adjustment by rotating wheel.

Note

Do not confuse brake drag with bearing tightness when rotating wheel to check bearing for excessive tightness. See paragraph 4—417.

4—410. TIRES AND TUBES—MAIN LANDING GEAR.

4—411. DESCRIPTION. *(See figure 4—55.)* The main wheel tires are Goodyear 32″ x 8″, 8-ply nylon cord with 32″ x 8″ regular tubes. Tires should be inflated to 90 psi for a gross weight of 12,000 lbs. For maximum load (approximately 15,800 lbs.) the tire pressure is 120 psi for land-based operation. Interpolation may be used for tire pressures between these two weights. The above pressures apply for both land and carrier-based operation.

4—412. TROUBLE SHOOTING.

Trouble	Probable Cause	Suggested Remedy
	TIRES	
Ruptures or breaks inside of tire casing carcass.	*a.* Hitting rock or other hard object during landing.	*a.* Do not attempt any repairs. Replace tire.
Blisters and loose cords inside and out of tire side walls.	*a.* Manufacturing fault.	*a.* Replace tire.
	TUBES	
Valve damaged.	*a.* Slippage of casing during hard landing.	*a.* Send tubes to a specialized repair station.
	b. Faulty attachment to tube.	*b.* Same as above.
Thin spots, cuts or punctures in tube body.	*a.* Manufacturing fault.	*a.* Repair by patching or vulcanizing. Limit number of patches and patch sizes because of tire and tube balance.
	b. Operating on rough terrain.	*b.* Same as above.

4—413. REMOVING. With wheel removed from airplane (see paragraph 4—406), deflate tire completely and then work bead over rim with two tire irons.

4—414. INSTALLING. The red balance marks on the tire and tube should be aligned when placing them on wheel with tire and tube in a deflated condition.

a. Screw a valve extension onto the valve stem to hold it in position.

b. To aid in seating the tire and the tube correctly, the tube should be partially inflated slowly, until the casing bead seats properly. Deflate to eliminate crimps or creases in the tube and to obtain tube contour, and then reinflate to proper pressure.

4—415. BRAKE SYSTEM.

4—416. DESCRIPTION. *(See figure 4—56.)* The multiple disc type brakes are actuated by two independent hydraulic systems, left and right. The brake pedals are mounted on the rudder pedals and are connected to master cylinders. Hydraulic fluid is conveyed from the master cylinder through a flexible hose, then through aluminum alloy tubing to a union above the shock strut knuckle fitting and thence through flexible hose to the wheel brake unit. Fluid used is the same as that used in the hydraulic system, mineral oil. Spec. AN-O-366 (red fluid). Figure 4—56 should be used in conjunction with the following chart for identification of all tubing in right and left brake hydraulic systems.

Note

Tubing cut in lengths for replacement purposes shall be 10% longer than the actual length required.

BRAKE SYSTEM TUBING CHART
(Refer to Figure 4—56.)

PART NO.	REF. ON FIGURE	O.D. INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
			RIGHT SIDE			
AN6264-6-38 Hose	7	5/16 I.D.		38	AN-H-24	AN776-6D Elbow AN775-6D Bolt AN901-6A Gasket VS-53506 Swivel Fitting
VS-58312-135 Tube	6	3/8	.035	6 5/8	52S0	AN815-6D Union
VS-41261-119 Tube	5	3/8	.035	20 1/4	52S0	AN837-6D Elbow
VS-48147-105 Tube	4	3/8	.035	36 1/16	52S0	AN837-6D Elbow AN924-6D Nut
VS-48147-139 Tube	3	3/8	.035	16 1/16	52S0	AN815-6D Union
VS-48147-141 Tube	2	3/8	.035	30	52S0	VS-10855 Fitting AN901-6A Gasket
AN6264-6-55 Hose	1	5/16 I.D.		55	AN-H-24	AN776-6D Elbow AN775-6D Bolt AN901-6A Gasket
			LEFT SIDE			
AN6264-6-38 Hose	14	5/16 I.D.		38	AN-H-24	AN776-6D Elbow AN775-6D Bolt AN901-6A Gasket VS-53506 Swivel Fitting
VS-58312-129 Tube	8	3/8	.035	8 7/16	52S0	AN815-6D Union
VS-58312-137 Tube	13	3/8	.035	22 3/8	52S0	AN837-6D Elbow
VS-48147-37 Tube	10	3/8	.035	37 13/16	52S0	AN837-6D Elbow
VS-48147-135 Tube	11	3/8	.035	16	52S0	AN815-6D Union
VS-48147-137 Tube	12	3/8	.035	29 11/16	52S0	VS-10855 Fitting AN901-6A Gasket
AN6264-6-55 Hose	9	5/16 I.D.		55	AN-H-24	AN776-6D Elbow AN775-6D Bolt AN901-6A Gasket

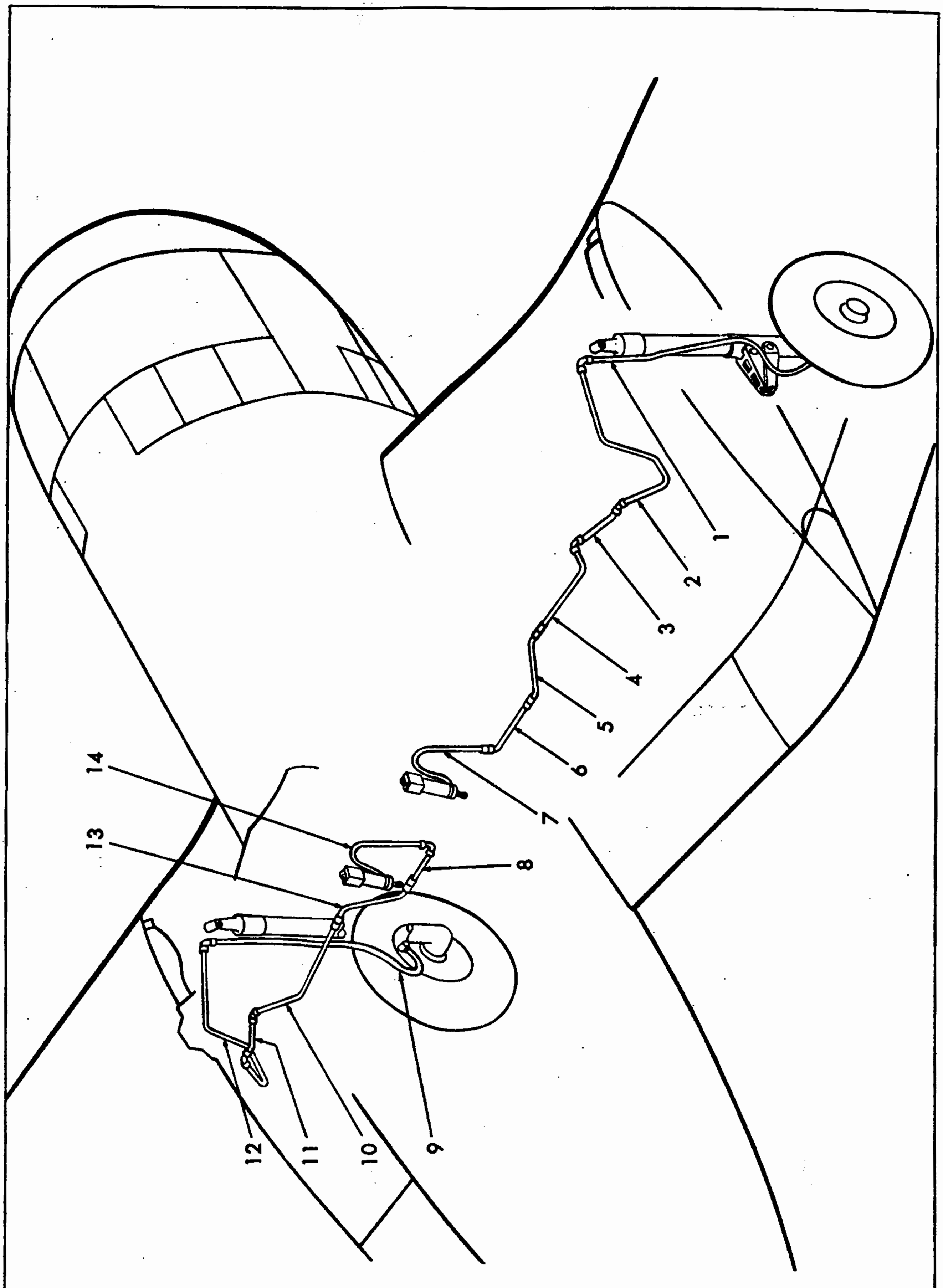


Figure 4–56. Brake System Tubing Diagram.

4—417. TROUBLE SHOOTING.

Trouble	Probable Cause	Suggested Remedy
Insufficient braking action.	*a.* Normal wear of discs. As the discs wear and become thinner, the brake piston must travel farther, requiring greater fluid displacement.	*a.* Adjust brake clearance; see paragraph 4—423.
	b. Worn discs. When the discs become worn, it may be impossible to tighten the adjusting nut sufficiently to secure proper clearance.	*b.* A stationary steel disc should be inserted in the stack next to the adjusting nut. Then adjust brake to proper clearance.
	c. Improper disc clearance.	*c.* Adjust brake clearance.
	d. Leak in the system.	*d.* Check the entire system for leaks. If the brake piston is worn, shrunk, or damaged, replace it with new seal. Check the condition of the piston packing in the master cylinder.
	e. Air in system. Any air in system will result in insufficient braking action.	*e.* Bleed the system; refer to paragraph 4—430 for procedure.
	f. Lack of fluid.	*f.* Fill and bleed the system; see paragraph 4—430 for procedure.
	g. Relief valve in master cylinder plugged. If the relief valve at the top of the master cylinder should become plugged, a partial vacuum might result and impede the braking action.	*g.* Check relief valve to see if it permits the passage of air.
Dragging brakes.	*a.* Too little clearance. If discs are adjusted to provide too little clearance, excessive heat and dragging may result and consequent locked brakes.	*a.* Adjust brake clearance; see paragraph 4—423.
	b. Dirt in the system. Dirt may get under the brake piston seal or the master cylinder piston padding and cause leaks, or may mix with brake fluid to form a gummy substance and cause sticking of the brake piston.	*b.* Disassemble brake and master cylinder. Flush out the lines with clean brake fluid. Clean all parts thoroughly.
	c. Dished or warped discs. Dished or warped discs will change the adjustment and dragging of brakes will result.	*c.* Flatten out dished or warped discs.
	d. Dirt on discs "pick up" or deposits on the brake disc will increase friction.	*d.* Remove and soak the discs in solution of 20% sodium cyanide for one day.

4—418. BRAKES — WHEEL UNIT.

4—419. DESCRIPTION. *(See figure 4—55.)* The wheel unit of the brake is a Goodyear, multiple disc type (Goodyear Drawing No. 510807). The braking elements are alternate rotating and stationary discs. The stationary discs are keyed to the brake anchor bracket, while the rotating discs, consisting of steel cores on both sides of which friction material is deposited to serve as a bearing surface against the non-rotating steel discs, are keyed to the wheel. Hydraulic pressure from the master cylinder located below the brake pedals causes the discs to be squeezed together by the action of the piston in the brake unit.

4—420. LOCATION AND ACCESS. The brakes are located on the main landing gear axles in the brake cavities of the main landing gear wheels. To gain access to the brakes, remove main landing gear wheels.

4—421. REMOVING AND DISASSEMBLY. *(See figure 4—55.)*

a. Jack the wheels; see paragraph 3—27.

b. Loosen the drain plug on the brake housing, place a can below the drain, and pump the brake pedal fore and aft until the system is empty.

c. Then remove the landing gear wheel. (See paragraph 4—406.)

d. Remove lock screw and take off the disc retaining nut.

e. Slide off the movable and stationary discs, and the insulator disc, and remove the piston return springs, and the piston.

f. Remove the expander spring and the brake cylinder.

4—422. ASSEMBLING AND INSTALLING. The brake is reassembled by reversing the disassembly procedure, with attention to the following:

a. Install the expander ring in the piston seal, lips up, the wide slots adjacent to the inner circumference of the seal, and the narrow slits adjacent to the outer circumference of the seal.

b. Locate the ends of the spring in the seal first, making certain that they meet but do not overlap.

c. All segments of the spring must be inside of the lips of the seal. Lubrication of the spring with brake fluid will facilitate its installation.

d. Clean the brake piston cavity thoroughly, cover with brake fluid and insert the assembled seal and spring, lips inward, fitting the seal into the cavity so as not to cut the lips or force the springs from under them.

e. With the piston in place, install the insulator disc and follow up with alternate stationary and movable discs. Be sure that a stationary disc is next to the insulator, and also on the outside of the stack of discs, next to the adjusting nut.

f. When reinstalling the brake unit on the axle stub, be sure to restore it to its original position with the bleeder plug on top.

4—423. ADJUSTING — WHEEL REMOVED. To adjust the brake disc clearance, tighten the adjusting nut hand-tight against the discs, and then back the nut off 270° or three-quarters of a full turn. Tighten the nut to the next lock position and safety lock screw. This will give a clearance of approximately .042 inch, on the basis that each full turn of the adjusting nut gives .060 inch clearance.

4—424. ADJUSTING — WHEEL INSTALLED. After adjusting the disc clearance as described above, and mounting the wheel (see paragraph 4—409), the clearance should be checked by rotating the wheel. Any binding will indicate high spots and if it is not possible to eliminate them by rotating some of the discs, the discs must be removed and inspected for warping and dishing. If it is impossible to secure a uniform disc clearance after straightening them, a new set of discs must be installed.

4—425. BRAKES — MASTER CYLINDER.

4—426. DESCRIPTION. *(See figure 4—57.)* The master cylinders are mounted in a vertical position, attaching to the rudder pedals. Each cylinder consists of a combined reservoir and cylinder casting, a piston rod assembly, and both a level indicator and venting device in the reservoir chamber. The piston rod is connected by a link to the brake pedal, an internal spring serving to hold the piston in the compressed position. When the piston is depressed, oil is forced down through the brake hose, actuating the brake. The vent hole in the reservoir allows air to enter and break the vacuum caused by the piston's travel. Upon releasing the pedal, the spring forces the piston up, releasing the braking pressure. A special shoulder on the piston between the piston rod and its locking cup meters the flow of oil between the cylinder and the reservoir necessitated by thermal expansion or contraction of fluid in the lines, or to make up fluid lost in minor leaks. The master brake cylinders are manufactured by the Warner Aircraft Corporation of Detroit, Michigan, their drawing number 12133-1; part number 12132.

4—427. REMOVING. To remove the master brake cylinder, proceed as follows:

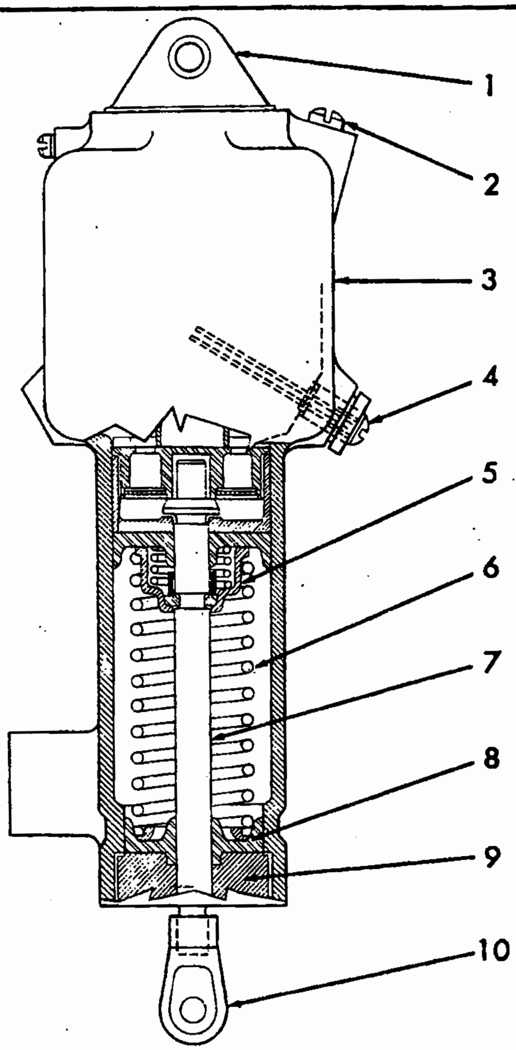
a. Drain the fluid from the brake system at the wheel brake housing and uncouple and plug the hydraulic line at the master brake cylinder.

b. Then disconnect the master cylinder from the support bracket and the brake pedal.

4—428. INSTALLING. To install the master brake cylinder, reverse the removal procedure described in paragraph 4—427 and fill the system as outlined in paragraph 4—430.

4—429. FILLING. The fluid level in the master brake cylinder should be checked whenever the pilot reports mushy brakes or at a maximum interval of 30 hours. To check the fluid level in the reservoir:

a. Remove the screw from the level indicator plug and unscrew the filler plug at the top of the cylinder.



1. Attaching Lug
2. Vent Plug and Filler Screw
3. Reservoir and Cylinder Casting
4. Level Indicating Screw
5. Piston Assembly
6. Spring
7. Piston Rod Assembly
8. Seal Cup
9. Cylinder Cap
10. End Fitting

Figure 4—57. Brake Master Cylinder.

b. Add a small quantity of hydraulic fluid Spec. AN-O-366 until overflow through the level indicator indicates the correct level.

c. If it is necessary to add any considerable amount of fluid, bleed system as directed in paragraph 4—430.

4—430. FILLING AND BLEEDING. *(See figure 4—57.)*

a. A flexible hose should be connected to the filler plug at the top of the master cylinder and an overflow receptacle provided.

b. Attach a pump and a source of supply of AN-O-366 hydraulic fluid to the bleeder plug at the brake unit on the wheel; see figure 4—55. If a pump is not available, a can and sufficient flexible hose to raise the can above the cockpit level may be used.

c. Force fluid into brake and up through master cylinder using pump or raised can. Keeping end of overflow tube from master brake cylinder below surface of the fluid in can, continue to force fluid through the system until the overflow is free of all air bubbles. It is important that at least a quart of fluid be circulated through the brake, in order that it may be properly bled.

d. Close bleeder valve at wheel and remove hose; remove hose from master cylinder and reinstall filler plug.

Note

Be sure to reinstall filler plug to prevent fluid from squirting into cockpit in negative "g" maneuvers or in catapulting.

e. Pump brakes several times; then, with brakes depressed, open each bleeder valve slightly to allow small amount of air trapped at top of wheel brake unit to escape. When fluid flows from bleeder, close valve.

f. Remove the small screw from the level indicator plug at the middle of the master cylinder. Catch the overflow oil. Insert a clean, fine wire three inches long into the level indicator hole to break any surface tension and insure draining of fluid to proper level.

Note

The importance of using clean fluid cannot be overemphasized. Fluid which has been discharged during bleeding operation should be run through a micronic filter before being reused. Supply of fluid should be carefully protected from entrance of foreign materials.

4—431. SOLID TAIL WHEEL.

4—432. DESCRIPTION. *(Refer to figure 4—49.)* The tail wheel is a Thermoid, 8 1/2" x 4", cast with a moulded solid tire. It is manufactured by Thermoid Corporation of Trenton, N. J. Their drawing No. is C-2067; their part No. is 898.

4—433. REMOVING.

a. Jack up airplane; refer to paragraph 3—26.

b. Remove safety-locked screws at axle head and nut of wheel assembly.

c. Remove axle, allowing tire and wheel to slip out of tail wheel yoke.

4—434. CLEANING AND LUBRICATING. Wash tail wheel with mild soap and fresh water. Pack bearing and hub space between bearing with Spec. AN-G-5 medium grease after every 30 hours of service.

4—435. INSTALLING. Install solid Thermoid wheel assembly in yoke, insert axle and screw on nut. Draw up axle nut until the bearing just binds, back nut off to the nearest castellation and safety. Check to make sure tail wheel rotates freely without binding or side play.

CAUTION

Pneumatic 12 1/2" diameter wheel cannot be used on this airplane. Use only 8 1/2" diameter solid wheel.

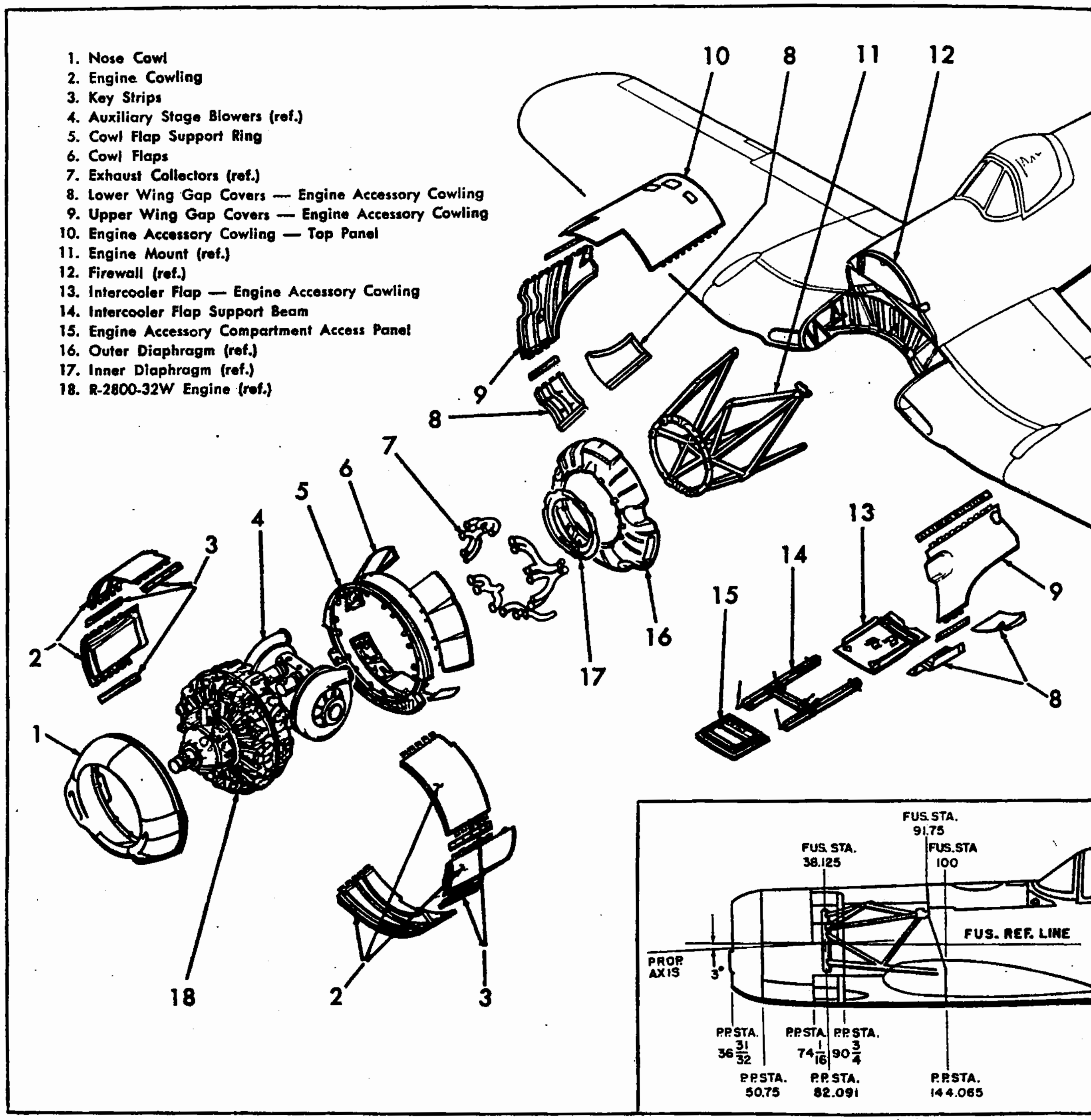


Figure 4–58. Engine Cowling and Cooling Flaps.

4–436. ENGINE COWLING AND COOLING FLAPS.

4–437. DESCRIPTION. *(See figure 4–58.)* Engine cowling is provided for the purpose of directing cooling air to the engine cylinders and their baffles and to the engine compartment in order to maintain engine operating temperature limits. Air enters the engine through the nose cowl, passes over the engine cylinders between the baffles and is exhausted into the atmosphere through cowl flaps located at the rear of the engine cowling. The flaps are actuated manually or automatically and are opened or closed to maintain engine temperatures within operating limits. In addition to this, the cowling is designed to provide adequate cooling with minimum drag.

4–438. Five side panels (2) enclose the power section and extend from the nose cowl (1) aft to the cowl flap support ring (5). The panels are secured to each other longitudinally by means of extruded fasteners riveted to each panel, which dovetail with the fasteners of the adjacent panels. Key strips (3) are secured to the extruded panel fasteners by Dzus fasteners. The panels are also attached to supporting rings about the circumference of the engine by Dzus fasteners. There is a sealing strip on the panels, located opposite the forward edge of the rear cylinder baffles and the aft edge of the front cylinder baffles, so that all the engine cooling air will flow through the engine between the cylinder baffles and the cylinders.

4—439. The two top panels are identified by stamped markings designating right and left hand sides. The two side panels each incorporate a section of the air induction system to the auxiliary stage blowers on each side of the engine and mate with the two scoops located on each side of the lower half of the nose cowl (1). The aft sections of these panels are unsupported (extending aft to the engine diaphragm) except for two Dzus fasteners which secure the rear section of the panels to the cowl flap support ring. The bottom panel extends aft of the nose cowl to the flap support ring (5).

4—440. *(See figure 4—58.)* Eleven movable flaps (6) hinged to the supporting ring (5) which is attached to the rear bank engine cylinder heads, are electrically actuated either automatically or manually. When the cowl flap operating switch, located on the left hand control panel inboard of the oil cooler switch, is placed in the "AUTOMATIC" position, the flaps automatically open or close to maintain engine cylinder head temperatures, below an operating limit of approximately 248 degrees C. When the control switch is manually held in the "OPEN" or "CLOSED" position, the flaps move accordingly. A cowl flap electric actuating motor, located on the upper right hand side of the engine mount, is energized through the switch located in the cockpit. Flexible drive shafts connecting the motor with eleven screwjacks are rotated by the motor and cause the screwjacks to extend or retract, and thus open or close the flaps. The automatic cowl flap control is reset to a lower operating temperature by the propeller governor control when the governor control is set to govern at or below 2300 rpm, the flaps opening at 232 degrees C. The automatic control responds to the hotter of two thermocouples located in engine cylinders numbers two and four. The thermocouples are connected to the controller located on the left hand side of the engine mount. The controller automatically energizes the cowl flap actuating motor to open or close the flaps according to the cylinder temperature as measured by the two thermocouples. When the airplane is on the ground a microswitch located on the left hand landing gear scissors is actuated, overriding the automatic control, causing the flaps to open. See paragraph 5—79 for further information on the electrical system.

4—441. The cowl flaps should never be closed (switch moved to "CLOSE" position) during ground operation to speed the warm-up time of the engine because of the danger of damaging spark plug elbow leads. If the flaps are closed during ground warm-up not enough cooling air will flow through the engine and over the spark plug elbows at the rear of the cylinders of each bank, and may result in ignition leak or harness breakdown. For flight operation of cowl flaps, see Pilot's Handbook (AN 01-45HD-1).

CAUTION

If cowl flaps fail to remain open (with switch in "AUTOMATIC" position) during ground operation, check cowl flap override circuit from microswitch on left hand main landing gear; see paragraph 5—79.

4—442. *(See figure 4—58.)* The accessory compartment cowl consists of nine panels which extend from the diaphragm (16) aft to the firewall. With the exception of the Dzus fasteners in the keystrips used to secure the sides of the top panel (10) and the upper wing gap covers (9), Camloc fasteners are used throughout for attachment. The top panel contains filler access doors to the hydraulic and oil tanks, as well as engine accessory compartment cooling louvers. The right upper wing gap cover contains an access door to the water injection tanks filler neck. The lower wing gap covers are fabricated in two pieces to facilitate installation. The bottom portion of the accessory compartment cowling consists of a forward panel (15), containing an access door to the carburetor and secured to a beam assembly by Camlocs, and the intercooler flap (13), hinged at its forward end to fittings on the beam assembly and actuated by a hydraulic cylinder.

4—443. The beam (14) to which the forward bottom panel (15), and the intercooler flap are secured, is attached at its forward end to channels on the right and left hand bottom sides of the diaphragm (16) and to fittings on the main beam. Quick-disconnect, spring-loaded pins secure the beam at its fore and aft ends. At approximately the center of the beam at power plant station 110-7/16, a clevis rod attached to the intercooler flap hinge fitting is secured to the rear clamps of the water injection system tank and at its forward end to eyebolts which pass through the forward support channel.

4—444. *(See figure 4—58.)* The intercooler flap (13) is provided to control the flow of cooling air through the intercoolers (the heat exchanging units that reduce the temperature of the engine air after it has left the auxiliary stage supercharger and before it enters the main stage). In opening or closing, the flap swings about hinges on its forward edge when actuated by a hydraulic cylinder attached to a bracket on the forward face of the main beam. The position of the flap is automatically controlled by a presure switch which is sensitive to the pressure differential across the cooling air side of the intercooler. The pressure switch is electrically connected to a solenoid valve which causes the hydraulic cylinder to extend or retract, opening or closing the intercooler flap. In addition to automatic operation, the intercooler flap can be opened or closed by the override positions of the cowl flap control switch located on the aft side of the engine control unit. The intercooler flap electrical circuit is also designed so that whenever the propeller is governed to 2300 engine rpm or below, the intercooler flap will close.

4—445. Provisions are made for the installation of armor plate on the engine cowl and accessory section cowl panels.

Note

It should be noted in referring to figure 4—58, that the thrust line of the engine-propeller unit is inclined downward 3° from the fuselage reference line. All stations leading from the outermost point of the propeller dome to the firewall are noted as power plant stations. All stations aft of that point are known as fuselage stations.

4—446. NOSE COWL.

4—447. DESCRIPTION. *(See figures 4—58 and 4—59. Parenthesized numbers refer to callouts on figure 4—59.)* The nose cowl is fabricated of alclad sheet and reinforced by ribs to which fittings are attached and through which the nose cowl is secured to lugs on the front engine valve rocker boxes. Adjustable links (2) are provided to allow for manufacturing tolerances. These links are attached to the fittings (5) secured to the nose cowl ribs (4), and to the brackets (1) secured to the valve rocker boxes (8) on the engine. The lower left and right hand sides of the nose cowl contain integral air scoops for passage of air to the dual auxiliary stage impellers of the engine via the side panels. A special bracket is added on number six cylinder for the purpose of securing both the adjustable link of the nose cowl at that point and also to act as the propeller governor control support.

4—448. TROUBLE SHOOTING.

a. Check nuts on link and bracket connections for security.

b. Examine cowl for dents, holes, deep scratches and corrosion.

c. Inspect for sheared rivets and spotwelds.

d. Inspect for loosened Dzus fasteners.

e. Examine air scoop for foreign material.

4—449. REMOVING. *(See figure 4—59.)*

a. Remove propeller; see paragraph 4—628.

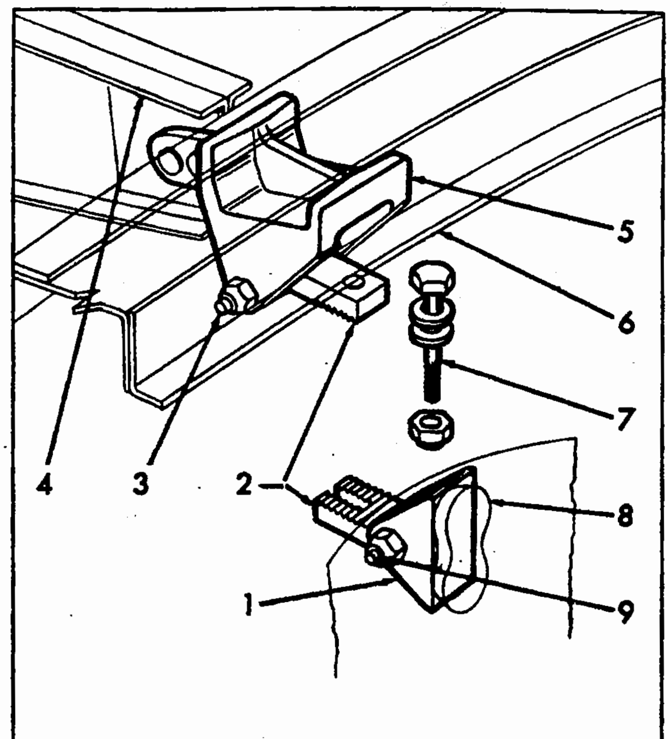
b. Remove engine cowl panels; see paragraph 4—455.

c. Disconnect bonding cables from nose cowl, opposite engine cylinders Nos. 2, 8, 12, and 16.

d. Remove bolts, washers, bushings and nuts (9) securing each of the eighteen nose cowl adjustable links (2) to brackets (1) on engine valve rocker boxes.

e. Remove nose cowl.

f. Remove brackets (1) from engine valve rocker boxes.



1. Bracket
2. Adjustable Links
3. Bolt Attaching Nose Cowl Fitting to Link
4. Nose Cowl Rib (ref.)
5. Nose Cowl Link Support Fitting
6. Nose Cowl Channel (ref.)
7. Bolt
8. Engine Cylinder (ref.)
9. Bolt Securing Adjustable Link to Bracket on Engine

Figure 4—59. Nose Cowl Attachment.

g. Remove adjustable links (2) from nose cowl, marking the links so that they will be replaced on the same valve rocker box and hold the same adjustment.

4—450. REPAIRING.

a. Dents in the nose cowl can be removed by bumping, using suitable tooling, provided there are no abrasions. To remove dents in the nose cowl area covered by the inner liner, the liner must be removed.

b. Parts excessively corroded as indicated by pitting and deterioration, should be replaced. Slight corrosion, evidenced by discoloration and grittiness of the surface, can be salvaged by refinishing the part in accordance with approved structural repair methods; refer to General Manual for Structural Repair (AN 01-1A-1).

4—451. INSTALLING. *(See figure 4—59.)*

a. Install brackets (1) on engine valve rocker boxes.

b. Install adjustable links (2) on nose cowl making certain the links are the same length as when removed.

c. Install nose cowl on engine by first connecting three adjustable links to the nose cowl mounting brackets on the engine valve rocker boxes, preferably on three or more upper cylinders and on at least two lower cylinders.

d. After temporarily securing the nose cowl on the engine, adjust links (2) so that the centerlines of the bolts (3) attaching nose cowl fittings to links are located on power plant station 50 45/64.

Note

The links have been made adjustable to allow for manufacturing variations in the nose cowl and engine. The links are installed to provide for radial expansion of the engine. It is necessary that the links on nose cowl and flap channel ring be adjusted to hold the required measurements in order that no difficulty will occur in installing engine cowl panels and in the operation of the cowl flap actuating mechanism.

e. Install bracket supporting the propeller control actuating cable, on number six engine cylinder.

4–452. ENGINE COWL PANELS.

4–453. DESCRIPTION. *(See figure 4–58.)* The five engine cowl panels (2) which cover the power section of the engine are fabricated of alclad sheet, reinforced by stiffeners, and extend from the nose cowl (1) to the cowl flap support channel (5), with the exception of the two side panels which extend aft to the diaphragm. The panels are attached to each other by means of key strips (3) which fit into extrusions riveted to each panel, and are held in place by Dzus fasteners. The two top panels may be identified by markings designating right or left. The side panels extend from the nose cowl (1) aft to the diaphragm (16) being secured to the cowl flap support ring (5) in two places, forward of the diaphragm. The side panels carry air ducts which, when the panels are installed, mate with the air scoops in the nose cowl and the auxiliary stage entrance ducts extending forward through cutouts in the diaphragm. When installed, the panels seat on flanges of the air scoop of the nose cowl and of the auxiliary stage entrance ducts. Synthetic seals secured to the air ducts act to prevent leakage.

4–454. TROUBLE SHOOTING.

a. Examine key and fastener assemblies for broken or missing Dzus fasteners. The key strips should fair in with the surface of the panels. If not, the cowl installation should be investigated thoroughly since the keys aid in maintaining the hoop strength of the cowl panels.

b. All fasteners should be secure and in good working order. Examine holes of Dzus fasteners for cracks.

c. Synthetic seals should be replaced, if damaged.

4–455. REMOVING. Any panel may be removed without disturbing the remaining panels by loosening the key strip at the point of attachment on the nose cowl and cowl flap channels, and then loosening the key strip from the extruded fasteners of the panel to remain on the airplane. After this is done, the Dzus fasteners at the fore and aft edges of the panel should be released and the panel removed. The panel should lift off easily; if not, it can be generally loosened by striking it gently near its center with the palm of the hand, or by shaking it fore and aft.

Note

If all panels are to be removed, the bottom panel should be removed first, then the side panels, ending with the removal of the top panels. When removing the bottom panel, the Dzus fasteners at the forward edge should be loosened before the key strips are removed to avoid the possibility of the panel's hanging from the forward edge and becoming distorted. The cowl flaps should be opened before the bottom panel is removed.

CAUTION

Two men should remove the bottom and side panels to avoid dropping them.

4–456. REPAIRING. The cowl panels should be removed when damaged so that a thorough investigation can be made of both sides. All repairs should be made in accordance with approved structural repair procedures.

a. Broken Dzus fasteners should be replaced, using standard Dzus tools.

b. Replace broken or severely distorted Dzus springs.

c. Replace broken or severely distorted key strips.

4–457. INSTALLING. There is no set order of installation of the engine cowl panels. Installation is simple but should be performed with care to insure security of attachment.

a. Fit either top panel into position over the nose cowl and flap ring. The neoprene strip should slope forward at its inner edge.

b. Tighten two Dzus fasteners at the forward and aft edges to hold panel secure.

c. Place other top panel in position in the same manner as the first. Install the connecting key strip over the extruded fastener.

d. Tighten all remaining fasteners on the two panels and key strip.

e. Secure remaining panels in the same manner.

WARNING

It is important that the cowl panels and locking key strips are securely fastened. Broken or missing Dzus fasteners must be replaced before the airplane is flown.

4–458. COWL FLAPS AND COWL FLAP SUPPORT RING.

4–459. DESCRIPTION. *(See figure 4–60.)* The engine cowl flap installation consists of eleven movable flaps extending about the engine just forward of the diaphragm, actuated by means of telescoping rods driven by screwjacks through flexible shafting and a linear actuator. To improve visibility, a section of the accessory section cowling extends forward and replaces a movable flap at the uppermost point of the flap installation. The engine cowl side panels which carry the air intake ducting to the superchargers, extend aft of the cowl flap support ring, thus forming two additional fixed flaps.

4—460. The flaps are attached to the cowl flap support ring (13) by means of quick-disconnect hinge pins (10), both ends of which pass through eyebolts in the flap support ring (13). Locking clips are provided to hold the pins in the locked position when the flaps are installed. In addition, a spring-loaded quick-disconnect locking pin (12) secures the flap actuating rod of one screwjack to each flap.

4—461. The flap support ring (13) is secured to the rear bank engine cylinders through adjustable links in the same manner as is the nose cowl. Brackets (20), secured to the engine valve rocker boxes, carry the same type adjustable links as used on the nose cowl and are secured to fittings (21) attached to the cowl flap support ring. The links are adjusted to maintain the centerline of the flap support ring at power plant station 74.060, forward of the engine mount ring at power plant station 82.091. Each flap is bonded to the support ring by two cables (11) which are secured to the eyebolts in the ring and to the two flap hinges.

4—462. TROUBLE SHOOTING.

a. Examine all cowl flaps for distortion, sheared spotwelds, holes, and cracks, and repair in accordance with approved structural repair procedures.

b. Clean up rough edges.

c. Examine phenolic plates between flaps for signs of failure; replace if necessary.

4—463. REMOVING. *(See figure 4—60.)*

a. Open flaps using switch in cockpit and disengage each quick-disconnect pin (12) which secures actuating rod of each screwjack to each cowl flap.

b. Disconnect both bonding cables (11) from flaps' hinge brackets.

c. Disconnect pins (10) securing each flap to eyebolts of support ring (13) and remove flaps.

d. Remove top accessory compartment cowl panel; see paragraph 4—480a.

e. Remove engine cowl side panels; see paragraph 4—455.

f. Remove bolts securing links (19) in support brackets.

Note

Do not disturb adjustment of links since their lengths have been predetermined to allow proper installation of the cowling and cowl flap operating mechanism. The free ends of the screwjacks should be secured to prevent accidental rotation; otherwise readjustment will be necessary.

g. Remove cowl flap support ring (13) by removing eight bolts securing upper half of support ring to the lower half.

h. Remove bolts securing brackets (21) and links (19) to support ring.

i. Remove support brackets (20) from engine valve rocker boxes.

4—464. INSTALLING. Installation of the cowl flap support ring is the reverse of the procedure described in removal. It is necessary that the adjustable links hold the cowl flap support ring at power plant station 74.060 to insure that no interference with the operation of the flap screwjacks occurs and that the engine cowl panels can be installed without difficulty.

4—465. COWL FLAP ACTUATING MECHANISM.

4—466. DESCRIPTION. *(See figure 4—60.)* The cowl flaps are operated electrically, opening or closing automatically or by manual selection. A cowl flap operating switch located in the cockpit on the left hand control panel, inboard of the oil cooler doors switch, has four positions, "AUTOMATIC", "OFF", "OPEN" and "CLOSE". When the switch is in the "AUTOMATIC" position, the flaps will start to open at 248° C (478° F) (or at 232° C (450°F) when engine rpm is governed at 2300 rpm and below). Thermocouples in numbers two and four engine cylinder heads are connected to a controller box (16) manufactured by the Bristol Co. (their drawing number 32C, Sheet 32D369) located on the left hand side of the engine mount at power plant station 116.75. The controller box is sensitive to the hotter of the two thermocouples and actuates the cowl flap motor to open the flaps whenever the temperatures of either cylinder head (numbers two or four) exceeds the above noted temperatures. If the temperatures are below those noted, the flaps will close. The cowl flap actuating motor (14) is manufactured by Lear, Inc., their model number Lear D12A or DD-12-52P (24 volt) their drawing number 159-BC. It is connected to the flap screwjacks by flexible shafting. For a description of the principles of operation of the motor (or linear actuator) which is similar to that used for trim tab actuation, see paragraph 4—138. In addition to this automatic feature, a microswitch, located on the left hand landing gear lower scissor, overrides the automatic control and opens the flaps when the airplane is on the ground. The override microswitch is effective only when the switch in the cockpit is in the "AUTOMATIC" position. For further details on the electrical system, see paragraph 5—79.

4—467. Each of the eleven screwjacks which displaces the cowl flaps, is secured at one end to a support bracket (18) on the aft face of the engine mount ring, and at the other end to the flap by a spring-loaded quick-disconnect pin (12), after passing through the diaphragm. Rotation of the screwjacks is obtained through the linear actuator (14) and flexible shafts. The female driving spline of the flexible shaft (b) engages the male driving spline of the actuator (14) and actuates all screwjacks

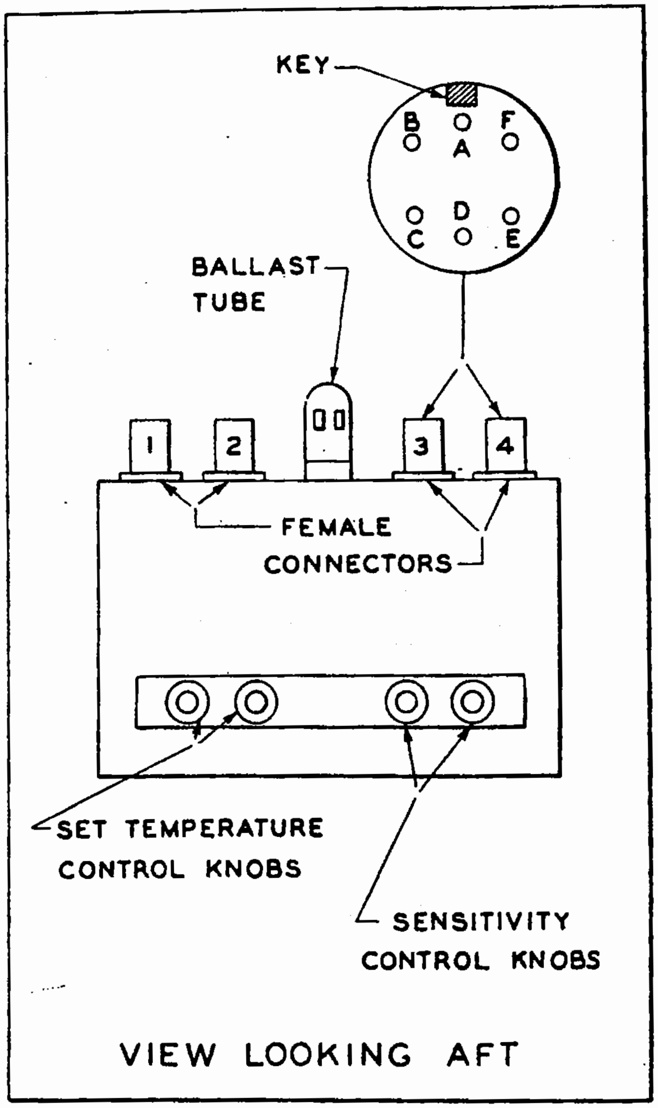


Figure 4—59A. Automatic Cowl Flap Control Unit.

through the flexible shafting. When the rotating cores of the screwjacks are engaged, the torque tube or actuating rod of each screwjack moves in or out and opens or closes the flaps.

4—468. It should be noted that the flexible shafts are not of constant length nor do the screwjacks have a constant stroke. Therefore in removal, note should be made of the location of each screwjack and attached flexible shaft in order that each will be replaced in the position from which it was removed. The following table gives the stroke of each screwjack and lengths of each flexible shaft; see figure 4—60 for location of each unit.

Note

"Normal" indicates the required stroke, whereas "Design" indicates the actual stroke obtainable, thus allowing additional lengths for adjustment. Before installing the screwjacks, they should be adjusted to the normal extended lengths. The lengths are measured from the center of the bolt attaching the screwjacks to the bracket on the engine mount, to the center of the bolt securing the screwjack to the flap.

a. Screwjacks (A) R/L, actuate flaps (1) R/L:

LENGTHS OF SCREWJACKS (A)

	Retracted Inches	*Stroke Inches*	*Extended Inches*
Normal	8	3	11
Design	7 3/16	3 3/8	11 3/16

b. Screwjacks (B) R/L, actuate flaps (2) R/L:

LENGTHS OF SCREWJACKS (B)

Same as lengths of screwjacks (A)

c. Screwjacks (C) R/L, actuate flaps (3) R/L:

LENGTHS OF SCREWJACKS (C)

Same as lengths of screwjacks (A)

d. Screwjacks (D) R/L, actuate flaps (4) R/L:

LENGTHS OF SCREWJACKS (D)

	Retracted Inches	*Stroke Inches*	*Extended Inches*
Normal	9 1/2	3	12 1/2
Design	9 5/16	3 3/8	12 11/16

e. Screwjacks (E) R/L, actuate flaps (5) R/L:

LENGTHS OF SCREWJACKS (E)

	Retracted Inches	*Stroke Inches*	*Extended Inches*
Normal	11	3	14
Design	10 13/16	3 3/8	14 3/16

f. Screwjack (f) actuates flap (6).

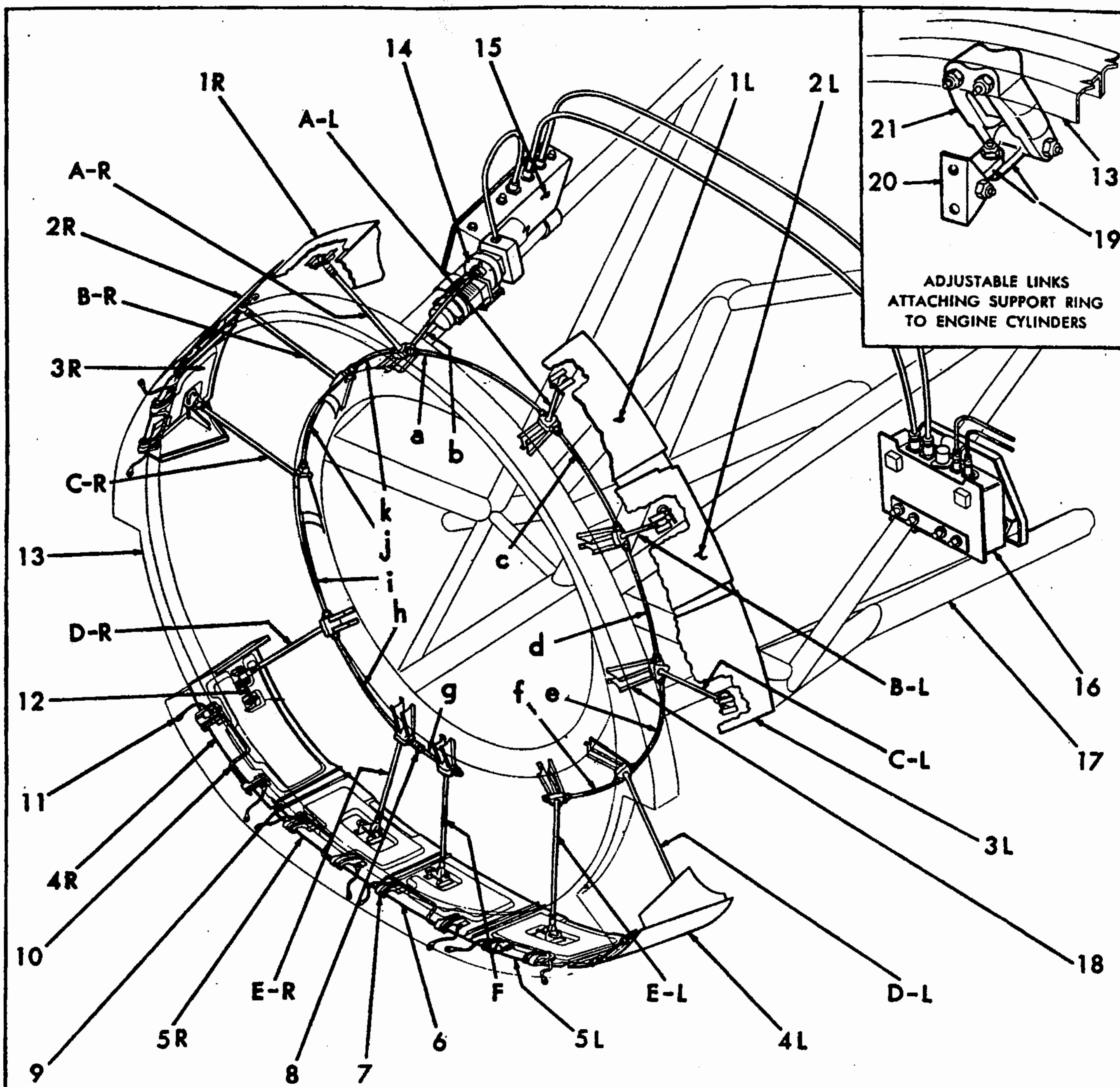
LENGTH OF SCREWJACKS (F)

Same as lengths of screwjacks (E)

g. Lengths of flexible shafting:

			Length Inches	
Flexible	Shafting	(a)	13.94	approx.
"	"	(b)	4.36	"
"	"	(c)	7.15	"
"	"	(d)	10.25	"
"	"	(e)	13.15	"
"	"	(f)	8.48	"
"	"	(g)	3.625	"
"	"	(h)	8.48	"
"	"	(i)	13.15	"
"	"	(j)	10.25	"
"	"	(k)	7.15	"

4—469. TROUBLE SHOOTING. *(See figure 4—59A.)* The following chart is to be used for correcting improper operation of the automatic cowl flap control:



a. Flexible Shafting
b. Flexible Shafting
c. Flexible Shafting
d. Flexible Shafting
e. Flexible Shafting
f. Flexible Shafting
g. Flexible Shafting
h. Flexible Shafting
i. Flexible Shafting
j. Flexible Shafting
k. Flexible Shafting

A. R/L Screwjacks
B. R/L Screwjacks
C. R/L Screwjacks
D. R/L Screwjacks
E. R/L Screwjacks
F. Screwjack

1. R/L Engine Cowl Flaps
2. R/L Engine Cowl Flaps
3. R/L Engine Cowl Flaps
4. R/L Engine Cowl Flaps
5. R/L Engine Cowl Flaps
6. Engine Cowl Flap
7. Hinges
8. Boot
9. Phenolic Plates
10. Quick-disconnect Hinge Pins
11. Bonding Cables
12. Flap Actuating Rod Quick-disconnect Pins
13. Cowl Flap Support Ring
14. Flap Actuating Motor and Electrical Leads
15. Engine Section Electrical Junction Box
16. Cowl Flap Controller Box
17. Engine Mount
18. Screwjack Mounting Brackets
19. Adjustable Links
20. Bracket
21. Cowl Flap Ring Support Fitting

Figure 4—60. Cowl Flaps Actuating Mechanism.

Trouble	Testing Procedure	Remedy
Cylinder head temperature gage does not indicate properly.	*a.* Replace indicator. *b.* Use check 1. *c.* Use check 2. *d.* Replace control unit. *e.* Use check 4.	Replace defective leads. Replace reversed leads. Correct improper wiring and replace defective microswitch.
Operation reversed: (Flaps open at low temperature and close at high temperature.) Flaps stay wide open after take-off.	*a.* Use check 2. *b.* Use check 3. *c.* Use check 4.	Replace reversed leads. Replace control units. Correct improper wiring.
Control inoperative: Flaps do not move in autimatic. Flaps stay wide open after take-off.	*a.* Use check 1. *b.* Use check 3. *c.* Use check 4.	Replace defective leads. Replace control unit. Correct improper wiring.
Control allows excessive overheating or undercooling.	*a.* Use check 1. *b.* Use check 3.	Replace defective leads. Replace defective control unit.

Check 1. Disconnect thermocouple leads from control. Connect low range ohmeter to pins A and B in the connector. The ohmeter should read 3.6 (plus or minus 0.2) ohms. With the ohmeter connected shake the lead wire throughout as much of its length as possible. Any change in the ohmeter reading caused by shaking the lead indicates a break in the wire. Such a break is most likely to occur at the connector or at any sharp bend in the lead. The same method is used to check pins C and D and E and F. These should read 9 (plus or minus 0.5) ohms, and shaking the lead should cause no change in the ohmeter reading.

Check 2. Connect the A and B pins in the thermocouple lead connector to some sensitive current measuring device such as a 0-100 microammeter or a cylinder head temperature gage such as is mounted in the cockpit. The A lead should be connected to the plus terminal on the meter and the B lead to the minus terminal. Remove the thermocouple from the cylinder head well and heat the thermocouple tip with a hot soldering iron. The meter should read a positive value. If the meter needle moves below the zero point the wires are reversed in the lead. The same check should be made on the C and D and E and F pins with C connected to the plus and D to the minus, and E connected to the plus and F to the minus. There should be no reversed wires in the lead.

Check 3. Before making this check open the landing gear switch temporarily with a screwdriver. The pins within the female thermocouple lead connectors (mounted on the control unit) are designated by letters as shown in Figure 4—59A. Female connectors 3 and 4 mounted on the control unit receive the male connectors on the thermocouple leads. Pins A and B are connected to the indicator circuit, pins C and D to the selector circuit and pins E and F to the control bridge circuit within the unit. To check the calibrations of the control unit a potentiometer test set is connected to pins C and D of either connector with the plus connected to C and the minus connected to D. With this polarity the potentiometer is set to create an emf of from 6 to 8 millivolts across pins C and D. This will cause the selector circuit to connect the E and F pins of the chosen female connector to the measuring bridge circuit. A second potentiometer is connected with the plus terminal to the E pin and the minus terminal to the F pin so that a varying emf may be created across the E and F pins of the same connector. With the propeller governor control in the high speed position (above 2300 rpm) the flaps should close when the emf across pins E and F is less than 11.9 millivolts and open when the emf is greater than 12.2 millivolts. With the propeller governor control in the low speed position (below 2200 rpm) the flaps should close when the emf is less than 11.4 millivolts and open when the emf is greater than 11.6 millivolts. The flap motion will be very slow when the emf is near the balance point. A suitable temperature connection must be used when necessary.

Check 4. Check all power wiring to the control unit for loose connections, reversed polarity, etc. Check landing gear switch for proper operation.

a. Move cowl flap switch to either of the manual control position; flap should open or close accordingly. In addition, the flaps should open to any intermediate position and remain there when the switch is returned to neutral. All flaps should open and close simultaneously. If not, examine screwjacks for fouling of flexible shafts and actuating rod mechanism.

b. Examine flap actuating motor, controller box and electrical connections for security.

c. Examine flexible shafting and screwjack for proper location, freedom of rotation, and security of installation. Examine seals around screwjack openings in diaphragm for cracks or burns. Replace any damaged parts.

4—470. REMOVING. *(See figure 4—60.)*

a. Remove engine cowl panels to facilitate removal of cowl flaps and support ring. Remove accessory compartment cowling to facilitate removal of controller box, flap actuating motor, screwjacks, and flexible shafting.

b. Open the flaps and disengage the quick-disconnect pin on each flap which secures the screwjack (or flap actuating rod) to the flap.

c. Disconnect bonding from each flap.

d. Disconnect the pin which secures the two hinge points of each flap to the support ring and remove flaps.

Note

It is important that each screwjack and each piece of flexible shafting be replaced in its exact position. Therefore location of these units should be carefully noted in removal; see paragraph 4—468.

e. Working in rear of diaphragm, remove flexible shafting from the screwjacks by loosening retaining nuts at each end of the flexible shaft. The short flexible shaft between screwjacks actuating flap number (6) and right hand flap number (5) is covered by a boot instead of a conduit.

f. Remove the flexible shaft (b) between the actuating motor and screwjack.

g. Remove each screwjack from the mounting lugs on the engine mount, pulling them aft through the diaphragm without damaging the rubber seals.

h. Disconnect electrical cable leading to flap actuator motor.

i. Remove bolts from clamps securing actuator motor mounting pad to engine mount and remove motor from mounting pad.

j. Disconnect electrical leads to controller box.

k. Loosen brace rod from upper clamp supporting controller box bracket.

l. Loosen lower clamp of supporting bracket to which the controller box is secured.

m. Remove controller box from bracket by removing bolts securing controller box to mounting brackets.

4—471. REPAIRING.

a. Defective flap actuator motors should be replaced, also defective screwjacks and flexible shafting.

b. Replace defective rubber seals.

c. Replace defective phenolic plates between flaps. Replaced plates should be greased with Spec. AN-G-25 low temperature grease.

d. Replace worn tape on outside of nose cowl channel and flap support channel.

e. Replace worn or corroded flap retaining pins which secure flaps to support channel. Oil or grease replacement pins with Spec. AN-G-25 grease.

f. Examine shock mounts of controller box; replace if damaged.

4—472. ADJUSTING.

a. Adjustment of the flap linear actuator is made at the place of manufacture. The limit switches contained within the actuator are adjusted so that the circuit will open at the end of the opening and the closing strokes.

CAUTION

During adjustment, or after any work has been done on the cowl flap actuating mechanism, the motor should be operated manually in small increments to check the action of the open and close limit switches of the motor. This should be done to prevent possible damage to the system in the event a limit switch has gone out of adjustment.

b. The screwjack flap actuating rods are to be adjusted in accordance with the lengths cited in table in paragraph 4—468. The adjustment is made by turning the end to be secured to the flap, in or out, until the proper length is obtained.

c. The flexible shafting cannot be adjusted and therefore must be replaced by shafting of the same length.

4—473. LUBRICATING.

a. Lubricate phenolic plates between flaps with low-temperature grease Spec. AN-G-25.

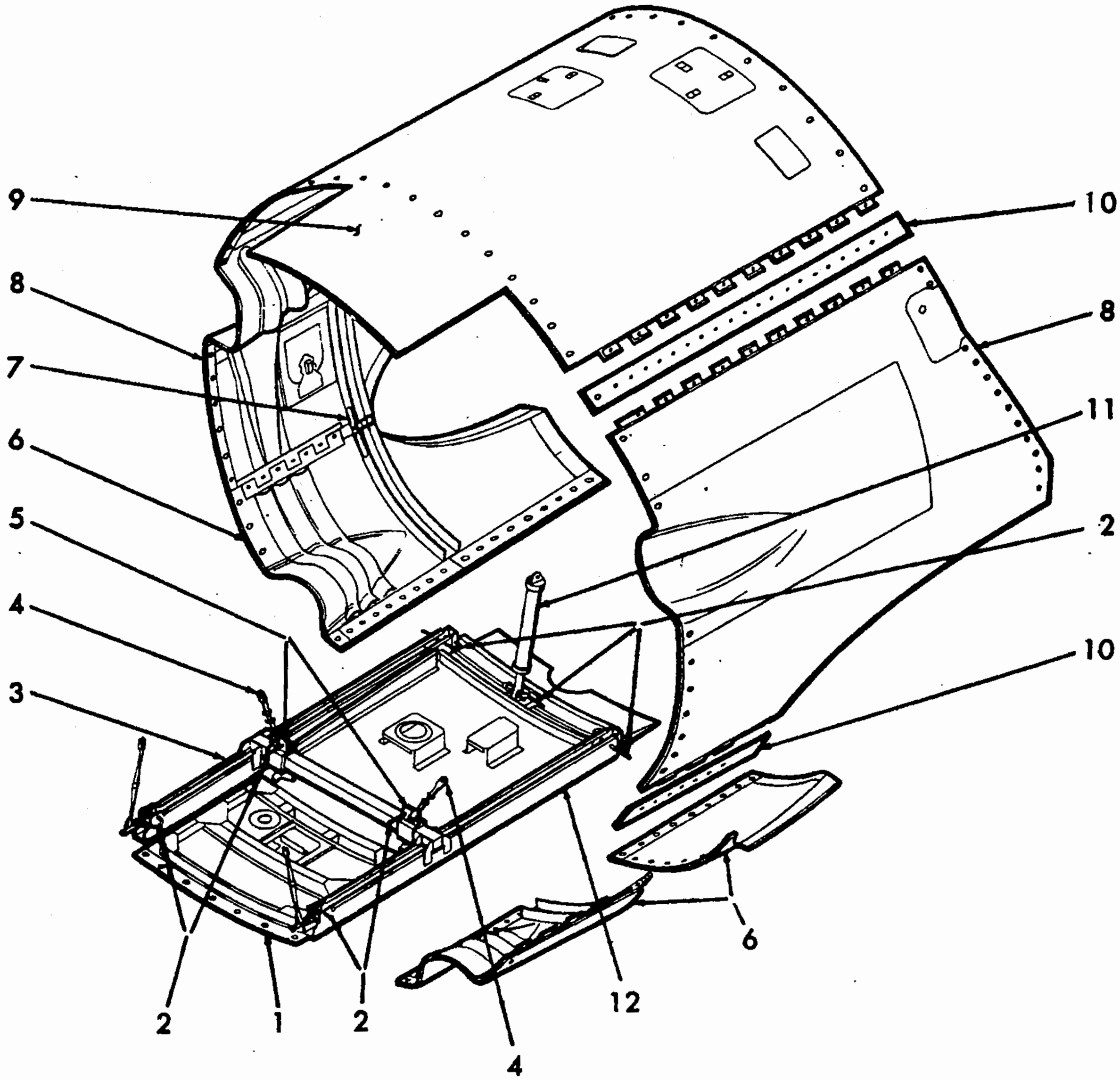
b. Grease hinges and quick-disconnect pins to prevent corrosion, with Spec. AN-G-25 grease.

4—474. INSTALLING. Installation of the cowl flap actuating mechanism is the reverse of procedure given in paragraph 4—470.

4—475. ACCESSORY COMPARTMENT PANELS.

4—476. DESCRIPTION. *(See figure 4—61.)* The accessory compartment cowling consists of nine panels covering the accessory section of the engine. The top panel (9) extends from the firewall forward to the diaphragm with a portion extending beyond the diaphragm and fitting into the cowl flap support ring. The panels are secured laterally by Camlocs and longitudinally by key strips (10) as are the engine cowl panels. The upper side panels, (or upper wing gap covers) (8) are secured in the same manner as are the two lower wing gap covers (6). The upper and lower wing gap covers are additionally secured to each other on each side by squeezing together two small handles (7) located at the aft ends of the panels at the wing leading edge. With the exception of the key strips (10), Camloc fasteners are used throughout the installation for attachment. The upper wing gap covers contain integral exhaust wells, made of stainless steel extending from power plant stations 90 13/32 to 126 9/32. The two-piece lower wing gap covers are fabricated of stainless steel throughout, and also contain an integral exhaust well.

4—477. A beam assembly (3) to which the lower sides of the lower wing gap covers are secured, is located at the bottom of the cowling. It extends from attaching channels, located on the aft right and left sides of the diaphragm at power plant station 92 5/16, aft to the forward face of the main beam at power plant station 136.45. In addition, the beam is secured to a bracket on the engine mount by clevis rods (4). The beam is held in position by quick-disconnect pins (2).



1. Lower Engine Compartment Access Panel
2. Quick-disconnect Pins
3. Beam Assembly
4. Clevis Rods
5. Hinge Fittings
6. Lower Wing Gap Covers
7. Upper and Lower Wing Gap Cover Lock
8. Upper Wing Gap Covers
9. Top Accessory Compartment Cowl Panel
10. Key Strips
11. Intercooler Flap Hydraulic Actuating Cylinder
12. Intercooler Flap

Figure 4—61. Accessory Compartment Panels.

4—478. A bottom fixed panel (1) which allows access to the carburetor, attaches to the forward section of the beam and extends from power plant station 90 13/32 to power plant station 108 1/8. Within this panel a small door provides access for front centerline pylon attachment. Aft of this, an intercooler flap (12) fabricated of Metalite, is located and is hinged to fittings on the beam immediately aft of the forward bottom panel. The aft end of the flap is connected to a hydraulic actuating cylinder (11) by a quick-disconnect pin (2).

4—479. TROUBLE SHOOTING.

a. Examine Camloc and Dzus fasteners for tightness and working order.

b. See that quick-disconnect pins are functioning properly.

c. Examine key fasteners for fit, missing Dzus fasteners, nicks and cracks.

d. Examine beam assembly for distortion.

4—480. REMOVING. *(See figure 4—61.)*

a. Remove top accessory compartment panel (9) by releasing the Dzus fasteners on key strips (10) that splice upper panel and wing gap covers, and remove the key strips. Release Camloc fasteners on fore and aft edges of the panel and remove panel.

b. Release catch (7), located near wing leading edge, which secures upper and lower wing gap covers, by squeezing the two small handles together.

c. Remove upper wing gap covers (8) by releasing key strips (10) from lower edges and Camloc fasteners from fore and aft edges.

d. Remove lower wing gap covers (6) by releasing Camloc fasteners from fore and aft sides and where secured to beam (3).

e. Release Camloc fasteners securing forward bottom panel (1) to beam (3).

f. Break hose connections at water pump and strainer mounted on intercooler flap.

g. Release intercooler flap (12) from the beam (3) by withdrawing the quick-disconnects (2) at the two forward hinge points of the flap and beam, and at the intercooler flap actuating cylinder (11).

CAUTION

Never hang intercooler flap from actuating cylinder rod end only.

h. Remove clevis rods (4) securing mid-section of beam (3) to brackets on engine mount either at rod end secured to bracket or at beam fitting.

i. Remove beam assembly (3) from diaphragm by withdrawing forward quick-disconnects (2).

j. Pull quick-disconnect pins (2) at aft ends of beam.

4–481. REPAIRING.

a. Replace broken Camloc fasteners.

b. Replace badly damaged panels.

4–482. INSTALLING. Installation of the accessory section cowl panels is the reverse of the procedure descibed in paragraph 4–480.

4–483. INTERCOOLER FLAP.

4–484. DESCRIPTION. *(See figure 4–61.)* The intercooler flap is the rectangular movable flap (fabricated of Metalite), located beneath the accessory section compartment, hinged at two points on the forward end, and secured at its aft end, to a hydraulic cylinder. Refer to paragraphs 4–1886 through 4–1896 for Metalite information. All three points of attachments are secured by quick-disconnects.

CAUTION

Intercooler flap supports water injection pump and motor and weighs 18 pounds. When armor plate is installed on flap, it weighs 55 pounds. Make certain all personnel are clear of flap when releasing quick-disconnect.

4–485. The purpose of the flap is to provide a controlled exit area for the flow of air passing through the intercoolers into the accessory section. The degree of cooling afforded by the intercoolers is dependent on the amount of cooling air passing through the intercooler from the wing intake ducts to the engine accessory compartment, and out the intercooler flap exit gill at the trailing edge of the flap. The pressure differential across the intercooler is controlled by the intercooler flap. The more the flap is opened, the greater the pressure difference, and conversely, when the flap is closed, the less the pressure difference.

Note

When the centerline pylon is installed, movement of the intercooler flap to the open position is restricted.

4–486. The intercooler flap is actuated by a hydraulic actuating cylinder which is controlled by an electromagnetic bank valve. This valve, during operation, is energized through the pressure switch on the forward side of the left hand intercooler. The pressure switch automatically controls the flap position to maintain adequate cooling flow through the intercoolers; see paragraph 4–492. For further details concerning the intercooler flap hydraulic system, see paragraphs 4–1195 through 4–1218. Besides operating automatically, the intercooler flap can be opened and closed manually, by moving the switch located on the aft side of the engine control unit on the left hand control shelf to either "OPEN" or "CLOSE." See paragraph 5–81 for electrical information connected with intercooler flap operation.

4–487. A flap position indicator located on the left hand console (which also indicates oil cooler door positions) is actuated electrically by a transmitter coupled to the intercooler flap actuating cylinder. Refer to paragraphs 4–1519 through 4–1530 for information on indicator and transmitter.

4–488. TROUBLE SHOOTING.

a. Open and close the intercooler flap manually several times. The flap should close completely. If the flap fails to open, remove the accessory compartment panels for access to the hydraulic actuating mechanism, and check operation of the hydraulic system.

b. If the intercooler flap does not fully close, open the flap and release the quick-disconnect securing the flap to the actuating cylinder. Shorten the rod of the cylinder by rotating the threaded rod end until the proper length is obtained and the flap closes fully when the actuating cylinder rod end is in the fully retracted position.

c. If the cockpit indicator does not read in accordance with the flap position, check electrical installations; see paragraph 5–91.

d. Raise and lower the intercooler flap and inspect for binding at hinges and edges of flap.

4–489. REPAIRING.

a. Since the intercooler flap is of Metalite construction, any damage to the flap is cause for replacement.

b. For cleaning and refinishing information, refer to paragraph 4–1896.

4–490. REMOVING. See paragraph 4–480 f. and g.

4–491. INSTALLING. To install intercooler flap, reverse procedure given in paragraph 4–480 f. and g.

4–492. INTERCOOLER FLAP PRESSURE SWITCH.

4–493. DESCRIPTION. *(See figure 4–61A.)* A differential pressure switch manufactured by the Aerotec Company of White Prains, New York, their part number P-401, is located on the forward face of the left hand intercooler for the purpose of automatically opening and closing the intercooler flap in accordance with a predetermined pressure differential across the cooling air side of the intercoolers, to provide adequate cooling of the carburetor air. The switch consists of a case divided into two compartments by a flexible diaphragm. One compartment is connected by a pressure tube to the high pressure side (outboard) of the left hand intercooler; the other side of the switch is vented to the engine accessory compartment. Movement of the diaphragm, caused by the pressure differential between the two compartments, actuates micro-switches within the switch which cause an electromagnetic hydraulic banked valve to extend or retract the hydraulic cylinder attached to the intercooler flap. The micro-switches are called the lower limit switch (flap open) and the upper limit switch (flap closed). With an absolute pressure of 30 inches of mercury on the high pressure port, the lower limit switch should close at a pressure differential of 1.5 inches of water and less, and the upper limit switch should be closed at a pressure differential of 4.5 inches of water and above. The pressure differential at which the lower limit switch should be closed should increase linearly from a pressure differential of 1.5 inches of water at an absolute pressure of 30 inches of mercury on the high pressure port to a pressure differential of 9.2 inches of water at an absolute pressure of 10 inches of mercury on the high pressure port. The pressure differential at which the upper limit switch should be closed should increase linearly from a pressure differential of 4.5 inches of water at an absolute pressure of 30 inches of mercury

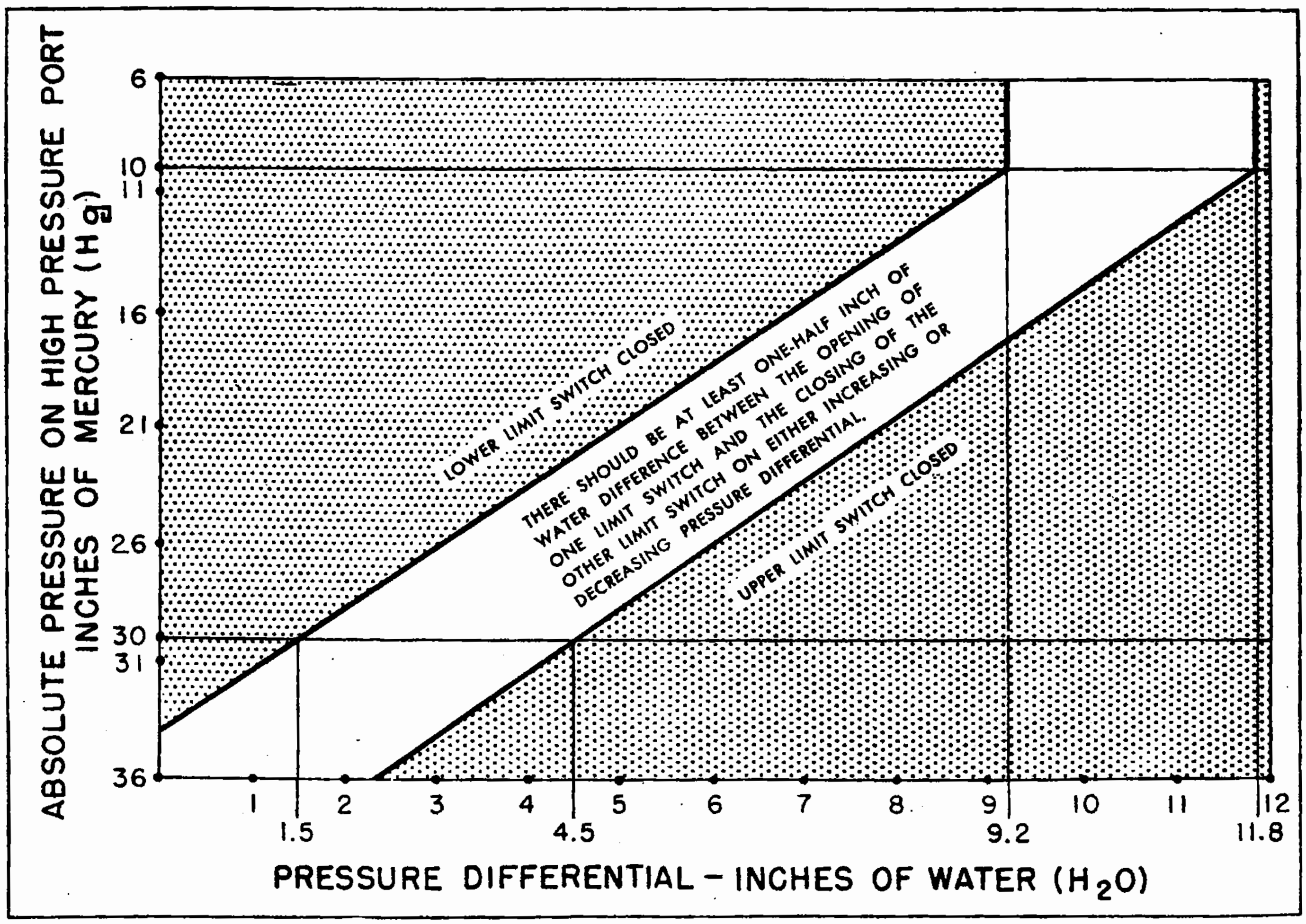


Figure 4–61A. Intercooler Flap Pressure Switch — Operation Graph.

on the high pressure port to a pressure differential of 11.8 inches of water at an absolute pressure of 10 inches of mercury on the high pressure port. At absolute inlet pressure of 10 inches of mercury and below on the high pressure port, the lower limit switch should be closed at pressure differentials of 9.2 inches of water and below, and the upper limit switch should be closed at pressure differentials of 11.8 inches of water and above. There should be at least one-half inch of water difference in pressure differential between the opening of one limit switch and the closing of the other limit switch on either increasing or decreasing pressure differential. For details covering the intercooler flap operation, see paragraphs 4—483 through 4—487.

4—494. TROUBLE SHOOTING. If it is suspected that the pressure switch has ceased to function properly, it is recommended that the switch be removed from the airplane and a new switch installed. The operation of the pressure switch can be checked as follows:

a. With the engine off, close the intercooler flap manually, using electric hydraulic pump. Switch to "AUTOMATIC" and the flap should open.

b. After the flap has opened, pull the propeller governor control handle aft and the flap should close. The switch actuated by the propeller governor control should be adjusted so that it is closed when the propeller governor control handle is in the position to govern at 2200 to 2300 rpm and below. This position should be determined during engine run and noted before making the check on the flap.

4—495. REMOVING. The pressure switch can be removed while the intercooler remains in the airplane. To remove the switch, proceed as follows:

a. Remove the upper and lower left hand wing gap covers.

b. Break the electrical connection at the pressure switch.

c. Disconnect the high pressure air inlet tube from the bottom of the pressure switch and remove from the intercooler.

d. Remove the three machine screws, spacers and nuts, which secure the pressure switch to the mounting bracket on the intercooler.

4—496. TESTING. Special test apparatus is required to determine that the pressure switch is functioning properly. It is therefore recommended that the ground check procedure in paragraph 4—494 be made, and if the switch is found to be defective that it be removed from the airplane and a new switch installed.

4—497. INSTALLING. Installation is the reverse procedure of that described in paragraph 4—495.

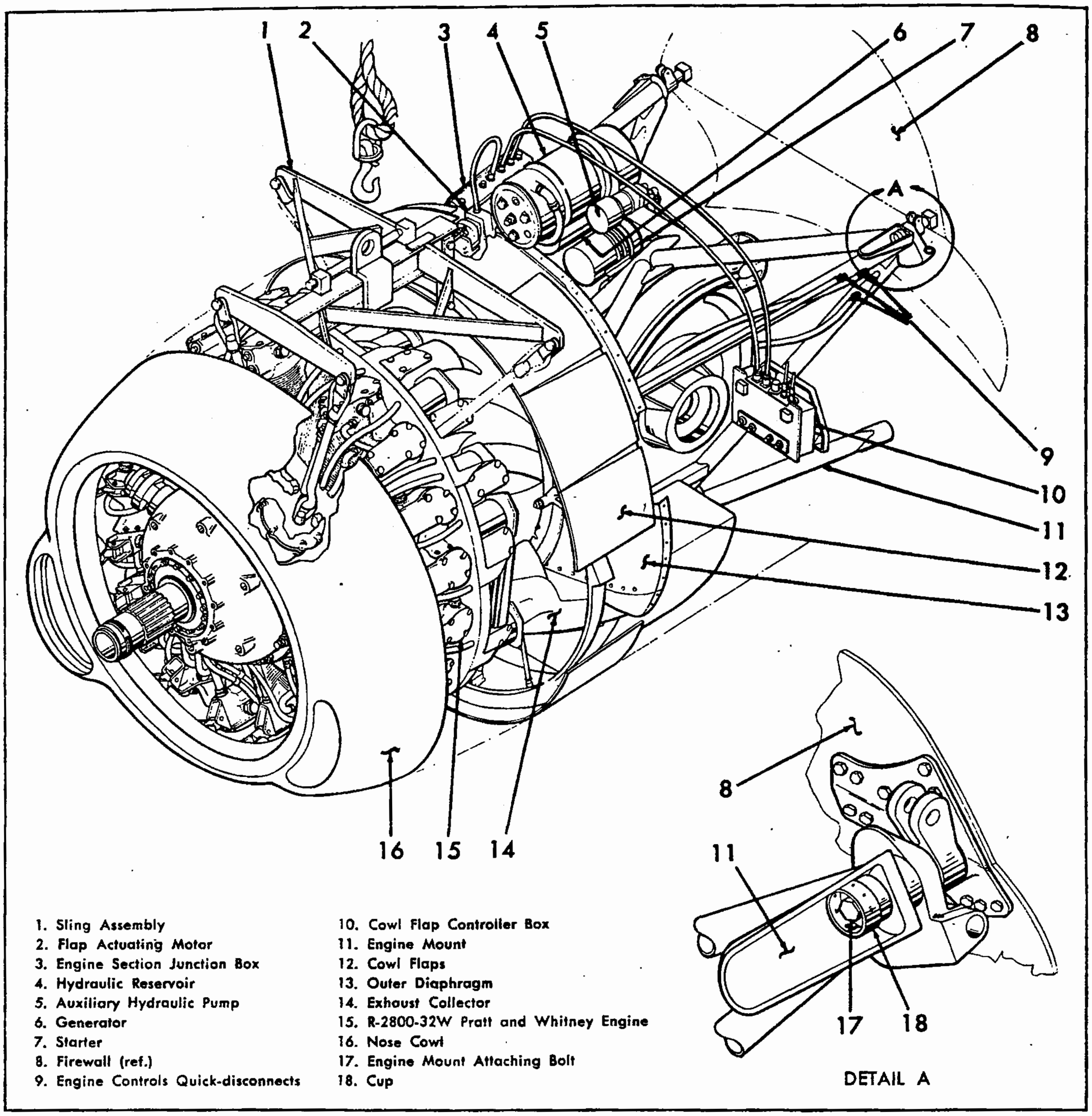


Figure 4—62. Engine Quick-change Unit.

4—498. POWER PLANT.

4—499. DESCRIPTION. *(See figure 4—62.)* The power plant group, usually referred to as the engine quick-change unit, consists of an R-2800-32W Pratt and Whitney engine, the split engine mount, nose cowl, cowl flaps, engine accessories, and hydraulic and electrical equipment. The entire assembly may be quickly removed or installed as one unit. The power plant group extends aft from the propeller to the firewall, the engine mount being attached to the upper portion of the firewall at fuselage station 91 3/4 and to the main beam at fuselage station 100.

4—500. ENGINE ACCESSORIES. The following engine accessories are discussed in the Power Plant Section:

a. Diaphragms — Refer to paragraph 4—508.
b. Exhaust Collector — Refer to paragraph 4—516.
c. Engine Mount — Refer to paragraph 4—521.
d. Breather — Refer to paragraph 4—526.
e. Carburetor — Refer to paragraph 4—534.

f. Automatic Power Control — See paragraph 4—530. For information on other engine accessories, refer to Section IV, pertinent paragraphs in the Air Induction System, Engine Water Injection System, Engine Controls, Propeller and Accessories, Starting System, Oil System, Fuel System, Hydraulic System, and Instruments. Refer also to the Electrical System in Section V.

4—501. REMOVING ENGINE QUICK-CHANGE UNIT. *(See figure 4—62.)*

Note

Before removing the engine, preservative measures should be taken in accordance with the Pratt and Whitney Engine Service Instructions Manual AN 02-10GE-2.

a. The following equipment is required in order to remove the quick-change unit:

Sling Assembly — VS-55360-1 (included in Ground Handling Equipment — Loose Accumulations)

Chain hoist of two ton minimum capacity

Single quick change engine stand — knock-down type — Bureau of Aeronautics Drawing MA-1384-F

Adapter Set — QECU Mounting (One set supplied with each spare QECU in addition to one set with each ground handling equipment set).

Two or more work platforms.

b. The engine change should be made in a hangar, if possible, preferably a portion which combines good conditions of light, temperature, and cleanliness. Note that quick change unit weighs approximately 3,260 lbs.

c. Weight and jack up the tail until the airplane is in approximately thrust line level position. Refer to paragraph 3—23 for jacking procedure.

d. Remove the propeller. Refer to paragraph 4—628 for procedure.

WARNING

All lines and parts which are exposed during remainder of removal procedure must be properly capped or covered to guard against dirt.

e. Remove engine accessory cowling. Refer to paragraph 4—480 for removal procedure.

f. Open the intercooler flap. Disconnect lines to the water injection strainer, pump, and motor. Remove the intercooler flap and the "H" beam assembly. Refer to paragraph 4—480 for removal procedure.

g. Place fuel selector valve on left hand control panel in "OFF" position.

h. Disconnect the intercooler exit duct hose. Remove the carburetor air box. See paragraph 4—558. Remove the carburetor. Refer to paragraph 4—536 for additional information on carburetor removal.

i. Drain engine oil. Refer to paragraph 4—676 for procedure.

j. Break hydraulic line quick-disconnects just forward of firewall on upper slanting portion, right hand side.

k. Disconnect the fuel line at the fitting on the fuel strainer mounted on the firewall.

l. Disconnect the fuel vapor return line at the disconnect on the forward upper part of the firewall.

m. Disconnect the vent (balance) line hose to the fuel pressure gage at the cross union.

n. Break the "oil-in" hose connection between the diverter valve and the engine case. Break the scavenging oil return line at the hose connection at the oil cooler dummy by-pass unit located on the firewall. Break the vent line from the oil tank to the engine. Disconnect the oil drain lines from the engine and oil tank.

o. Break the line to the anti-blackout installation at the hose connection on the right hand side of the airplane just forward of the firewall.

p. Break the suction line to the turn and bank indicator at disconnect on left hand side of firewall. Remove fuel and oil pressure tubing to engine gage unit.

q. Disconnect electrical plug from receptacle located on aft end of lower left hand engine mount tube. Disconnect the two electrical conduits from right hand side of airplane just forward of firewall. Disconnect two thermocouples from the bracket located on aft end of lower right hand engine mount tube.

r. Disconnect auxiliary hydraulic pressure line at quick disconnect located on left hand side of firewall.

s. Disconnect engine controls (throttle, mixture, and propeller governor) at the left hand side of the firewall.

t. Disconnect all remaining lines running from the accessories through the firewall or wing fillets.

u. Install link assembly of engine hoisting sling on the engine mount ring by inserting the bolt. Insert the two forward hooks in the forward lifting eyes on the engine; bolt the sling link to the engine mount ring. The two aft hooks are not to be used when lifting the quick change unit, but are used when removing the engine only.

v. Hoist the sling to sufficient height to take up the slack in the cables.

w. Remove the cotter pins from the two upper and two lower engine mount cups and remove the cups. Remove the two lower engine mount bolts.

x. Hoist engine sufficiently to relieve upper mount bolts of engine weight and remove upper mount bolts.

y. Hoist the engine about two inches and pull it forward, keeping it at approximately thrust line level and taking care not to strike engine or mount against any part of the firewall or wings. Hang the unit on the knock down type quick engine change stand, Bu-Aer Drawing No. MA-1384-F, by use of the adapters (VS-39431). Install quick engine change unit cover (VS-57988).

4—502. INSTALLING ENGINE QUICK-CHANGE UNIT.

Note

Prior to installing a new power plant unit, test in accordance with approved testing instructions.

a. The same equipment used for power plant removal is used for power plant installation.

b. Prepare the airplane for quick-change unit installation by weighing and jacking the tail to thrust line level. Refer to paragraph 3—23 for jacking procedure.

c. Attach the sling to the engine at the two forward eyes. Bolt the sling link to the engine mount ring.

d. Hoist the quick-change unit up, centerline level, until it is about two inches higher than the fuselage centerline.

Note

The quick-change unit weighs approximately 3.260 pounds.

e. Move quick-change unit into position so that engine mount fittings line up with their attachment points.

f. If a new engine mount is to be installed, test bolt seat as follows before final installation of bolts. Blue the flat surface of the engine mount bolts and install all four bolts. Tighten the two upper bolts to 150, plus or minus five, foot pounds torque. Tighten the two lower bolts to one hundred, plus or minus five, foot pounds torque; then remove bolts. If the socket shows a uniform "chatter" indicating that 90% of the ring is seated, if the blue line is of 1/16 inch width minimum next to the bolt shank, if the blue line is at least 1/16 inch wide, or if the distance from the inside diameter of the blue line to the bolt shank is not more than 1/16 inch, the installation is satisfactory. If, however, the ring is too far from the bolt shank or if the "chatter" is not uniform, indicating insufficient seat, the installation is not acceptable.

WARNING

Do not use distorted bolts or bolts with damaged or imperfect threads.

g. Coat the engine mount bolts with Cosmolene or petrolatum, Spec. AN-P-51.

h. Insert the upper bolts, attach the nut and tighten to a torque value of 150, plus or minus five, foot pounds. Use the VS-43789 engine mount wrench; refer to paragraph 3—120.

i. Insert the lower engine mount bolts (the two short bolts) and tighten them to a torque value of 100, plus five minus zero, foot pounds. Use the VS-43789 engine mount wrench. No nuts are necessary in attaching the lower bolts.

j. With the weight of the power plant supported by the hoist, check the torque values of the upper bolts. Then remove the hoist and check the lower bolts against the torque values given above.

k. The bolt heads are locked by cups. Place the cups over the heads, concave surface pointing forward. Secure the cups with steel cotter pins. The cotter pins go through the cups and the engine mount sockets. (See figure 4—62.)

l. Connect all lines and fittings disconnected in paragraph 4—501.

Note

When replacing any accessories on the engine, check gaskets and replace, if cut or worn.

m. Fill the oil tank and install the "H" beam assembly, intercooler flap, and accessory compartment cowling in the order of removal. Refer to paragraph 4—482.

4—503. ENGINE.

4—504. DESCRIPTION. *(See figure 4—63.)* The Pratt and Whitney R-2800-32W engine is an 18 cylinder, 5 3/4 inch bore, six inch stroke, two-row, radial, air-cooled engine, having a total piston displacement of 2804 cubic inches. The engine incorporates a built-in torque indicating system, a hydraulically driven, automatically controlled, variable speed auxiliary stage supercharger, located on each side of the accessory section and a single rotation propeller shaft end. The engine is supplied with a Bendix Stromberg PR-64-B2 carburetor, which incorporates the water regulator, magnetos (Part No. DF-18LU-2), ignition distributors, radio shielded ignition assembly, RC-34S spark plugs, priming system on engine (solenoid priming valve), cooling air deflectors and baffles. accessory drive covers, water regulator, derichment valve, and automatic power control. The engine has a No. 60A (SAE) propeller shaft for installation of the hydromatic propeller discussed in paragraph 4—624. The engine has a reduction gear ratio of 0.450:1. The engine, known as an "E" series engine, is mounted rigidly with its thrustline 3° nose down with respect to the airplane reference line. The overall dimensions of the engine are: length — 94.75 inches, diameter — 52.8 inches, weight of basic engine — 2705 pounds.

The basic 32W engine includes the following components:

a. Main stage supercharger — driven at fixed gear ratio of 6.70:1.

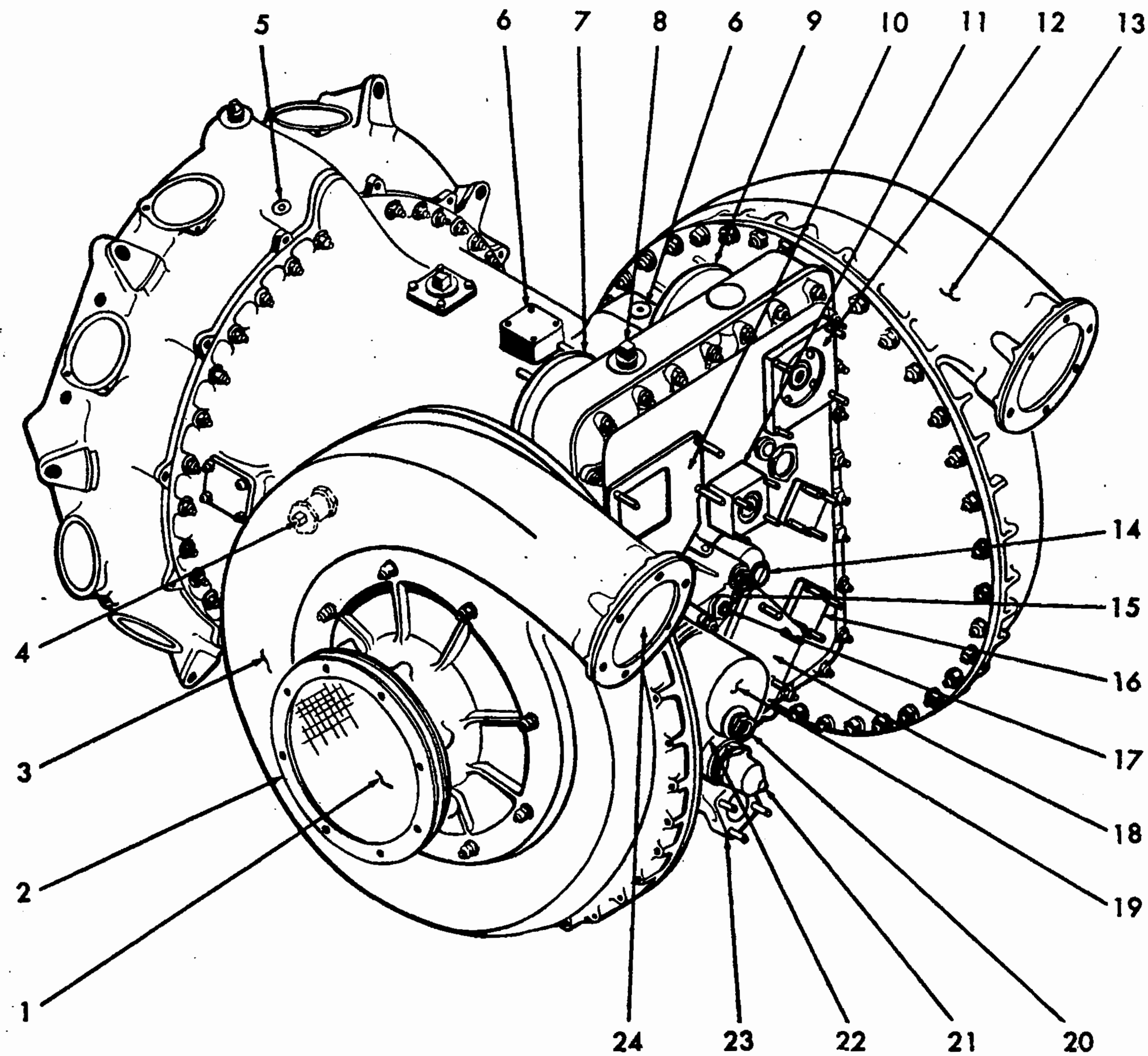
b. Dual auxiliary stage supercharger — variable speed up to 9.65:1, maximum.

c. Torquemeter system — (may be used to check power, if desired).

d. Propeller drive reduction gearing — 0.450:1.

e. Engine lubrication system oil pumps.

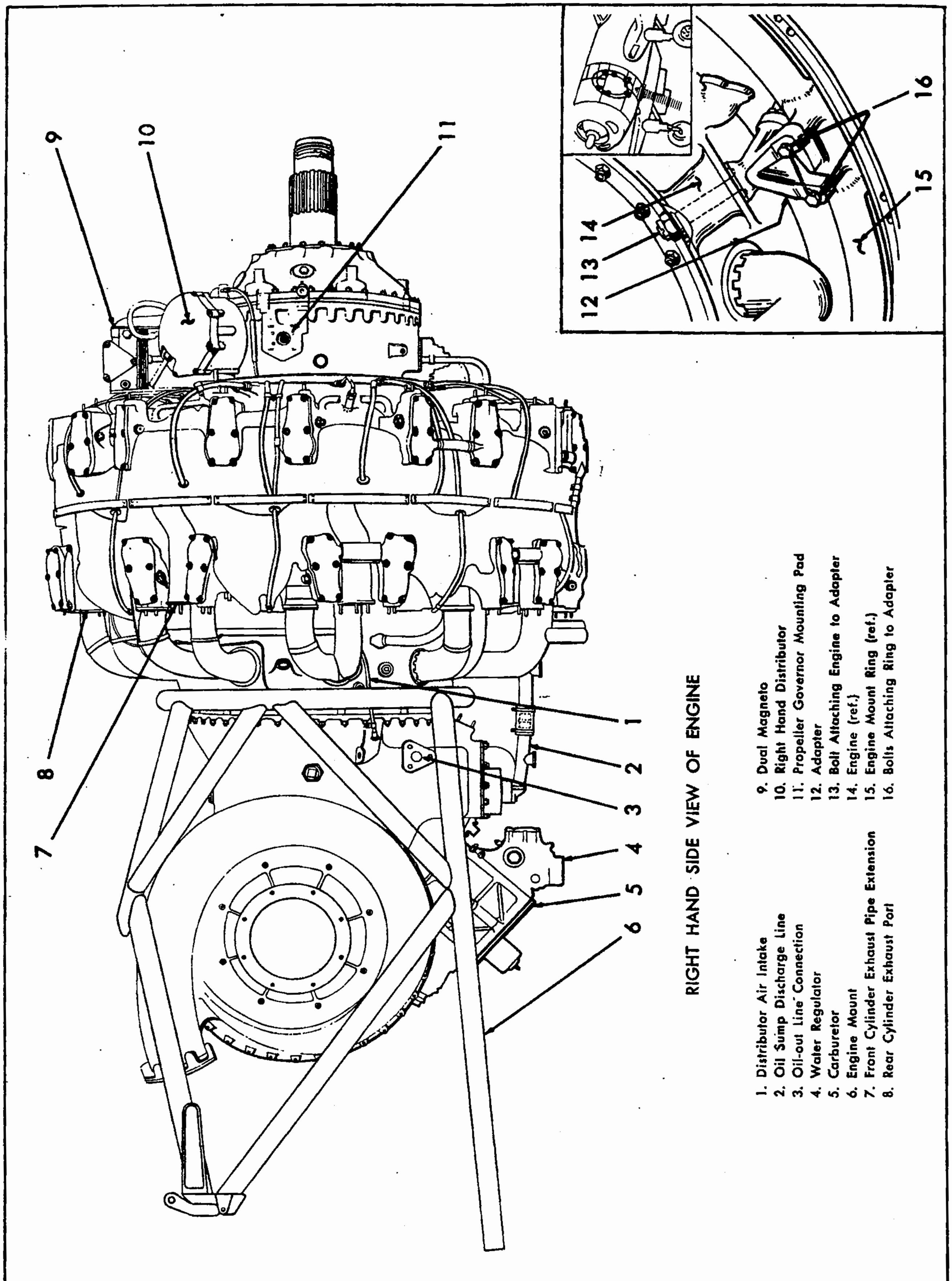
f. The following table lists accessory drive pads on the basic engine, the speed ratio of the accessory drives, the direction of rotation (looking at the end of the accessory drive shaft), and the text reference for additional information on each accessory.



THREE-QUARTER LEFT HAND REAR VIEW OF ENGINE REAR CASE

1. L. H. Auxiliary Stage Air Inlet Screen
2. L. H. Auxiliary Stage Air Inlet Flange
3. L. H. Auxiliary Stage Supercharger Housing (Scroll)
4. Breather Connection
5. Manifold Pressure Gage Connection
6. Starter and Generator Bracket Mounting Pads
7. Starter Mounting Pad
8. Oil Tank Vent Connection
9. Generator Mounting Pad
10. Automatic Power Control Mounting Pad
11. Tachometer Generator Mounting Pad
12. Hydraulic Pump Mounting Pad
13. R. H. Auxiliary Stage Supercharger Housing (Scroll)
14. Oil Inlet Temperature Connection
15. Oil Pressure Gage Connection
16. Fuel Pump Mounting Pad
17. Oil System By-pass Valve
18. Vacuum Pump Mounting Pad
19. Main Oil Screen Housing
20. Main Oil Screen Housing Drain Plug
21. Oil Pressure Relief Valve
22. Main Oil Pressure Pump
23. Oil Inlet Connection
24. Auxiliary Stage Air Outlet

Figure 4—63. (Sheet 1 of 2 Sheets) R-2800-32W Engine Reference Diagram.



RIGHT HAND SIDE VIEW OF ENGINE

1. Distributor Air Intake
2. Oil Sump Discharge Line
3. Oil-out Line Connection
4. Water Regulator
5. Carburetor
6. Engine Mount
7. Front Cylinder Exhaust Pipe Extension
8. Rear Cylinder Exhaust Port
9. Dual Magneto
10. Right Hand Distributor
11. Propeller Governor Mounting Pad
12. Adapter
13. Bolt Attaching Engine to Adapter
14. Engine (ref.)
15. Engine Mount Ring (ref.)
16. Bolts Attaching Ring to Adapter

Figure 4—63. (Sheet 2 of 2 Sheets) R-2800-32W Engine Reference Diagram.

ACCESSORY	SPEED RATIO	ROTATION	TEXT REFERENCE	
Starter	3.000:1	Clockwise	Paragraph	4—655
Generator	3.000:1	Clockwise	"	5—16
Fuel Pump	.886:1	C'clockwise	"	4—830
Tachometer	.500:1	C'clockwise	"	4—1462
Vacuum Pump	1.256:1	Clockwise	"	4—1323
Propeller Governor	.964:1	C'clockwise	"	4—633
Hydraulic Pump	1.400:1	C'clockwise	"	4—940

g. All piping and controls between engine parts.

4—505. REMOVING. *(Refer to figure 4—63.)* The following procedure provides for the removal of the engine from the quick change unit. If the engine is removed from the quick change unit after the latter has been removed from the airplane, as described in paragraph 4—501, some of the lines will have been previously disconnected.

a. Remove the propeller. (Refer to paragraph 4—628 for procedure.)

b. Remove the auxiliary stage air entrance ducts. (Refer to paragraph 4—562 for procedure.)

c. Remove the cowl flaps. (Refer to paragraph 4—463, steps a. through c. for procedure.)

d. Remove the exhaust collectors and lower support assemblies. (Refer to paragraph 4—518 for procedure.)

e. Remove the intercooler exit duct support from ducts and from engine mount members.

f. Remove the engine section blower drain and break the crankcase breather lines.

g. Remove the cowl flap jack shafts and cowl flap support ring. (Refer to paragraph 4—463, steps d. through i., and to paragraph 4—470 for procedure.) Remove the nose cowl. (Refer to paragraph 4—449 for procedure.)

h. Remove the outer diaphragm. (Refer to paragraph 4—511 for procedure.)

i. Disconnect the oil separator lines; disconnect the oil vent line to the engine oil tank.

j. Disconnect lines to the hydraulic reservoir and auxiliary hydraulic pump. Remove the hydraulic reservoir and support (see paragraph 4—932) and the auxiliary hydraulic pump (refer to paragraph 4—1092.)

k. Disconnect the throttle Teleflex control from the lever arm of the automatic manifold pressure regulator and from the quick-disconnect at the firewall. Disconnect the mixture Teleflex control at the carburetor, remove the telescopic end bracket from the supercharger air collector case and the quick-disconnect at the firewall.

l. Disconnect the intercooler duct hoses at the carburetor air box and remove the carburetor air box by removing bolts attaching it to the carburetor flanges. (Refer to paragraph 4—558.)

m. Remove the carburetor. (Refer to paragraph 4—536 for procedure.)

n. Disconnect propeller governor Teleflex controls at governor and at quick-disconnect at the firewall.

o. Drain engine oil. Disconnect the oil lines. (Refer to paragraph 4—676 for procedure.)

p. Disconnect electrical leads from the engine section junction box.

q. Disconnect the top intercooler entrance duct hoses from the auxiliary stage supercharger.

r. Remove the engine and engine mount from the firewall. (Refer to paragraph 4—501.)

s. Disconnect the lines to the hydraulic panel.

t. Remove induction vibrator.(See paragraph 4—664.)

u. Remove the generator blast tube by disconnecting it at the generator and at the left hand auxiliary stage air entrance duct. Disconnect electrical lines to the generator. Remove the starter (see paragraph 4—660), the generator (see paragraph 5—20) and their supports and connections.

v. Remove the hydraulic pump and connection. (Refer to paragraph 4—943.) Remove the vacuum pump and connection. (Refer to paragraph 4—1326.) Remove the tachometer and connection. (Refer to paragraph 4—1472.) Disconnect fuel and oil pressure tubing and electrical lead to the engine gage unit; see paragraph 4—1431, steps f. through i. Remove the propeller governor. (Refer to paragraph 4—637.) Remove fuel pump from the engine. (Refer to paragraph 4—836.)

w. Remove the inner diaphragm. (Refer to paragraph 4—512.)

x. With the engine mount properly supported, remove the engine mount in two sections (left and right) from the engine by removing bolts at the splice fittings. (Refer to paragraph 4—523.)

4—506. CLEANING. The engine must be kept clean in order to prolong its life by preventing excessive wear and to make cleaning and maintenance less difficult. Before washing the engine, look for oil leaks which may indicate loose connections, packings, or nuts. Clean the engine as follows:

a. Remove the engine cowl panels.

b. Wash all separate parts and accessories of the engine (with the exception of the starter, generator, magnetos, ignition and other electrical wiring) with kerosene, Spec. VV-K-211 or cleaning solvent, Spec. No. P-S-661.

CAUTION

Do not allow any of the cleaning fluid to enter the ignition manifold or magnetos.

c. Dry parts with compressed air.

d. Sand blast all cylinder heads.

e. Strip paint from magnesium parts not anodized or anodized and showing signs of corrosion. Refer to paragraphs 4—1897 through 4—1900 for maintenance of magnesium surfaces.

4—507. INSTALLING. Install the engine by reversing removal procedure given in paragraph 4—505. Tighten nuts attaching engine mount adapter to engine housing to a torque of 85 (plus or minus 15) foot pounds. If a newly overhauled engine is being installed, make certain that the thrust bearing cover plate stud protecting ring is reinstalled.

Note

When replacing any engine accessories, check gaskets and replace if cut or worn.

4—508. DIAPHRAGMS.

4—509. DESCRIPTION. *(See figure 4—62.)* The diaphragms consist of an inner diaphragm bolted to the engine and an outer or exhaust collector diaphragm extending around and fastened to the engine mount ring. The inner diaphragm consists of irregularly shaped stainless steel segments, spliced together, which seal the space between the engine and the engine mount tubing. The outer or exhaust collector diaphragm consists of three irregularly shaped segments, spliced and bolted together and shaped to fit snugly around the engine and equipment. The outer or exhaust collector diaphragm contains Camloc collars and Dzus fastener springs for attachment of accessory compartment panels and exits for the exhaust collector support struts and for the engine scavenger pipe line. The primary function of the diaphragms is to act as a firewall, shielding the accessory compartment from the engine exhaust heat, and to prevent airflow between the accessory compartment and the rear of the engine. The outer diaphragm forms, in addition, a shoulder or fairing, past which, the engine cooling air can flow without excessive drag.

4—510. REMOVING. The outer diaphragm, attached to the engine mount ring, should be removed first in accordance with paragraph 4—511. The inner diaphragm, bolted to the engine mount ring is then removed in accordance with paragraph 4—512. For access, remove engine accessory compartment panels and intercooler flap installation. Remove cowl flaps. Disconnect jackshafts at engine mount ring. Refer to paragraph 4—470.

4—511. REMOVING OUTER (EXHAUST COLLECTOR) DIAPHRAGM.

a. Disconnect the two exhaust collector support struts.

b. Disconnect the engine scavenge pipe from the exit in the lower part of the diaphragm.

c. Remove the auxiliary air entrance ducts from each side of the diaphragm. Refer to paragraph 4—562.

d. Remove exhaust collector. See paragraph 4—518.

e. Disconnect the hose clamp on the blower drain valve where it attaches to the diaphragm.

f. Remove the bolts attaching the diaphragm segments together by means of the splice plates.

g. Remove the bolts that secure the segments to the brackets on the engine mount ring.

h. Remove the exhaust collector diaphragm segments.

4—512. REMOVING INNER DIAPHRAGM.

a. Remove the carburetor air box. Refer to paragraph 4—558.

b. Remove the screws that splice the inner diaphragm segments together.

c. Remove bolts that secure segments to engine.

d. Pry the diaphragm segments aft and draw them out of the spaces between the engine mount tubes.

4—513. REPAIRING. It is not necessary to repair smooth, local dents up to 1/4 inch deep that have not caused rivets or spotwelds to shear, 1/8 inch nicks, or surface scratching. More extensive damage shall be repaired by patching, splicing, or replacement of a section or the entire diaphragm in accordance with approved instructions contained in Handbook of Instructions for Structural Repair (AN 01-45HB-3).

4—514. INSTALLING INNER DIAPHRAGM.

a. Slip the segments of the inner diaphragm in between the engine mount tubes and then onto the engine.

b. Place washers on the bolts and insert bolts through the diaphragm and into the sockets on the back of the engine. Tighten the bolts.

c. Secure the sections of the inner diaphragm by means of the screws that secure the segments together.

4—515. INSTALLING OUTER (EXHAUST COLLECTOR) DIAPHRAGM.

a. Place one of the sections of the exhaust collector diaphragm in its proper position on the engine mount ring and secure it to the ring with bolts.

b. Secure one of the adjacent segments to the engine mount ring with bolts.

c. Bolt the two segments together at the splice plates.

d. Continue attachment in the same manner with the other two segments.

4—516. EXHAUST COLLECTOR.

4—517. DESCRIPTION. *(See figure 4—62.)* The exhaust collector is composed of formed and welded stainless steel sheet and is constructed so as to conduct the engine cylinder exhaust gases out of the airplane in the most efficient manner. The exhaust collector is designed to cause the exhaust gas to stream back in a direction opposite to the flight path and the consequent propulsive force of these gases is thereby utilized to advantage. Each of the 18 engine cylinders has its own exhaust port, to which the exhaust collector tubes are fastened by means of three high temperature, self-locking Boots nuts furnished with the engine. The front cylinders, however, have short stacks fastened to their exhaust ports. These stacks extend back between the rear cylinders to allow for easier assembly of the exhaust section assemblies. The eighteen exhaust collector ports exhaust through six outlets sunk into four wells in the diaphragm. There are six outlets facing aft, located between the diaphragm and the trailing edge of the cowl flaps.

4—518. REMOVING.

a. The following tools are required: an individual socket (1/2 inch) with an extension and ratchet and an open end wrench (1/2 inch).

b. Remove the engine cowl panels for access to the exhaust collectors located between the nose cowl and the accessory compartment. Remove the cowl flaps. Thread the jackshafts with safety wire to maintain correct settings. Refer to paragraph 4—463.

c. Remove the three Boots nuts that fasten the exhaust collectors to each rear bank cylinder. The nuts may be identified by "V" notches on the six points of the hex. The exhaust collectors can now be removed by slipping them aft, away from the stacks.

CAUTION

When removing the exhaust section assemblies adjacent to the air duct through the diaphragm, care should be exercised so that the duct will not be damaged, dented, or moved from its position. If the exhaust section assembly shows positive interference with the air duct, the duct must be detached and moved aft to obtain necessary removal clearance.

Note

The following steps are necessary only if the short exhaust stacks are to be removed.

d. Disconnect the spark plug cables on the front bank cylinders.

e. Remove the top cooling baffle on each front bank cylinder. (The baffles can be left hanging on the spark plug cables.)

f. Remove the three Boots nuts that hold each stack to the front cylinder ports.

g. If the one nut that cannot be seen behind each stack is turned down too tightly to be removed by means of the universal slipped between the stack and the side cooling baffle adjacent to the stack, it will be necessary to loosen the adjacent baffle. Loosen (but do not remove) the nuts which hold the side baffle.

CAUTION

Do not remove the nuts, simply loosen them. If the nuts are removed, the baffle is likely to spring out of its retaining ring at base of cylinder. It is an extremely delicate operation to restore the baffle to its proper position.

4—519. REPAIRING.

a. Weld punctured or cracked tubes in accordance with approved instructions given in Handbook of Instruction for Structural Repair (AN 01-45HB-3.)

b. Replace stacks which are corroded or cracked beyond repair.

4—520. INSTALLING.

a. The same special tools are required for installing as for removal. See paragraph 4—518.

b. Place the short stacks (previously removed) on the front bank cylinder ports. Secure each stack with three Boots nuts furnished with the engine. Identify these nuts by "V" notches on the six points of the hex.

c. Lift the exhaust collectors into their proper location on the rear bank cylinders, and telescope the front cylinder short stacks into the collectors where slip joints are provided.

d. Connect each rear cylinder exhaust flange to the proper cylinder with three Boots nuts.

e. Tighten all nuts to a torque valve of 150-175 inch pounds.

4—521. ENGINE MOUNT.

4—522. DESCRIPTION. *(See figure 4—62.)* The engine mount is a welded tubular steel truss that supports the engine, and transfers engine loads to the fuselage. The engine is attached to the engine mount ring which is a circular steel tube, split on the vertical centerline at the top and bottom. The engine mount is split to provide for installation over the auxiliary stage blowers on the engine. The upper splice fitting includes the power plant hoist sling attachment. The lower portion of the engine mount ring is reinforced to increase bending strength since the lower tubes of the mount are eccentric to the engine attaching lugs. The centerline pylon support fitting is supported by a fitting on the engine mount. Attachments are provided on the mount for the water injection tank and hydraulic reservoir. Six engine mount adapters, bolted to lugs on the engine, provide for attachment points on the engine mount ring. Welded to the ring are steel tubes that function as the support truss and terminate in four fittings, by means of which the mount is attached to the fuselage. The two upper fittings are bolted to the ends of the upper longerons and the two lower fittings are bolted to the center section main beam at the end of the lower longerons.

4—523. REMOVING. With engine quick change unit removed from airplane and supported on knock-down type quick engine change stand (see paragraph 4—501), proceed as follows to remove the engine:

a. Remove the starter (see paragraph 4—660), generator (see paragraph 5—20), tachometer generator (see paragraph 4—1472), fuel pump (see paragraph 4—836), vacuum pump (see paragraph 4—1326), hydraulic pump (see paragraph 4—943), and propeller governor (see paragraph 4—637) from the engine.

b. Remove the inner diaphragm. (Refer to paragraph 4—512).

c. Remove the emergency hydraulic pump (see paragraph 4—1092) and hydraulic reservoir (see paragraph 4—932).

d. Remove the engine section junction box by removing clamps and bolts.

e. Remove the cowl flap actuating motor and controller box (see paragraph 4—470h. through m.), the water injection tanks (see paragraph 4—581), the intercooler exit duct supports, and all other accessories, lines and fittings attached to the engine mount.

f. Loosen the adapter bolt nuts securing engine to engine mount and remove the adapter bolts. Disconnect left and right hand sections of the engine mount at the top and bottom splices by removing bolts.

g. Remove the engine mount in two sections (left and right).

4—524. REPAIRING. The engine mount should be inspected periodically for cracks, distortions, misalignment, and condition of the protective coating. The mount should be thoroughly cleaned during inspection in order to enable the mechanic to find small cracks that may be present in the welded joints. The engine mount must be free of cracks, breaks, and corrosion. A small crack may form a focal point for stress concentration and rapidly increase in size.

a. In case of sudden engine stoppage caused by obstruction of propeller rotation, remove the engine mount and check the attachment fittings by proof loads. Failure of the fittings is most likely to occur in the lower fittings, especially the lower left fitting.

b. Renew the protective coating of the engine mount, if chipped or deteriorated, in order to prevent corrosion and weakening of the mount.

c. Replace support lugs on the engine mount which are distorted or show wear.

d. Replace the engine mount, if any tube member is bent out of line more than 1/400 of its length.

e. Replace the engine mount, if the middle third of the length of each tube in the supporting truss structure shows indentations, cracks, or abrasions greater in depth than 1/30 of the tube diameter.

4—525. INSTALLING. Install engine mount by reversing removal procedure given in paragraph 4—523.

Note

The adapters must be attached to the engine lugs before the engine can be fastened to the engine mount ring. "Snug up," but do not tighten nuts until adapters have been lined up with the engine mount ring. Tighten nuts to a torque of 85 (plus or minus 15) foot pounds.

4—526. BREATHER.

4—527. DESCRIPTION. *(See figure 4—63.)* The breather consists of a tube attached to a fitting on the upper aft left hand accessory section of the engine. The tube, clamped to the engine mount, extends down and vents to the atmosphere through the outer diaphragm at the centerline of the airplane just aft of the cowl flap. The purpose of the breather is to vent the rear case of the engine to prevent excessive internal pressures.

4—528. REMOVING.

a. Remove the accessory compartment upper cowl panel and the upper and lower left hand wing gap cover panels for access to the breather tube. Open the intercooler flap.

b. Break the hose connection between the forward breather tube and elbow by removing two clamps.

c. Remove clamps attaching the tube to engine mount and to diaphragm support ring.

d. Disconnect elbow from engine crankcase.

4—529. INSTALLING. Install the breather tube by reversing removal procedure.

4—530. AUTOMATIC POWER CONTROL.

4—531. DESCRIPTION. *(See figure 4—63A.)* The automatic power control is a hydraulic mechanical device which automatically maintains any manifold pressure selected by the pilot above taxiing and normal ground operation through the combat power range until critical altitude is reached. Normal ground operation is under the positive control of the pilot's throttle lever. The power control is furnished with the engine, and is manufactured by the Bendix Aviation Corporation, their Model No. CO-3F (Pratt and Whitney Part No. 90656). It is mounted over the upper left side of the rear engine accessory drive case cover. The power control consists of two independent regulating units, the manifold pressure regulator and the carburetor drop regulator.

4—531A. The pilot's throttle control lever is directly connected to the carburetor throttle and to the manifold pressure regulator. The manifold pressure regulator is made sensitive to manifold pressure and, through an oil selector valve and power piston, can move the carburetor throttle independently of the pilot's control lever. Movement of the pilot's control lever results in establishing a setting on the manifold pressure regulator. Once the pilot has established a setting on the control to call for a certain manifold pressure, it is not necessary for him to move his control lever to maintain the same manifold pressure as the airplane climbs or dives or as the rpm changes. The manifold pressure is automatically controlled by the regulator by opening or closing the carburetor throttle through the oil selector valve and power piston and by operation of the auxiliary stage. Once the pilot sets his control lever at a fixed position, motion of the selector valve and resultant motion of the power piston and carburetor throttles are controlled by the manifold pressure. By this action, if the manifold pressure starts to fall below the setting established by the pilot, the selector valve moves automatically through the action of the manifold pressure bellows to let oil pressure act on the power piston to open the throttle farther. Conversely, if the manifold pressure starts to increase above the setting established by the pilot, the selector valve is moved to let oil pressure act on the power piston to close the throttle. Thus the carburetor throttle motion is automatically controlled to maintain a constant manifold pressure.

4—531B. There is no direct control over the auxiliary stage supercharger by the pilot. Its operation is automatically controlled by the carburetor-drop regulator. The carburetor-drop regulator is sensitive to the engine air static pressure drop across the carburetor throttle. This regulator is set to regulate to approximately a constant carburetor air pressure drop. A decrease in carburetor air static pressure drop below the setting of the regulator results in motion of an oil control valve to permit engine oil to be metered to the hydraulic couplings, thereby speeding up the auxiliary stage to supply a greater airflow to the engine. The increase of airflow to the engine results in an increase in the static pressure drop across the carburetor. The auxiliary stage superchargers are then brought up to a speed high enough to return the carburetor air static pressure drop to the setting of the regulator. This action of the auxiliary stage regulator together with the manifold pressure regulator results in automatically maintaining constant manifold pressures below critical altitude for fixed positions of the pilot's throttle control lever regardless of changes in flight conditions.

4—532. REMOVING.

a. Disconnect the linkage to the throttle and the carburetor.

b. Disconnect two air pressure lines from the carburetor.

c. Disconnect the water injection solenoid connection.

d. Disconnect the oil pressure line.

e. Remove six nuts and bolts and remove the regulator.

4—533. INSTALLING. Install the automatic manifold pressure regulator by reversing the removal procedure. Check gaskets and replace with new ones if cut or worn.

4—533A. CARBURETOR HEADER BLEED VALVE.

4—533B. DESCRIPTION. *(See figure 4—63A.)* The Pratt and Whitney designed auxiliary stage bleed valve (their Part No. PW 135056) is a spring-loaded relief valve sensitive to the pressure differential between manifold pressure and carburetor deck (carburetor air box) pressure. The valve is located in the accessory compartment immediately above the carburetor air box, mounted to a bracket on a channel supported by the engine mount tubes. A short section of 3-1/2 inch diameter hose connects the valve to the carburetor air box, and another 3-1/2 inch diameter hose vents overboard at the left side of the intercooler flap. Engine manifold pressure is tapped into the valve from the instrument line to the manifold pressure gage in the cockpit.

4—533C. This valve is installed to eliminate engine surge which may be encountered when operating at high altitude at low power. Engine surge, which may be encountered at high altitudes and cruise powers, is caused by the auxiliary stage superchargers pumping more air than is required by the engine. The bleed valve eliminates the surge by bleeding excess air out of the carburetor air box overboard through the intercooler flap. The valve thus allows engine airflow requirements to be satisfied and at the same time maintains the airflow through the auxiliary stage high enough to permit surge-free operation. The operation of the valve is entirely automatic. The valve is spring-loaded and is sensitive to the pressure differential between manifold pressure and carburetor deck pressure. When the manifold pressure is ten or more inches of mercury higher than the carburetor deck pessure, the valve is fully closed. The valve starts to open at a pressure differential of 10 inches of mercury and is fully open at a pressure differential of approximately 7 inches of mercury. At normal rated and military power, the differential is greater than 10 inches of mercury, and the valve is fully closed.

4—533D. TROUBLE SHOOTING. Since the function of this valve is dependent on air pressures encountered in flight, it cannot be tested on the ground. Replace the valve if its proper function is doubted or if surge is reported.

4—533E. REMOVING.

a. Working through the intercooler flap, break hose connection to carburetor air box and remove overboard line by removing clamps.

b. Disconnect manifold pressure line at top of valve.

c. Remove four bolts attaching valve to mounting bracket, and remove valve.

4—533F. INSTALLING. Reverse removing procedure.

4—534. CARBURETOR.

4—535. DESCRIPTION. *(See figure 4—63.)* The engine is equipped with an up-draft injection type carburetor (Pratt and Whitney Part No. 123953) which meters fuel in proportion to the mass air flow to the engine. The carburetor is mounted to the bottom slanting portion of the accessory drive housing. The mass air flow to the engine is controlled by the setting of the pilot's throttle control and engine rpm. After being metered by the carburetor, the fuel is carried through an internal passage to the fuel feed valve in the accessory drive case. The fuel feed valve opening is controlled by impact pressure from the carburetor acting on the outboard side of the fuel feed valve dia-

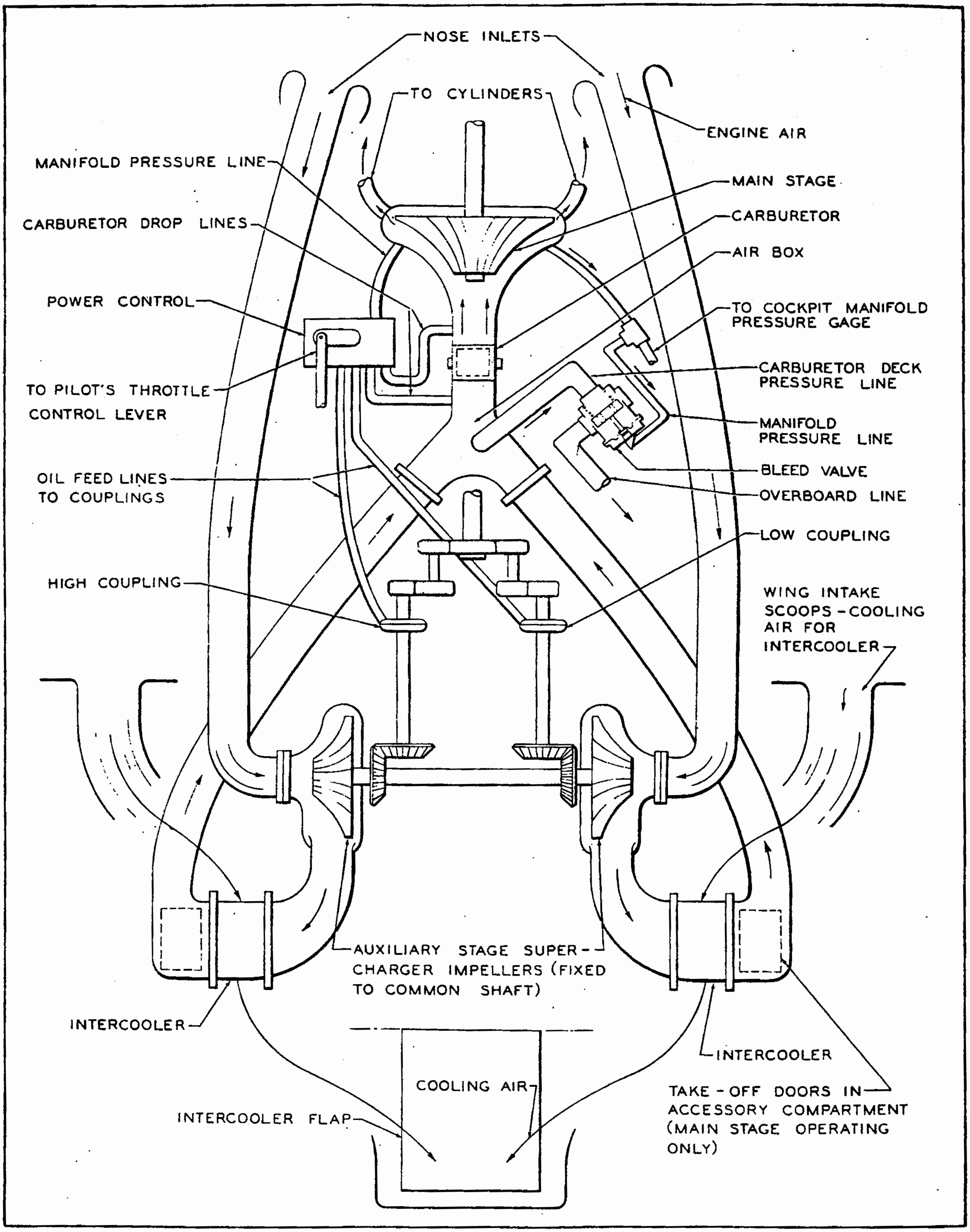


Figure 4—63A. Induction System Schematic Showing Automatic Power Control and Bleed Valve.

phragm through a small bleed to the carburetor, and by metered fuel pressure from the carburetor acting on the inboard side of the diaphragm. A spring on the outboard side of the diaphragm acts to oppose these forces and holds the valve on its seat until the metered fuel pressure is sufficient to overcome the force of the spring. The fuel, discharged from the fuel feed valve at the impeller throat where it is mixed with the air and vaporized by the impeller, passes through the diffuser to the supercharger collector rim, and is then distributed to the cylinders through the intake pipes and inlet valves. A solenoid priming valve controlled by the primer switch and used in starting is incorporated as an integral part of the carburetor. Refer to paragraph 4—642 for additional information. The variable water-air ratio regulator is mounted to the carburetor. Refer to paragraph 4—572 for additional information.

4—536. REMOVING.

a. Disconnect the hose coupling between the intercooler exit duct and the carburetor air box.

b. Disconnect lines to the carburetor air box and remove the carburetor air box from the carburetor flange by removing bolts.

c. Disconnect the throttle linkage, mixture control, and automatic manifold pressure control linkage from the carburetor.

d. Disconnect water regulator lines from carburetor.

e. Disconnect two differential pressure lines from the automatic manifold pressure control.

f. Disconnect fuel primer lines from carburetor.

g. Disconnect the main fuel line from the carburetor.

h. Cut the safety wire from ten carburetor attaching bolts and remove bolts and carburetor.

4—537. INSTALLING.

a. Install the carburetor by reversing removal procedure.

b. Tighten the ten carburetor attaching bolts to a torque of 175 to 225 inch pounds.

c. Check to make sure the gaskets under the bolts are properly in line with the holes in the carburetor flange. Use new gaskets if old ones are cut or worn.

4—538. RUBBER INSULATION.

4—539. DESCRIPTION. *(See figure 4—64.)* The following chart is included for ease in identifying rubber insulation for replacement.

RUBBER INSULATION CHART
(Refer to figure 4—64.)

FIG. REF.	PART NO.	QTY.	NAME OF PART	SIZE	MATERIAL	DURO-METER
1	VS-57819	2	Tape—Intercooler Flap Beam	.017 x 1½ x 44¼	Syn. Rub. PAW N-9 GR. A	—
2	VS-56366	2	Seal—Outer Diaphragm	1/16 x 3 x 14	Syn. Rub. E15 GR. 60 CL II GRM	—
3	VS-56173	1	Insulation—Bottom Eng. Cowl Panel	.017 x 1⅝ x 42	Syn. Rub. E15 GR. 80 CL II	—
4	VS-56267	2	Insulation—Engine Cowl—Top Panel	.017 x 1½ x 40¾	Syn. Rub. Sht. CVA-523 Type 1	—
5	VS-57945	2	Boot—Exhaust Collector Support	—	U.S. Rubber Co. No. X-1803	—
6	VS-56159	1	Seal—Bottom Engine Cowl Panel	⅛ x 10 x 40	Syn. Rub. E15 GR. 60 CL II	—
7	VS-56158	2	Seal—Bottom Engine Cowl Panel	1 1/16 x 1¼ x 4¼	Syn. Rub. E15 GR. 60 CL II	—
8	VS-56172	1	Insulation—Bottom Eng. Cowl Panel	.017 x 1½ x 46	Syn. Rub. E15 GR. 80 CL II	—
9	VS-56081	1	Seal—Nose Cowl	—	CVC-911-6-400	—
10	VS-56082	2	Seal—Nose Cowl	—	CVC-930-32 AMS-3208	45—55
11	VS-56251-2	1	Seal—Cowl Flap Support Channel	1/16 x 1¾ x 43	Syn. Rub. E15 GR. 40 CL II	—
12	VS-56062	2	Seal—Nose Cowl	—	CVC-931-15	—
13	VS-56219	2	Seal—Engine Cowl Side Panel	20	CVC-931-AMS-3208	45—55
14	VS-56221	2	Seal—Engine Cowl Side Panel	⅛ x 8 x 22	Syn. Rub. E15 CL II GRM	—
15	VS-56080	2	Seal—Nose Cowl	—	CVC-911-6-400	
16	VS-56625	1 R.H.	Seal—Engine Cowl Top Panel	⅛	Syn. Rub. E15 GR. 60 CL II GRM	—
17	VS-56222	4	Seal—Engine Cowl Side Panel	13	Molded Syn. Rub. AMS-3208	—
18	VS-56022	1	Seal—Nose Cowl	—	CVC-930-4½	—
19	VS-56426	2	Seal—Auxiliary Air Entrance Elbow Duct	15	CVC-919 AMS-3209	65—75
20	VS-56220	2	Seal—Engine Cowl Side Panel	24	CVC-931 AMS-3208	45—55
21	VS-56115	2	Seal—Outer Diaphragm	⅛ x 8 x 16	Cellular Neoprene CVA-526	—

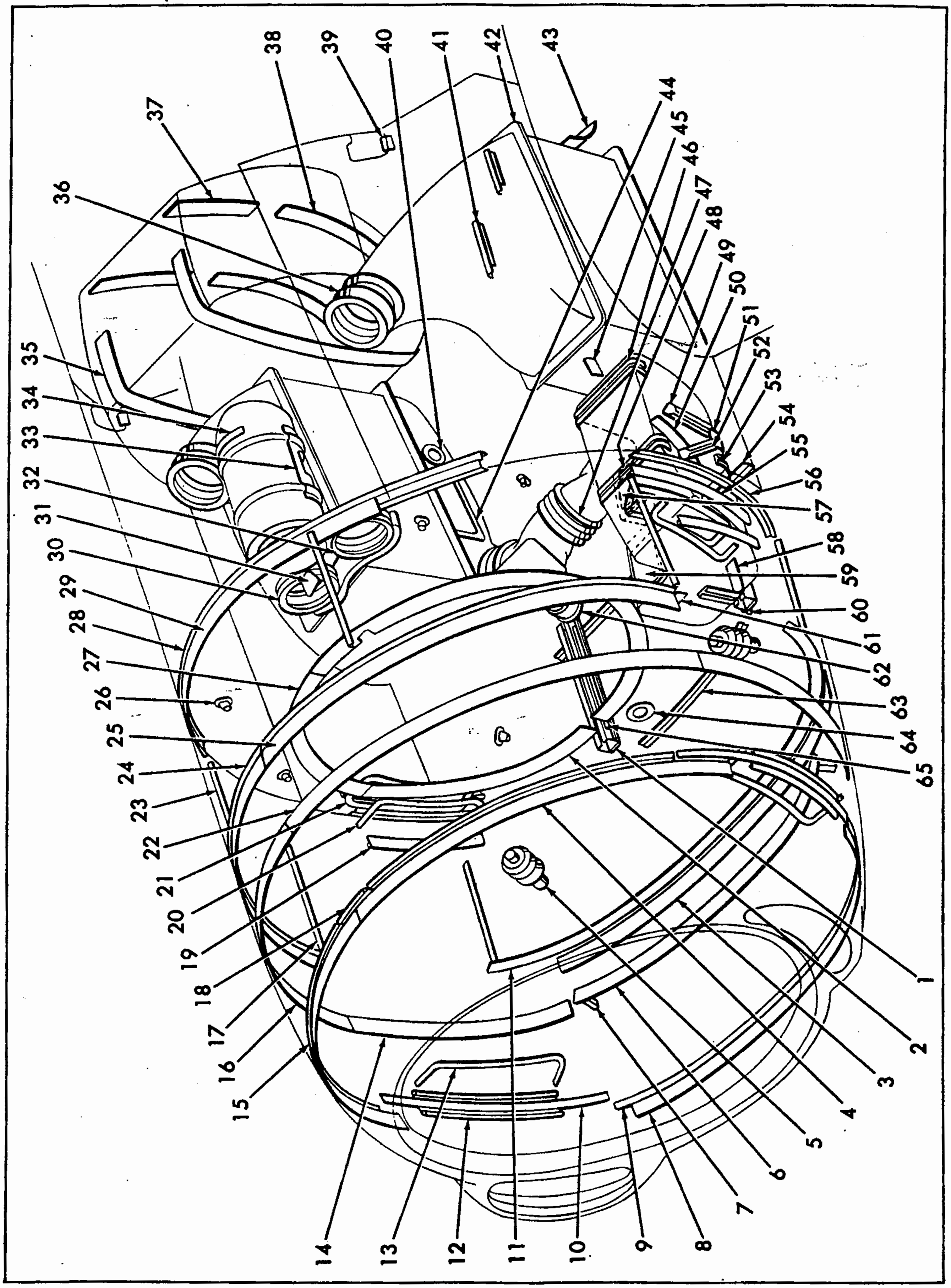
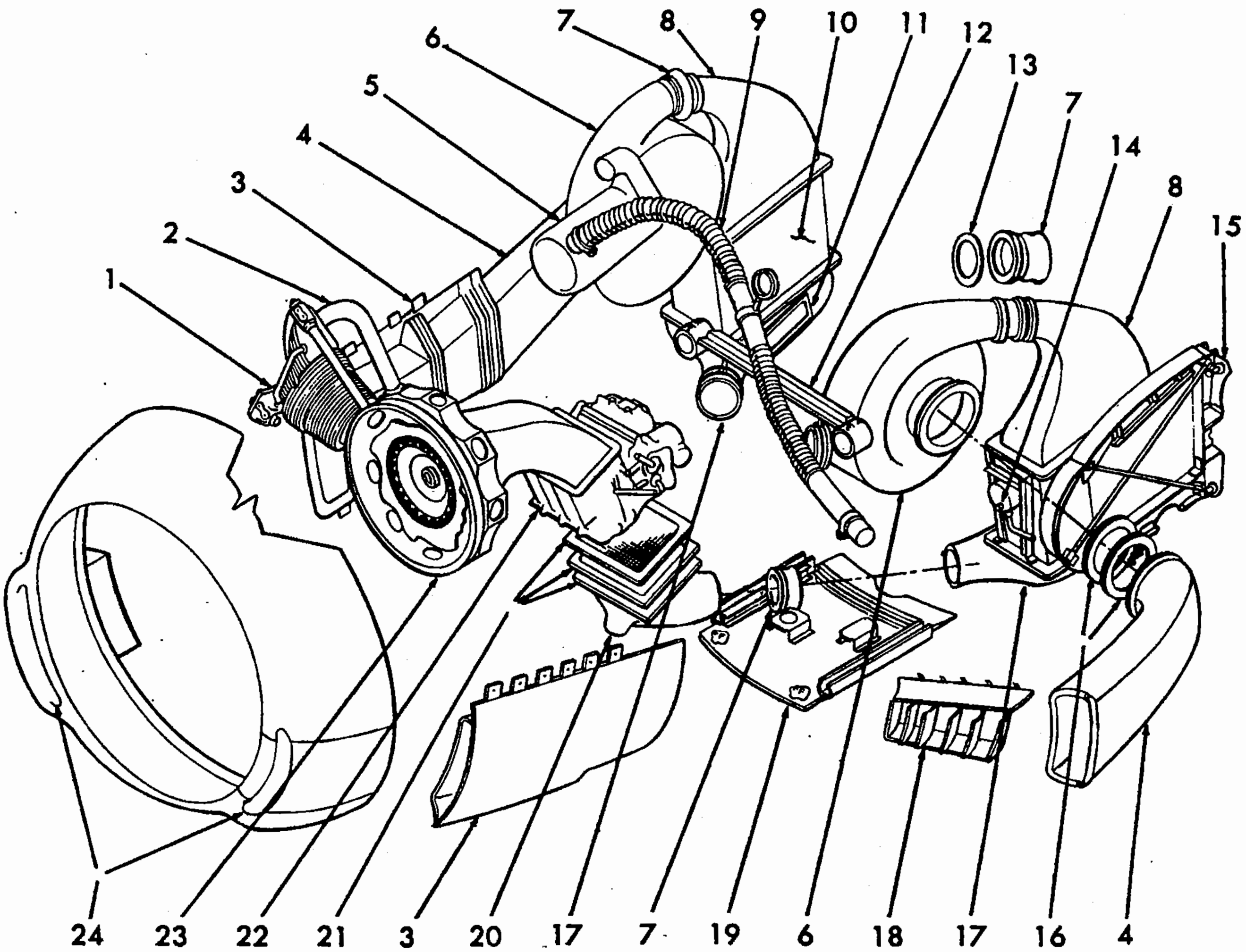


Figure 4-64. Location of Rubber Insulation.

RUBBER INSULATION CHART (Con't.)

FIG. REF.	PART NO.	QTY.	NAME OF PART	SIZE	MATERIAL	DURO-METER
22	VS-56624	1 L.H.	Seal—Engine Cowl Top Panel	1/8	Syn. Rub. E15 GR. 40 CL II GRM	—
23	VS-56480	2	Seal—Top Accessory Compartment Panel	12 3/32	Molded Syn. Rub. AMS-3208	—
24	VS-56251-1	2	Seal—Cowl Flap Support Channel	1/16 x 1 3/4 x 33	Syn. Rub. E15 GR. 40 CL II	—
25	VS-56268	2	Insulation—Engine Cowl Top Panel	.017 x 1 3/8 x 41 1/2	Syn. Rub. Sht. CVA-523 Type I	—
26	VS-56377	11	Boot—Outer Diaphragm	.060	Molded	—
27	VS-56386	1	Seal—Outer Diaphragm	1/16 x 14 x 35	Syn. Rub. E15 GR. 60 CL II	—
28	VS-56388	1	Seal—Outer Diaphragm	36	CVC-911-6	—
29	VS-56498	1	Tape—Top Accessory Compartment Panel	.017 x 1 1/2 x 39	Syn. Rub. E15 CL. II GR. 80	—
30	VS-59679	1	Pad—Starter & Generator Support Installation	—	NAS-188-3A-191	—
31	VS-59649	1	Pad—Cowl Flap Motor Installation	1/4 x 2 7/8 x 3 1/8	Syn. Rub. AMS-3204	—
32	VS-59680	1	Pad—Starter & Generator Support Installation	—	NAS-188-3A-140	—
33	VS-58377	1	Padding—Hydraulic Reservoir	1/8 x 9 3/8 x 12	Neoprene CVA 526	—
34	VS-58384	1	Padding—Hydraulic Reservoir	1/8 x 1 x 9	Neoprene CVA 526	—
35	CVC-947-32 1/2	2	Padding—Oil Tank Support	—	Rubber AMS-3209	65—75
36	VS-57894	2	Boot—Engine Accessories	—	Molded	—
37	CVC-947-8 3/4	2	Padding—Oil Tank Support	—	Rubber AMS-3209	65—75
38	CVC-947-18 1/2	2	Padding—Oil Tank Support	—	Rubber AMS-3209	65—75
39	VS-56685	2	Seal—Upper Wing Gap Cover	1/16 x 1 1/4 x 3 1/2	Syn. Rub. E15 GR. 60 CL II GRM	—
40	VS-57972	2	Gasket—Engine Accessories		—	—
41	VS-56499	2	Seal—Top Accessory Compartment Panel	6 7/8	CVC-932-6 7/8	—
42	VS-53618	4	Gasket—Intercooler Support Rib	1/32x10 1/4x25 11/16	Johns Manville Style No. 76	—
43	VS-43581	1	Block—Fumeproof Installation	1/4 x 3 3/8 x 5	Syn. Rub. E15 GR. 40 CL II GRM	—
44	VS-57825	2	Gasket—Intercooler Air Exit Duct	1/8 x 4 x 11	Neoprene Sht. E15 GR. 40 CL II	35—45
45	VS-56676	1	Seal—R.H. Panel Upper Wing Gap Cover	1/16 x 1 1/4 x 5 3/4	Syn. Rub. E15 GR. 60 CL II GRM	—
46	VS-56328-4	4	Padding—Water Tank	12 1/4	CVC-947 AMS-3209	65—75
47	VS-57907	2	Boot—Engine Accessories	—	Molded	—
48	VS-56634-1	2	Chafing Strip—Water Tank	1/8 x 2 1/2 x 6	Syn. Rub. E15 GR. 40 CL I	—
49	VS-56328-1R	2	Padding—Water Tank	12 3/8	CVC-947 AMS-3209	65—75
50	VS-56328-2	2	Padding—Water Tank	15	CVC-947 AMS-3209	65—75
51	VS-56634-4	2	Chafing Strip—Water Tank	1/8 x 2 1/2 x 4 1/4	Syn. Rub. E15 GR. 40 CL I	—
52	VS-56328-1L	2	Padding—Water Tank	12 3/8	CVC-947 AMS-3209	65—75
53	VS-56328-3	2	Padding—Water Tank	9 3/8	CVC-927 AMS-3209	65—75
54	VS-56093	1	Seal—Intercooler Flap	22 7/16	CVC-911-6	—
55	VS-56217	2	Seal—Engine Cowl Side Panel	22	CVC-931 AMS-3208	45—55
56	VS-56113	2	Seal—Outer Diaphragm	28	CVC-911-6	—
57	VS-56634-2	2	Chafing Strip—Water Tank	1/8 x 2 1/2 x 2 7/8	Syn. Rub. E15 GR. 40 CL I	—
58	CVC-947-7 1/2	1	Padding—Water Tank	—	Rubber AMS-3209	65—75
59	VS-56634-3	4	Chafing Strip—Water Tank	1/8 x 2 1/2 x 2	Syn. Rub. E15 GR. 40 CL I	—
60	VS-56295	2	Seal—Intercooler Flap Beam	12 9/16	CVC-911-6	—
61	VS-56626	2	Seal—Engine Cowl Top Panel	1/16 x 1 1/2 x 3	Syn. Rub. Sht. E15 GR. 60 CL II	—
62	VS-59637	1	Seal—Air Box Assembly	—	Syn. Rub. AMS-3212	—
63	VS-56372	1	Seal—Outer Diaphragm	22 1/2	CVC-911-6	—
64	VS-59646	1	Seal—Outer Diaphragm*	3 x 1/8	Neoprene CVA 526	—
65	VS-56184	2	Seal—Intercooler Flap Beam	—	Molded Syn. Rub. AMS-3208	—



1. Engine Cylinder
2. Intake Pipe
3. Engine Cowl Side Panel Duct
4. Auxiliary Stage Supercharger Entrance Ducts
5. Generator
6. Auxiliary Stage Supercharger Housing
7. Boot
8. Intercooler Entrance Ducts
9. Generator Blast Tube
10. Intercoolers
11. Take-off Door and Screen
12. Intercooler Exit Ducts Support
13. Gasket
14. Intercooler Flap Pressure Switch
15. Intercooler Support Rib
16. Auxiliary Stage Supercharger Entrance Duct Screen and Gaskets
17. Intercooler Exit Ducts
18. Air Intake Vanes in Wing
19. Intercooler Flap
20. Carburetor Air Box
21. Carburetor Screen and Gaskets
22. Carburetor
23. Main Stage Blower
24. Nose Cowl Inlets

Figure 4—65. Air Induction System Reference Diagram.

4—540. AIR INDUCTION SYSTEM.

4—541. DESCRIPTION. *(See figures 4—65 and 4—66.)* The air induction system consists of a series of ducts, two intercoolers, and attaching parts, which are incorporated in the airplane for the purpose of providing air to engine at a minimum loss in pressure and at carburetor air temperatures within allowable limits. The design provides two paths of airflow.

a. When operating solely on main stage supercharging during ground operation, or low altitude flight, air enters the wing leading edge air intake scoops and flows through the intercoolers and into the engine accessory compartment. Some of the air is then drawn through screens and take-off doors, located on the inboard faces of the intercooler air exit ducts leading from the intercooler to the carburetor, and enters the engine via the carburetor air box. After passing through the carburetor, the air passes into the main stage supercharger, where it is mixed with fuel and compressed before entering the engine cylinders.

b. When taking off or when flying at higher altitudes requiring operation of the dual-stage auxiliary blowers to obtain desired power, air enters the engine nose cowl inlets located on both sides of the nose cowl, passes through connecting ducts incorporated in each engine cowl side panel and flows into the auxiliary stage entrance ducts leading to the dual-stage auxiliary blowers. From here the air, which has become heated due to compression, is conducted to the intercoolers via the intercooler entrance ducts and then to the carburetor. The take-off doors are held in the closed position by the pressure of the auxiliary stage supercharger air. A generator blast tube is connected to the left hand auxiliary stage air entrance duct for the purpose of directing cooling air to the generator on the right hand side of the engine accessory section. Air is directed from the left hand intercooler exit duct to pressurize the left hand external auxiliary fuel tank. The hydraulic reservoir pressurizing line attaches to the outboard side of the right hand intercooler entrance duct.

4—542. The components of the system consists of the following, in addition to nose cowl inlet scoops and ducts incorporated in engine nose cowl and side panels:

a. Auxiliary stage entrance ducts.
b. Intercooler entrance ducts.
c. Intercoolers.
d. Intercooler exit ducts.
e. Carburetor air box.

4—543. TROUBLE SHOOTING. The air induction system should be carefully checked at frequent intervals for leakage. The "high pressure" side of the system is particularly important. Excessive leakage in the "high pressure" side will require the auxiliary stage blower to pump more air than is required by the engine, with the result that the effectiveness of the intercoolers will be reduced. In addition, excessive leakage in either the inlet ducts or "high pressure" side ducts will also lower the pressure available at the carburetor and thus lower the critical altitude of the airplane. Excessive leakage or obstructions in the "low pressure" induction system will reduce the pressure available to the auxiliary stage inlets and thereby decrease the manifold pressure available, resulting in a decrease in critical altitude of the airplane.

WARNING

Loose objects, such as screws, washers, etc., left in any of the ducts will be carried through the system and may cause serious damage to the blowers and to the engine.

a. Inspect all ducts for cracks, distortion, holes and dents, especially at hose connections. Cracks and holes can be repaired by a welded patch; refer to the General Manual for Structural Repair (AN 01-1A-1) for welding procedure. The inside of the ducts should be left smooth and held to original contour. Ducts should be cleaned of dirt and grease.

b. Inspect attachment of ducts to engine and intercoolers.

c. Inspect seals for deterioration. Replace if necessary; refer to paragraph 4—538.

d. Check condition of screens and gaskets.

e. Examine intercoolers for clogged and broken cores and security of installation.

f. Check condition of rubber boots connecting ducts to system.

g. Inspect attaching clamps.

h. Inspect take-off doors. Doors should work freely and seat properly on neoprene seals when closed. It is permissible for the doors to hang slightly open when the engine is not running. Replace defective hinges.

i. Inspect condition of screen on take-off doors, auxiliary stage inlet and at carburetor.

j. Inspect seals on diaphragm where auxiliary stage entrance ducts pass through cutouts in diaphragm.

k. Interior vanes that are bent should be straightened. Check condition of rivets. Replace loose rivets.

l. Damaged intercoolers should be replaced. To clean intercooler cores, flush with kerosene.

m. The following parts are interchangeable from the left to the right hand sides of the airplane: intercoolers; clamps, and hose connections, according to duct sizes.

n. Replace all parts damaged beyond repair.

WARNING

AN AIRPLANE IN WHICH ANY COMPONENTS OF THE AIR INDUCTION SYSTEM ARE DAMAGED OR MISSING SHOULD NOT BE FLOWN UNTIL THE PARTS ARE REPAIRED OR REPLACED.

4—544. INTERCOOLERS.

4—545. DESCRIPTION. *(See figure 4—65.)* The two intercoolers located on each side of the engine mount just forward of the firewall between power plant stations 114 and 140 approximately, are manufactured by the Harrison Radiator Division, General Motors Corporation, Lockport, N. Y., their drawing number 8508865. The purpose of the intercoolers is to cool the air after it has left the auxiliary stage blower before it enters the carburetor. The air passes through the cores of the intercooler and is cooled by the ram air flowing from the air scoops in the wing leading edge into the engine accessory compartment. Two ducts are installed on each intercooler. One, an intercooler entrance duct guides warm air from the auxiliary supercharger into the intercooler. The other duct guides the cooled air

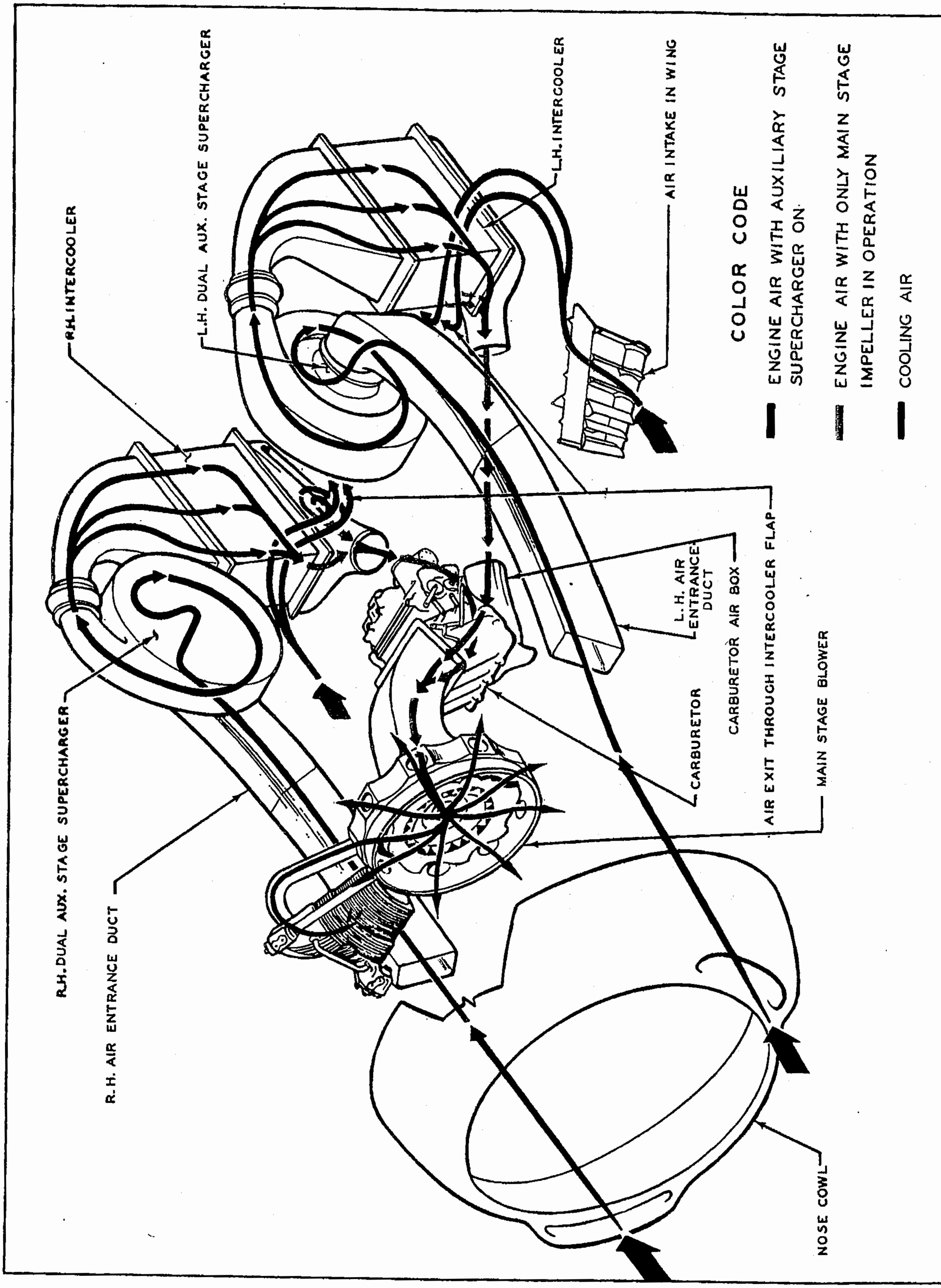


Figure 4–66. Air Induction System—Schematic.

from the intercooler to the carburetor air box, carburetor and engine. Both ducts are secured to the intercooler by bolts which pass through the flanges of the intercooler and the ducts, and through flanges of supporting ribs secured to the main wing beam. A pressure switch is located on the forward face of the left hand intercooler. This switch actuates an electro-magnetic banker valve whose function is to open or close the intercooler flap. For further details covering the pressure switch, see paragraph 4—492. The ducting is connected to the engine by rubber boots (hose connections) and bolts. Screens of 1/4 inch mesh are located at the entrance to the carburetor and at the entrance to each auxiliary stage blower. Hinged screens located in front of the take-off doors prevent foreign material from entering the induction system. Both intercoolers and exit ducts are supported by a brace assembly extending from right hand to left hand engine mount members. Straps, manufactured by the Marman Products Company, Inc., Inglewood, California, their part number 41747, are mounted over pads around the forward ends of the ducts and are attached to the channel by trunnions and eye turnbuckles to complete the support.

4—546. *(See figure 4-65.)* The intercoolers, intercooler entrance, and exit ducts are generally removed from the airplane as a unit after the engine has been removed. Otherwise, proceed as follows:

a. Remove upper and lower wing gap covers, intercooler flap, and "H" beam.

b. Remove catapult hook fairings from main beam; see paragraph 3—45.

c. Disconnect the intercooler entrance ducts (8) by disconnecting boots (7), and all bolts securing ducts to top of intercooler.

d. Cover supercharger exit ports.

e. Disconnect the intercooler exit ducts (17) from the carburetor air box (20) by removing boots (7) and clamps.

f. Remove air seal installations secured by Camlocs to the intercooler support rib (15) and the inboard air ducts rib.

g. Disconnect the hydraulic reservoir pressurizing line on outboard side of right hand intercooler entrance duct.

h. Disconnect electrical plug on pressure switch (14) located on the forward face of the left hand intercooler.

i. Remove the intercooler exit duct support (12) from ducts and engine mount members.

j. Remove lower outboard bolts securing intercooler to support rib (15).

k. Remove intercooler and the exit duct, forward and down, out of engine section.

l. Remove two special bolts securing the support ribs (15) to main beam and remove ribs. *(See figure 5—67.)*

4—547. INSTALLING. Reverse removal procedure.

4—548. INTERCOOLER ENTRANCE DUCTS.

4—549. DESCRIPTION. *(See figure 4—65.)* Two ducts lead from the auxiliary stage blower exits on both sides of the engine to the top of each intercooler. These ducts contain internal guide vanes to smooth out the airflow from the blowers passing to the intercoolers. Beaded flanges are incorporated at the upper ends of the ducts over which neoprene boots are fitted and secured to the ducts by clamps. The boots are connected to the engine by bolts passing through retainers. Gaskets are installed between the ducts and the engine mounting bosses. The lower ends of the ducts are secured to the top of each intercooler and support rib by bolts and are sealed against leakage by gaskets cemented on both sides. The right hand intercooler entrance duct contains a fitting for connecting the hydraulic reservoir pressurizing line.

4—550. REMOVING. The intercooler entrance ducts are best removed when the intercoolers are removed from the airplane as described in paragraph 4—546. To remove the intercooler entrance ducts from the intercoolers, proceed as follows:

a. Remove bolts securing the upper flange of each intercooler to the flange of each duct.

b. Remove shim, if used, on the outboard side of each intercooler assembly.

c. Remove the intercooler gasket, if damaged; replace with a new gasket. Cement both sides of the replacement gasket with EC-613 Cement.

CAUTION

During installation of the intercooler entrance and exit ducts, too much torque applied to attaching bolts on one side of the intercoolers will cant the ducts in the direction of the excessively tightened bolts and may result in misalignment of duct connections.

4—551. INSTALLATION. Reverse removal procedure.

4—552. INTERCOOLER EXIT DUCTS.

4—553. DESCRIPTION. *(See figure 4—67.)* Two intercooler exit ducts are located at the bottom of both right and left hand intercoolers. These ducts are also secured to the bottom of the intercooler support rib. Cooled engine air passes from the intercoolers, through these ducts into a carburetor air box which guides the air into the carburetor. Take-off doors are incorporated in the inboard sides of the exit ducts to admit air into the engine during neutral blower operation. Screens are located in front of each door to prevent foreign material from entering the system. Each duct is also provided with

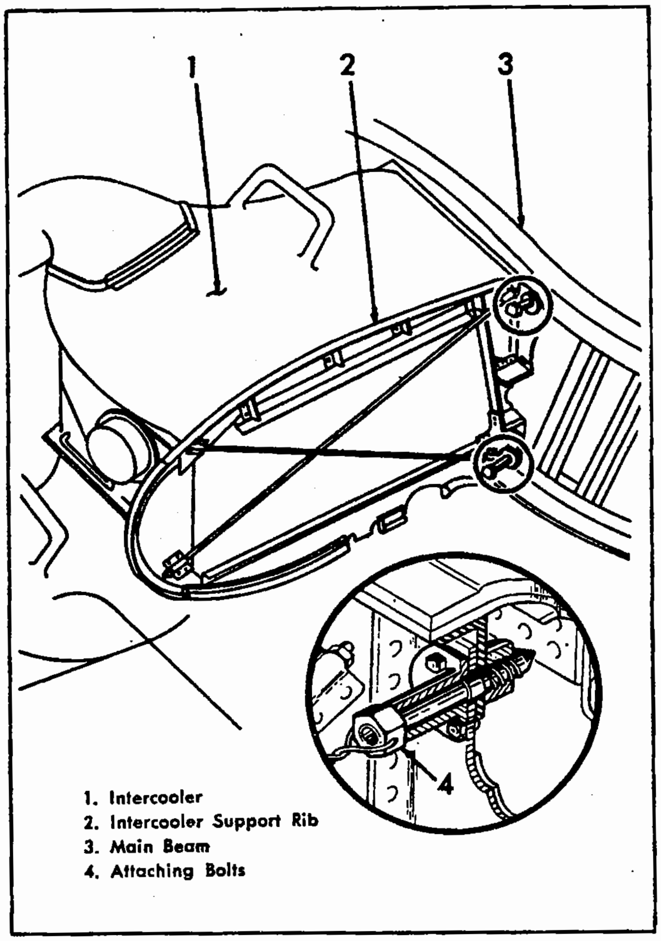


Figure 4—67. Intercooler Attachment.

a stiffening vane which runs parallel to the direction of air flow through the duct. Aft of the take-off door in the left hand intercooler exit duct, a pipe fitting is attached to allow installation of the external auxiliary fuel tank pressurizing line. Extending across the two lower engine mount members, a channel secured to these members supports the forward end of the intercooler exit ducts by means of a trunnion and turnbuckle eye fittings secured to clamps around the forward ends of the ducts. The forward ends of the ducts are secured to the carburetor air box by means of neoprene boots and clamps.

4—554. REMOVING. After the intercoolers and duct assemblies have been removed from the airplane as an assembly *(see paragraph 4—546)*, remove the intercooler exit ducts as follows:

a. Remove the bolts, and shims if used, securing the ducts to the bottom of the intercooler and support rib.

b. Remove the take-off doors and screens on the inboard sides of each exit duct by pulling the hinge pin.

4—555. INSTALLING. Reverse removal procedure.

4—556. CARBURETOR AIR BOX.

4—557. DESCRIPTION. *(See figure 4—65.)* The carburetor air box is a three-way duct which connects the right and left hand intercooler exit ducts to the carburetor. The box is provided with an external boss for mounting the carburetor air temperature warning light thermostatic switch and a drain valve. The drain valve can be used to extinguish fire in the carburetor or ducts by placing the extinguisher nozzle against the valve opening and allowing the CO_2 to enter the air box and carburetor. The box is fastened to the carburetor at the single outlet by bolts and to each intercooler exit duct by hose connections and clamps. A 1/4 inch mesh screen and two gaskets (supplied by Pratt and Whitney) are placed between the carburetor mounting boss and the air box flange.

4—558. REMOVING. The carburetor air box can be removed without disturbing the intercooler installation.

a. Disconnect the line leading to the carburetor air temperature thermostatic switch boss.

b. Remove the hose connections and clamps securing the carburetor air box to the intercooler exit ducts.

c. Remove bolts securing the carburetor air box to the carburetor.

d. Remove the air box and cover the carburetor port with a wooden cover or with heavy paper, leaving the screen and gaskets in place.

4—559. INSTALLING. Reverse removal procedure.

4—560. AUXILIARY STAGE AIR ENTRANCE DUCTS.

4—561. DESCRIPTION. *(See figure 4—65.)* The auxiliary stage air entrance ducts lead from the air ducts incorporated in each engine section side panel, pass through cut-outs in the diaphragm, and terminate at the auxiliary stage air entrance ports on each side of the engine. The forward ends of the auxiliary stage entrance ducts are secured to the engine section side panels by lapping flanges that bear against the side panel ducts, and are sealed by synthetic rubber seals. At the point where the ducts pass through the diaphragm, the diaphragm seals prevent air from passing between the accessory compartment and the area behind the engine. Screens and gaskets are installed between the ducts and mounting bosses on the engine to prevent the entrance of foreign material into the auxiliary stage blowers.

4—562. REMOVING.

a. Remove the intercooler flap and the engine accessory cowl panels.

b. Disconnect the generator blast tube located on the left hand auxiliary stage entrance duct.

c. Disconnect the ducts at the auxiliary stage entrance ports on the engine.

d. Remove the ducts by pulling them aft through the diaphragm.

e. Cover the auxiliary stage blower entrances, leaving the screens and gaskets in place.

4—563. INSTALLING. Reverse removal procedure.

4–564. WATER INJECTION SYSTEM.

4–565. DESCRIPTION. *(See figure 4–68.)* The water injection system permits the engine to be operated safely at powers higher than the present military power ratings. This extra power is obtained by leaning the mixture and by operating at a higher manifold pressure. To prevent detonation, water is injected to cool the intake charge from the engine supercharger and to retard the speed flame travel in the combustion chamber. Combat power may be used, in case of emergency, during combat. The system consists of two supply tanks with a capacity of approximately 28 gallons, a water strainer, pump and motor assembly connected to the tanks, a water regulator and a derichment valve on the carburetor. A master water injection switch is located on the left hand control panel and a throttle contact microswitch is provided within the engine control unit.

4–566. FUNCTION. *(See figure 4–69.)* The water injection system is actuated when the master water injection switch on the left hand control panel is turned beyond to the "ON" position and when the throttle is advanced beyond the take-off power stop, and closes the microswitch within the engine control unit. When the throttle actuated microswitch is closed by the movement of the throttle (with the master water switch in the "ON" position), the water pump is started and the solenoid actuated cut-off valve on the water regulator is opened. Water is drawn from the water tanks by the pump through a strainer and supply line and pumped to the water regulator mounted on the carburetor. The water regulator, which is of the non-hesitating variable water-air ratio type, meters water to the engine as required. The water pressure of the water flowing to the engine is used to close electrical circuits actuating the derichment valve solenoid on the carburetor and the combat power solenoid valve on the automatic manifold pressure regulator. Actuation of the derichment valve solenoid on the carburetor reduces the fuel flow through the carburetor to a predetermined setting for best power mixture ratio. Actuation of the combat power solenoid in the automatic manifold pressure regulator resets the regulator to a new schedule, allowing power between military power and combat power to be obtained below critical altitude. The power obtained can be regulated by the throttle position between the take-off power stop and the full forward throttle position. When the water supply becomes exhausted and no water flows to the engine, the electrical circuits actuating the derichment valve solenoid on the carburetor and the combat power solenoid on the automatic manifold pressure regulator are broken. When the electrical circuits are broken, the carburetor is returned to normal water-off operation and the automatic manifold pressure regulator to the normal "water-off" schedule.

Note

Combat power manifold pressures will be included at a later date.

4–567. PRESERVING AND PROTECTING ENGINE WATER INJECTION SYSTEM. Use the following procedure for water injection system preservation without the unit being removed from the aircraft or engine, with the water regulator removed from the carburetor and without running the engine:

a. Remove the drain cover and gasket located on the bottom of the regulator and held by one 1/4 inch stud.

b. Remove the 1/8 inch NPT (National Pipe Thread) vapor vent return plug.

c. Remove the 1/2 inch NPT water inlet plug.

d. Loosen only those water metering valve cover screws which hold down the metered and unmetered fuel channel cover plate.

e. Remove the 1/8 inch NPT plug in the water metering valve cover, and replace it with a special plug incorporating a pin to displace the diaphragm and metering valve.

Note

Special plug is made by drilling and tapping for an AN 520-6-24 screw through the center of an AN 913-1D pipe thread plug. It should be distinctly marked so that there is no danger of leaving it in on completion of preserving procedure.

f. Rotate the water regulator until no further fuel or water drains out. Air pressure, not to exceed 15 psi, may be introduced into the 1/2 inch NPT water inlet to assure removal of all fuel or water.

g. Apply oil pressure, not in excess of 15 psi, into the 1/2" NPT inlet connection.

CAUTION

Do not allow oil to enter the electric switch spacer vent hole or electrical connectors.

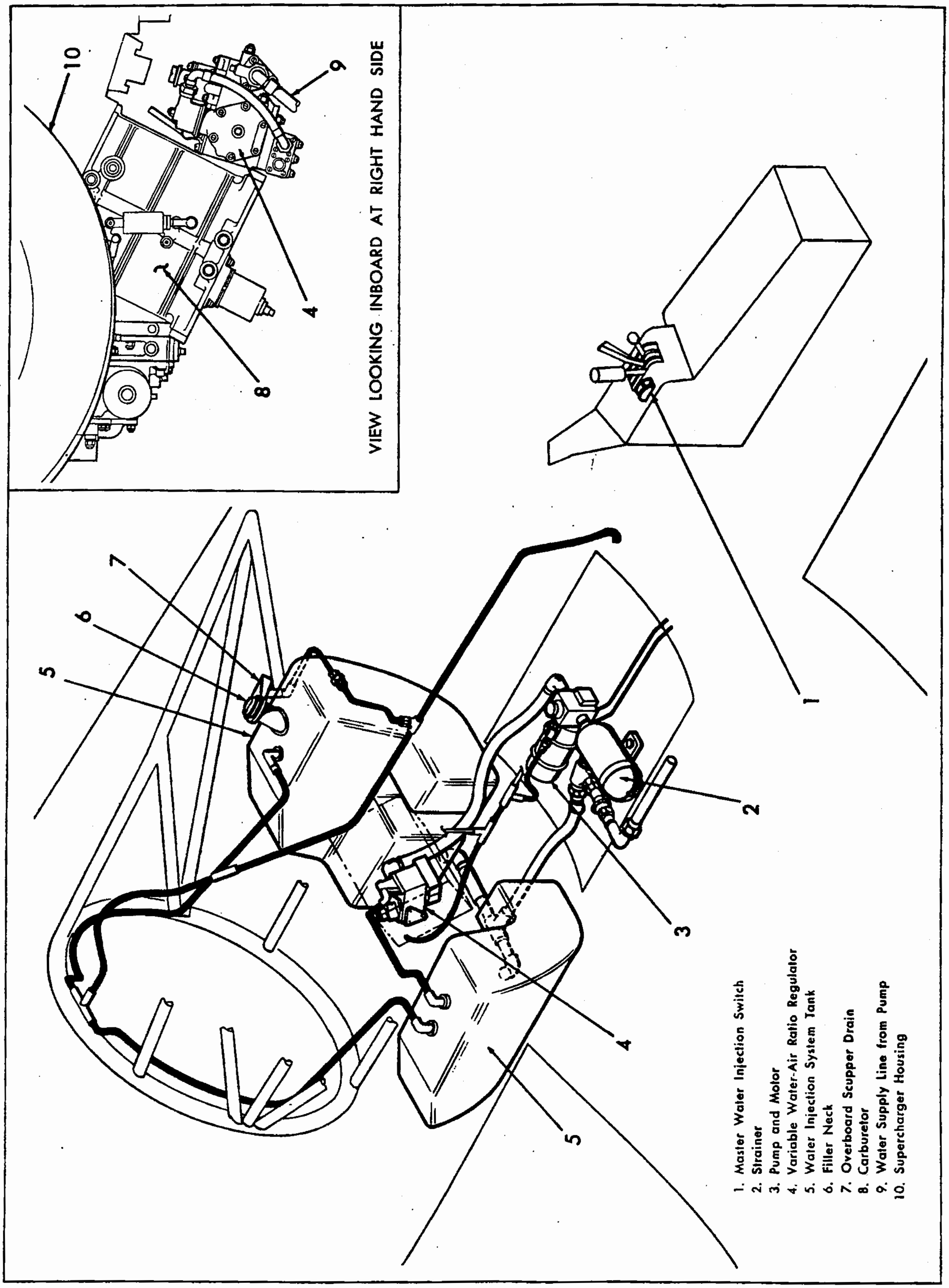
h. Restrict the flow of oil from the water regulator check valve so that sufficient pressure is built up to permit oil to flow through the reset valve passages. This can be noted by observing oil flow out of the drain passages nearest the reset switch.

i. When the bubble-free oil is noted at the vapor vent tap and drain cover holes, replace the 1/8 inch NPT plug and drain cover respectively. Allow oil to continue to discharge from check valve for 30 seconds.

j. Place the regulator so that the switch box is on top, and apply an oil pressure of from 3 to 5 psi to the metered and scoop vent passages on the water regulator mounting pad. These passages are the two end holes of the three in a line. Continue applying oil pressure until bubble-free oil is noted coming out from under the plate cover mentioned in step d.

k. Remove the special plug mentioned in step e, reinstall plugs and covers, and safety wire.

l. Reinstall the regulator on the carburetor using a



1. Master Water Injection Switch
2. Strainer
3. Pump and Motor
4. Variable Water-Air Ratio Regulator
5. Water Injection System Tank
6. Filler Neck
7. Overboard Scupper Drain
8. Carburetor
9. Water Supply Line from Pump
10. Supercharger Housing

Figure 4–68. Water Injection System Reference Diagram.

copper gasket VS-53686 between the water regulator gasket, and another water regulator gasket added to the mounting pad of the carburetor.

Note

Place in the pilot's cockpit in a conspicuous place a tag bearing the following inscription: "Water injection system preserved. Remove copper gasket between carburetor and water regulator before using."

m. Fill the water tanks with oil, Spec. AN-0-8 Grade 1065. Run the water pump until oil flows freely out of the discharge line.

n. Remove, clean, re-oil and reinstall strainer.

o. Remove plugs in the bottom of the tanks and drain oil. Reinstall plugs and reconnect the pump discharge line.

p. Safety wire the water injection master switch in the off position.

4—567A. DEPRESERVING ENGINE WATER INJECTION SYSTEM.

a. Remove drain cover and gasket located on the bottom of the water regulator and held by one 1/4 inch stud. Unsafety water injection master switch.

b. Remove 1/8 inch NPT vapor vent return plug.

c. Remove 1/2 inch NPT water inlet plug.

d. Loosen only those water metering valve cover screws which hold down the metered and unmetered fuel channel cover plate.

e. Remove 1/8 inch NPT plug in water metering valve cover, and replace with special plug incorporating a pin to displace the diaphragm and metering valve.

Note

Special plug is made by drilling and tapping for an AN 520-6-24 screw through the center of an AN 913-1D pipe thread plug. It should be distinctly marked so that there is no danger of leaving it in on completion of preserving procedure.

f. Drain all oil possible from the water regulator. Air pressure may be introduced into the inlet connections to aid in the removal of the oil. Air pressure must not exceed 15 psi.

g. Restrict the water regulator outlet.

h. Apply clear gasoline to the inlet connection at a pressure not exceeding 15 psi.

i. Allow clear gasoline to flow from the check valve drain cover pad and vapor vent for 1/2 minute.

j. Reinstall drain cover pad and vapor vent plugs and continue applying clear gasoline for one minute.

k. Allow water regulator to stand filled with clear gasoline for two hours.

l. Repeat steps h through j.

m. Drain clear gasoline from the water regulator. Air pressure not exceeding 15 psi may be applied to the inlet to insure the removal of all gasoline.

n. Remove special plug mentioned in step e; reinstall plug and covers. Reinstall water regulators on carburetor.

o. Disconnect and plug the discharge line at the strainer.

p. Use five gallons of clear gasoline in the water tanks; ground airplane.

q. Remove the plug and connect an air hose to discharge line.

r. Remove the water tank filler cap and agitate the gasoline with the air hose connected to the discharge line.

s. Remove the air hose and reconnect the discharge line to the strainer.

t. Start water pump, and pump system dry.

u. Using three gallons of water injection mixture (see paragraph 4-569), repeat steps o, q, r, s, and t.

v. Reinstall outlet line on water regulator, being sure to remove solid copper gasket and the extra water regulator gasket, between carburetor and water regulator, and retaining the standard water regulator gasket. Clean strainer. System is now ready for operation.

w. Remove water injection preservation tags from cockpit and tank filler neck.

4—567B. GROUND TEST PROCEDURE. Data not available.

4—568. FILLING AND DRAINING SYSTEM.

4—569. FILLING WATER INJECTION SYSTEM. The term "water" indicates any mixture that may be used in the water injection system. In order to provide a satisfactory engine performance, the use of a standard mixture of 25% methyl alcohol, 25% ethyl alcohol and 50% water by volume as a water injection fluid is mandatory for all model airplanes with water injection systems installed. The standard mixture of 50% alcohol and 50% water will provide freezing protection down to −37°C (−35°F). For cold weather operation whenever ground temperatures are below −17.8°C ((0.F), the alcohol-water mixture ratio should be increased to 60/40; this will provide freezing protection down to −48.3°C (−55°F). The use of alcohol-water mixture ratios greater than 60/40 is not recommended. The proportions of alcohol and water (Spec. AN-A-24) are on a volume basis.

a. Components of water injection fluid shall be thoroughly mixed and all mixing shall be accomplished prior to the addition of the fluid to the water injection system tanks.

b. Fill the water injection system tanks through the single filler neck located on the right hand tank. Access to the filler neck is gained through a small door located in the right hand upper wing gap cover. There is only one filler neck through which both tanks are filled simultaneously.

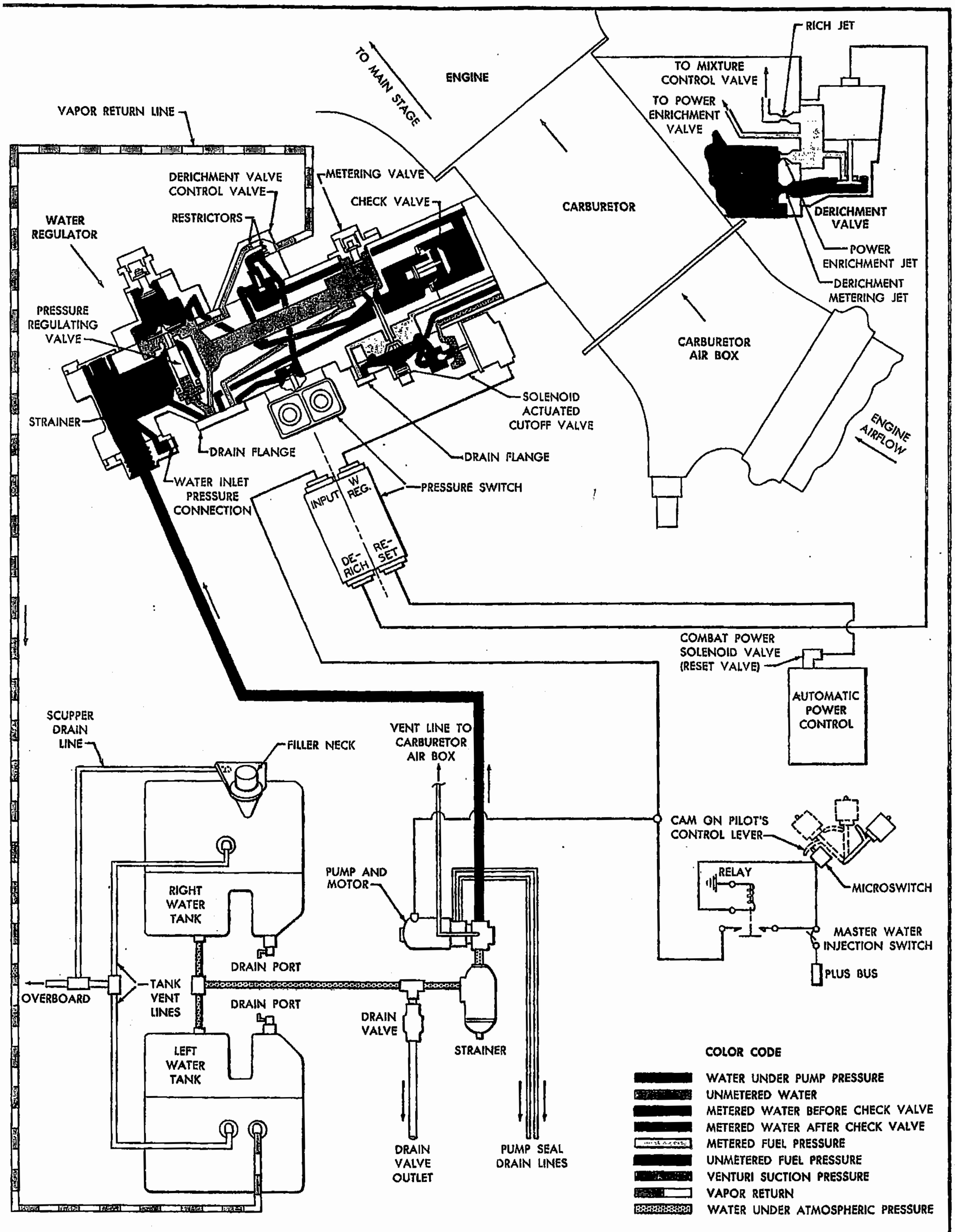


Figure 4–69. Water Injection System—Schematic.

c. The combined capacity of the tanks is approximately 28 gallons.

4—570. DRAINING WATER INJECTION SYSTEM. Draining of the system becomes necessary when an unpreserved water injection system has not been operated for more than ten days.

Note

When an unpreserved water injection system has not been operated for more than ten days, the water regulator and solenoid valve must be disassembled and inspected for corrosion.

Draining of the system is also required when cold weather temperatures are such that the standard 50/50 alcohol-water mixture provides insufficient protection against freezing, and the 60/40 mixture is required; see paragraph 4—569. Proceed as follows to drain the system:

a. Removal panel forward of intercooler flap.

b. Working through access thus obtained, open drain valve located on the bottom aft end of each tank. Catch fluid in clean container.

c. Open drain valve on the line from tank to strainer and disconnect hose line from pump to regulator; allow lines to drain.

d. Drain strainer assembly by removing drain plug at bottom of the strainer.

4—571. TROUBLE SHOOTING. Locating and correcting water injection system troubles should be accomplished by first studying the pilot's report of the symptoms carefully, and then checking each possible cause. Data on ground test procedure is not available.

a. Check water regulator vent line. If clogged, remove vent line and blow out with compressed air or replace line.

b. Check solenoid wiring for loose and broken connections; see paragraph 5—73.

c. Check water regulator strainer by removing and cleaning. If damaged, replace with new strainer.

d. Check water supply lines for restriction and leaks.

e. Check water tank vent line for leakage. Repair, if necessary.

f. Check pump operation. If it fails to run, check wiring first and then replace, if necessary.

g. Check pump relief valve for condition and cleanliness. If foreign matter is found under relief valve, remove and clean valve assembly.

4—572. VARIABLE WATER-AIR RATIO REGULATOR.

4—573. DESCRIPTION. *(See figure 4—69.)* The water regulator (Pratt and Whitney, Part No. 123953) is the non-hesitating, variable water-air ratio type, and is furnished with the engine. The water regulator supplies water to the engine as necessary, and is so designed that the water-air ratio increases as the power is increased. The water regulator is designed to start metering water when operating at approximately rated power. However, the water system is not energized until the throttle is moved past the take-off stop so that no water will flow to the engine until powers higher than military power are used.

4—574. FUNCTION. *(See figure 4—69.)* With the master water injection switch in the "ON" position, the water injection system is actuated when the microswitch within the engine control unit is closed by advancing the throttle beyond the take-off power stop. When the system is actuated the water pump is started, and the solenoid actuated cut-off valve on the water regulator is opened allowing unmetered fuel pressure to act on the diaphragm of the metering valve, which then opens and allows water to flow through the regulator. Water under pump pressure opens the spring-loaded pressure regulating valve which automatically controls the water flow to maintain a constant pressure drop across the metering valve. Metered water pressure opens the check valve allowing metered water to flow to the engine through the fuel discharge nozzle. The water flow pressure drop across the check valve is used to open the derichment valve control valve on the regulator allowing metered. water pressure to close the electrical circuits to the derichment valve on the carburetor and to the combat power solenoid valve on the automatic manifold pressure regulator. When these circuits are closed, the derichment valve on the carburetor is closed, reducing the fuel flow through the carbuetor to a predetermined setting for best power mixture ratio; the combat power solenoid valve on the automatic manifold pressure regulator opens automatically, resetting the regulator to a new schedule, allowing powers between military power and combat power to be obtained below critical altitude. When the water supply becomes exhausted and no water flows to the engine, the electrical circuits acuating the derichment valve solenoid on the carburetor and the combat power solenoid on the automatic manifold pressure regulator are broken. When the electrical circuits are broken, the carburetor is returned to normal water-off operation and the automatic manifold pressure regulator to the normal "water-off" schedule.

Note

Combat power manifold pressures will be included at a later date.

The derichment valve is supplied as an integral part of the carburetor; see paragraph 4—534.

4—575. LOCATION AND ACCESS. The regulator is mounted on the forward side of the carburetor. Access to regulator is gained by removing the access panel forward of the intercooler flap.

4—576. REMOVING. To remove the water injection regulator, disconnect the following connecting lines at regulator, and cap all openings.

a. Water supply line from pump.

b. Vapor discharge line to left hand tank.

c. Electrical lead to derichment valve.

d. Electrical lead on regulator solenoid.

e. Detach the attaching bolts and remove regulator.

4–577. INSTALLING. Reverse the removal procedure given in paragraph 4–576.

4–578. WATER INJECTION SYSTEM TANKS.

4–579. DESCRIPTION. *(See figure 4–68.)* Two aluminum alloy tanks, having a total capacity of approximately 28 gallons, carry the water-alcohol mixture used in the water injection system. The tanks are mounted on strap assemblies attached to the engine mount. The tanks are interconnected through a hose, allowing them to be filled simultaneously through a filler neck on the right hand tank. The supply line for the water pump is teed into this hose line. The filler neck assembly on the right hand tank consists of a screen located in the tank at the filler neck, a cap and a scupper with an overflow tube. A vent line from the left side of the right hand tank extends to the upper part of the accessory compartment to join the vent tube from the left hand tank at a tee fitting. An overboard vent line is attached at this tee fitting, venting both tanks simultaneously to the atmosphere. Drain plugs, attached to the bottom aft end of each tank, are accessible through the access panel forward of the intercooler flap. Strap guides are welded to the top and bottom of each tank and chafing strips are installed on the lower portion of each tank. The left hand water injection tank is similar to the right hand tank in all respects except that it has no filler neck, and the vapor vent line from the water regulator is connected to a fitting located on the top aft end of the tank.

4–580. LOCATION AND ACCESS. The water injection supply tanks are installed in the bottom of the engine accessory compartment. They are attached by strap assemblies to the engine mount. The tank drain plugs may be reached through the access panel immediately forward of the intercooler flap. Access for removing the tanks is gained by removing the upper wing gap covers.

4–581. REMOVING. Working through the access panel forward of the intercooler flap, open drain valves on both tanks and permit them to drain; see paragraph 4–570.

a. Remove upper wing gap covers and break all hose and line connections from system units to tanks.

b. Disconnect the overboard and vapor vent lines.

c. Cut safety wire and unfasten the strap assemblies supporting the tanks.

d. Remove the tanks.

4–582. REPAIRING. The 52SO aluminum alloy of which the tanks are constructed permits repair of leaks or other damage by welding in accordance with instructions contained in the General Manual for Structural Repair (AN 01-1A-1).

4–583. FLUSHING. Tanks are flushed with light oil Spec. AN-O-8, Grade 1065 for protection during storage. This should be removed by slushing with unleaded gasoline Spec. AN-F-22, Grade 22 or any petroleum base solvent prior to installation.

4–584. TESTING. To test tanks prior to installation, proceed as follows:

a. With tank on bench, plug all openings except the one through which air is introduced.

b. Coat all seams and fittings with soapy water.

c. Apply 2.5 pounds per square inch air pressure.

d. Bubbles at seams or fittings indicate leakage.

4–585. INSTALLING. Install the water tanks by reversing the removal procedure given in paragraph 4–581. Strap assemblies should be drawn up snug, but not tightened excessively.

4–586. WATER PUMP AND MOTOR.

4–587. DESCRIPTION. *(See figure 4–68.)* The electric motor-driven water injection pump is a rotary, positive displacement pump. It is provided to pump water from the supply tanks to the water regulator. The water pump and motor assembly consists of a Delco motor and a Ceco (Model No. 4292 or 4293) water pump. The pump is manufactured by the Chandler-Evans Corporation of South Meriden, Connecticut. The pump body houses the mechanism which consists of a stainless steel liner, press-fitted in the bore of the body with carbon anti-drive end bearings. The liner is kept from rotating by a lockpin. A stainless steel rotor, which carries four carbon vanes and rotates in the specially designed bore of the liner, produces a non-pulsating discharge flow. The internal assembly is held in place by a special shut-off seal which closes any path the water might take in leaking out along the rotor from the pumping chamber. An integral pressure relief and regulating valve is contained in a separate housing mounted on the pump. The relief valve is of the poppet type. The valve is controlled by a spring which may be set by an adjusting screw to maintain a uniform pressure under varying conditions. Absolute compensation is provided by venting the regulating valve to the carburetor air box. The motor is a 1/5 hp, 24 volt, dc series wound motor. It is coupled to the water pump by means of a gear reduction unit and a spline drive. Four brushes on the commutator end of the unit are accessible through the screw end cover cap. Electrical connections are brought out to a receptacle provided with prongs for a plug type connector; see paragraph 5–73 for electrical information. The gear housing assembly contains a driven gear that meshes with a pinion gear on the armature shaft. The spline drive shaft, which is an integral part of the gear, turns in a sleeve bearing pressed into the gear case. A splined coupling connects this gear to the pump shaft. A drain plug is provided at the bottom of the housing.

4–588. LOCATION AND ACCESS. *(See figure 4–68.)* The water pump and motor are mounted on a supporting bracket attached to the inside surface of the intercooler flap. Access to the pump and motor is obtained by opening the intercooler flap.

4—589. REMOVING. To remove the water pump and motor, proceed as follows:

a. Drain the water from the tanks. See paragraph 4—570.

b. Break hose connections between pump and regulator at pump.

c. Disconnect water pump vent tubes.

d. Detach strainer from pump by removing nipple fitting.

e. Disconnect electrical lead from motor.

f. Disconnect carburetor air box vent line from pump.

g. Unfasten the four bolts holding the pump to the supporting bracket on the intercooler flap and remove the pump and motor assembly.

4—590. TESTING. Prior to installing a new pump, place it on a test stand and proceed to test it in the following manner:

a. Run pump for three minutes and adjust flow to 100 gallons per hour, with an outlet pressure of 26.5 psi. This is done by rotating the adjustment screw in the relief valve clockwise.

b. Check relief valve for sticking by increasing flow from 100 gallons per hour to 200 gallons per hour discharge pressure. Reduce discharge pressure to 100 gallons per hour. Repeat this check twice. The discharge pressure at 100 gallons per hour should remain at the original setting.

c. Check seals for leakage during this check. There should be no seal leakage.

d. After testing, paint a red dot on the inlet and outlet ports to indicate high pressure setting.

4—591. INSTALLING. To install the pump and motor assembly, reverse the removing procedure given in paragraph 4—589.

4—592. STRAINER AND DRAIN VALVE.

4—593. DESCRIPTION. *(See figure 4—68.)* The water strainer is mounted on a supporting bracket attached to the intercooler flap. It interconnects the water tanks and the pump. The function of the strainer is to prevent foreign matter from entering the pump and the engine, and to provide a means of removing dirt from the system. The strainer screen is contained in an aluminum alloy housing. It is supported in the removable bottom cover which also serves as a sump to catch sediment. A drain is provided to remove foreign matter from the bottom of the strainer. The strainer is manufactured by the Aero Supply Mfg. Co., Inc., of Cory, Pennsylvania. Their part number is 104244-3-1.

4—594. LOCATION AND ACCESS. The water injection strainer is located on the intercooler flap to the left of the pump assembly. Access to the strainer is gained by opening the intercooler flap.

4—595. REMOVING.

a. Drain water-alcohol mixture from tanks. See paragraph 4—570.

b. Remove hose connections.

c. Remove nipple which connects strainer to pump.

d. Remove the bolts holding the strainer to the support.

e. Remove strainer.

4—596. INSTALLING. To install the strainer, reverse the removal procedure.

4—597. WATER INJECTION SYSTEM TUBING.

4—598. DESCRIPTION. *(See figure 4—70.)* The tubing in the water injection system consists of hose lines, hose connectors, and 52SO aluminum alloy tubing. All lines are held by clips every 24 inches and all are bonded in accordance with Spec. AN-B-10a. The hose leading forward from the pump and strainer must be long enough to permit opening of the intercooler flap without binding or disconnecting the lines. The connecting line between the derichment valve and the water regulator is an engine part and it is supplied with the engine. Tube and hose ends are color-coded with one-half inch bands of red-white-red.

Note

Tubing cut in lengths for replacement purposes shall be 10% longer than the actual length required.

WATER INJECTION SYSTEM TUBING CHART

(Refer to Figure 4—70)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-57871-7	1	¼	.035	19¾	52 SO Al. Alloy Tube Spec. WW-T-787	AN818-4D Coupling (1) AN819-4D Sleeve (2) AN822-4D Elbow (1) AN915-1D Elbow (1)
VS-57871-27	2	¾	.049	6	52 SO Al. Alloy Tube Spec. WW-T-787	AN818-12D Coupling (1) AN819-12D Sleeve (2) AN822-12D Elbow (1) VS-78069 Valve (1)

WATER INJECTION SYSTEM TUBING CHART *(Cont'd.)*
(Refer to Figure 4—70)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
CVC-1813-12-113	3	¾ ID		28¼	Synthetic Hose Spec. M-709	AN911-6D Nipple (2) AN917-6D Tee (1) AN840-12D Adapter (1) AN844-12D Elbow AN748-38 Clamp (2)
VS-57932-29	4	¼	.035	10 3/16	52 SO Al. Alloy Tube Spec. WW-T-787	AN818-4D Coupling (2) AN819-4Z Sleeve (4) AN837-4D Elbow (1)
VS-57932-25	5	¼	.035	8 5/16	52 SO Al. Alloy Tube Spec. WW-T-787	AN818-4D Coupling (12) AN819-4Z Sleeve (4) AN824-4D Tee (2)
CVC-1813-12-35	6	¾ ID		8¾	Synthetic Hose Spec. M-709	AN917-6D Tee (1) AN840-12D Adapter (1) AN748-38 Clamp (2) AN911-6D Nipple (1)
VS-57932-23	7	¼	.035	8⅝	52 SO Al. Alloy Tube Spec. WW-T-787	AN818-4D Coupling (2) AN819-4Z Sleeve (4)
CVC-1813-4-120	8	¼ ID		30	Synthetic Hose Spec. M-709	AN840-4D Adapter (1) AN748-22 Clamp (2)
VS-57871-1	9	⅜	.035	44 11/16	52 SO Al. Alloy Tube Spec. WW-T-787	AN818-6D Coupling (2) AN819-6D Sleeve (4)
VS-57871-9	10	⅜	.035	44	52 SO Al. Alloy Tube Spec. WW-T-787	AN818-6D Coupling (2) AN819-6D Sleeve (4)
VS-57871-17	11	½	.035	23½	52 SO Al. Alloy Tube Spec. WW-T-787	AN818-8D Coupling (1) AN819-8D Sleeve (2) AN833-8D Elbow (1) AN926-8D Tee (1) AN919-12D Reducer (2) AN6227-12 Packing (3) AN924-8D Nut (1)
VS-57871-19	12	½	.035	26 1/16	52 SO Al. Alloy Tube Spec. WW-T-787	AN818-8D Coupling (1) AN819-8D Sleeve (2) CVC-1813-8-14 Hose (2) AN748-30 Clamp (4)
VS-57871-23	13	¼	.035	13 11/16	52 SO Al. Alloy Tube Spec. WW-T-787	AN818-4D Coupling (2) AN819-4D Sleeve (4) AN822-4D Elbow (1)
VS-57871-25	14	½	.035	11 13/16	52 SO Al. Alloy Tube Spec. WW-T-787	AN818-8D Coupling (2) AN819-8D Sleeve (4) AN919-10D Reducer (1)
CVC-1813-10-144	15	⅝ ID		36	Synthetic Hose Spec. M-709	AN912-7D Reducer (1) AN842-10D Elbow (2) AN748-34 Clamp (2)
VS-57871-29	16	½	.035	45	52 SO Al. Alloy Tube Spec. WW-T-787	AN818-8D Coupling (1) AN819-8D Sleeve (2) AN824-8D Tee (1)
VS-57871-5	17	¼	.035	17 5/16	52 SO Al. Alloy Tube Spec. WW-T-787	AN818-4D Coupling (1) AN819-4D Sleeve (2) AN822-4D Elbow (1)

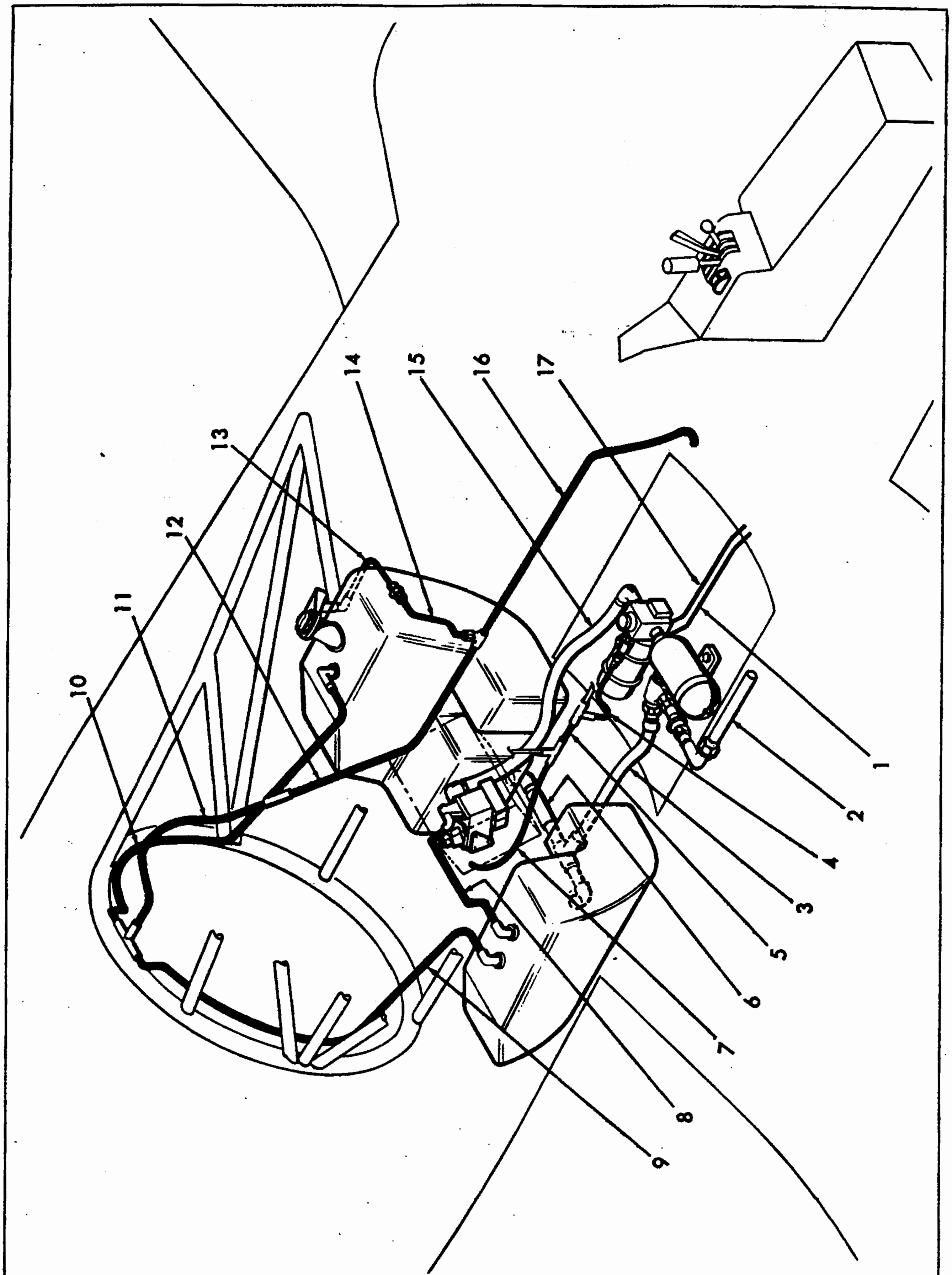


Figure 4—70. Water Injection System Tubing Diagram.

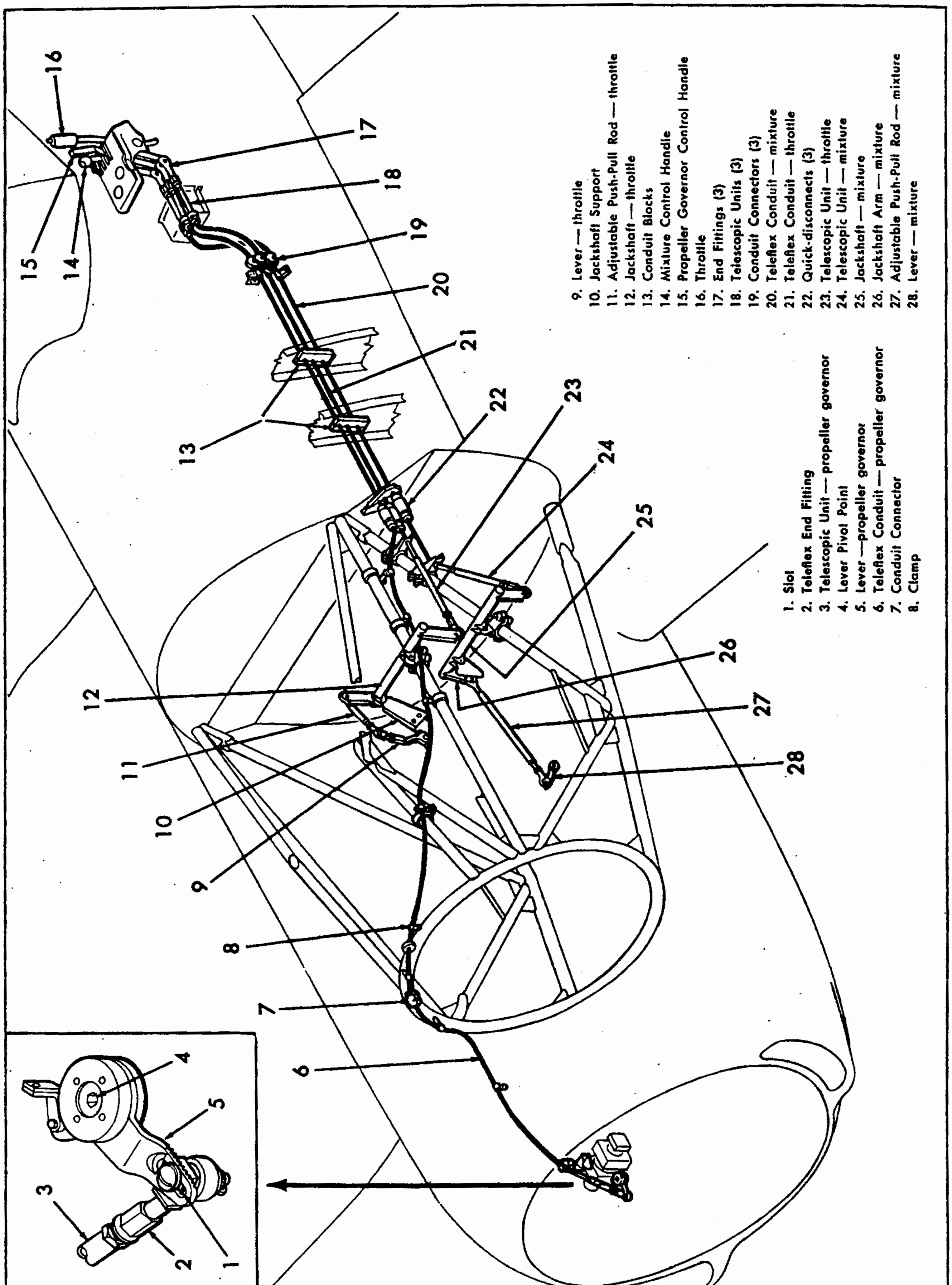


Figure 4–71. Engine Controls Installation.

4—599. ENGINE CONTROLS.

4—600. DESCRIPTION. *(See figure 4—71.)* The engine controls are the means by which the pilot regulates the power output of the engine. Three engine control handles are incorporated in the engine control unit which is located on the left control shelf in the cockpit. These are the throttle (16), mixture (14) and propeller governor control (15) handles. Movement of the handles transmits push and pull motion to Teleflex cables contained within rigid conduits (6,20,21). The Teleflex cables in turn actuate jackshafts (12,25) in the throttle and mixture control systems. The jackshafts are connected to the engine throttle and mixture control levers by means of adjustable push-pull rods. The propeller governor system does not incorporate a jackshaft, but uses Teleflex cable throughout. All units in the propeller governor, mixture and throttle control systems are readily accessible for servicing and removal. The throttle regulates airflow to the engine; the mixture control sets the carburetor to "NORMAL" or "RICH" mixture; the propeller governor control sets the propeller governor to regulate engine speed through pitch changes of the propeller blades. No separate auxiliary stage supercharger control is provided. The auxiliary stage is controlled automatically through an automatic power control actuated by the throttle. The automatic control tends to maintain a constant manifold pressure for a given position of the throttle control regardless of change in altitude; see paragraph 4—530. A friction knob is incorporated in the engine control unit to prevent the control levers from creeping.

4—601. TROUBLE SHOOTING.

a. Examine engine control unit for broken levers and cracked or missing knobs.

b. See that the engine control unit and supporting brackets are securely fastened to the cockpit structure and that no attaching screws are loose or missing.

c. Test each control for freedom of movement and adjust friction knob accordingly.

d. Check angular throws of throttle, mixture, and propeller governor levers.

e. Check Teleflex control installation with procedure given in paragraphs 4—602 through 4—604G.

f. If control is extremely stiff, check for the following: cables may be dirty; conduits may contain foreign matter; welts inside of conduits may chafe cables; ends of conduit may not be chamfered; bends may be irregular; friction knob may be too tight; conduits may be dented.

g. Check backlash. Excess backlash can be caused by the following: cables which are too long or too short, improperly installed cable locks, slider tubes insufficiently tightened in rod ends, nipples securing conduits not tightened, clamps not securing conduit on each side of bend, supporting members for telescopic units and conduit clamps weaving under load.

4—602. TELEFLEX CONTROL INSTALLATIONS.

4—603. DESCRIPTION. *(See figure 4—72.)* The Teleflex control installations manufactured by Teleflex, Inc. of Philadelphia, Pa. are used in the engine controls system, the emergency bomb and external fuel tank manual release system, the heating and ventilating system, the pilot's seat lock pin, the oil cooler door automatic control installation, the wing hinge pin lock and the canopy sliding section control installation; see paragraph 6—6A. The Teleflex control installations are used because they are light in weight, compact, and easily installed, but it is important that they be installed correctly.

4—604. TELEFLEX CABLE. *(See figure 4—72.)* The Teleflex cable (5) (Teleflex drawing number SA118A) transmits the motion of the control levers to the actuating levers. It consists of a cable core, termed the tension member, over which is wound a compression winding laid in the opposite direction to the core winding. Over these windings is incorporated a "helix" winding which is spaced by windings of small diameter wire. The cable moves back and forth within a close fitting fixed conduit (1). The following procedure should be used for installing the cable in the conduit:

a. With the control and the remote end operating levers set in the extended position, measure and cut the cable slightly longer than required. The cable may be cut with a cold chisel, hack saw, or large wire cutter. It will not unravel. After it is cut, the ends should be chamfered smooth with a file or an a grinding wheel.

Note

All filing must be done in the direction of the winding of the helix of the cable. Be sure that the end of the cable is filed smooth, and that it is free from filings or other foreign matter, since these will cause scoring of the conduit walls.

b. Clean and wipe the cable with Sovasol No. 5. Do not grip the cable with pliers or otherwise roughen its surface; do not use cable that has been "kinked." Coat lightly with AN-G-25 grease and insert into the conduit.

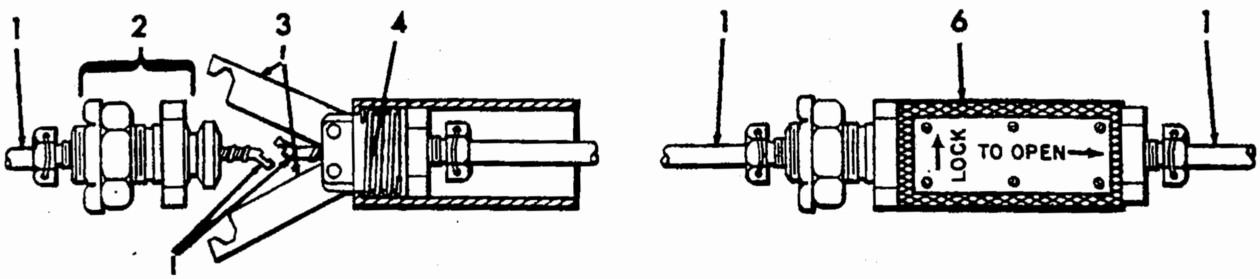
c. Pull the cable through the conduit (See paragraphs 4—604A and 4—604B for information on conduit) so that all dirt and foreign matter are removed from the bore of the conduit.

d. After the cable has been pulled through the conduit, clean the cable thoroughly with Sovasol No. 5. It is important that the cable does not come in contact with the floor or otherwise pick up dirt and grit.

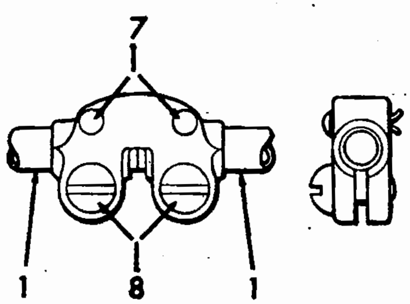
e. Reinsert the cable in the conduit.

f. With the remote end and control end levers in the same extended position, place the cable against the end fitting and cut to the proper length (i.e. between the "GO" and the "NO GO" inspection holes).

g. Chamfer the cable as described in step a, clean off the filings, and attach to the end fitting as explained in paragraph 4—604E.



QUICK-DISCONNECT

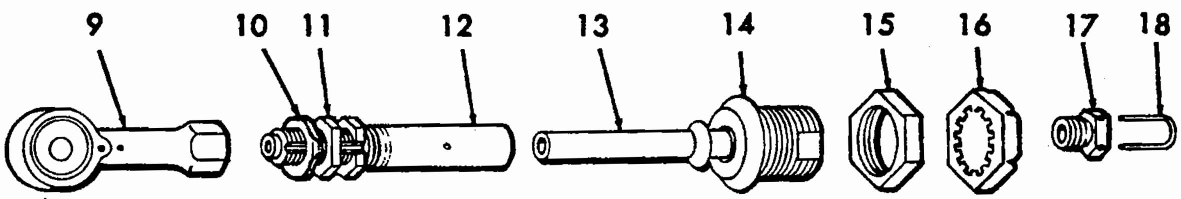


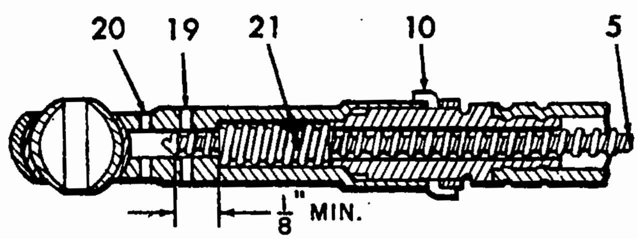
CONDUIT CONNECTOR

1. Conduit
2. Fitting
3. Jaws
4. Spring
5. Teleflex Cables
6. Quick-disconnect Cover
7. Locking Pins
8. Clamping Screws
9. End Fitting (rod end)
*10. Tab Washer
11. Jam Nut
12. Outer Slider Tube
13. Inner Slider Tube
14. Swivel Fitting
15. Attaching Nut
16. Check Nut
17. Nipple
18. Locking Clip
*19. "NO GO" Inspection Hole
*20. "GO" Inspection Hole
21. Cable Lock

*IN LATER MODELS OF THE F4U-5 AIRPLANE, THE TAB WASHER (10), DESIGNED FOR USE WITH HEXAGON SHAPED END FITTINGS, HAS BEEN ELIMINATED SINCE IT IS INEFFECTIVE IN LOCKING THE JAM NUT (11) TO THE ROUNDED END FITTING SUPPLIED. ALSO, TO PROVIDE EASIER ACCESS TO THE "GO" AND "NO GO" INSPECTION HOLES (20 AND 19), THE HOLES HAVE BEEN ROTATED 90°.

TELESCOPIC UNIT REFERENCE DIAGRAM AND ASSEMBLY PROCEDURE

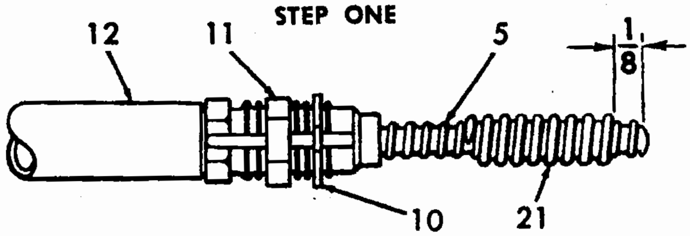




END FITTING — CROSS SECTION

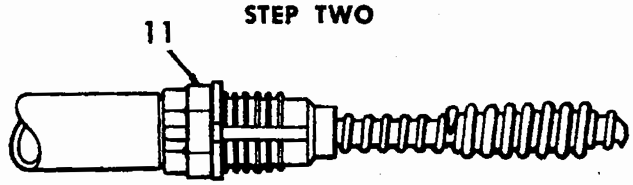
OBSERVE THE FOLLOWING STEPS TO INSURE THAT CABLE IS SECURELY LOCKED IN END FITTING AND THAT TELESCOPIC UNIT IS CORRECTLY ATTACHED TO END FITTING.

STEP ONE



INSERT CABLE (5) THROUGH OUTER SLIDER TUBE (12). SCREW ON JAM NUT (11) AND PLACE TAB WASHER (10) IN FRONT OF JAM NUT. THREAD CABLE LOCK (21) ONTO CABLE UNTIL CABLE END EXTENDS THROUGH THE LOCK 1/8".

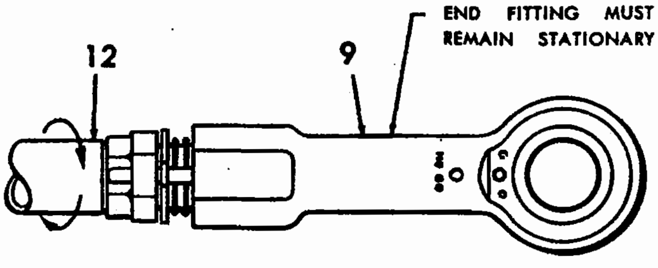
STEP TWO



BACK UP JAM NUT (11) TO LIMIT.

Figure 4–72 (Sheet 1 of 2 Sheets). Teleflex Units.

STEP THREE

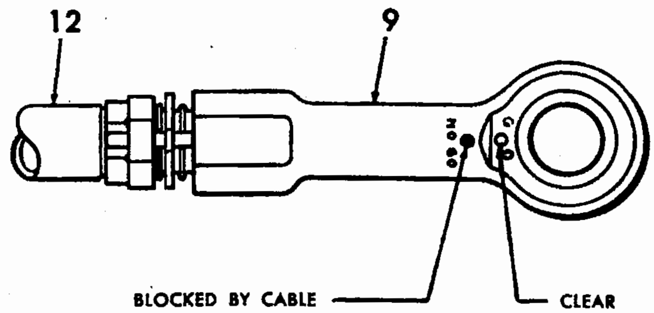


INSERT CABLE LOCK AND CABLE INTO END FITTING (9) AND SCREW OUTER SLIDER (12) INTO END FITTING AS TIGHTLY AS POSSIBLE TO INSURE THAT CABLE LOCK IS FULLY COMPRESSED AND PROPERLY GRIPPING CABLE. *CABLE MAY ROTATE OUT OF LOCK AND CAUSE CONTROL FAILURE IF OUTER SLIDER IS NOT TIGHTENED SUFFICIENTLY TO COMPRESS CABLE LOCK.*

WARNING

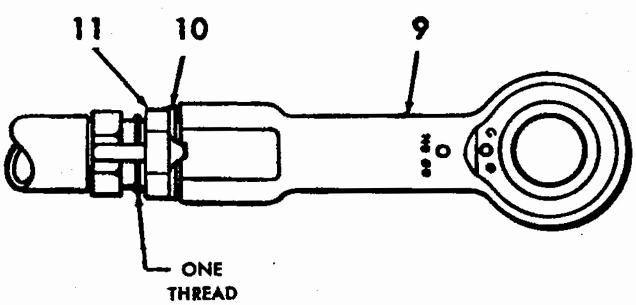
ALWAYS SCREW OUTER SLIDER INTO END FITTING. NEVER SCREW END FITTING ONTO OUTER SLIDER AS THIS WILL SCREW CABLE LOCK OFF CABLE AND CAUSE CONTROL FAILURE.

STEP FOUR



CHECK "GO" AND "NO GO" INSPECTION HOLES IN END FITTING WITH WIRE. WIRE SHOULD PASS THROUGH "GO" HOLE BUT SHOULD BE BLOCKED BY CABLE END WHEN INSERTED INTO "NO GO" HOLE. IF CABLE IS NOT IN PROPER POSITION IN THE END FITTING, DISASSEMBLE AND ADJUST CABLE LOCK. REASSEMBLE AND CHECK AS DIRECTED IN STEPS ONE THROUGH FOUR.

STEP FIVE

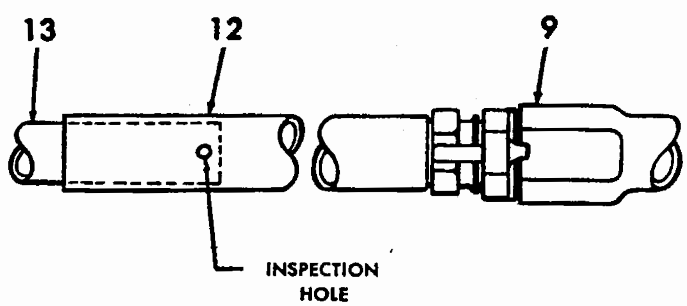


TIGHTEN JAM NUT (11) AGAINST END FITTING AND TURN OVER TAB WASHER (10) AS SHOWN TO LOCK THE NUT AND END FITTING.

WARNING

ONLY ONE THREAD SHOULD SHOW BEHIND JAM NUT, OTHERWISE OUTER SLIDER IS NOT SCREWED TIGHTLY ENOUGH INTO END FITTING.

STEP SIX



WITH TELESCOPIC UNIT FULLY EXTENDED, MAKE CERTAIN THAT THE OUTER SLIDER TUBE (12) OVERLAPS THE INNER SLIDER TUBE (13) AT LEAST ONE INCH. CHECK THROUGH INSPECTION HOLE LOCATED ONE INCH FROM THE END OF THE OUTER SLIDER TUBE. THIS HOLE SHOULD BE BLOCKED AT ALL TIMES BY THE INNER SLIDER.

WARNING

NEVER ADJUST CONTROL LENGTH BY TURNING END FITTING OR OUTER SLIDER. THESE UNITS MUST BE DRAWN AS TIGHT AS POSSIBLE. FAILURE TO OBSERVE THIS WARNING MAY CAUSE A CONTROL FAILURE.

Figure 4—72 (Sheet 2 of 2 Sheets). Teleflex Units.

h. After passing final inspection, tighten the jam nut (11) and turn over the tab washer (10) to lock the nut and the end fitting.

i. Check the operation of the control system to insure that it operates freely, and does not develop backlash.

4–604A. TELEFLEX CONDUIT. *(See figure 4–72.)* The Teleflex conduit (1) (Teleflex drawing number SA116A) forms a fixed close-fitting container for the cable (5). It requires careful handling and storage in order to prevent dents, nicks and scratches. Conduits are not to be used as foot rests and ladders, nor as supports for other items. Careless handling and use of conduits may result in rejections. When a slotted conduit is employed in an installation, all excess solder must be removed from the cable terminal end pin which is attached to the cable. The terminal end pin must slide freely along the slot in the tube. The following procedure conduit:

a. When cutting conduit to size, care must be taken that the conduit is not flattened. This is extremely important. The ends of the conduit must be cut squarely (plus or minus 0.5°) so that they will butt evenly when joined in the conduit connector. After the conduit has been cut, the bore shall be chamfered using a 45° countersink and removing one-third to approximately two-thirds of the wall thickness. Deburr and blow out with compressed air to remove filing or other foreign matter.

b. When bending Teleflex conduit, the conduit must be bent cold, using a bending machine or by hand. The proper bending block must be used or flattening may occur. A minimum bend radius of five inches is recommended for Teleflex applications to keep handle operating loads as low as possible.

c. After the bends are completed, pass a suitable length of Teleflex cable through the chamfered conduit to determine whether flattening has taken place, and to remove any dirt or filings that may be in the conduit. If an abnormal amount of resistance is met in drawing the test cable through the conduit, the conduit shall be rejected.

d. All conduits shall be inspected after cutting, chamfering, and bending to insure adherence to these requirements.

4–604B. INSTALLING. *(See figure 4–72.)* The conduit should be blown out with compressed air before installation. It is important that the conduit be fitted accurately to its ultimate position and not placed under strain when connected to terminal fittings or supports. There are two methods for connecting conduit. When connecting two conduit ends together, conduit clamp connectors (Teleflex drawing number SA115A-1) are used, and when connecting conduit to the swivel fitting (14) of the telescopic unit and to the quick-disconnects, collet-type nipples (17) and locking clips (18) are used.

a. When using the conduit clamp connector, insert the end of one piece of conduit in the entry hole of the conduit clamp connector so that it penetrates to a point midway through the connector body where it can be seen through the slot. Tighten the clamp screw (8) securely. Insert the end of the other piece of conduit in the opposite entry hole so that it butts firmly and squarely against the piece of conduit already in place in the connector. Tighten the clamp screw (8) securely. A considerable force can be applied to these screws without causing them to be stripped. Be sure the screws are tight enough to hold the conduit securely. The maximum gap between the butting ends of the conduit in the connector shall be 0.005 inch, but under ordinary circumstances the ends should butt squarely together.

Note

Do not drill through locking pin holes until inspection of the whole conduit installation is completed.

When the whole conduit line is completely installed and has passed inspection, run a No. 41 drill through the two locking pin holes (7) in the conduit clamp connectors. It is important that the correct size drill be used, as it is necessary to cut a groove in the wall of the conduit that will not penetrate to the bore. Keep the drill straight so that it will not enlarge the locking pin holes.

Note

When reinstalling conduit in the conduit clamp connectors, if, after the clamping screws are tightened, the locking pin holes in the connector do not line up with the drilled holes in the conduit, the conduit must be rejected and replaced.

Insert the locking pins in the conduit clamp connector and spread the points. The locking pins secure the conduits in position in addition to the clamping feature of the connector. In the event the position of the conduit or connector is changed after the drill has been run through the locking pin holes, the conduit must be rejected and replaced.

b. When using the collet-type nipple connection, remove the locking clip (18) from the nipple (17) and unscrew the nipple. Insert the conduit in the nipple until the conduit bottoms in the swivel fittings (14), then slide the nipple back and forth several inches on the conduit to insure that the end of the conduit is free from burrs and that the outside diameter of the conduit is not oversize. The nipple must slide freely. With the conduit bottomed in the swivel, and held in this position, install and tighten the nipple until it holds the conduit firmly. It will require the application of considerable torque, between 80 and 100 pound-inches, to tighten the nipple sufficiently. A box socket wrench, reworked as shown in figure 4–72A, should be used to prevent stripping the hexagon head of the nipple. No more than three threads should show after the nipple has been tightened. The installation must be inspected to insure that the conduit is securely fastened by the nipple. When the whole conduit line is completely installed and has passed inspection, run a No. 51 drill through both pilot holes in the nipples (17). It is important that the correct size drill be used as it is necessary to cut a groove in the wall of the conduit that will not penetrate to the bore. Keep the drill straight so that it will not enlarge the pilot holes.

Note

When reinstalling conduit in the nipple connection, if, after the nipple is tightened, the pilot holes do not line up with the drilled holes in the conduit, the conduit must be rejected and replaced.

Insert the locking clip (18) in the two pilot holes on the nipple (17) and crimp the free ends of the clip inward to lock it in position. In the event the position of the conduit or nipple is changed after the drill has been run through the pilot holes, the conduit must be rejected and replaced.

Note

The purpose of the locking clip is to prevent the nipple from loosening. It does not secure the conduit.

4—604C. REMOVING. Removal of the conduit from the connectors is the reverse of the installation procedure.

4—604D. TELESCOPIC UNITS. *(See figure 4—72.)* The telescopic units (Teleflex drawing number SA160A) consist of a ball rod end (9) which is attached to its respective lever by a bolt passing through the steel ball which rotates in a bearing contained within the rod end. A slider tube (12) is threaded into the rod end and is locked in place by a jam nut (11) held by a locking tab (10). The inner slider tube (13) attached to the swivel (14) is placed within the outer slider tube (12), making certain that when the control is fully extended, the outer and inner slider tubes overlap at least one inch. The swivel should be used for cutting, chamfering and bending the (14) is then installed on its respective bracket.

4—604E. INSTALLING. *(See figure 4—72.)* The following procedure must be observed to insure that the cable is securely locked in the end fitting, and that the telescopic unit is correctly attached to the end fitting:

a. Unscrew outer slider tube (12) and remove the cable lock (21) which is held in the end fitting (9) by the outer slider tube. Insert cable (5) through outer slider tube (12). Screw on jam nut (11) and place tab washer (10) in front of jam nut. Thread cable lock (21) onto cable until cable end extends through the lock 1/8 inch.

b. Back up jam nut (11) to limit.

c. Insert cable lock and cable into end fitting (9) and screw outer slider (12) into end fitting as tightly as possible to insure that cable lock is fully compressed and properly gripping cable. Cable may rotate out of lock and cause control failure if outer slider is not tightened sufficiently to compress cable lock.

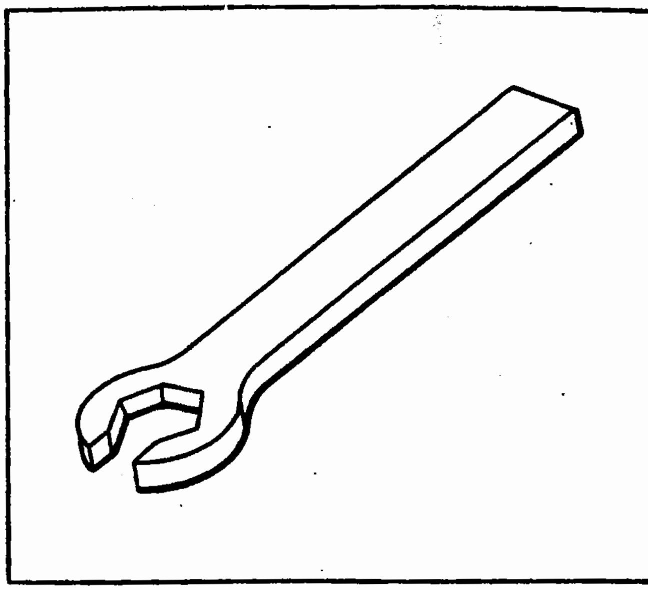


Figure 4—72A. Reworked Box Socket Wrench.

WARNING

Always screw outer slider into end fitting. Never screw end fitting onto outer slider as this will screw cable lock off cable and cause control failure.

d. Check "GO" and "NO GO" inspection holes in end fitting with wire. Wire should pass through "GO" hole, but should be blocked by cable end when inserted into "NO GO" hole. If cable is not in proper position in the end fitting, disassemble and adjust cable lock. Reassemble and check as directed in steps a. through d.

e. Tighten jam nut (11) against end fitting and turn over tab washer (10) to lock the nut and end fitting.

WARNING

Only one thread should show behind jam nut, otherwise outer slider is not screwed tightly enough into end fitting.

f. With telescopic unit fully extended, make certain that outer slider tube (12) overlaps inner slider tube (13) at least one inch. Check through inspection hole located one inch from end of outer slider tube. This hole should be blocked at all times by inner slider.

WARNING

Never adjust control length by turning end fitting or outer slider. These units must be drawn as tight as possible. Failure to observe this warning may cause a control failure.

g. Mount the swivel securely. Where the bracket holding the swivel is less than 1/16 inch thick, a flat washer 1/16 inch thick shall be used between the securing nut and bracket.

4—604F. REMOVING. *(See figure 4—72.)* To disconnect the rod end and cable, it is only necessary to straighten the locking tab (10), loosen the jam nut (11) and turn the rod end off the cable and cable lock.

4—604G. QUICK-DISCONNECT. *(See figure 4—72.)* Quick-disconnects (Teleflex drawing number XA145A-1, Issue G), are used for releasing the control linkage, in the Teleflex system, without removing the installation. To part the fore and aft components of the system, it is only necessary to move the cover (6) of the quick-disconnect in the direction indicated by an arrow "TO OPEN" and to rotate the cover until the bayonet-type lock holds the cover in the open position. When the quick-disconnect is opened, two jaws (3) are released, which secure a fitting (2) containing the conduit (1) of one side of the system, to the main body of the quick-disconnect. The exposed Teleflex cables (5) which are coupled by notching, are then separated, thus severing the fore and aft components of the Teleflex control systems. When quick-disconnect end fittings are employed in an installation make sure that the knurled sleeve is in the fully extended or locked position. For procedure to be followed when connecting conduit to the quick-disconnect see paragraph 4—604B, step b.

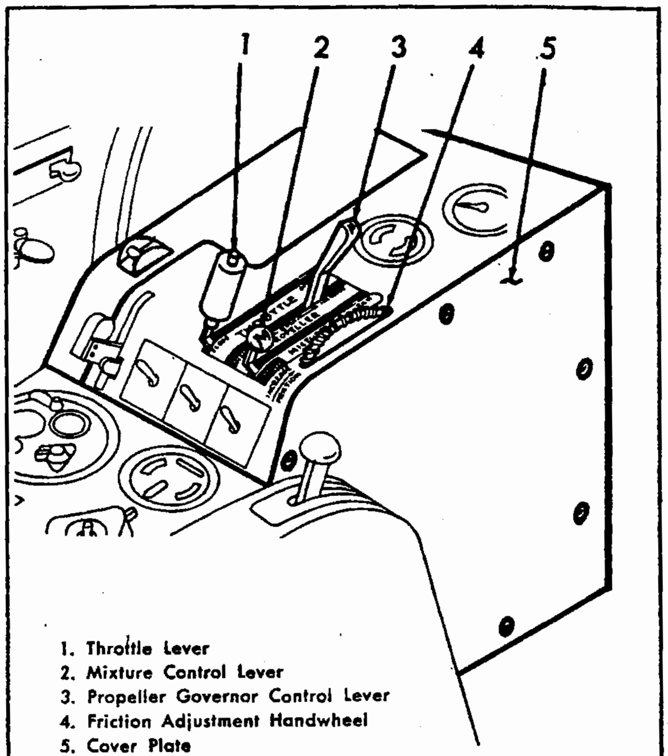


Figure 4—73. Engine Control Unit

4—605. ENGINE CONTROL UNIT.

4—606. DESCRIPTION. *(See figure 4—73.)* The engine control unit (manufactured by the Aero Supply Mfg. Co., Inc. of Corry, Pa., their drawing number 74604), located on the left hand console at station 160, carries three engine control levers which govern engine operation. They are the throttle (16), mixture (17) and propeller governor control (15) handles identified by letters and operating positions. A friction knob is provided on the inboard side of the unit for the purpose of preventing the control levers from creeping. The throttle positions indicated on the unit are "CLOSE" and "OPEN", those for the mixture control lever are "IDLE CUT-OFF," "NORMAL," and "RICH," and for the propeller governor control lever, "DECREASE" and "INCREASE" rpm. The engine control unit is secured to a bracket in the left hand shelf and to the fuselage structure. Three switchettes are incorporated in the engine control unit. One switchette is actuated by the propeller governor control lever and closes when engine speed is governed at and below 2300 rpm. When this switch is closed, the automatic cowl flap controller is reset to open the cowl flaps when the cylinder head temperature exceeds 232°C (450°F) and the intercooler flap is closed. The second switchette is operated by the throttle control lever and actuates the water injection system during combat power conditions, providing the master water injection switch is "ON." A third switchette, located in the engine control unit, is operated by the wing flap control lever when the flap is moved into the "EMERGENCY DOWN" position. See paragraph 4—192.

4—607. REMOVING.

a. Remove cover on inboard side of engine control unit by releasing the Dzus fasteners securing the cover.

b. Disconnect Teleflex cable and rod ends from levers.

c. Remove panel attached to upper outboard side of the engine control unit.

d. Disconnect electrical wiring and hydraulic line secured to the hydraulic pressure gage.

e. Remove bolts attaching engine control unit to inclined panel containing landing gear control.

f. Remove bolts securing engine control unit to aft section of the console, and remove the unit.

4—608. INSTALLING. Reverse the removal procedure.

4—609. THROTTLE CONTROL.

4—610. DESCRIPTION. *(See figure 4—71.)* The throttle control handle (16) in the cockpit operates the engine throttle lever (9) which is linked to the automatic power control. This control, located on the upper left hand side of the rear cover of the engine accessory drive case, eliminates the use of a separate supercharger control. The control operates both the carburetor throttle and the auxiliary stage supercharger selector valve. It tends to maintain constant manifold pressure for a fixed setting of the throttle control lever in the cockpit regardless of change in altitude. The throttle grip is of the "ranging" type, by which the pilot can rotate the grip right or left in order to align his target in the reticule of the gunsight; see paragraphs 4–1800 through 4–1806. Combat power is obtained by moving the throttle full forward jast a joggle stop where the handle contacts a switchette manufactured by General Electric Company, their part number CR1070-C103C3. When the switchette is closed, the water injection system is energized, provided the master water switch is "ON", and thus permits the engine to operate at combat power. The plate carrying the joggle stop is adjustable for a range of approximately 9-1/2 degrees, and is adjusted so that the switchette is closed as soon as the throttle passes the joggle stop. The movement of the throttle handle in the cockpit is transmitted to the engine throttle lever by means of a Teleflex cable within a conduit (21) and a throttle jackshaft (12). Both ends of the Teleflex cable are secured to telescopic unit end fittings (18, 23). The end fittings in turn are attached to the throttle handle and throttle jackshaft respectively. The conduit (21) in which the cable is contained passes forward from the throttle handle telescopic unit, through blocks and fuselage frames on the left side of the airplane, through the firewall to the telescopic unit which is attached to the throttle jackshaft. The jackshaft is mounted on two supports (10) incorporating sealed bearings. The bearings provide the means for attachment, and are the pivot point for the jackshaft. One support is bolted to the engine mount (10) while the other is bolted to the engine scroll. The jackshaft incorporates an upper and lower arm. The lower arm (outboard) is connected to the Teleflex cable while the upper arm (inboard) connects to a push-pull rod which is linked directly to the engine throttle lever. The push-pull rod and engine throttle lever are adjustable and provide a means of adjusting the entire throttle control system.

4–611. REMOVING. *(See figure 4–71.)* Access to the throttle handle and telescopic unit in the cockpit is obtained by removing the engine control unit cover. The telescopic unit bracket and Teleflex conduit in the cockpit are accessible merely by reaching forward of the engine control unit on the left hand side. Removal of the main fuel cell cover permits access to the conduit in the space between the cockpit and the firewall. All throttle controls forward of the firewall, i.e. the jackshaft, telescopic unit, adjustable push-pull rod and engine throttle lever are accessible after removal of the left hand upper wing gap cover and the top engine accessory compartment cowl panel. See paragraph 4–480 for removal of engine accessory compartment panels. To remove the throttle control installation observe the following procedure:

a. Detach telescopic units (18, 23) from end fittings secured to throttle handle in cockpit and to jackshaft (12) in engine. Remove cable locks from cable ends.

b. Open quick-disconnect unit located just forward of firewall. Grasp ends of cables where they join in quick-disconnect and pull cables out from conduits.

c. Remove the two throttle telescopic units from their respective brackets, one located just forward of engine control unit at fuselage station 150-1/2, the other located on the left hand side of the engine mount. To detach a telescopic unit, remove locking clip from conduit nipple and then remove check nut and attaching nut which secure telescopic unit to bracket. Pull telescopic unit out from bracket. Avoid misplacement of parts by wiring them together.

d. If required, remove two Teleflex end fittings (Telescopic units were detached from end fittings in step a) by removing cotter key, bolt, nut and washer which secure end fittings to throttle handle in cockpit and to jackshaft in engine accessory section. After end fittings are removed, secure them to telescopic units to avoid misplacement.

e. Remove locking clips from nipples which secure forward and aft sections of conduit to quick-disconnect (22) located just forward of the firewall. Remove two sections of quick-disconnect from conduit.

f. Loosen blocks securing throttle conduit to fuselage at stations 120-1/2, 108, and at firewall.

g. Remove conduit connector (19) located at station 138.6 on left hand side of fuselage by removing locking pins and clamping screws.

h. Remove aft section of throttle conduit leading to engine control unit and forward section of conduit leading to quick-disconnect.

i. Detach adjustable push-pull rod (11) from throttle jackshaft and from throttle lever on engine by removing the cotter key, nut, washer and bolt which secures it at each end.

j. Remove the throttle jackshaft by removing the cotter key, nut, washer and bolt which secure the jackshaft to each of the two support bearings.

k. Remove the throttle conduit bracket and jackshaft support secured to the engine mount on the left side by removing the four bolts which secure each of these units in place. Remove the jackshaft support secured to the supercharger scroll by removing two bolts.

4–612. INSTALLING. To install the throttle control installation, reverse the removal procedure in paragraph 4–611. For Teleflex cable and conduit lengths see figure 6–2.

CAUTION

In installing Teleflex controls the procedures given in paragraphs 4–602 through 4–604G must be followed exactly.

4–613. ADJUSTING. *(See figure 4–71.)* The throttle control system is designed to permit a 1/8 inch overtravel in both the "OPEN" and "CLOSED" positions of the throttle handle. Overtravel may be increased or decreased by shortening or lengthening the engine throttle lever (9). This is done by adjusting the fork end fitting which is threaded into the lever. Overtravel can be equalized so that it is the same at both the "OPEN" and "CLOSED" positions by adjusting the push-pull rod (11) which connects to the engine throttle lever.

a. Secure throttle handle in "CLOSED" position.

b. Secure engine lever (9) in close position against stop, i.e. 17 degrees aft of a vertical reference line passing through lever attaching point on automatic power control.

c. Adjust push-pull rod (11) so that it can be connected to engine throttle lever. Temporarily connect push-pull rod to lever.

d. Move throttle handle from "CLOSED" to "OPEN" position. Engine throttle lever should be against stop in "OPEN" position 37 degrees forward of "CLOSED" position. Make certain that throttle handle can move through entire range without binding or backlash.

e. Check for equal overtravel at both the "CLOSED" and "OPEN" positions of the throttle handle. When there is greater overtravel at "CLOSED" position, lengthen push-pull rod (11) until the overtravel is equal for both the "CLOSED" and "OPEN" positions. If there is greater overtravel at "OPEN" position, shorten push-pull rod, etc.

f. There should be 1/8 inch overtravel for both the "OPEN" and "CLOSED" positions of the throttle control handle. This insures positive positioning of engine throttle lever against open and closed position stops. If the overtravel is over 1/8 inch at both positions, lengthen engine throttle lever (9) by adjusting fork-end fitting which is threaded into lever. Shorten engine throttle lever, i.e. screw in fork-end fitting, if springback is insufficient.

g. Place a piece of paper between the closed position stop and the engine throttle lever. Exert steady pressure on throttle handle in "CLOSED" position. If overtravel is sufficient, paper cannot be loosened. Repeat the same procedure with the handle in the "OPEN" position.

h. If it is found that it is impossible to adjust the throttle control system due to excessive binding or backlash, inspect the throttle system thoroughly. If binding is the reason, check for excessively tight control unit friction knob, dented conduit or telescopic units, loose connections, dirty cables, improperly lubricated cables, or for foreign matter in the conduits. If backlash is causing the trouble, check as described above. Also make certain that telescopic units are properly assembled and tight, and that the cables are locked properly in the end fittings. If backlash is not being caused by any of the conditions described above, it is an indication that the Teleflex cables are either too long or too short. Excessive backlash preventing the throttle handle from going into the "CLOSED" position would be caused by a cable which is too long. If backlash prevents the handle from going into the "OPEN" position, it is an indication that the cable is too short.

4–614. MIXTURE CONTROL.

4–615. DESCRIPTION. *(See figure 4–71.)* The mixture control handle (14) in the cockpit operates the mixture control lever on the carburetor. The three positions provided for the lever are "IDLE CUT-OFF," "NORMAL," and "RICH." The mixture control system is identical in principle to the throttle control system. The routing of the mixture control cables and conduit follows the path of the throttle and propeller governor controls up to the quick-disconnect just forward of the firewall. At this point the mixture control conduit takes a downward path to a telescopic unit which is secured to a bracket on the engine mount. The telescopic unit connects to and actuates the mixture control jackshaft. This jackshaft is supported in a manner which is identical to that of the throttle jackshaft; see paragraph 4–609. The mixture control jackshaft (25) is approximately the same size as the throttle jackshaft (12) and only differs in that it has two arms, both of which project downward, whereas the throttle jackshaft has an arm projecting down and one projecting up. The inboard arm on the mixture control jackshaft connects to a push-pull rod which is linked directly to the mixture control lever. The push-pull rod may be secured to either one of two attachment points on the jackshaft arm. The usual connection is the lower attachment point; however, to increase springback at the mixture control handle, the rod may be secured to the upper attachment point which is closer to the jackshaft pivot point. The rod itself may be lengthened or shortened to permit springback equalization.

4–616. REMOVING. Removal of the mixture control installation follows the same procedure as removal of the throttle control installation; see paragraph 4–611 and figure 4–71. Note that access to the mixture control lever and push-pull rod may be gained through the intercooler flap and by reaching up behind the "Y" duct.

4–617. INSTALLING. To install the mixture control system, reverse the removal procedure given in paragraph 4–611. For Teleflex cable and conduit lengths see figure 6–2.

CAUTION

In installing Teleflex controls the procedure given in paragraphs 4–602 through 4–604G must be followed exactly.

4–618. ADJUSTING. The mixture control system is designed to permit a 1/8 inch springback (backlash) in both the "IDLE CUT-OFF" and "RICH" positions of the mixture control handle. The amount of springback depends on which attachment point on the jackshaft is used when securing the push-pull rod (27) to the jackshaft (25). Springback can be equalized so that it is the same at both the "IDLE CUT-OFF" and "RICH" positions by adjusting the push-pull rod (27).

a. Secure mixture control handle in "IDLE CUT-OFF" position.

b. Secure mixture control lever (28) in "IDLE CUT-OFF" position against the stop, i.e., 63-1/2 degrees forward of vertical reference line passing through lever attaching point on carburetor.

c. Adjust push-pull rod (27) so that it can be connected to mixture control lever (28). Temporarily connect push-pull rod to lever.

d. Move mixture control handle from "IDLE CUT-OFF" to "RICH" position. Mixture lever on carburetor should be against stop in "RICH" position, 90 degrees aft of "IDLE CUT-OFF" position. Make certain that mixture control handle can move through entire range without binding or backlash.

e. Check for equal springback at both the "IDLE CUT-OFF" and "RICH" positions of the mixture control handle. When there is greater springback at "IDLE CUT-OFF" position, shorten push-pull rod (27) until the springback is equal for both the "IDLE CUT-OFF" and "RICH" positions. If there is greater springback at "RICH" position lengthen push-pull rod.

f. There should be 1/8 inch springback for both the "IDLE CUT-OFF" and "RICH" positions of the mixture control handle. If springback is under 1/8 inch at both positions, detach push-pull rod from the lower attachment point on jackshaft arm and connect it to upper attachment point which is closer to jackshaft pivot point.

g. Place a piece of paper between the "IDLE CUT-OFF" point in stop and the mixture control lever on the engine. Exert steady pressure on mixture control handle in "IDLE CUT-OFF" position. If springback is sufficient, paper cannot be loosened. Repeat the same procedure with the handle in the "RICH" position.

h. If it is found that it is impossible to adjust the mixture control system due to excessive binding or backlash, inspect the mixture control system thoroughly. If binding is the reason, check for excessively tight control unit friction knob, dented conduit or telescopic units, loose connections, dirty cables, improperly lubricated cables or for foreign matter in the conduits. If backlash is causing the trouble, check as described above. Also make certain that telescopic units are properlry assembled and tight, and that the cables are locked properly in the end fittings. If backlash is not being caused by any of the conditions described above, it is an indication that the Teleflex cables are either too long or too short. Excessive backlash preventing the mixture control handle from going into the "IDLE CUT-OFF" position is caused by a cable which is too long. If backlash prevents the handle from going into the "RICH" position, it is an indication that the cable is too short.

4–619. PROPELLER GOVERNOR CONTROL.

4–620. DESCRIPTION. *(See figure 4–71.)* The propeller governor control regulates the setting of the governor, a double-acting unit which directs high pressure oil to either side of the propeller blade angle change mechanism in the propeller dome; see paragraphs 4–633 through 4–639 for further information on propeller governor. This system is designed to maintain a selected engine speed. The propeller governor control system consists essentially of the propeller governor control handle which actuates a Teleflex cable leading directly to the propeller governor mounted on the forward end of the engine. Both ends of the Teleflex cable are secured to telescopic unit end fittings (2, 17). The end fittings in turn are attached to the propeller governor handle in the cockpit and to the propeller governor lever at the forward end of the engine. The conduit in which the cable is contained passes forward from the telescopic unit in the cockpit, to a quick-disconnect located just forward of the firewall. Up to this point, the propeller governor installation is identical to that of the throttle and mixture control. Forward of the quick-disconnect, however, the conduit is routed over the engine mount to the right hand side, passes through the outer diaphragm and then leads directly to the telescopic unit which actuates the propeller governor lever. The conduit is made up of four sections which are joined together by the quick-disconnect and connectors located just forward of the cockpit and the outer diaphragm. The Teleflex cable consists of two sections which are locked together by the quick-disconnect.

4–621. REMOVING. *(See figure 4–71.)* To gain access to any units in the propeller governor system located behind the outer diaphragm, see paragraph 4–611. Access to the propeller governor conduit leading forward from the outer diaphragm to the propeller governor telescopic unit may be gained after opening the cowl flaps and by removing right hand side engine cowl panel. The propeller governor lever and telescopic unit are easily reached through the front of the engine. To remove the propeller governor installation, observe the following procedure:

a. Remove engine control unit cover, engine fuel cell cover, left hand upper wing gap cover panel, upper engine accessory compartment cowl panel, right hand side engine cowl panel and open cowl flaps.

b. Detach telescopic units (18, 3) from end fittings (17, 2) secured to propeller governor control handle in cockpit and to propeller governor lever on engine. Remove cable locks from cable ends.

c. Open quick-disconnect unit located just forward of firewall. Grasp ends of cables where they join in quick-disconnect and pull cables out from conduits. The cables may also be removed with locks remaining on ends if quick-disconnect is opened first and then cables are pulled out from telescopic ends at propeller governor handle in cockpit and lever on engine.

d. Remove the two propeller governor telescopic units from their respective brackets, one located just forward of the engine control unit at fuselage station 150-1/2, the other located on the right hand side of the propeller governor on the engine. To detach a telescopic unit, remove locking clip from conduit nipple and then remove swivel clamp block which secures telescopic unit to bracket. Pull telescopic unit out from bracket. Avoid misplacement of parts by wiring them together.

e. If required, remove the two Teleflex end fittings (telescopic units detached from end fittings in step b) by removing cotter key, bolt, nut and washer which secure end fittings to propeller governor control handle in cockpit and to governor lever in engine. After end fittings are removed, secure them to telescopic units to avoid misplacement.

f. Remove locking clips from nipples which secure forward and aft sections of conduit to quick-disconnect (22) located just forward of firewall. Remove two sections of quick-disconnect from conduit.

g. Loosen blocks securing conduit to fuselage at stations 120-1/2, 108 and at firewall.

h. Remove conduit connectors (19) located at station 138.6 on left hand side of fuselage and on right hand side of the forward face of the outer diaphragm.

i. Remove aft section of propeller governor conduit leading to engine control unit and forward section of conduit leading to quick-disconnect.

j. Detach four clamps which secure propeller governor conduit to engine mount and outer diaphragm. This section of conduit leads from the quick-disconnect at the firewall to the conduit connector located forward of the outer diaphragm. Remove conduit.

k. Remove two clamps which secure section of conduit leading from conduit connector forward of diaphragm to propeller governor telescopic unit. Remove conduit.

4—622. INSTALLING. To install the propeller governor control system, reverse the removal procedure in paragraph 4—621. For Teleflex cable and conduit lengths see figure 6—2.

CAUTION

In installing Teleflex controls the procedures given in paragraphs 4—602 through 4—604G must be followed exactly.

4—623. ADJUSTING. *(See figure 4—71.)* The propeller governor control system is designed to permit a 1/8 inch springback (backlash) in both the "DECREASE" and "INCREASE" (FULL FORWARD) positions of the propeller governor control handle. Springback may be increased or decreased by repositioning the telescopic end fitting in the slot on the propeller governor lever. If necessary, springback can be equalized so that it is the same at both the "DECREASE" and "INCREASE" positions of the propeller governor handle by adjusting the Teleflex cable locks or by shortening the cable.

a. Secure propeller governor handle (15) in cockpit to "INCREASE" (full forward) position.

b. Connect telescopic end fitting to governor lever but do not tighten.

c. Place a piece of paper between high rpm stop screw and governor lever. Adjust end fitting in lever slot, i.e., move end fitting towards lever pivot point until lever bears against high rpm stop sufficiently to prevent loosening the paper. Tighten end fitting to governor lever.

d. Move propeller governor handle in cockpit from "INCREASE" to "DECREASE" position. Propeller governor lever should move 120 degrees to "DECREASE" position. Make certain that control handle in cockpit moves through entire range without binding or backlash.

e. Check for equal springback at both the "INCREASE" (full forward) and "DECREASE" positions of the control handle. When there is greater springback in the "DECREASE" position it is an indication that the cables are too long. If adjustment required does not exceed 1/4 inch, cables may be adjusted at end fittings. This is done by turning cable locks further onto cables, not in an amount, however, that would permit cable ends to extend out more than 1/4 inch and block "GO" holes in end fittings. If the adjustment required exceeds 1/4 inch, the cables must be shortened by cutting ends. Shorten cables until springback is equal for both the "DECREASE" and "INCREASE" positions. If springback is greater in the "INCREASE" (full forward) position, it is an indication that the cables are too short. In this case, turn cable locks out so that cable ends extend a minimum of 1/8 inch from cable locks. DO NOT TURN CABLE LOCKS OUT IN AN AMOUNT THAT WOULD PREVENT CABLES FROM EXTENDING FAR ENOUGH INTO END FITTINGS TO BLOCK "NO GO" HOLES. THE "NO GO" HOLES MUST BE BLOCKED AT ALL TIMES BY CABLE ENDS. If cables are too short even after adjusting cable locks, they must be replaced with cables of greater length.

f. There should be 1/8 inch springback for both the "DECREASE" and "INCREASE" positions of the control handle. If the springback exceeds 1/8 inch at both positions, move end fitting further out on governor lever slot; i.e., increase distance of end fitting from lever pivot point. Move end fitting in on slot if springback is insufficient. After adjustment make certain that piece of paper between high rpm stop screw and lever is pinched sufficiently to prevent removal when steady pressure is exerted on governor handle in "INCREASE" position.

g. If it is found that it is impossible to adjust the propeller governor control system due to excessive binding or backlash, see paragraph 4—618, step h. Backlash in the "DECREASE" position would be caused by the same conditions existing for backlash in the "IDLE CUT-OFF" position of the mixture control.

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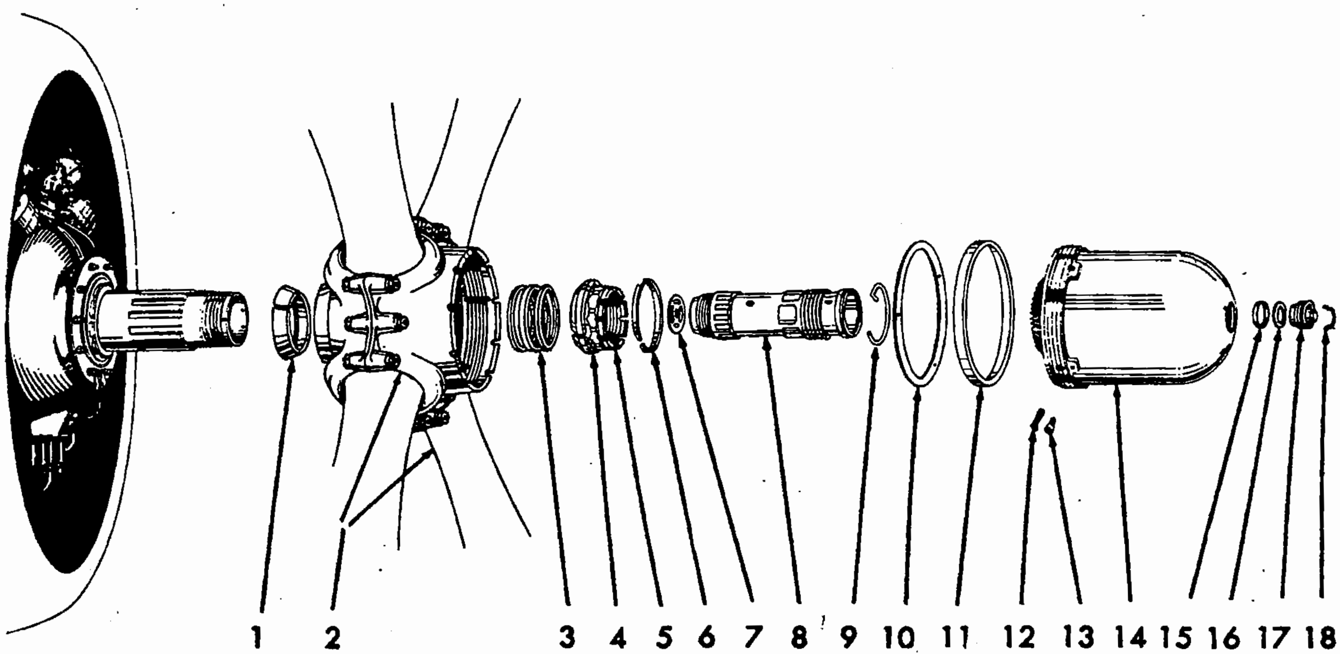


1. Rear Cone
2. Hub and Blades Assemblies
3. Spider-shaft Oil Seal Group
4. Front Cone
5. Propeller Retaining Nut
6. Hub Snap Ring
7. Engine Shaft Gasket
8. Engine Shaft Extension
9. Propeller Retaining Nut Lock Wire
10. Dome-Barrel Preload Shim
11. Dome-Barrel Seal
12. Dome Retaining Nut Lock Screw Cotter
13. Dome Retaining Nut Lock Screw
14. Dome Assembly
15. Dome Breather Hole Seal
16. Dome Breather Hole Washer
17. Dome Breather Hole Nut
18. Dome Breather Hole Nut Lock Wire

Figure 4–74. Propeller Assembly.

4–624. PROPELLER AND ACCESSORIES.

4–625. DESCRIPTION. *(See figure 4–74.)* The propeller used on the F4U-5 airplane is a four-blade Hamilton Standard Hydromatic constant speed propeller comprising a 24E60-159 hub and four 6837A-O type blades. The propeller diameter is 13 feet and 2 inches. Since the full-feathering feature is not used, an engine shaft extension replaces the distributor valve in the hub assembly. The shaft extension is fitted directly into the propeller shaft with a gasket installed between the base of the housing and the shaft itself. No oil transfer plate is used. The propeller is composed of three major assemblies: the hub asesmbly, the dome assembly, and the engine shaft extension. The hub assembly is the basic propeller mechanism in that it contains the blades and the means of holding them in position. The blades are supported by a spider and are retained by the barrel. Each blade is free to turn about its axis under control of the dome assembly. The dome assembly is the pitch changing mechanism. It is mounted on the outboard end of the barrel and its rotating cam meshes with the gear segments on the blades to turn them as a piston within the dome is acted upon by oil from the governor. The engine shaft extension provides oil passage from the engine-propeller shaft to both sides of the piston in the dome. A double-acting constant speed control (governor), which automatically brings about the adjustments in propeller blade angles necessary to maintain constant engine speed under varying flight conditions, is mounted on the right hand side of the engine nose close to the right hand distributor. Double-acting governor pump output oil is directed by the governor to either side of the propeller piston. The oil on the side of the piston opposite the governor oil, returns to the intake side of the governor pump and is used over again. Engine oil at engine supply pressure does not enter the propeller but is supplied only to the governor. Operation of the propeller is determined by the type of governor used. When a double-acting governor is used, the propeller is called "double-acting."

4–626. DOUBLE-ACTING PROPELLER OPERATION. Basically, double-acting propeller operation is very similar to that of the single-acting type, the difference being that governor oil is directed to either side of the propeller piston as the operating conditions require. This makes necessary two lines from the governor, one to each side of the piston. No distributor valve is used since direction of oil flow is determined within the governor for all operating conditions. Propeller oil goes back to the governor and is used over again rather than going into the engine oil system. For a description of the governor control, see paragraphs 4—633 through 4—635.

a. UNDERSPEED. If the engine speed drops below the rpm for which the governor is set, the governor speeder spring moves a pilot valve downward. Oil on the inboard side of the propeller piston is drained to the intake side of the governor pump while governor pump oil, through the *DECREASE PITCH* governor-propeller line, is directed to the outboard side of the propeller piston. This action moves the piston in an inboard direction, the blades are turned to a lower angle (with the assistance of the blade centrifugal twisting force that is present) and the propeller returns to on-speed operation.

b. ON-SPEED. During on-speed operation, the oil is held in the propeller to maintain a constant blade angle. The governor supplies to the propeller only enough oil to equalize that lost through normal internal leakage.

c. OVERSPEED. If the engine speed increases above the rpm for which the governor is set, the increased centrifugal force of the governor flyweights raises the governor pilot valve. Oil on the outboard side of the propeller piston is drained to the intake side of the governor pump while oil at governor pump pressure is directed to the inboard side of the propeller piston through the *INCREASE PITCH* governor-propeller line. This action moves the piston in an outboard direction, the blade angle is increased, and the propeller is returned to on-speed operation. For further details of Hydromatic propellers, see the Hamilton Standard Propeller Service Manual No. 140C (AN03-20CC-1).

4—627. TROUBLE SHOOTING.

a. Inspect all blades for bends, nicks, cracks, raised edges, etc. If a more complete check for cracks is considered necessary, apply local etching. See Hamilton Standard Propeller Service Manual No. 140C. (AN03-20CC-1).

b. If the airplane is operated near salt water, wash the blades thoroughly with clean (fresh) water, dry completely, and then apply a thin film of clean engine oil.

c. Examine the exterior of the propeller hub for any evidence of damage.

d. Visually check for oil leakage at the dome breather hole, dome retaining nut, barrel blade bores, barrel halves parting line, and at the rear cone.

Note

If the propeller has just recently been installed, residual oil may show up. This should not be misinterpreted as propeller leakage.

e. Check the propeller installation for security of mounting. This includes all external cotter pins and safety wire.

f. If propeller vibration has been reported, check all blade angle settings by using a bubble protractor at the blade reference station (42 inch station). If necessary, check the track of each blade. Blade should track within 1/8 inch.

Note

Faulty ignition or carburetion can cause excessive vibration.

g. Remove the dome assembly (see paragraph 4—628), and partially disassemble the dome by removing the stop rings and dome shell. The piston and cams should not be disassembled. The cams, piston, and the inside of the dome shell should be washed in unleaded gasoline to remove carbon and sludge deposits. After cleaning, reassemble the dome assembly and install on the propeller.

h. Check the propeller retaining nut for looseness. Each check should be made with the proper wrench and the nut tightened (1500 pound-feet) as required and properly safetied. If repeated tightening of the nut is necessary to maintain the proper tightness, the propeller should be removed and the cause ascertained.

i. Check the propeller operating time since the last overhaul. If the maximum allowable operating time will be exceeded before the next succeeding 100-120 hour inspection period, remove the propeller for overhaul unless an engine change is scheduled after the current 100-120 hour inspection period and prior to the expiration of the specified maximum propeller operating time. If for any reason, the propeller is removed prior to the specified overhaul period, the propeller hub cone seats, cones, and other attaching parts should be inspected for galling, wear, bottoming, proper fit, etc. Defects should be corrected before reinstallation of the propeller.

j. Remove any raised edges of cuts, scars, scratches or nicks, providing their removal or treatment will not materially weaken the blade, reduce its weight, or impair its performance. Suitable sandpaper or fine cut files may be used for removing the necessary amount of metal. In each case, the area involved shall be smoothly finished with No. 00 sandpaper and each blade from which any appreciable amount of metal has been removed will be properly balanced before use. If removal or treatment takes the blade below allowable repair limits, the blade shall be retired from service.

k. The metal around longitudinal surface cracks, narrow cuts, and shallow scratches should be removed in such a way that shallow, saucer-shaped depressions are formed. Blades requiring the removal of metal which would form a finished depression more than 1/8 inch in depth at its deepest point, 3/8 inch in width, and one inch in length, should be sent to an approved overhaul base.

l. The metal at the edge of wide scars, cuts, scratches, nicks, etc. should be rounded off and the surfaces within the edges smoothed out. Blades that require the removal of metal to a depth of more than 1/8 inch and a length of more than 3/4 inch should be sent to an approved overhaul base.

m. Blades that have the leading edges pitted from normal wear may be re-worked by removing sufficient material to eliminate the irregularities. The metal shall be removed by starting at approximately the thickest section and working forward over the leading edge camber so that the contour of the re-worked portion will remain substantially the same. In all cases, avoid abrupt changes in the section or blunt edges.

n. Replace any damaged gaskets or seals.

o. With the engine running at reduced throttle, operate the propeller control three or four times throughout its entire range. The propeller should respond to movement of the governor control (as indicated by the tachometer) within the power limit of the throttle setting. This test serves to expel air which might have been trapped in the propeller system, and at the same time discloses the improper operation of the propeller, governor, or engine. For complete details for service and maintenance of Hamilton Standard Hydromatic propellers, see Hamilton Standard Propeller Service Manual No. 140C (AN03-20CC-1).

4—628. REMOVING. *(See figure 4—74.)* The following special tools necessary for the removal of the propeller, may be secured from the local supply depot: a combination wrench (Hamilton Standard No. 59919), a heavy duty retaining nut wrench (Hamilton Standard No. 53207), and a dome lifting handle (Hamilton Standard No. 54325). In addition to the above, a blade persuader, Hamilton Standard No. M-712 will be useful.

a. Remove the lockwire from the nut in the dome breather hole and remove the nut. Install the dome lifting handle.

Note

The dome is usually filled with engine oil; therefore it is advisable to have a receptacle on hand when removing either the dome breather nut or the dome itself.

b. Turn the blades to high pitch, using a blade persuader.

c. Remove the cotter pin and lockscrew from the dome retaining nut.

d. Using the combination wrench, loosen the dome retaining nut and lift off dome in a line parallel with the propeller shaft.

e. Remove preload shims.

f. Remove the lock ring from the propeller retaining nut.

CAUTION

This lock ring must be removed before the engine shaft extension is turned, or damage to the shaft extension locking splines will result.

g. Using the combination wrench, back off the propeller retaining nut a few turns to relieve any compression on the propeller shaft. Then, with the combination wrench, remove the engine shaft extension.

h. Remove the propeller retaining nut and the front cone. This will cause the outer ledge of the cone to pick up the hub snap ring and start the hub and blades assembly off the rear cone and propeller shaft. Remove the snap ring, retaining nut, and front cone.

i. Move the propeller back on the shaft slightly and remove the spider shaft oil seal ring, seal, and washer.

j. Cover the propeller shaft threads with a thread protector, or wrap them with tape.

k. Remove the propeller from the shaft using an appropriate sling.

l. Clean, oil, and cover the propeller shaft.

4—629. INSTALLING. *(See figure 4—74.)* In addition to the tools mentioned in the previous paragraph, the following tools will be required: a dome strap wrench (Hamilton Standard No. M2187) and a rotating cam wrench (Hamilton Standard No. M-952). All parts which are accessible without disassembling should be visually examined for damage and checked for fit and freedom of movement. All traces of corrosion and all raised edges of nicks, burrs, cuts, galling, and scoring on joining surfaces of attaching parts should be carefully stoned down. Inspect the propeller shaft splines and threads for nicks, burrs or similar damage. Dress down any such imperfections with a fine stone and polish with crocus cloth. Wash the shaft with unleaded gasoline and allow to dry throughly. Then apply a light film of clean engine oil to both the inside and outside of the propeller shaft.

a. Apply a thin film of thread lubricant AN-C-53 to the propeller shaft and install the rear cone.

CAUTION

It is not recommended that a coating of oil or other compound be applied to the rear cone seat before installing the propeller. Even though the propeller is tightened to the proper torque, this coating prevents direct contact between the rear cone seat and the propeller. Since this film may break down and permit relative movement, galling of the mating surfaces and possible damage may result. It is recommended that the rear cone and spider be wiped dry at propeller installation. This will allow maximum tightness of the propeller when the recommended retaining nut torque is applied.

b. Cover the propeller shaft threads with a thread protector and install the hub and blades assembly. Then remove protector.

c. Install the spider-shaft oil seal washer, the spider-shaft oil seal, and the spider-shaft oil seal ring in the order named.

d. Install the front cone and propeller retaining nut by first applying AN-C-53 lubricant to the threads of the propeller retaining nut. Install the front cone halves on the nut. Turn the blades into reverse pitch to move the toothed portion of the blade gear segments down into the hub to provide clearance for the retaining nut and cone halves, and then start the propeller retaining nut and cone halves on the propeller shaft threads.

e. Tighten the propeller retaining nut on the shaft using the proper wrench. The required torque for this operation is 1500 pound-feet using a bar and a 2-1/2 pound hammer. Determine if one of the locking slots in the retaining nut is aligned with one of the holes in the propeller shaft. If not, continue tightening until nearest slot and hole are aligned.

f. Compress the snap ring and install it in the spider hub snap ring groove.

g. If the engine is new, make sure the engine shipping plug has been removed from the shaft and then install the engine shaft extension gasket.

h. Apply Spec. AN-C-53 lubricant to the threads of the engine shaft extension and screw it into the propeller shaft by hand.

Note

No difficulty should be encountered when installing the shaft extension. If there is noticeable binding, remove the extension shaft and check the threads. If binding persists, back off a few turns of the propeller retaining nut, since it occasionally produces a sufficient compressing effect to cause binding between the shaft extension and the propeller shaft, and then screw the engine shaft extension into the propeller shaft.

i. Tighten the shaft extension into the propeller shaft, using the proper wrench in conjunction with a one foot bar, and apply a force of 100 pounds to the end of the bar. Strike the bar near the wrench with a 2 1/2 pound hammer, if necessary, to align one of the locking slots on the extension housing with the same locking hole in the propeller shaft as previously determined for the retaining nut.

CAUTION

Never back off a shaft extension even slightly in order to obtain slot and hole alignment. If alignment cannot be obtained without exceeding the specified torque, remove the shaft extension and reinstall it, using a new shaft extension gasket or reducing the thickness of the first gasket by lapping it slightly.

j. Insert the propeller retaining nut lock wire in the lock wire groove of the retaining nut, making certain that the extended portion of the wire fits through the retaining nut, the propeller shaft, and locks into a slot in the engine shaft extension.

k. Before installing the dome assembly, check the setting of the high and low pitch stop rings; see paragraph 4—630. If the high and low pitch stop rings are correctly installed, install the dome.

l. Install the required number of preload shims over the fixed cam locating dowels in the hub assembly; see paragraph 4—631.

m. Using the proper tool, move the rotating cam until the cam stop lugs contact the high pitch stop ring lugs. This places the dome in the high pitch position. Then rotate the propeller blades into the high pitch position by lining up the correct angle stamped on the blade butt with the index line on the inner periphery of the dome-barrel shelf. All blades should be at the same angle as the dome. If the blade angles do not coincide with the stop ring settings, the blade and stop ring settings should be reset. See paragraph 4—630 for adjustment procedures.

CAUTION

When installing the dome assembly, it is absolutely essential that the cam gear in the dome assembly mesh properly with the blade gear segments. By setting the dome assembly and the blade assemblies at the same high pitch angle, the mating teeth will mesh properly. Make certain that the high pitch angle set in both the dome and hub assembly is identical.

n. Install the dome lifting handle in the dome breather hole at the outboard end of the dome.

o. Install the dome without the dome-barrel seal making certain the arrow etched on the base of the fixed cam coincides with the arrow stamped on the barrel. The oil seal rings of the engine shaft extension should be staggered and should enter properly into the piston sleeve in the dome.

p. Tighten the dome retaining nut, using enough torque to seat the dome securely on the barrel shelf (approximately 250 pound-feet). Mark the position of the dome-retaining nut with respect to the barrel.

q. Remove the dome assembly and install the dome barrel seal on the fixed cam so that the tapered end of the seal is facing away from the retaining nut.

r. Reinstall the dome assembly and apply sufficient torque to the dome retaining nut to bring it at least to the previously marked position, and enough in addition to obtain alignment of the retaining nut lock screw with one of the crescent slots in the outboard edge of the barrel.

s. Install the dome retaining nut and lock screw and safety with a cotter pin.

t. Check high and low pitch blade angles. These should be the same as the high and low pitch settings of the stop rings. High pitch is 65°, low pitch is 27°.

u. Install dome breather hole seal in the dome breather hole with tapered portion facing into the dome.

v. Install dome breather hole nut, tightening to a torque of 30 to 50 pound-feet until one of the holes in the nut aligns with a slot in the dome shell.

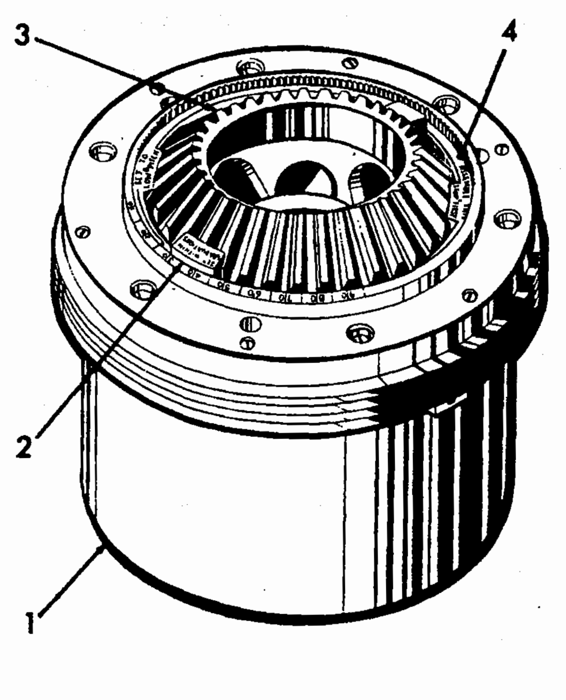
w. Install the dome breather hole nut lock wire into the groove inside the nut, resting the extending part of the wire in the dome shell groove.

x. After the initial 1-1/2 hours engine run, following the installation of a propeller, the propeller dome should be removed and the engine shaft extension and the propeller retaining nut retightened to the correct torque values.

4—630. ADJUSTING. *(See figure 4—75.)* Prior to dome installation, the high and low pitch stop rings must be checked for correct positioning in the dome. The arrows stamped on these rings should coincide with the degree marks on the fixed cam flange and should be:

HIGH PITCH 65°
LOW PITCH 27°

If it is desired to reset the stop rings, the rings can be best removed by inserting 10-24 screws into the tapped holes in the stop lugs of the rings and lifting the rings out of the dome by the screws. In order to insure that the stop rings will not fall out of the dome during installation, it is permissible to "spring" the stop rings to a slightly out-of-round shape so as to provide sufficient friction to hold them against their own weight.



1. Dome Assembly
2. Rotating Cam Stop Lug
3. Rotating Cam
4. Low Pitch Stop Ring

Figure 4—75. Setting Propeller Stop Rings.

Such "springing" shall not be greater than will permit installation of the rings by hand alone. Reinstall the rings as follows:

a. Install the low pitch stop ring to the desired low angle setting by inserting it in the stop ring flange (on the base of the fixed cam) so that the arrow stamped on the stop ring coincides with the desired degree mark stamped on the fixed cam flange. This degree mark represents the blade angle at the reference station. The angle set must be the same as, or higher than, the pitch range limit stamped on the stop ring.

b. Install the high pitch stop ring to the desired high angle setting, by inserting it on top of the low pitch stop ring in such a way that the arrow stamped on the ring coincides with the desired high pitch degree mark stamped on the fixed cam stop ring flange. The angle set must be the same as, or lower than, the pitch range limit stamped on the stop ring.

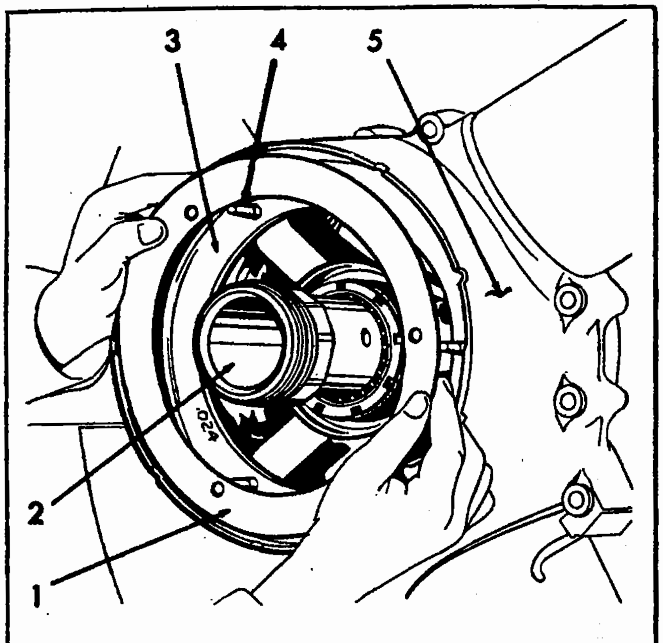
c. The stop lug on the rotating cam gear marked "SET WITHIN GRADUATIONS" must lie within the graduated arc of the stop ring flange on the base of the fixed cam. Check to insure that the stop ring lugs are actually limiting cam rotation. When the dome is placed in both the high and low pitch positions, there should be contact between the rotating cam stop lugs and the stop ring lugs. If there is not, the stop rings are either set or marked incorrectly.

Note

To move the rotating cam stop lug toward the high pitch position, hold the dome in a suitable fixture so that the cam teeth are up. Place a phenolic or wooden block of proper diameter against the end of the piston, and tap it down. This will move the lug toward high pitch. To move the stop lug toward low pitch position, hold the dome with the dome strap wrench and turn the rotating cam by means of the rotating cam wrench.

4—631. Before assembling the dome to the hub, the correct number of preload shims must be installed over the fixed cam locating dowels in the hub; *see figure 4—76.* The number of shims which are supplied in thicknesses of .005 and .015 inch, is determined from the measurement (P.D.) stamped on the barrel shelf. The average preload should be .018 plus or minus .003 inch. The P.D. marking of the 24E60 propeller stamped on the barrel shelf is the reading minus the specified preload, indicating the shim thickness required. For example, P.D. .024 minus the specified preload .018, gives a value of .006. Therefore, one .005 shim is required to bring the actual preload within .003 of the specified value. Since the dome is used in determining preload, it must be kept with the propeller with which it is paired. The total thickness of shims used in the propeller shall not exceed .045 inch.

4—632. PROPELLER OPERATION CHECK. After completion of propeller installation, move the blades



1. Preload Shim
2. Engine Shaft Extension
3. Dome Barrel Shelf
4. Dowels
5. Propeller Hub

Figure 4—76. Installing Preload Shim.

into low pitch by means of the blade persuader. Make certain that the correct angular relationship between the rotating cam gear and blade gear segments has been established. This can be checked by using a protractor at the blade reference station (42 inches) or by noting whether the scribe marks on the shank of each blade are aligned with the correct low pitch angle degree mark stamped on the external lip of the barrel blade bore. This low pitch angle should agree with the low stop setting in the dome assembly.

a. Set the cockpit governor control to the high rpm position and then start the engine and warm it up in accordance with procedures outlined in paragraphs 3—81 through 3—90 respectively. When the engine is started, the outboard end of the propeller dome will fill with governor pump oil. This pressure, in conjunction with the blade centrifugal twisting moment, will hold the blades against the low pitch stops. With the blades in full low pitch and the actual engine rpm lower than that for which the governor is set, the engine rpm will vary with engine horsepower output. Under this condition, the magnetos may be checked at suitable power by watching the tachometer for a drop in rpm as the magneto switch is turned. See paragraph 3—94.

b. After completing the engine warm-up period, advance the throttle to some intermediate setting (65 to 70 percent of the normal rated), for example, an engine speed of 1800 rpm. Move the governor cockpit control to the minimum rpm position. At this control setting, the engine will be turning faster than the speed for which the governor is set, and the governor will supply decrease pitch oil to the inboard side of the propeller piston. In a very short time, the inboard end of the propeller dome will have been filled with oil, and the propeller blades will move toward a higher pitch. This action will change the engine rpm to the minimum governor setting.

c. After the inboard and outboard ends of the dome have been filled with oil, move the governor control several times between the minimum and maximum settings, (allowing time for the engine speed to follow the propeller control) in order to eliminate trapped air from the propeller system. Care must be taken that engine operating temperatures are not exceeded.

d. Then move the governor control to the full "INCREASE" position.

e. Advance the throttle to hold an engine speed of 2000 rpm.

f. Move governor control from "INCREASE" to full "DECREASE". The engine speed should drop to approximately 1200 rpm.

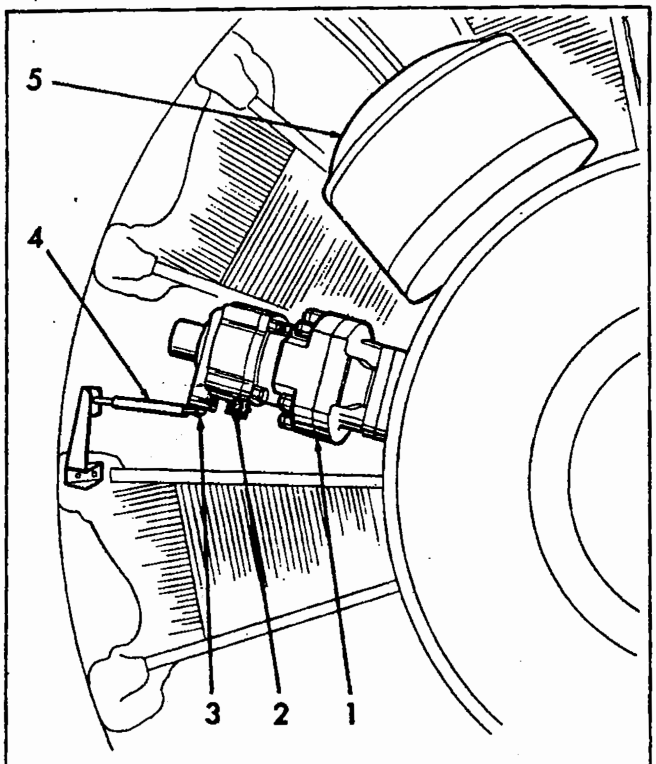
g. Return the propeller control to full "INCREASE;" the rpm should return to 2000 rpm.

h. If the above check is not satisfactory, a check of the propeller system will be necessary. If the test is satisfactory, again check the constant speed control by setting the governor to maintain constant engine rpm, and open the throttle gradually. The engine rpm should remain constant and the manifold pressure should increase.

4—633. PROPELLER GOVERNOR.

4—634. DESCRIPTION. *(See figure 4—77.)* The Hamilton Standard Hydromatic, constant speed, double-acting governor, Model 4U18-S20G, is a self-contained unit which automatically brings about the adjustments in propeller blade angles which are necessary to maintain constant engine speed under varying flight conditions. Double-acting governor pump output is directed to either side of the propeller piston. Engine oil at engine supply pressure does not enter the propeller, but is supplied only to the governor. The governor, or constant speed control, is mounted on the right hand side of the engine nose section near the right hand distributor, and is engine-driven. The propeller constant speed control unit consists of the following: gear pump, which boosts the oil to the pressure required for propeller operation, a pilot valve actuated by flyweights which controls the flow of oil through the governor, and a relief valve system which regulates the operating pressures in the system.

4—635. The rpm at which the propeller will operate is adjusted in the governor head. The operator can alter the setting by changing the position of a rack contained within the governor by means of the governor cockpit control lever; see paragraph 4—619. As the rack is lowered (propeller governor lever "INCREASE"),



1. Governor
2. High RPM Adjusting Screw
3. Lever Assembly
4. Telescopic Unit
5. R. H. Distributor (ref.)

Figure 4—77. Propeller Governor.

compression in a speeder spring is increased. *(See figure 4—78.)* This means that the engine speed necessary to maintain a balanced relationship between the flyweight's centrifugal force and the speeder spring (a state of equilibrium which establishes the on-speed condition) is also increased. If the operator raises the rack, the compression in the speeder spring is lessened and the engine rpm necessary to establish a balance between the flyweight's centrifugal force and the speeder spring is decreased. The position of the pilot valve, which is raised or lowered in accordance with the force exerted by the flyweights, regulates the quantity of oil which will flow to and from the propeller. For further details of governor operation and maintenance, see Hamilton Standard Propellers Service Manual No. 140C (AN 03-20CC-1) and Hamilton Standard Propellers Service Bulletin 108 (Navy Bulletin 48).

4—636. TROUBLE SHOOTING.

a. Check the position of the governor control lever in cockpit. Lever should be 1/8 inch from its full forward position, and the lever on governor up against the high rpm adjustment screw.

b. Check the security of the governor control linkage leading from cockpit control lever to the governor.

c. Check the security of the governor to the engine mounting pad.

d. Check the governor control shaft nut to see that it is securely locked. If nut is not secured, the control shaft may disengage from the speeder rack.

e. Check for external leakage at governor and when necessary, replace damaged gaskets and seals.

f. Disconnect the governor hub and remove control shaft packing nut. Check for wear on the control shaft packing nut bushing and replace the entire unit if it is badly worn.

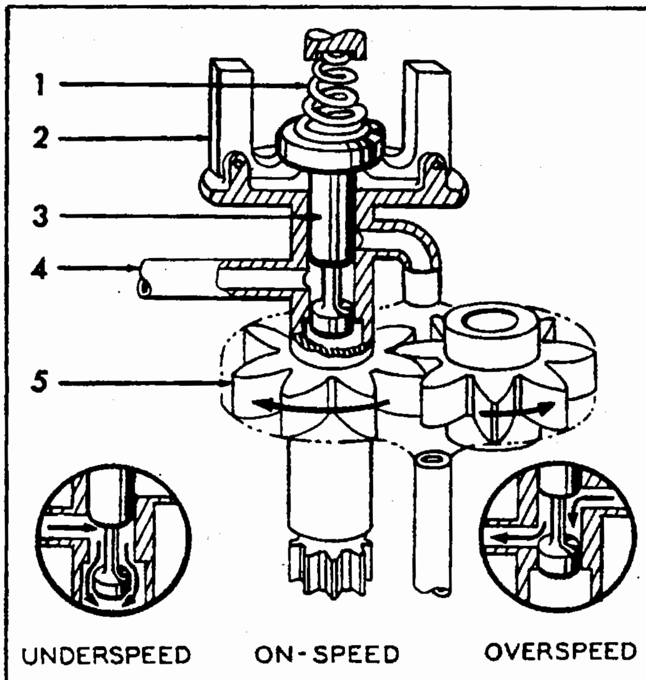
g. Place the governor control in the high rpm position ("INCREASE") and start and warm up the engine. With the engine running at reduced throttle, move governor control between the high and low settings and check operation of the system.

4—637. REMOVING. *(See figure 4—77.)* To remove propeller governor, proceed as follows:

a. Disconnect the governor control cable telescopic unit from actuating lever of the governor.

b. Remove nuts and washers securing governor to engine nose.

c. Remove governor and governor mounting gasket from mounting pad on the engine.



1. Speeder Spring
2. Fly-weights
3. Pilot Valve
4. Propeller Passage
5. Booster Gear Pump

Figure 4—78. Governor Basic Operating Diagram.

Note

After removing the governor, install the governor mounting pad cover on the engine until governor is again installed.

4—638. ADJUSTING. The governor is usually adjusted for the take-off rpm on a test stand. However, if additional adjustment is necessary, the procedure for determining the final setting is as follows:

a. Set the governor for 2800 rpm.

b. Open the throttle until 2800 engine rpm is obtained. If the engine rpm remains at 2800 as the throttle is opened further, the high rpm setting is satisfactory. If not, further adjustment of the governor must be made.

WARNING

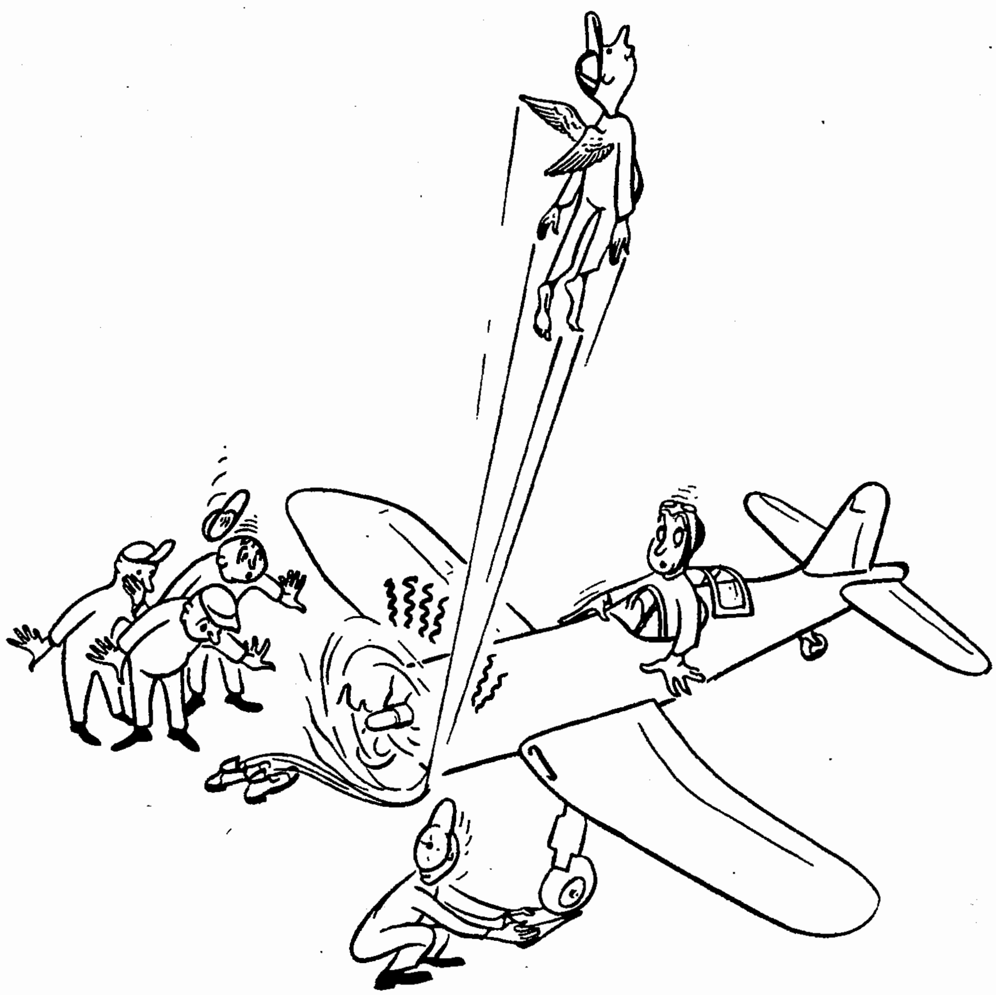
The tail of the airplane must be tied down when ground-running the engine at this manifold pressure.

c. To increase the rpm (low blade angle), rotate the high rpm adjusting setscrew counterclockwise (facing the screw slot). One complete turn of the screw increases the rpm by approximately 25 rpm. *(See figure 4—77.)*

d. To decrease the rpm, rotate the high rpm setscrew clockwise. One complete turn will decrease engine rpm by approximately 25 rpm.

e. Additional adjustment of the governor can be made at the ring and hub assembly where the forward end of the governor control telescopic unit is secured. To make the adjustment, remove the lock wire from the four nuts and bolts holding the governor actuating lever in the ring and hub assembly. Loosen the nuts and rotate the lever to the desired position, afterward tightening and safety wiring the nuts.

4—639. INSTALLING. Installation of the governor is the reverse of the procedure described in paragraph 4—637.



4—640. STARTING SYSTEM.

4—641. DESCRIPTION. The electrical power for starting and operation of the engine is supplied by an installation consisting of a 24 volt, 17 ampere-hour battery, and a 28 volt, 200 ampere generator, along with the necessary switches and relays. The power for starting can be taken from the battery or from an external power source. These sources are all connected to the plus bus in the electrical control panel, the system thus operating on the plus bus regardless of source. See paragraphs 5—65 and 5—67 for electrical wiring diagram information. The following comprise the electrical units of the starting system:

a. A starting switch, located on the pilot's right hand console, is moved to close the electrical circuit between the power source and both the induction vibrator and the starter. The switch is the momentary or push button type and must be held in the "on" position as long as the starter is to operate.

b. A starter circuit-breaker, located on the inboard face of the right hand console, protects the starter circuit. The circuit-breaker will remain closed during normal operation, but will snap open and remain open should an electrical overload occur.

c. A primer switch and solenoid, which actuates a valve on the carburetor is provided to feed gasoline to the top engine cylinders. Power for the primer circuit is taken from the starter circuit-breaker which is connected to the plus bus.

d. A starter relay is located in the main junction box beneath the circuit-breaker panel under the cockpit floor. Access to the main junction box is through the belly access door.

e. The induction vibrator is a device which supplies a pulsating current to the primary coils of the magneto to aid in starting the engine while engine rpm and magneto voltage are low. The induction vibrator is located on the right hand side of the engine mount and is accessible when the right hand accessory section cowling is removed.

f. The electrical starter is mounted on the left hand side of the forward face of the engine accessory drive housing and when energized, causes the engine to rotate through the meshing of the starter dog and mating dog of the engine gear train.

g. The engine ignition system, which consists of a dual magneto, right and left hand distributors and spark plugs, completes the starting system. The magneto has two breaker systems, each of which controls the current to one distributor. The left distributor supplies current to the rear spark plugs in all cylinders and the right distributor supplies the front spark plugs in all cylinders. The two distributors and ignition harness form a completely shielded unit to carry current to the spark plugs. Each distributor carries an air pump and is provided with a piping system, to pressurize the magneto and the distributors.

h. The battery is located underneath the cockpit floor on the left hand side of the cockpit. The battery switch is located on the right hand console, inboard and underneath the voltammeter. When the battery switch is "ON," current is furnished to start the engine and operate accessories. When the switch is "OFF," no power is furnished by the battery for any load. When the airplane is on the ground and the engine is not running, the battery switch should be moved to the "OFF" position to prevent drain on the battery. For all ground running and flight operation, the battery switch should be turned "ON." However, when power to start the engine is taken from an external source, the battery switch should be "OFF."

Note

It is recommended that an external source of power be used for engine starting, to conserve battery energy.

The external power receptacle is located on the right hand side of the fuselage at station 165. Two disconnects for the starting system are made at the firewall junction box at fuselage station 100 (on the front face of the main beam).

i. An ignition switch (AN3212-1) is located on the upper left hand corner of the instrument panel to the left of the manifold pressure gage. When the ignition switch is "ON" ("BOTH"), the circuit is open, in contrast to all other electrical circuits which are closed when their switches are on. When the ignition switch is "OFF," the circuit is closed and the current grounded.

4—642. STARTING PROCEDURE. The following is the recommended procedure and check list to be used when starting the engine. See figures 3—11, 3—12 and 3—13 for cockpit familiarization. For details of engine warm-up, ground test and engine stopping, see paragraphs 3—89 to 3—106 inclusive.

a. Ignition switch—"OFF."

b. Cowl flap switch—"AUTOMATIC." (The flaps will be open while the airplane is on the ground, the microswitch on the left hand landing gear actuating the flap open circuit.)

c. Oil cooler door switch — "AUTOMATIC."

d. Intercooler flap switch — "AUTOMATIC."

e. Master water injection switch — "OFF."

f. Mixture control — "IDLE CUT-OFF."

g. Throttle — set to give 800-1000 rpm (approximately one inch from full closed position) after engine starts.

h. Propeller control — full "INCREASE."

i. Auxiliary (booster) fuel pump switch — "OFF."

j. Transfer pump switch — "OFF."

k. Oil dilution switch — "OFF."

l. Battery switch — "OFF" and external power source disconnected until propeller is pulled through four or five complete revolutions of the crankshaft to clear out engine; then have external power source connected.

m. Fuel selector — "ON."

n. Auxiliary (booster) fuel pump switch—"LOW" (check that fuel pressure is approximately 10 psi).

o. Ignition switch—"BOTH."

p. Prime engine as necessary.

q. Engage starter. If engine does not fire almost immediately, continue to prime. Do not operate the mixture control or pump the throttle to prime.

r. When the engine begins to fire regularly on prime, move the mixture control to "RICH." Do not pump or move the throttle abruptly. There will be a lapse of time after moving the mixture control into the "RICH" position until fuel feeds from the discharge nozzle. Therefore, it is IMPORTANT to keep the engine firing regularly (at least 350-400 rpm) by continuing to use the priming switch until normal carburetion is established. If, for any reason, the engine stops firing, move the mixture control to "IDLE CUT-OFF" immediately, and continue cranking and priming until the engine starts.

Note

Normally, it should not be necessary to operate the starter any more than 30 seconds in order to start the engine. If the starter switch is held on for one minute and the engine does not start, allow the starter to cool for one minute before making another attempt to start. After the second and succeeding cranking cycles, allow five minutes for cooling.

s. Idle the engine 600 to 800 rpm until normal oil pressure is built up (100 psi minimum). If oil pressure does not register on gage almost immediately, STOP THE ENGINE AND INVESTIGATE.

Note

The high pressure oil relief valve will register values up to 400 psi until engine oil is at running temperature, and then fall off rapidly to 100 psi. High pressure is necessary to force oil through every oil passage in the engine.

4—643. FAILURE TO START ON FIRST ATTEMPT. If the engine does not start, wait a few minutes to allow excess fuel to drain out of the blower drain and the carburetor air box drain. Ground crew standing by with fire extinguisher should check for fire in the induction system through the carburetor air box drain and for fire in the exhaust pipe outlets; see paragraph 4—645.

4—644. IMPROPER PRIMING. Inspection of the exhaust pipe outlets of the upper cylinders should indicate whether the engine has been over- or under-primed. No trace of smoke from the exhaust pipe outlets indicates under-priming. Excessive black smoke from the exhaust outlets indicates over-priming. If the engine is over-primed, clear the cylinders and induction system of excess fuel as follows:

a. Mixture control—"IDLE CUT-OFF."

b. Auxiliary (booster) fuel pump switch—"OFF."

c. Ignition switch—"OFF."

d. External power supply—disconnected.

e. Throttle—full open.

f. Clear engine by turning the engine over at least four complete revolutions by hand.

WARNING

Never turn over a hot engine by hand.

4—645. ENGINE FIRE DURING STARTING. If an induction system fire should break out while starting the engine, keep the engine running. In many cases, this will draw the flames back up into the cylinders. If this, and the application of CO_2 by the ground crew to the drain valve in the carburetor air-box is not effective in extinguishing the flames (while the ground crews continue to apply CO_2), proceed as follows:

a. Move mixture control to "IDLE CUT-OFF."

b. Auxiliary (booster) pump switch "OFF."

c. Throttle—open.

d. Ignition—"OFF."

4—646. IGNITION SAFETY CHECK. The ignition safety check may be performed during warm-up with the engine idling at 1000 rpm.

a. Switch ignition from "BOTH" to "RIGHT" and back to "BOTH."

b. Switch ignition from "BOTH" to "LEFT" and back to "BOTH."

c. Switch ignition to "OFF" (momentarily) and back to "BOTH." A slight drop in rpm when operating on each separate magneto and complete cutting out of the engine at the "OFF" position indicates proper connection of the ignition leads.

4—647. After the engine has warmed up, perform the following test. With the propeller in high rpm position, and mixture control in "RICH," operate the engine on both magnetos then switch from operation on "BOTH" to "LEFT" and note the drop in rpm. The normal drop-off is 50 to 75 rpm, and should not exceed 100 rpm. Switch back to operation on "BOTH" to clear the plugs which have been inoperative; then operate on "RIGHT." The difference between operation on "LEFT" and "RIGHT" should not exceed 30 to 40 rpm. If the rpm drop-off is in excess of these limits, the ignition system must be thoroughly checked and the cause determined.

4—648. TROUBLE SHOOTING. The following chart outlines the most common symptoms of engine troubles, their possible causes and remedies. Locating and correcting engine starting troubles should be accomplished by first studying the symptoms carefully and then checking each possible cause beginning with the most probable, until the exact cause of the trouble is determined.

Trouble	Probable Cause	Suggested Remedy
Failure to start.	*a.* Insufficient or fluctuating fuel pressure.	*a.* Check fuel gage to make sure fuel tanks are full. Check operation of engine-driven and auxiliary fuel pumps. Check fuel lines, connections, joints, and clamps for tightness.
	b. Under priming.	*b.* Increase priming; check auxiliary fuel pump pressure (10 psi in "LOW"). If prime is still insufficient, check for clogged lines and leaks in system.
	c. Over priming.	*c.* See paragraph 4—644; repeat starting procedure, maintaining priming to a minimum.
	d. Defective priming solenoid valve.	*d.* If prime to cylinders is excessive, check priming solenoid valve for leakage and sticking. If prime fuel is insufficient, check auxiliary pump. Repair or replace solenoid valve or pump if necessary.
	e. Vapor in fuel system.	*e.* Operate auxiliary pump; allow vapor to vent from lines. Remove vent plug from carburetor, place mixture control in "RICH," and operate (booster) pump until fuel spurts from vent; then reinstall vent plug.
	f. Incorrectly adjusted carburetor control linkage.	*f.* Adjust linkage so that movement of cockpit controls results in corresponding correct movement of throttle and mixture control levers. (See paragraphs 4—613 and 4—618.)
	g. Internal carburetor trouble.	*g.* Replace carburetor. (See paragraph 4—534.)
	h. Loose or defective spark plugs.	*h.* Tighten loose plugs to a torque of 300 to 360 inch-pounds. Check for fouled plugs, plugs improperly gapped, cracked ceramic insulation. Replace the plugs; see paragraph 4—666.
	i. Defective spark plug lead connectors.	*i.* Clean dirty or oily connectors with a dry, clean cloth. Replace cracked connectors.
	j. Moisture or oil in magnetos.	*j.* Clean the distributor terminal blocks and distributor rotor with lintfree cloth.
	k. Internal magneto trouble.	*k.* Trouble indicated by an excessive drop-off in either left or

Trouble	Probable Cause	Suggested Remedy
Failure to start (Con't.)		right ignition switch position (but not both may be localized as follows: By means of auxiliary jumper leads, it is possible to reverse the ignition switch operation so that turning the switch to "RIGHT" will fire the rear spark plugs and turning the switch to "LEFT" will fire the front spark plugs. Thus, if the ignition trouble remains with switch position in which it was first encountered, it is obvious that the magneto is at fault. If the trouble should change to opposite switch position, the ignition manifold and cable assembly or spark plugs are defective.
	l. Defective ignition manifold and cable assembly.	*l.* To determine that an ignition wire is defective, apply continuity and high voltage tests. Replace spark plug leads where indicated. (See P & W Engine Service Instructions Manual AN 02-10GE-2.)
	m. Inoperative induction vibrator.	*m.* If no buzzing sound is heard from the vibrator when starter switch is on, replace vibrator. See paragraph 4—662.
	n. Restriction or leaks.	*n.* Remove airbox from carburetor (see paragraph 4—558) and check screen for foreign matter. Check security of carburetor on engine and that all intake nuts are tight. Check intake pipes for cracks. Check airplane air induction system; (see paragraph 4—543.)
	o. Improper cylinder valve clearance.	*o.* Adjust clearance. (See P & W Engine Service Instruction Manual AN 02-10GE-2.)
	p. Sticking cylinder valves.	*p.* Lubricate sticking valves. Replace cylinder if necessary. (See P & W Engine Service Instructions Manual AN 02-10GE-2.)
	q. Broken cylinder valve springs.	*q.* Replace. (See P & W Engine Service Instructions Manual AN 02-10GE-2.)
	r. Insufficient cranking speed.	*r.* Check for weak battery (see paragraph 5—45) and condition of starter. (See paragraph 4—659.)

4—649. STARTING SWITCH.

4—650. DESCRIPTION. The starting switch, manufactured by Acro Manufacturing Corporation, Cleveland, Ohio, (their part number 3N05-5P), is a push button type switch located on the right hand console outboard of the battery switch, and under the voltammeter. Pushing and holding the switch down initiates the engine starting cycle.

4—651. STARTER CONTACTOR.

4—652. DESCRIPTION. The starter contactor (relay), Army type B-8, is located in the main junction box below the circuit-breaker panel, under the cockpit floor, at fuselage station 149. When the starter switch is closed, current passes from the plus bus to the starter relay which directs current to both the starter and the induction vibrator. Refer to paragraph 5—67 for wiring diagram information.

4—653. REMOVING.

a. Remove belly access door.

b. Remove cover of main junction box.

c. Disconnect leads from right hand control shelf.

d. Disconnect leads from starter relay to starter and induction vibrator.

e. Remove screws securing starter relay to junction box.

4—654. INSTALLING. Reverse removal procedure.

4—655. STARTING MOTOR.

4—656. DESCRIPTION. *(See figure 4—79.)* The Jack and Heintz starter, (their model number JH6PKR3), AN4116-R5 is an electric, direct cranking type starter. It is mounted to the forward face of the engine accessory drive housing, on the left hand side. Access to the starter is obtained by removing the upper engine accessory section cowl panel. Current is supplied to the starter from the airplane battery, or an external power source, if used, through the electric conduit connector on the starter motor case. The starter is grounded to the upper left hand engine mount member. See paragraph 5—67 for wiring details.

4—657. When the motor is energized, the starter jaw is mechanically engaged to the engine jaw, and when the engine starts, the sloping ramps of the teeth disengage the jaws. When the starter motor is de-energized and comes to rest, the starter jaw remains clear of the engine jaw. The electric starting motor converts electrical energy into mechanical energy. A traveling nut cone of the starter jaw and cone assembly tends to rotate at the same speed as the jaw by reason of the conical clutch surfaces of these two parts which are engaged by jaw spring pressure. A sun gear shaft extension, whose spiral splines engage similar splines of the nut cone, turns six times as fast as the jaw and nut cone. In this starter (right hand) these spiral splines are cut left hand, and the sun gear shaft extension, turns to the right in relation to the jaw, forcing the jaw out from the starter. The jaw moves outward its full travel (about 5/16 inch) in approximately 12 degrees rotation of the jaw. The jaw moves out until it is stopped either by engagement with the engine jaw or by a jaw stop retainer. The traveling nut continues to move slightly beyond the limit of jaw travel, just enough to relieve some of the spring pressure on the conical clutch surfaces. As long as the starter continues to rotate, there will be just enough pressure on the conical clutch surfaces to provide torque on the spiral splines to balance most of the pressure of the jaw spring. The remaining small force of the jaw spring is applied to the conical clutch surfaces to provide the balancing force originally mentioned. If the engine fails to start, the starter jaw will not retract, since the starter mechanism provides no retracting force. However, when the engine fires and the engine jaw overruns the starter jaw, the sloping ramps of the jaw teeth force the starter jaw into the starter against the jaw spring pressure. This disengages the conical clutch surfaces entirely, and there is no longer any engaging force, so the jaw spring pressure forces the nut cone to slide in along the spiral splines until the conical clutch surfaces are again in contact. With the starter and engine both running there will be an engaging force keeping the jaws in contact, which will continue until the starter is de-energized and comes to rest. However, the rapidly moving engine jaw teeth, striking the slowly moving starter jaw teeth, hold the starter jaw disengaged. As soon as the starter comes to rest, the engaging force is removed, and the starter jaw will be thrown into its full retracted position, where it will remain in preparation for the next start. When the starter jaw first engages the engine jaw, the motor armature frequently has had time to reach considerable speed due to its high starting torque. The sudden engagement of the moving starter jaw with the stationary engine jaw would develop forces sufficiently high to severely damage the engine or starter, were it not for the starter clutch, which slips when the torque exceeds a certain value. The clutch serves a similar function in the case of engine backfire, which attempts to drive the engine and the starter backwards. In normal direct cranking action, the internal gear clutch plates are held stationary by the friction of the bronze clutch plates with which they are interleaved. When the torque imposed by the engine exceeds the clutch setting, however, the internal gear clutch plates rotate against the clutch friction, which allows the planet gears to rotate while the planetary carrying arm and the jaw remain stationary. When the engine comes up to speed at which the starter is trying to drive it, the torque drops off to a value less than the clutch setting, the internal gear clutch plates are again held stationary, and the jaw rotates at the speed at which the motor is attempting to drive it. The starter is not provided with hand cranking facilities nor is it designed for inertia or a combination of inertia and direct cranking.

4—658. To operate the starter, close the main battery switch, or if available, an outside source of direct 24 volt current can be plugged into the external power recep-

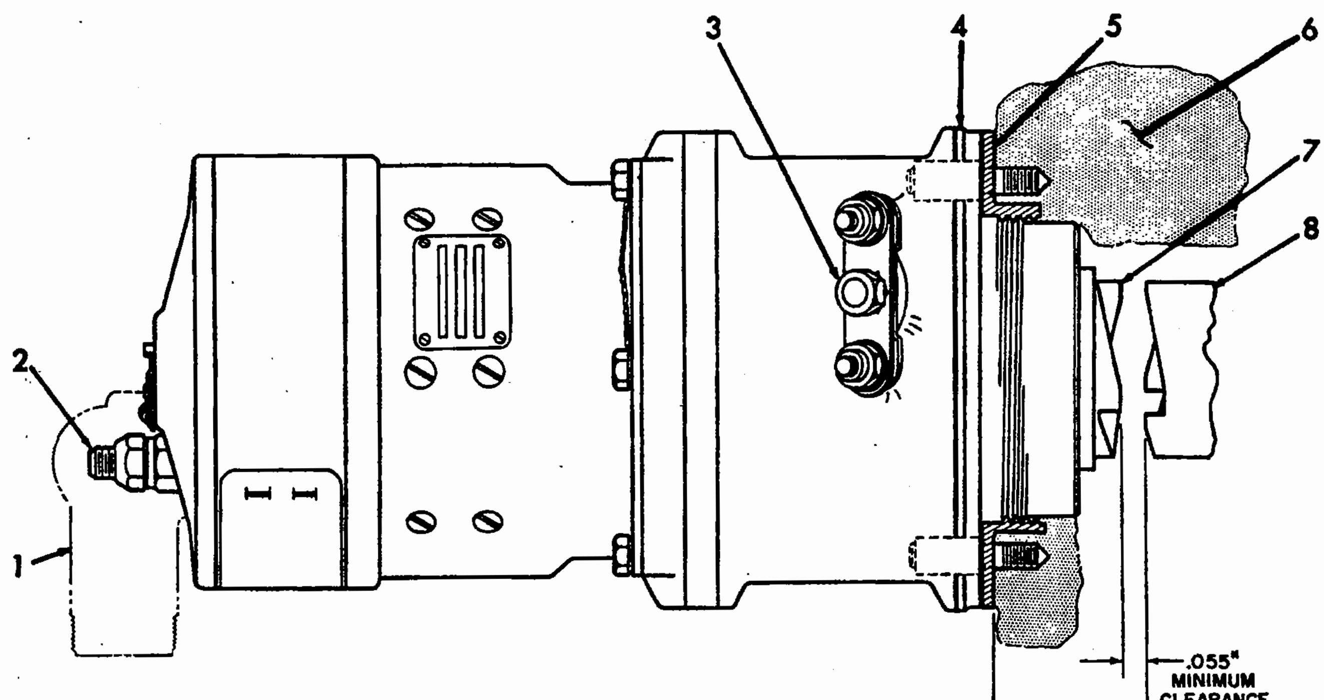


Figure 4—79. Engine Starting Motor.

tacle in the right hand side of the fuselage, just above the flap match angle. ALWAYS USE EXTERNAL POWER IF AVAILABLE, TO CONSERVE THE BATTERY. Then close the starter switch. When the starter motor is energized, the starter jaw engages the engine jaw and cranks the engine.

CAUTION

When the airplane battery is used as the sole source of power supply for cranking, do not crank for a period exceeding 30 seconds at any one time. Allow a 30 second rest period between successive crankings. Using an outside source of power, do not crank for more than one minute and allow one minute cooling periods.

4—659. TROUBLE SHOOTING.

a. Inspect starters daily for cracked housing or flanges, for security of mounting, tightness of housing, missing bolts and nuts, and safetying of all attaching or connecting bolts.

b. Inspect main power cable to be sure it is tightly secured to the terminal post.

c. Inspect the starter for cleanliness. There should be no excessive evidence of oil, especially around the band over the brushes.

d. Remove the band assembly over the commutator and brushes, and examine brushes for freedom of movement. Brushes should have at least 80 percent seating surface, and should not be badly chipped, cracked, pitted or worn on the sides from contact with the brush holders.

e. Replace brushes if length is 5/8 inch or less. New brushes should be inserted correctly for the direction in which motor rotates. Seat new brushes on the commutator by running the starter on a low voltage source of dc power, such as a 6 volt storage battery. Do not use any higher voltage. A mild brush seating compound can be used on the commutator to speed the seating. At least 80 percent seat should be obtained. Blow all dust out of motor using low pressure compressed air.

f. Inspect the commutator which must be smooth and free from badly blackened or pitted bars. The commutator can be rotated slowly for inspection by slipping the spring cover in the end bell to one side and inserting a 5/16 inch Allen wrench in the hexagon hole in the end of the armature shafts. After inspection, immediately slip the spring cover back in place.

g. Inspect brush holders for looseness, damage, and weak or broken springs.

h. Inspect brush leads for fraying, and see that leads are securely fastened to brush holders.

i. Inspect commutator for roughness and pits. To smooth commutator, use the commutator honing kit recommended by the manufacturer. Apply the hone solidly and with a light pressure. Hone only enough to remove burrs on edges of commutator bars.

j. Clean commutator of grease and oil.

Note

Starters are to be overhauled at time of engine overhaul. The time between starter overhauls is not to exceed 800 hours.

Trouble	Probable Cause	Suggested Remedy
Starter fails to operate or, operates at too low a speed.	*a.* Low voltage due to discharged battery.	*a.* Check and recharge battery; see paragraph 5—45.
	b. Loose, dirty, or improper external electrical connections.	*b.* Check wiring for defective connections. *See figure 5—8.*
	c. Control switch or relay inoperative.	*c.* Adjust or replace.
	d. Binding, worn, or improperly seated brushes.	*d.* Service the brushes.
	e. Dirty commutator.	*e.* Clean commutator.
	f. Rough, pitted, or scored commutator.	*f.* Resurface the commutator.
	g. Commutator not concentric.	*g.* Resurface the commutator
	h. Shorted, grounded, or open armature.	*h.* Replace armature.
	i. Grounded or open field coil.	*i.* Replace field coil.
	j. Brushes worn out.	*j.* Replace brushes if commutator is undamaged. Otherwise return starter to overhaul activity.
Motor operates but jaw fails to engage.	*a.* Defective jaw engaging mechanism.	*a.* Return starter to overhaul activity.

4—660. REMOVING. To remove the starter, proceed as follows:

a. Remove engine accessory section upper cowl panel and left hand upper wing gap cover.

b. Disconnect the electrical conduit at the starter.

c. Disconnect ground wire at side of starter.

d. Depress the spring-loaded locking plate which secures the starter mounting bolt. Note position of locking plate in relation to the mounting bolt and rotate the bolt to remove the starter.

e. Remove starter from engine.

f. If necessary, remove starter mount adapter from engine by removing the six special nuts which secure the adapter to the engine.

4—661. INSTALLING. Installation of the starter is the reverse procedure of that described in removal. In the event a new starter is to be installed, the following steps should be observed.

a. Check to see that the engine jaw and starter jaw are identical as to the number of teeth, size of jaw, and direction of rotation as indicated by the cut of the teeth.

b. Check the depth from the face of the engine mounting pad, less the gasket and adapter, to the tip of the engine jaw teeth. The depth should be 1.688 inches (plus .016, minus .031 inch) to insure that there will be at least .055 inch clearance between the engine and starter jaws, when the starter jaw is in its fully retracted position; *See figure 4—79.* Measure the depth of the starter jaw from the face of the starter mounting adapter. This distance should be 1.625 inches. Gasket thicknesses should be determined so that the clearance between the engine and starter jaws is at least 1/16 inch.

4—662. INDUCTION VIBRATOR.

4—663. DESCRIPTION. The 27 volt, 3 ampere induction vibrator, (AN4114-1) manufactured by American Bosch Corporation of Springfield, Mass., (their part number VJR-24C3 or VJR-24C5), is mounted on the right hand upper side of the engine mount and is accessible when the upper engine accessory cowl panel and the right hand upper wing gap cover are removed. The purpose of the induction vibrator is to furnish a pulsating current to the primary coils of the magneto to aid in providing sufficient current when starting the engine. After the engine starts, the magnetos take over the function of the vibrator. *See figure 5—9 for wiring diagram information.*

Figure 4—80 deleted

4—664. REMOVING. To remove the induction vibrator, proceed as follows:

a. Remove upper engine accessory cowl panel and right hand upper wing gap cover.

b. Disconnect electrical lead from induction vibrator to dual magneto.

c. Disconnect electrical lead from induction vibrator to engine section junction box.

d. Remove three bolts and nuts securing vibrator to bracket on right hand upper engine mount member.

e. Remove mounting bracket from engine mount member.

4—665. INSTALLING. Installation of the induction vibrator is the reverse of that procedure described in removal.

4—666. SPARK PLUGS.

4—667. DESCRIPTION. Two RC-34S Champion spark plugs are installed in each engine cylinder to complete the ignition system. The front row spark plugs of each cylinder are supplied electrical current by the right hand distributor, while the rear row spark plugs of each cylinder are supplied by the left hand distributor. All spark plugs are installed in Heli-coil inserts previously inserted in each spark plug cylinder port. The purpose of the Heli-coil inserts is to protect the spark plug port threads from damage.

4—668. TROUBLE SHOOTING.

a. Inspect spark plugs for looseness and defects. Remove slight thread imperfections by running an 18-1.5 mm die by hand over the imperfect threads.

b. Inspect spark plug leads for defects.

c. Inspect spark plug gap clearance.

d. Inspect spark plug terminal sleeves for presence of oil, dirt, cracks or scratches.

e. Check spark plug lead nuts for tightness.

f. Inspect Heli-coil inserts for breakage.

4—669. REMOVING.

a. Disconnect the spark plug lead from the spark plug, using a PWA-1683 wrench.

b. Remove spark plug with a PWA-3168 wrench.

Note

Instructions for removing Heli-coil inserts are given in Pratt and Whitney Engine Service Instructions Manual (AN 02-10GE-2).

4—670. INSTALLING.

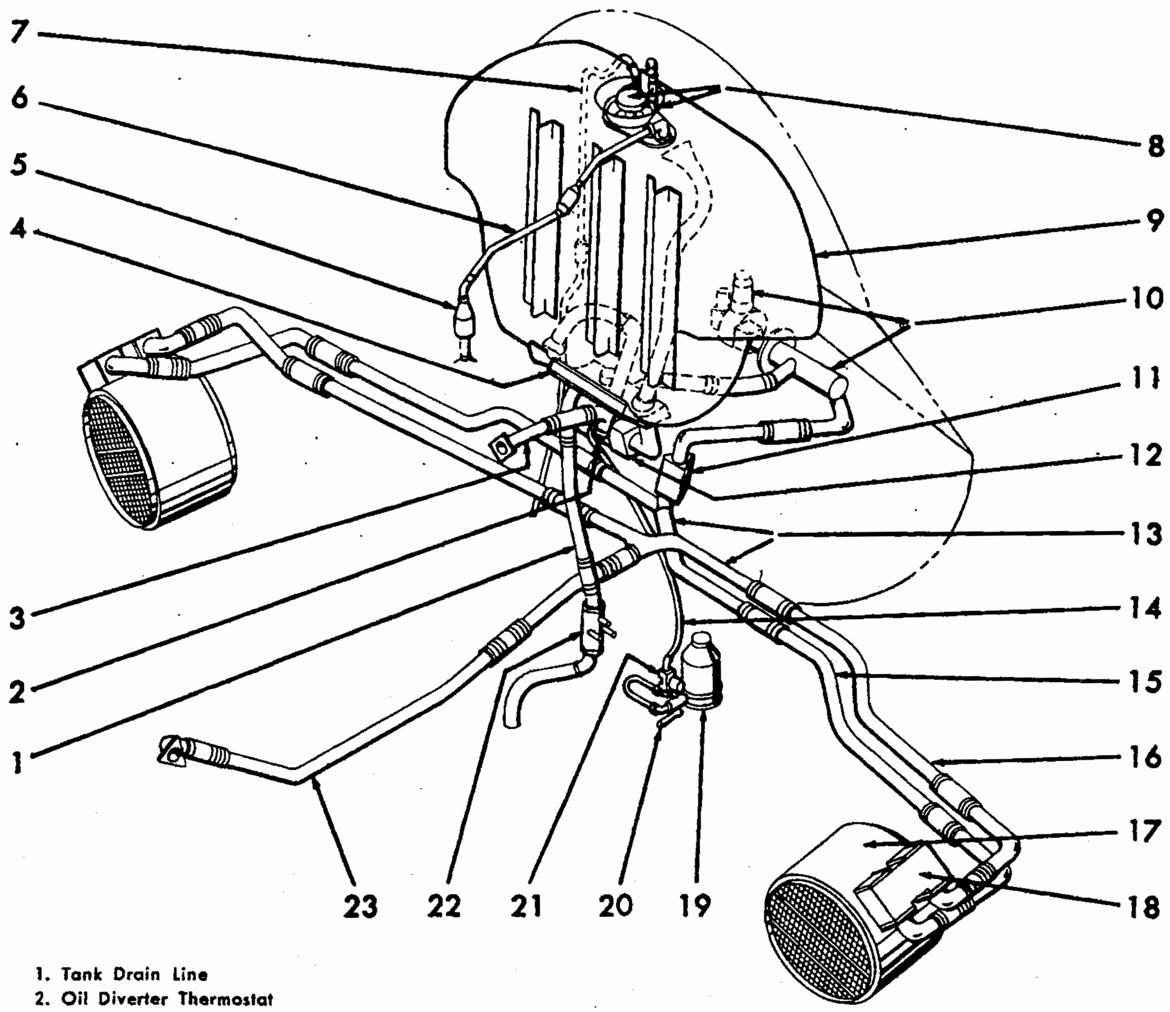
a. Install spark plugs after inspecting plugs for nicks, burrs, or other imperfections. Clean plugs, if necessary, with unleaded gasoline, then dry and bomb test. Apply a small amount of Champion No. 119 graphite or graphite-petrolatum (Spec. No. AN-C-147) anti-seize compound to the first two or three threads and install a serviceable solid copper gasket. Be certain that only one gasket is installed. Start the plug in the insert and screw it down with the fingers until the gasket is seated. Use a PWA-3168 wrench to tighten the plug to a torque of 300 to 360 inch-pounds.

WARNING

Because of their high electrical conductivity, it is of the utmost importance that graphite compounds be handled carefully. Barely perceptible traces of graphite, especially on the spark terminal contact sleeves of the ignition cable, will reduce insulation efficiency greatly and cause flashover in the plug barrel with resulting plug failure. Similarly, the plug will be shorted, if the graphite compound is smeared on any part of the electrodes.

b. Using a brush, apply a thin coating of AN-C-128 compound to the spark plug lead connector. Do not apply the compound with fingers, as moisture tends to make compound inefficient.

c. Carefully insert each connector into its spark plug barrel. Before tightening the spark plug lead nuts, remove any compound which may have been deposited on the threads of the spark plug barrels. Tighten the lead nuts finger tight and then a half turn more, using a PWA-1683 wrench.



1. Tank Drain Line
2. Oil Diverter Thermostat
3. Oil-to-Engine Line
4. Sump Assembly
5. Pressure Regulating Check Valve
6. Vent Line to Engine
7. Scupper Drain Tube
8. Filler Neck and Scupper
9. Oil Tank (see figure 4-83)
10. Automatic Oil Cooler Door Control Valve
11. Check Valve
12. Diverter Valve
13. Dummy By-pass Unit
14. Oil Dilution Fuel Line
15. Line to Oil Cooler
16. Line from Oil Cooler
17. Oil Coolers (left and right)
18. Oil Cooler Thermostatic Valves (left and right)
19. Fuel Strainer
20. Oil Dilution Manual Shutoff Valve
21. Oil Dilution Solenoid Valve
22. Drain Valve
23. Oil-from-Engine Line
24. Oil Cooler Door Control Switch
25. Oil Cooler Door and Intercooler Flap Position Indicator
26. Engine Gage Unit — ("Oil-in" Temperature and Oil Pressure Indicator)
27. Oil Dilution Switch

OIL COOLER SHUTOFF CONTROLS AND WARNING LIGHTS. NOTE: THESE CONTROLS ARE INOPERATIVE (NOT CONNECTED) UNLESS BY-PASS VALVES ARE INSTALLED.

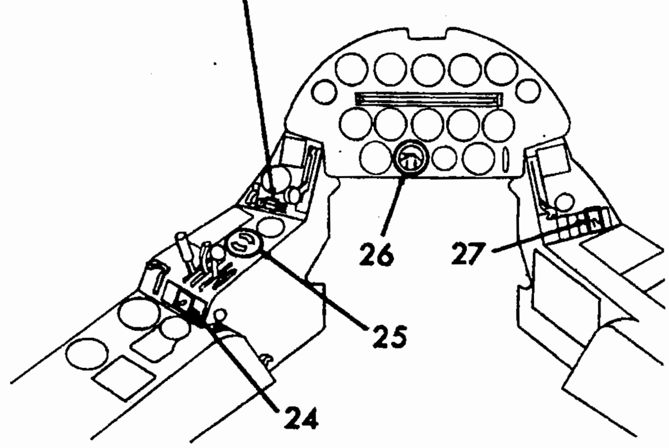


Figure 4—81. Oil System Reference Diagram.

4—671. OIL SYSTEM.

4—672. DESCRIPTION. *(See figure 4—81.)* The major units in the oil system include the supply tank, necessary piping and connections, a parallel by-pass system of oil distribution to the oil coolers, the oil coolers, an oil dilution system for cold weather starting, an oil diverter valve, a temperature gage and a pressure gage.

4—673. FUNCTION. *(See figure 4—82.)* The oil for the engine and propeller is carried in an aluminum alloy tank in the top of the accessory compartment just forward of the firewall. The oil is drawn through a supply line at the bottom of the tank into the engine lubricating system. The oil is pumped from the engine by the engine scavenge pumps out through the oil return lines, and simultaneously distributed to both oil coolers. This oil cooling system is known as a parallel system. When the oil scavenged from the engine is comparatively cool, the thermostatic valves on the oil coolers will automatically by-pass the oil around the oil cooler cores, permitting it to flow through the return lines to the warm-up compartment of the tank without much cooling. After the engine is warmed up and the oil reaches a normal temperature, the hot oil opens the thermostatic valves on the cooler which then direct the oil through the cores of the coolers; from the coolers the oil returns through the oil return lines to the top of the oil tank. Cooling air for the oil coolers is furnished through air intake ducts located in the wing center section leading edge. Automatically controlled oil cooler doors, located on the under side of the wings directly behind each oil cooler, regulate the flow of air through the oil coolers. The oil cooler door control valve is actuated by a thermosensitive element immersed in a well in the oil return line. The thermosensitive element controls the hydraulic valves which open and close the oil cooler doors through hydraulic actuating cylinders. This automatic control valve is set to start to open the oil cooler doors when the oil reaches a temperature of 75°C (167°F). The doors reach the full open position at 95°C (203°F). An electrical override permits manual operation of the doors to either the open or closed position. See paragraphs 4—1219 through 4—1244 for complete hydraulic information on the oil cooler door control system. A check and vacuum relief valve in the oil tank vent line regulates the oil tank pressure to four psi for all normal operation and prevents more than one psi vacuum in the tank during a dive. Oil is supplied to the engine and the propeller in inverted flight by a pendulum type intake tube within the warm-up compartment of the oil tank. The volume of oil contained in this compartment is limited to eight gallons. Usable oil in the inverted position is 7.5 gallons. Oil temperature and pressure are read on the engine gage unit on the instrument panel. (For further detail on engine gage unit, see paragraphs 4—1425 through 4—1432.) The indicated temperature and pressure is that existing in the engine just after the oil has passed the engine main oil pump.

4—674. Due to difficulties in starting aircraft engines in cold weather, an oil dilution system is incorporated in the oil inlet line to the engine. When cold starting conditions are anticipated for the next flight, the oil dilution shut-off valve in the engine accessory compartment is manually opened and the pilot closes the oil dilution switch in the cockpit before the engine is stopped, allowing fuel to enter the "oil-in" line. This operation permits diluted oil to replace the undiluted oil throughout the entire engine, thereby facilitating starting in cold weather. The diluted oil is returned through a diverter valve on the bottom of the tank to the warm-up compartment of the oil tank. Diluted oil then will be the first oil used at the next start, thereby insuring a more positive flow to the engine pump and oil passages. After the engine has been started, the gasoline in the diluted oil evaporates as the engine warms up so that the lubricating oil returns to its original condition.

4—675. FILLING OIL SYSTEM. The oil tank filler neck is accessible when the oil filler door on the upper accessory compartment panel is opened. A bayonet-type gage is attached to the filler cap. When filling the tank, do not exceed the rated oil capacity of 27.5 U. S. gallons. Use grade 1100, Spec. AN-O-8 oil when filling the oil tank for flight operations. Drain and refill the oil tank at maximum intervals of 60 hours of operations. The oil should be changed sooner if it is found to contain excessive amounts of carbon or sludge. After the filling operation is completed, open the oil system drain cock and allow a small quantity of oil to flow through the connecting lines, thus eliminating any air entrapped in the system.

4—676. DRAINING OIL SYSTEM.

a. The system should be drained preferably while the engine is still warm. Drain the oil tank by cutting the safety wire and opening the oil drain valve mounted on the lower left hand tube of the engine mount. Drain the oil into a clean container.

b. To drain the remaining oil from the tank, remove the oil tank sump plug; this oil may contain dirt accumulation and should not be used again.

c. Remove the oil drain plug from the rocker box oil sump located in front of engine between cylinders number ten and twelve.

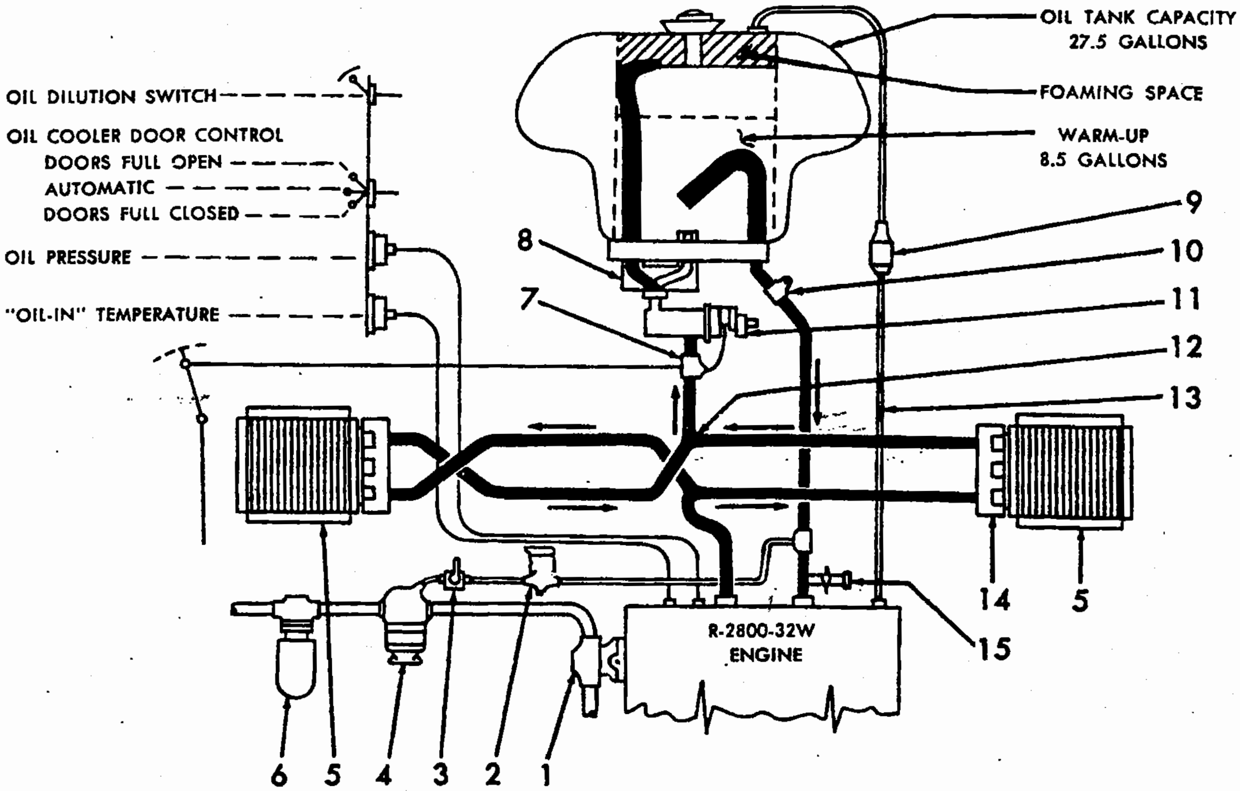
d. Remove oil drain plug from the main oil sump, and from the main oil screen cover in the rear section.

e. Remove the rear section oil drain plug located at the left side of the main oil screen chamber.

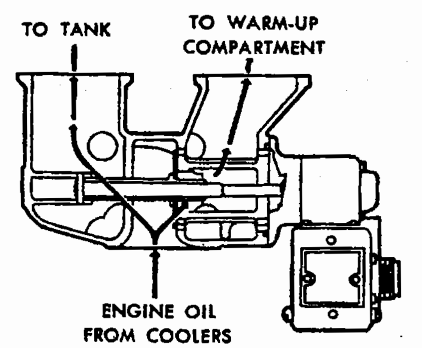
f. Check all oil drain plugs and strainers for foreign matter or metallic particles.

g. Clean and replace the plugs, strainers, and screens when drainage has been completed.

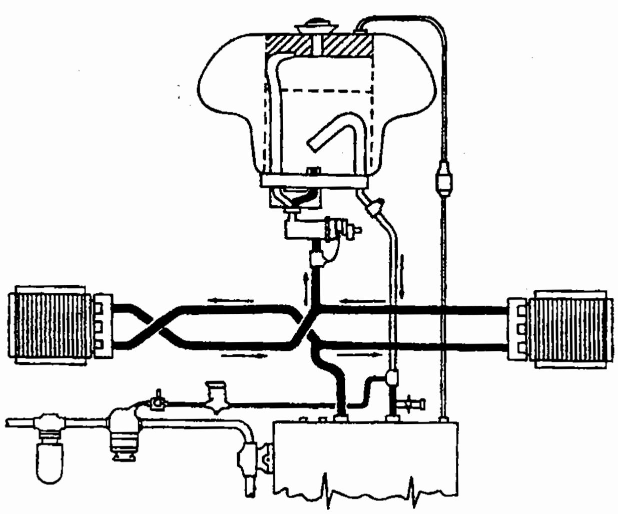
h. If metal chips are still present after a second run-in of the engine, investigate to determine the source of trouble.



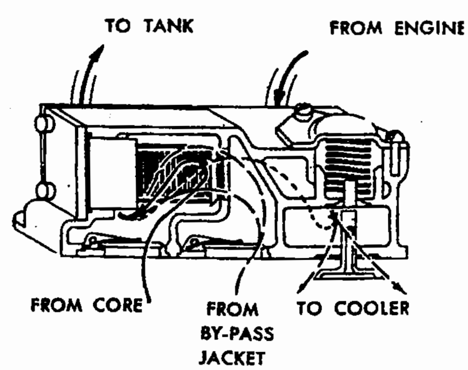
1. Engine-driven Fuel Pump (ref.)
2. Oil Dilution Solenoid Valve
3. Oil Dilution Manual Shutoff Valve
4. Strainer (ref.)
5. Oil Cooler
6. Auxiliary Fuel Pump (ref.)
7. Check Valve
8. Oil Diverter Valve
9. Pressure Regulating Check Valve
10. Oil Diverter Thermostat
11. Automatic Oil Cooler Door Control Valve
12. Dummy By-pass Unit
13. Vent Line to Engine
14. Oil Cooler Thermostatic Valve
15. Drain Valve



OIL DIVERTER VALVE



OIL DILUTION COLD WEATHER
OPERATING CONDITIONS



THERMOSTATIC VALVE ASSEMBLY

Figure 4—82. Oil System Schematic Diagram.

4—677. TROUBLE SHOOTING.

Trouble	Probable Cause	Suggested Remedy
Low oil pressure.	*a.* Insufficient oil supply.	*a.* Stop engine and fill tank.
	b. Leakage, breakage or obstruction in either lines or fittings.	*b.* Check lines for cracks or damaged hoses. Clean and replace damaged parts.
	c. Foreign particles in strainers.	*c.* Remove and clean strainers; metal particles in oil system may mean engine trouble. Clean oil system before refilling with new oil.
	d. Damaged oil pump.	*d.* Remove and replace pump; see Engine Service Instructions Manual AN 02-10GE-2.
	e. Metal particles or grit under relief valve.	*e.* Remove oil pressure relief valve; clean or replace.
	f. Oil foaming because of water in oil or bad mixture of different oils.	*f.* Drain oil system of foaming oil and refill with new oil.
	g. Oil too thin.	*g.* Change to proper grade oil.
	h. Oil dilution solenoid valve leaking; valve remains open.	*h.* Remove and check solenoid for proper movement; see paragraph 4—743. Inspect condition of electric wiring; see paragraph 5—75.
	i. Improper adjustment of oil cooler thermostatic valve. Dirty valve.	*i.* Remove and replace valves; see paragraph 4—690.
Normal pressure, but high temperature.	*a.* Oil cooler congealed.	*a.* Check cooler core tubes for condition.
	b. Oil cooler doors not operating.	*b.* Check oil cooler door control system; see paragraph 4—700.

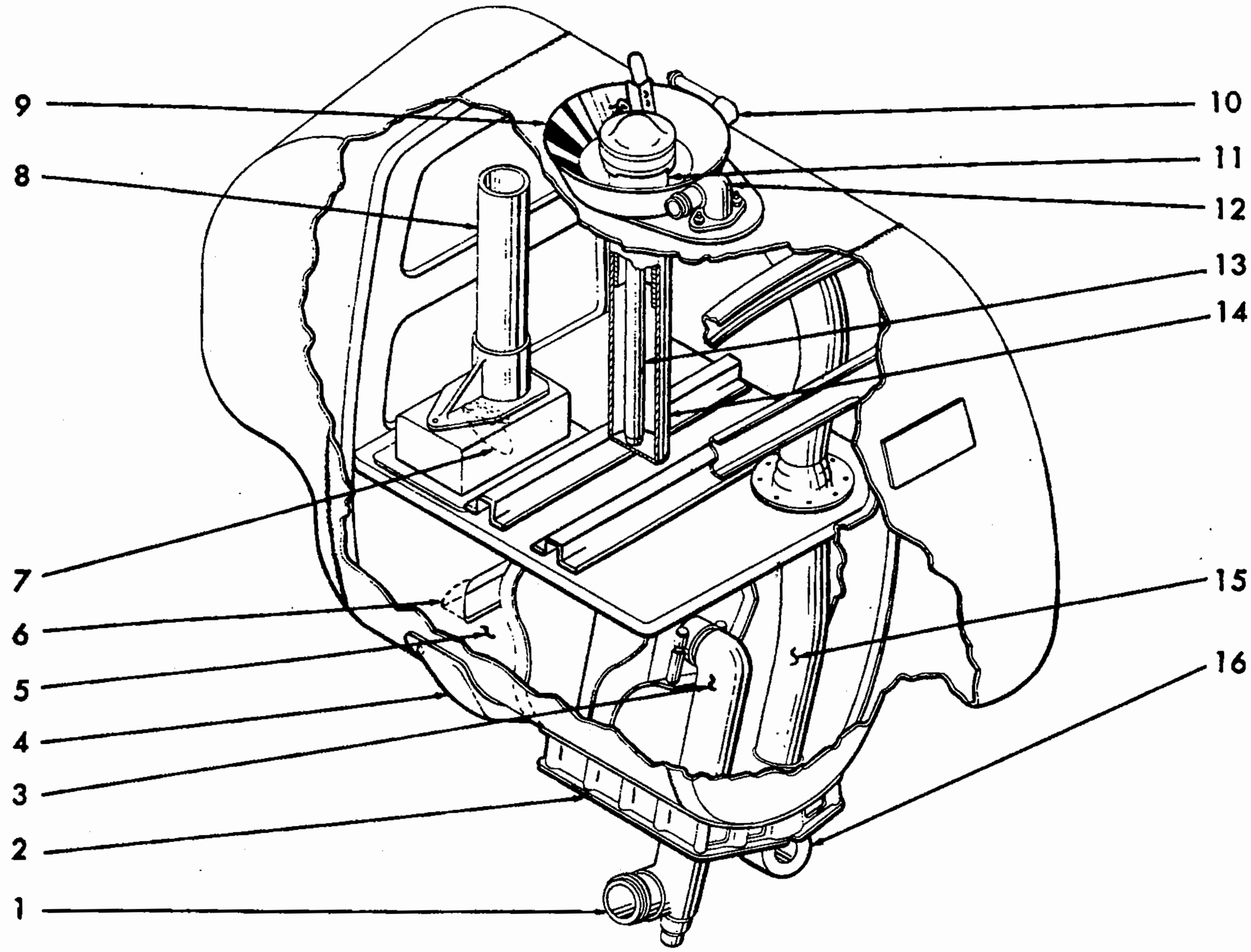
4—678. OIL PUMP.

4—679. DESCRIPTION. Oil from the tank is circulated through the engine by a gear type pressure pump. The pump is provided with mounting bosses for an oil inlet connection and for a pressure relief valve. The oil pressure relief valve is adjusted so that the main oil pressure will stay at the desired value. The oil pressure pump is an integral part of the engine; it is installed on the lower left side of the rear cover of the accessory drive case, and it is reached by opening the intercooler flap. For complete information on the oil pressure pump, refer to Engine Service Instructions Manual AN 02-10GE-2.

4—680. OIL PRESSURE SETTING. With an oil inlet temperature of 75°C to 80°C (167°F to 176°F) at 2200 engine rpm, adjust the oil pressure relief valve until the engine gage unit in cockpit registers a pressure of 125 psi (plus 5 or minus 0 psi) at the pump. The pressure relief valve is located at the left of the pump installation on the engine, and is reached through the intercooler flap.

4—681. OIL TANK

4—682. DESCRIPTION. *(See figure 4—83.)* The oil tank, which holds approximately 27.5 U. S. gallons, is constructed of aluminum alloy, the welded shell containing one horizontal lower baffle and two vertical baffles which form the warm-up compartment near the bottom of the tank. The tank is mounted on the forward side of the firewall and is held by means of straps and padded metal brackets. The oil connecting lines are attached to a single cast fitting which is bolted to a mating fitting welded to the bottom of the tank. The oil is drawn from the tank by means of a pendulum fitting, consisting of a free swinging corrugated flexible hose attached to the supply line, mounted in the warm-up compartment. The inlet end of this corrugated flexible hose is weighed down by a rubber coated scalloped metal tube. This assembly makes the flexible hose curve downward and swivel from the supply line attaching tube, permitting the inlet end of the tube to swing in any direction depending on flight conditions. In inverted



1. Outlet Assembly
2. Sump Assembly
3. Pendulum Fitting Assembly
4. Drain Sump
5. Warm-up Compartment
6. Louver
7. Flapper Valve
8. Breather Tube
9. Scupper
10. Drain Line
11. Filler Neck
12. Vent Line
13. Gage
14. Screen
15. Standpipe
16. Diverter Valve Inlet

Figure 4–83. Oil Tank.

flight or negative acceleration maneuvers, the mouth of the intake line remains immersed in the oil trapped in the warm-up compartment of the tank. Inverted flight or negative acceleration maneuvers should be restricted to the time limit specified in the Pilot's Handbook of Flight Operating Instructions (AN 01-45HD-1) since the oil in the warm-up compartment is not replenished during these conditions. Cold or diluted oil enters the warm-up compartment through the diverter valve on the bottom of the tank. A check valve in the oil return line prevents the oil from backing up into the engine from the oil tank. Warm oil discharges into the tank through a standpipe which extends to the top of the tank. A flapper valve in the horizontal baffle closes in inverted flight, isolating the warm-up compartment from the rest of the tank. The tank is vented by a line to the engine crankcase, a pressurizing valve being installed in this line as noted in paragraph 4–673. The oil tank is equipped with a sump chamber and drain plug for the collection and drainage of dirt and sediment. The sump is located at the right of the oil supply line on the aft side of the tank. The oil filler assembly consists of a removable No. 10 mesh brass screen, a filler neck, a cap and gage assembly, a spring actuated arm, and a scupper with an overflow tube. The spring actuated arm prevents closing of the oil filler door when the oil cap is not securely seated. To prevent filling the oil tank to the top, the filler neck extends into the tank about five inches and thus, during the filling operation, with the vent line closed by the check valve, the filler tube becomes the only escape passage for the air. When the oil level reaches and covers the mouth of the filler neck, additional entrance of oil into the tank is prevented by the entrapped air. This space between the oil level and the top of the tank allows for foaming of the oil. A scupper around the cap is connected with an over-flow tube to drain spilled oil during the filling operation. The gage rod attached to the cap is used for measuring amount of oil in tank.

4–683. LOCATION AND ACCESS. The oil tank is mounted on the forward face of the fire wall. Access is gained by removing the top engine accessory compartment cowl panel.

4–684. REMOVING. With the upper cowl panel removed, drain the oil through the oil drain valve on the engine oil supply line in the accessory compartment.

a. Loosen the clamps and disconnect hose connections at the tank to the return line, the supply line, the vent line, and the scupper drain tube.

b. Unsafety and remove the turnbuckles, open the straps and remove the tank by lifting it straight up.

4–685. DISASSEMBLY. Since the tank is a welded unit, it is possible to disassemble only the filler neck from the top, and the oil diverter valve assembly and the oil outlet assembly from the bottom of the tank.

a. Detach the filler neck and oil screen assembly from the studs in the top of the tank.

b. Remove the oil diverter valve assembly by unfastening the nuts which attach the assembly to the oil outlet fitting at the bottom of the tank.

c. Withdraw the oil outlet fitting with the pendulum fitting attached.

4–686. REPAIRING. Before any repairs are attempted, oil tank must be thoroughly cleaned. Flush tank for 15 minutes with hot water; this will remove deposits of oil. After flushing with water, clean tank with live steam for a minimum of one hour. This will remove combustible material. Begin repairs as soon as possible. The aluminum alloy tank is repaired by welding process. Reweld open seams, loose fittings and cracks, in accordance with procedure in General Manual for Structural Repair (AN 01-1A-1). Clean welded parts and treat against corrosion with two coats of zinc chromate primer.

4–687. ASSEMBLING. Assemble tank by reversing the disassembly procedure given in paragraph 4–685.

CAUTION

In assembling oil tank be sure that when oil outlet fitting is installed pendulum fitting is in right hand side of warm up compartment looking forward.

4–688. TESTING.

a. With tank on bench, plug all openings except the one through which air is introduced.

b. Coat all seams, rivets and fittings with soapy water.

c. Apply six pounds of air pressure.

d. Bubbles at seams, fittings, etc. indicate that leakage exists; tank is defective and must be replaced.

4–689. INSTALLING. Install the oil tank by reversing the removal procedure given in paragraph 4–684. Strap turnbuckles should be drawn up snug but not tightened excessively, since doing so might possibly damage the tank walls.

4–690. OIL COOLER THERMOSTATIC VALVES.

4–691. DESCRIPTION. *(See figure 4–82.)* There are two thermostatic valves in this oil system manufactured by Airesearch Manufacturing Co. of Los Angeles, California. Their part No. is 17589-1. The valve is a four-port valve, enabling unit to be changed over from a left to a right hand installation or vice versa, by simply reversing oil line connections to opposite side of valve. The entire assembly is contained in a cast aluminum housing, partitioned to direct flow as required. This thermostatic valve functions in three ways.

a. It incorporates a surge protection valve to guard the oil cooler against high oil pressures caused by oil congealing in the cooler. With a cold start and high pressures, the valve by-passes the oil leaving the engine, to the return line and warm-up compartment of the tank. The surge valve opens fully at 98 psi maximum, closing ports to oil cooler jacket and core.

b. As the oil begins to warm-up, the pressure will lower, allowing the surge valve to close at 45 psi. The oil then enters the cooler, flowing through the passages of the outer jacket, and out through the return line to the oil tank warm-up compartment.

c. As temperature of oil increases, by-pass valve will close entirely at a temperature of approximately 72°C (163°F plus or minus 2°F). The entire oil flow is then directed to the cores of the cooler and through the return line to the main compartment of the tank.

4–692. LOCATION AND ACCESS. Each thermostatic valve is mounted on the three hole base flange welded onto each oil cooler channel. Access is gained by removing the lower air duct panel.

4–693. REMOVING.

a. Remove lower air duct panel; see paragraph 4–6, steps a. through g.

b. Disconnect lines to thermostatic valve.

c. Remove the castellated nuts.

d. Lift valve off the flange.

4–694. INSTALLING. Reverse removal procedure.

4–695. OIL COOLERS.

4–696. DESCRIPTION. *(See figure 4–81.)* Two oil coolers are used in parallel in the return line of the engine oil system to maintain the oil at the proper temperature. The oil cooler is composed of a round shell, provided with header plates into which the cooler tubes are expanded. The shell is provided with a channel piece through which the oil flows into and out of the cooler. A three hole base flange is welded onto the channel for the purpose of mounting the thermostatic temperature regulating valve. Oil circulates between the tubes, and is cooled by the air passing through the cooler tubes. Several baffle plates inserted in the core keep the oil circulating past all of the cooling tubes of the core. The shell or outer jacket circulates oil through the cooler without cooling it appreciably. Thus when the oil reaching the oil cooler is already cool, the temperature regulating valve diverts the oil through the outer jacket instead of through the core. The outer jacket is also provided to decongeal cold oil trapped within the core. The oil cooler is manufactured by the Airesearch Manufacturing Co., Los Angeles, California; their part number is 18598.

4—697. LOCATION AND ACCESS. The oil coolers are mounted aft of the air entrance in the center section, one on each side of the airplane. Access to the coolers is obtained by removing the lower air duct panels.

4—698. REMOVING.

a. Remove lower air duct panel; see paragraph 4—6, steps a. through g.

b. Drain the oil cooler by removing plug and detach hose connections.

c. Remove lockwire and unfasten strap assembly.

d. Lift the straps off the hooks on the cradle assembly and lower oil coolers out of the cradle.

4—699. INSTALLING. The installation of the oil coolers is the reverse of the removal procedure.

4—700. AUTOMATIC OIL COOLER DOOR CONTROL.

4—701. DESCRIPTION. The oil cooler doors are operated by a conventional hydraulic cylinder in each wing. Action of the cylinders is automatically controlled by a hydraulic solenoid selector valve which is controlled by the oil temperature. The valve is set to start to open the doors when the oil reaches a temperature of 75°C (167°F). The doors reach the full open position at 95°C (203°F). Each actuating cylinder is located on the forward face of the main beam, its piston connected to a bracket on the oil cooler flap. The hydraulic solenoid valve which controls the flow of hydraulic fluid to the cylinders is mounted on the front face of the firewall to the left hand side of the oil tank, its actuating thermal element immersed in the oil tank return line. The oil cooler door switch, located on the left hand control shelf, normally should be in the "AUTOMATIC" position. The manually operated "OPEN" and "CLOSE" positions of the switch override the automatic control. An indicator on the control panel, electrically actuated by a transmitter located above the right oil cooler door, indicates the position of the doors to the pilot. For additional information covering function and removal, etc., of hydraulic units, see paragraphs 4—1219 through 4—1244.

4—702. OIL COOLER DOORS.

4—703. DESCRIPTION. The doors control the volume of cooling air passing through the coolers. These doors are made of reinforced alclad sheet metal and are located at the aft edge of the center section lower air duct panels. A piano type hinge is used. Two side vanes are riveted to the door to prevent leakage of cooling air out the sides of the flaps. Both doors are attached to teh hydraulic actuating cylinders by quick-disconnects. A flap position transmitter is attached on the right hand door, and a reset rod is attached to the left hand door. Both these units are secured by quick-disconnects.

4—704. REMOVING.

a. Using an external source of hydraulic power, open the door by means of the cockpit switch.

b. Unfasten the quick-disconnect pushrods.

c. Swing door completely open.

d. Remove the rod bracket from the center.

e. Remove elastic stop nuts on the piano hinge and lift off the door.

4—705. INSTALLING. Reverse removal procedure.

4—706. DUMMY BY-PASS UNIT.

4—707. DESCRIPTION. *(See figure 4—81.)* The dummy valve consists of a welded 4130 steel tube assembly designed to supply oil to the right and left oil coolers simultaneously, forming a parallel oil cooling system. All the tubes that make up the valve are beaded for hose installation except the oil return tube to the tank. This tube has a flange welded to it with drilled holes for attaching the return line check valve assembly with three standard bolts.

Note

Space provisions have been made on the forward face of the main beam in the accessory compartment and in the cockpit for the possible future installation of automatic by-pass valves. In case of combat damage to either oil cooler or its connecting lines, these by-pass valves (when installed) operating on oil pressure differentials will automatically shut off the lubricating oil and by-pass it to the undamaged portion of the oil system.

4—708. LOCATION AND ACCESS. The dummy valve is mounted on special brackets and attached to the forward face of the main beam. To gain access, open the intercooler door and remove accessory compartment cowling as necessary.

4—709. REMOVING.

a. Disconnect all hose connections to the dummy by-pass unit.

b. Remove the three elastic stop nuts holding check valve to the flange on the return line to tank.

c. Loosen the assembly and lift the check valve off the flange.

d. Unfasten the brackets from the forward face of the main beam and remove the dummy by-pass unit.

4—710. INSTALLING.

a. Align dummy valve retaining brackets to attaching points on forward face of main beam, and attach.

b. Connect hose lines from oil coolers and the hose line from the engine to valve.

c. Align the check valve with the flange on the return-to-tank portion of the dummy valve.

d. Insert the three standard bolts and secure the assembly with the required elastic stop nuts.

4—711. CHECK VALVE.

4—712. DESCRIPTION. *(See figure 4—81.)* The oil return line check valve is installed on the flange of the dummy valve return tube above the forward face of the main beam. Its function is to prevent the return of oil from the oil tank to the engine through oil cooler system when the engine is not operating. The valve is made by Pratt and Whitney Aircraft, East Hartford, Connecticut, their part number B-24989. It is an all metal valve with a flapper plate, spring-loaded to the closed position. Oil returning from the engine to the tank forces it open during normal operation.

4—713. LOCATION AND ACCESS. *(Refer to figure 4—81.)* The check valve is attached to the flanged return tube of the dummy valve. It is located on the forward face of the main beam above the dummy valve. Access to the check valve is obtained through the intercooler flap.

4—714. REMOVING.

a. Drain oil tank and connecting lines, see paragraph 4—676, steps a. and b.

b. Remove elastic stop nuts holding check valve to flange. Loosen valve and lift it off.

4—715. INSTALLING.

a. Align check valve with flange on dummy valve return-to-tank tube.

b. Insert the three standard bolts through valve boss and flange.

c. Tighten the assembly securely with elastic stop nuts.

d. Connect hose line between check valve and oil return line to the tank.

4—716. DIVERTER VALVE.

4—717. DESCRIPTION. *(Refer to figure 4—82.)* The oil diverter valve is designed to reduce warm-up time when starting a cold engine by controlling the flow of oil either to the warm-up compartment or to the main portion of the oil tank. During normal operation, the diverter valve is controlled by the oil diverter thermostat; see paragraph 4—721. The diverter valve also provides a means of directing diluted oil to the warm-up compartment of the tank during operation of the oil dilution system; see paragraph 4—736. This valve utilizes one single inlet, for oil-to-tank line, and two outlets, one leading to the warm-up compartment and one to the main oil tank. The diverter valve is manufactured by the Airesearch Manufacturing Company, Los Angeles, California; their part number is 12210-1.

4—718. LOCATION AND ACCESS. *(See figure 4—81.)* The diverter valve is attached to the sump assembly fitting at the bottom of the oil tank. The valve assembly can be reached through the intercooler door or by removing the accessory compartment top panels as necessary, exposing the tank assembly.

4—719. REMOVING.

a. Drain oil tank and connecting lines; see paragraph 4—676, steps a. and b.

b. Remove elastic stop nuts and hose lines.

c. Disconnect thermostat wiring.

d. Loosen the valve and pull it down, making sure threads on the studs are not injured.

4—720. INSTALLING. Install the oil diverter valve by reversing the removal procedure.

4—721. OIL DIVERTER THERMOSTAT.

4—722. DESCRIPTION. *(See figure 4—81.)* The thermostat is installed in the oil-to-engine line. In normal operation when starting the engine with cold oil, the thermostat is open and the diverter valve on the bottom of the tank directs oil to the warm-up compartment of the tank. As the temperature of the oil into the engine increases to 40°C or above, the thermostat closes, thus actuating the diverter valve on the bottom of the tank to direct the oil out of the engine to the top of the oil tank. During use of the oil dilution system, the oil diverter thermostat control is overridden and oil flows to the warm-up compartment of the oil tank regardless of the oil-in temperature; see paragraph 4—736. (For electrical information, see paragraph 5—75.) The oil diverter thermostat is manufactured by the Airesearch Manufacturing Co., Los Angeles, California, their part No. 11610.

4—723. LOCATION AND ACCESS. The thermostat is at the bottom of the tank sump assembly inserted in an oil well connecting the oil outlet assembly at the "oil-in" line to engine. Access is gained through the accessory compartment by removing top engine accessory cowl panel.

4—724. REMOVING.

a. Drain oil tank; see paragraph 4—676, steps a. and b.

b. Disconnect receptacle and electric wiring.

c. Remove thermostat from oil well.

4—725. INSTALLING. Reverse removal procedure.

4—726. DRAIN VALVE.

4—727. DESCRIPTION. *(See figure 4—81.)* The oil system drain valve has one inlet from the main tank. This valve is used to drain the oil tank. The drain valve is manufactured by Koehler Aircrafts Products Company, Dayton, Ohio; their part number is K-2450B. The valve consists of a cast aluminum alloy housing, containing a poppet valve which operates for open and close positions. The handle is spring-loaded and maintains a positive closed position when the drain valve is not used.

4—728. LOCATION AND ACCESS. The valve is mounted on a bracket which is clamped to the engine mount on the lower left hand side of the accessory compartment. Access is gained to the drain valve by opening the intercooler flap.

4—729. REMOVING.

a. Drain the oil system through the drain valve.

b. Remove the hose connections.

c. Remove the valve from the bracket.

4—730. INSTALLING. Reverse removal procedure.

4—731. PRESSURE REGULATING CHECK VALVE.

4—732. DESCRIPTION. *(See figure 4—81.)* The valve assembly in the oil tank vent line is a two-way check and relief valve. The valve regulates the pressure in the oil tank to 4 psi (plus or minus 1/2 psi) above the pressure in the engine rear case. The valve also prevents excessive negative pressures in the oil tank during a dive. The valve consists of two spring-loaded discs in a cylindrical housing. The outlet valve opens under a pressure of 4 psi (plus or minus 1/2 psi). The vacuum relief valve opens under a pressure of 1 psi (plus or minus 1/2 psi). The valve is manufactured by the Standard Aircraft Products, Inc., Dayton, Ohio. Their part number is 5A-3802-C.

4—733. LOCATION AND ACCESS. The valve assembly is located on the top of the left hand engine mount tube in the accessory compartment. Access is obtained by removing the accessory compartment top panel.

4—734. REMOVING.

a. Remove the hose connections.

b. Remove the attaching bolts.

c. Lift off the valve assembly from engine mount.

4—735. INSTALLING. Install the valve by reversing the removal procedure.

4—736. OIL DILUTION.

4—737. DESCRIPTION. *(See figure 4—82.)* An oil dilution system is installed in the airplane to facilitate starting the engine in cold weather. A line is connected from the fuel strainer to the oil tank return line. An oil dilution solenoid is mounted on the strainer clamped to the fuel inlet fitting. When the oil dilution switch in the cockpit is held down, the solenoid opens and fuel enters the above line and dilutes the oil returning from the engine. The switch in the cockpit is located on the inclined portion of the right hand control panel. The switch permits two-position control of the oil tank diverter valve: dilute and automatic. The switch also energizes the fuel booster pump when in the dilute "ON" position. Before the engine is shut off, when the oil dilution switch is turned "ON", the diverter valve directs the oil flow to the warm-up compartment of the tank. A thermostat, immersed in the return line and connected to the diverter valve motor, automatically controls the setting of the valve under all normal operating conditions. Thus the thermostat, sensitive to the oil-in temperature will cause the motor in the diverter valve to become energized. At an oil-in temperature of 40°C (104°F) and above, the thermostat closes and the diverter valve will move to close the warm-up compartment port and divert the flow of oil to the top of the oil tank. For electrical information, see paragraph 5—75.

4—738. USE OF OIL DILUTION. In the event of a low temperature forecast, below —5°C (+23°F) the oil from the warm-up compartment returning to the engine shall be diluted in the following manner:

a. Open the manual shut-off valve in the oil dilution line in engine accessory compartment. This valve is located on the forward side of the fuel strainer and is accessible from the ground through the intercooler flap.

b. Keep engine running at about 1000 rpm.

c. Place dilution switch in "ON" position energizing dilution solenoid. This permits fuel to dilute the oil to the engine.

d. Hold oil dilution switch "ON" approximately six minutes.

e. Stop engine by moving mixture control to "IDLE CUT-OFF"; cut the ignition.

f. Hold oil dilution switch "ON" until engine stops.

g. When a cold engine in which the oil was diluted prior to shut-down is subsequently started and, after running a short while, the oil pressure starts to fluctuate or drop, the dilution valve shall be opened intermittently for intervals of a few seconds over a period of about 15 seconds. If the oil pressure still does not steady out, stop the engine and wait for approximately five minutes before attempting another start.

h. Close the manual shut-off valve and safety wire before next take-off.

i. Do not over dilute.

j. For further information on oil dilution, refer to paragraphs 3—103 through 3—105.

4—739. OIL DILUTION MANUAL SHUT-OFF VALVE. *(See figure 4—82.)* The shut-off valve is a manually operated valve inserted in the oil dilution fuel line. It is a petcock type valve, with a cast handle and housing. The handle is normally safetied in the off position.

4—740. LOCATION AND ACCESS. The shut-off valve is located on the fuel strainer assembly and access is gained by opening the inter-cooler flap.

4—741. REMOVING.

a. Close fuel flow to strainer by turning the fuel selector valve in the cockpit to the 'OFF" position.

b. Drain strainer by opening the drain cock at the bottom of the unit.

c. Detach connecting tube.

d. Remove shut-off valve.

4—742. INSTALLING. Reverse removing procedure.

4—743. OIL DILUTION SOLENOID VALVE.

4—744. DESCRIPTION. *(See figures 4—81 and 4—82.)* The oil dilution solenoid valve controls the flow of gasoline into the oil return line to engine. It is normally in the closed position. The valve consists of a spring-sealed plunger in a circular housing with an inlet and outlet port. When the solenoid coil surrounding the plunger is energized, the plunger is unseated and fuel flows up through the outlet port. The solenoid is manufactured by the United Aircraft Products, Inc., Dayton, Ohio, their part number UC-3100. The operating voltage is 18-30 volts.

4—745. LOCATION AND ACCESS. The solenoid is attached to the inlet fuel line of the strainer. A clamp fastened to a bracket holds it in position. Access is obtained through the intercooler flap.

4—746. REMOVING.

a. Turn "OFF" the fuel selector valve in the cockpit.

b. Disconnect fuel lines and electrical wiring.

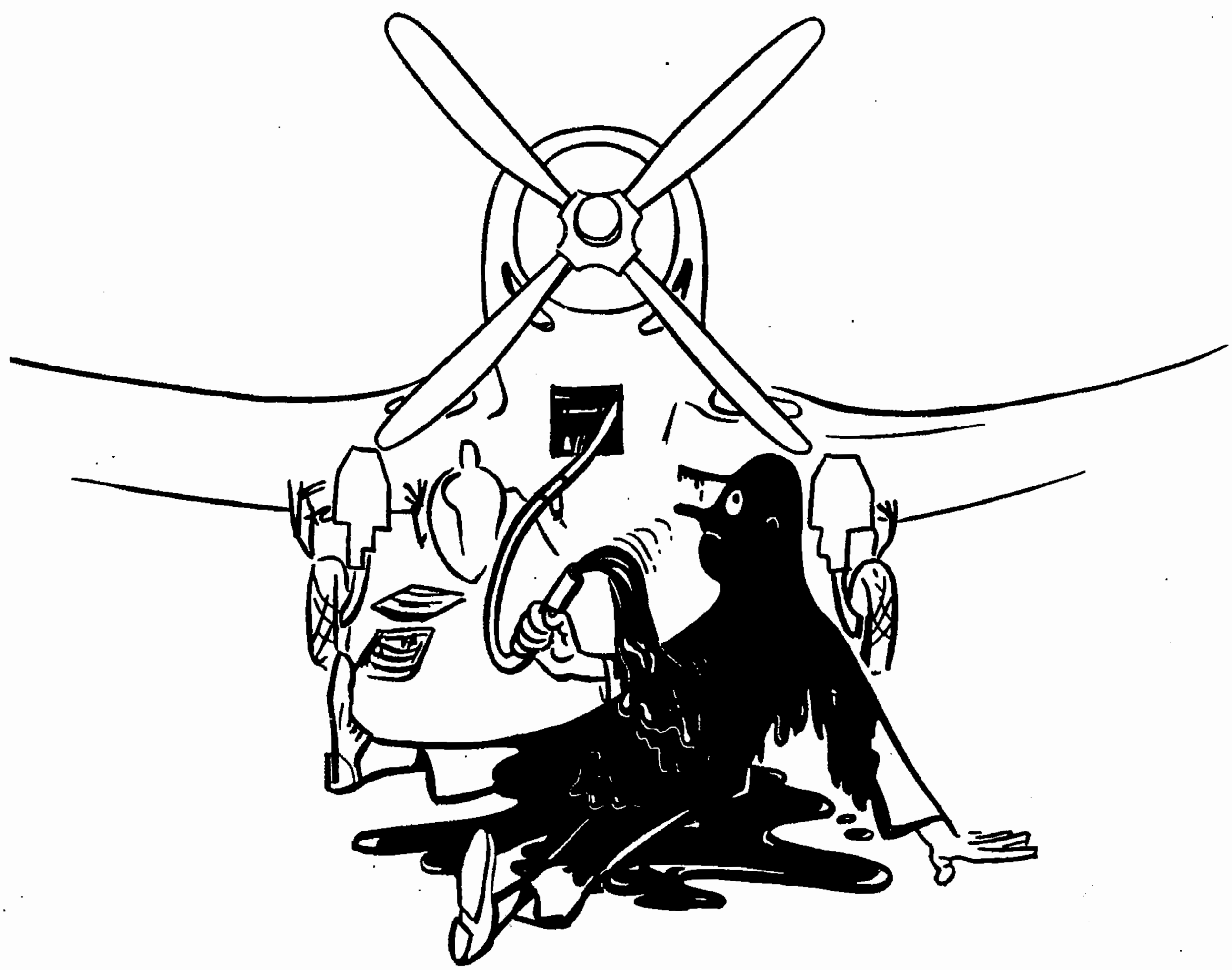
c. Detach clamp.

d. Remove solenoid valve.

4—747. INSTALLING. To install the valve, reverse the removing procedure.

4—748. OIL SYSTEM LINES AND TUBING.

4—749. DESCRIPTION. *(Refer to figure 4—84.)* The oil system tubing consists of 52S0 aluminum alloy tubes, flexible hose connectors and standard hose clamps. The tube ends are beaded for hose installation, and flared for fitting installation. The maximum diameter of the oil-carrying lines is one and one-half inches; the minimum diameter is three-quarter inch. An identifying yellow band is placed on each tube. The hose connectors and clamps, when installed, require one-eighth minimum distance from the outer edge of the hose connector to outer edge of the clamp. Hose clamps are tightened to 25 inch-pounds torque and should be checked several times after initial installation. Tubing cut in lengths for replacement purposes shall be cut 10% longer than the actual length required.



TUBING CHART — OIL SYSTEM

(Refer to Figure 4—84)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-56550-7	1	1	.035	11 1/16	52 SO Al. Alloy Tube Spec. WW-T-787	CVC-1813-24-19 Hose (2) AN748-66 Clamp (4) AN844-16D Elbow (2)
VS-56550-23	2	1/4	.035	38 1/8	52 SO Al. Alloy Tube Spec. WW-T-787	AN824-4D Tee
VS-56550-3	3	1 1/2	.049	34 1/4	52 SO Al. Alloy Tube Spec. WW-T-787	CVC-1813-24-20 Hose (Inbd.) AN748-66 Clamp (4) CVC-1813-24-25 Hose (Outbd.)
VS-56550-4	4	1 1/2	.049	31 5/8	52 SO Al. Alloy Tube Spec. WW-T-787	CVC-1813-24-20 Hose (Inbd.) CVC-1813-24-25 Hose (Outbd.) AN748-66 Clamp (4)
VS-56550-18	5	1 1/2	.049	19 5/8	52 SO Al. Alloy Tube Spec. WW-T-787	CVC-1813-24-20 Hose AN748-66 Clamp (2) VS-56134-R Elbow VS-56110 Gasket AN960-D 516 Washer (4) AN365-524 Nut (4)
VS-56550-17	6	1 1/2	.049	11 3/4	52 SO Al. Alloy Tube Spec. WW-T-787	CVC-1813-24-20 Hose AN748-66 Clamp (2) AN4111-6 Fitting VS-56110 Gasket AN960-D 516 Washer (4) AN365-524 Nut (4)
CVC-1813-24-33	7	1 1/2 ID		8 1/4	Synthetic Hose Spec. M-709	VS-56359 Fitting VS-56110 Gasket AN960-D 516 Washer (4) VS-56354 Elbow Outlet (Ref.) AN748-66 Clamp (2)
CVC-1813-12-52	8	3/4 ID		13	Synthetic Hose Spec. M-709	AN748-38 Clamp (2) AN844-12D Elbow (2)
CVC-1813-12-62	9	3/4 ID		15 1/2	Synthetic Hose Spec. M-709	VS-43085 Valve AN748-38 Clamp (2) VS-12398 Elbow VS-43216 Gasket
VS-56550-21	10	1/4	.035	30 9/16	52 SO Al. Alloy Tube Spec. WW-T-787	CVC-1813-4-32 Hose AN748-22 Clamp (2)
CVC-1813-24-19	11	1 1/2 ID		4 3/4	Synthetic Hose Spec. M-709	VS-56266 Well Assem. AN748-66 Clamp (2) VS-53602 Fitting
CVC-1813-24-19	12	1 1/2 ID		4 3/4	Synthetic Hose Spec. M-709	VS-56266 Well Assem. AN748-66 Clamp (2) VS-56112 Fitting
VS-59668 Dummy By-Pass Unit	13				4130 Stl. Tube Spec. AN-WW-T-850	
VS-56550-6	14	1 1/2	.049	34 7/8	52 SO Al. Alloy Tube Spec. WW-T-787	CVC-1813-24-25 Hose (Outbd.) AN748-66 Clamp (4) CVC-1813-24-20 Hose (Inbd.) AN748-66 Clamp (3)

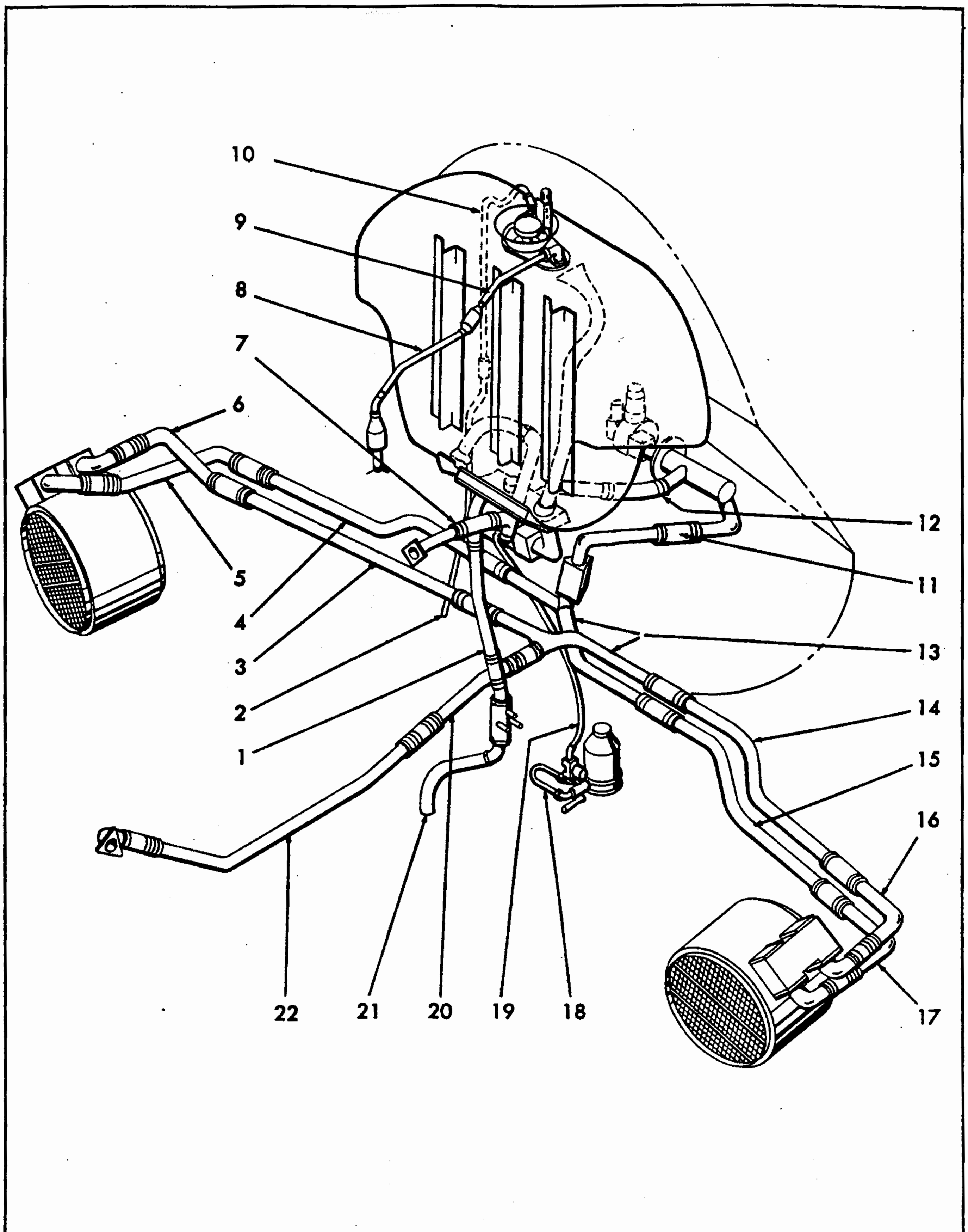


Figure 4—84. Oil System Tubing Diagram.

TUBING CHART — OIL SYSTEM (Continued)

(Refer to Figure 4—84)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-56550-5	15	1½	.049	32⅛	52 SO Al. Alloy Tube Spec. WW-T-787	CVC-1813-24-20 Hose (Inbd.) AN748-66 Clamp (3) CVC-1813-24-25 Hose (Outbd.) AN748-66 Clamp (4)
VS-56550-19	16	1½	.049	12¼	52 SO Al. Alloy Tube Spec. WW-T-787	CVC-1813-24-20 Hose AN748-66 Clamp (3) AN4111-6 Fitting VS-56110 Gasket AN960-D 516 Washer (4) AN365-524 Nut (4)
VS-56550-20	17	1½	.049	16⅝	52 SO Al. Alloy Tube Spec. WW-T-787	CVC-1813-24-20 Hose AN748-66 Clamp (3) VS-56134-L Elbow VS-56110 Gasket AN960-D 516 Washer (4) AN365-524 Nut (4)
VS-57881-19	18	¼	.035	8½	52 SO Al. Alloy Tube Spec. WW-T-787	CV-25391-37 Restrictor AN822-4-4D Elbow
VS-56550-10	19	¼	.035	13⁵⁄₁₆	52 SO Al. Alloy Tube Spec. WW-T-787	AN822-4D Elbow AN823-4D Elbow AN912-1D Reducer
VS-56550-2	20	1½	.049	29¼₆	52 SO Al. Alloy Tube Spec. WW-T-787	CVC-1813-24-20 Hose AN748-66 Clamp (3) CVC-1813-24-25 Hose (Fwd.) AN748-66 Clamp (4)
VS-56550-8	21	1	.035	6¹³⁄₁₆	52 SO Al. Alloy Tube Spec. WW-T-787	AN823-16-12D Elbow
VS-56550-1	22	1½	.049	23¼	52 SO Al. Alloy Tube Spec. WW-T-787	CVC-1813-24-20 Hose AN748-66 Clamp (3) VS-56360 Fitting VS-34336 Gasket AN960-D516 Washer (3)

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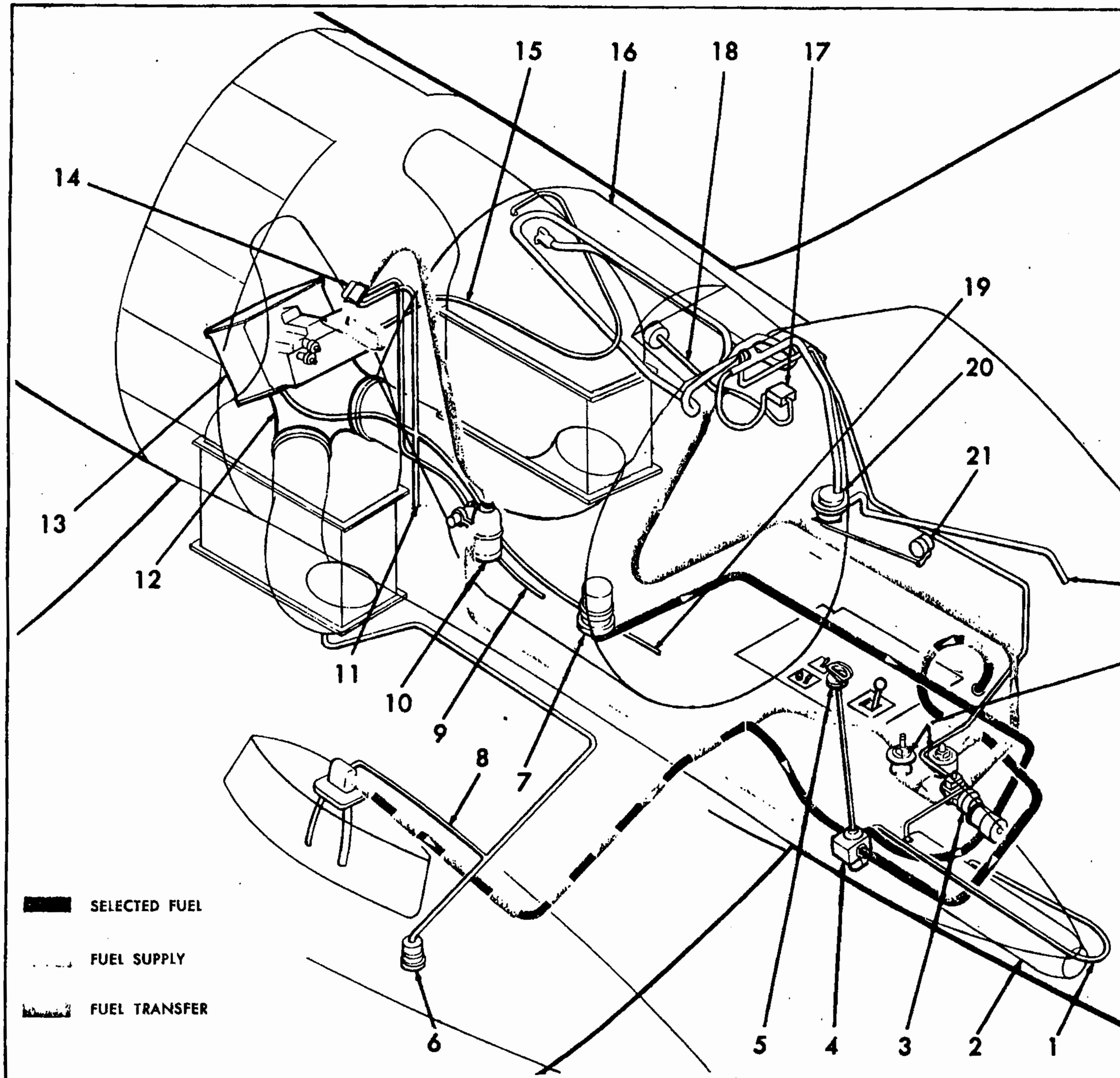


1. Fuel Line to Heater (ref.)
2. Cockpit Heater (ref.)
3. Fuel Transfer Pump
4. Fuel Selector Valve
5. Fuel Selector Control
6. L. H. External Tank Pressure and Vacuum Relief Valve
7. Auxiliary (Booster) Fuel Pump
8. L. H. External Tank Pressurizing Line
9. Seal Drain Overboard Line
10. Fuel Strainer
11. Water Pump Vent Line
12. Carburetor Air Box
13. Carburetor
14. Main Engine-driven Fuel Pump
15. Vapor Return Line
16. Main Fuel Cell
17. Fuel Transfer Indicator Pressure Switch
18. Fuel Transfer Shutoff Float Valve
19. Line to Fuel Pressure Gage
20. Fuel Cell Vent Valve
21. Fuel Cell Pressure Release Control
22. Fuel Cell Vent
23. Fuel Transfer Solenoid Shutoff Valves

Figure 4—85. Fuel System Reference Diagram.

4–750. FUEL SYSTEM.

4–751. DESCRIPTION. *(See figures 4–85 and 4–86.)* The fuel system consists of an internal fuel cell and provisions for carrying two external auxiliary fuel tanks, an electrically-driven, submerged, auxiliary (booster) pump, an engine-driven fuel pump for supplying fuel under pressure to the carburetor, fuel lines and strainer, an electrically-driven fuel pump for transferring fuel from the auxiliary tanks to the main cell, a fuel tank selector valve, check valves and vents, a system for pressurizing the main and the left hand drop tanks, gages and warning lights to indicate fuel quantities and pressures, and water injection equipment to permit operation at combat power. (See paragraph 4–564 for information on water injection.) The fuel system is also equipped to furnish gasoline for diluting the oil during cold weather operation as well as to furnish fuel for the cockpit heater. (See paragraphs 4–1592 through 4–1599 for information on the heater.) For oil dilution, fuel is taken from the fuel strainer and added to the oil entering the engine; see paragraph 4–736. The heater fuel line is tapped into the line between the main fuel cell and the fuel tank selector valve.

4–752. The main fuel cell, located in the fuselage between the firewall and the forward bulkhead of the cockpit, is a self-sealing cell with a 234 U. S. gallon capacity. Mk. 5, 150 U. S. gallon external auxiliary fuel tanks can be carried on the right and left center section pylons, and the centerline pylon. Provisions are made for connecting (on the ground) the centerline auxiliary tank line to the port used by the left hand auxiliary tank. No provision is made for carrying the centerline and the left hand auxiliary tanks simultaneously.

4–753. Potential high altitude boiling of fuel in the main cell and resultant fuel loss is minimized by pressurizing the cell. An automatic check-relief valve in the main fuel cell overboard vent line remains open under 18,000 feet. Above 18,000 feet, the valve maintains 2.25 psi (plus or minus .25 psi) maximum pressure in the fuel cell. A vacuum relief valve on top of the main cell prevents collapse of the fuel cell due to differential pressures in a dive. A manual tank pressure release control handle is located on the cockpit floor so that the pilot can relieve the fuel tank pressure before going into combat. When the control is in combat position, the fuel cell is vented to the atmosphere, thereby minimizing the damage which might occur under gunfire. The left auxiliary tank is pressurized to approximately four psi by a line tapped into the left hand intercooler duct. A check relief valve regulates the tank pressure. This tank is pressurized only when the auxiliary stage blower is in operation.

4–754. Pilot operated controls of the fuel system include the tank selector valve control, auxiliary (booster) fuel pump switch, fuel transfer switch, fuel tank pressure release control, throttle (see paragraph 4–609), mixture control (see paragraph 4–614), and normal and emergency auxiliary jettison controls.

4–755. Fuel system gages and warning lights in the cockpit include a fuel quantity gage, a fuel pressure gage in the engine gage unit, a fuel reserve warning light which indicates when 50 gallons or less remain in the main cell, and a fuel transfer warning light which indicates when the transfer switch is "ON" and the auxiliary tanks are empty.

4–756. FUNCTION.

4–757. NORMAL OPERATION. *(See figure 4–85.)* Fuel flow from the tanks to the engine driven pump is controlled by the fuel selector valve. The control for this valve, located in the cockpit, has four positions, "ON," "RIGHT DROP TANK STANDBY," "LEFT OR CENTER DROP TANK STANDBY," and "OFF." When the selector is turned to its normal "ON" position, all fuel is supplied to the engine from the main fuel cell. With the fuel transfer switch in a transfer position, the external auxiliary tank is emptied first by transferring its contents to the main cell, which is kept full automatically during transfer until the auxiliary tank being used is empty. An auxiliary (booster) fuel pump, submerged in the main cell, pumps devaporized fuel through the main fuel line to a fuel strainer and thence to the engine-driven fuel pump which regulates fuel pressure at the carburetor. Although the prime purpose of the auxiliary (booster) fuel pump is to provide vapor-free fuel under pressure to the engine-driven pump, it is also used to develop fuel pressure for starting, and to provide fuel under pressure for the cockpit heater.

4–758. FUEL TRANSFER SYSTEM OPERATION. *(See figure 4–85.)* The fuel transfer switch is a three-way toggle switch with "RIGHT TANK," "LEFT TANK," and "OFF" positions.

Note

When drawing fuel from centerline tank, turn switch to "LEFT TANK"

When the transfer switch is turned to either one of the two transfer positions, a solenoid shutoff valve in the line from the corresponding auxiliary tank is opened and the fuel transfer pump is started. During transfer, fuel flows from the auxiliary tank into the main tank until the float valve in the main tank closes the intake port. Flow is resumed when the fuel level in the main cell drops enough for the float valve to open again. The transfer pump continues to operate as long as the transfer switch is on, even though the main cell may be full. A warning light on the left hand control shelf indicates an empty auxiliary tank and the transfer switch should be turned to the other auxiliary tank or "OFF."

4–759. EMERGENCY OPERATION – STANDBY." *(See figure 4–86.)* The "RIGHT and "LEFT OR CENTER DROP TANK STANDBY" positions are emergency positions of the fuel selector valve which route external auxiliary tank fuel to the engine-driven pump directly, without first transferring it to the main fuel cell. These settings may be used in the event of failure of the fuel transfer system.

4–760. FILLING MAIN FUEL CELL. The main fuel cell is filled through the filler unit in the fuel cell manhole cover. Use only Spec. AN-F-48 grade 115/145 fuel.

Note

If lower grade fuel is used, i.e., 100 octane, the engine must be operated at lower ratings. See F4U-5 Pilot's Handbook of Flight Operating Instructions (AN 01-45HD-1).

Stand on the center section walkway to gain access. The tank is full when the gage on the instrument panel indicates "FULL." The capacity of the cell is 234 U. S. gallons.

WARNING

When servicing the airplane with fuel, plug the grounding line connected to the hose nozzle into the grounding jack labeled "GROUND HERE" on the Liquidometer access door. If the ground line is not available, insert the nozzle into the filler hole so that the nozzle makes definite contact with the airplane. If any gasoline is spilled, do not turn on any switches for at least 25 minutes.

4–761. FILLING EXTERNAL AUXILIARY FUEL TANKS. Provision is made on the right and left center section pylons, and on the centerline pylon to carry Mk. 5, 150 U. S. gallon auxiliary tanks. No special instructions other than those listed above are necessary for the individual filling of these tanks. See paragraph 4–856 for installation of the auxiliary tanks.

4–762. FUEL SYSTEM LINES AND TUBING.

4–763. DESCRIPTION. The fuel system lines consist of self-sealing hose and metal tubing. All of the lines are marked red for ready identification. The hose is marked by a red stripe running lengthwise or a red band near the hose clamp, and the metal tubes are marked by a red band. The lines are attached to the airplane structure with clamps. All clamps supporting rigid tubing serve as bonding clamps as well as supports. Tubing is clipped every 24 inches. Fittings interconnecting the metal lines or connecting them with the various units of the systems are hose connectors. These connectors are flexible and are attached with removable metal hose clamps. For identification of all fuel lines and end fittings, see paragraph 4–904.

4–764. REPLACEMENT OF METAL FUEL LINES. Metal fuel lines should be inspected and replaced if necessary as follows:

a. Replace all fuel lines which have deep dents or abrasions.

b. Tighten the bolts which hold clamps to airplane structure and replace clamps which remain loose after bolts have been tightened.

c. Replace lines which show fuel stains.

d. Tighten clamping screws at connections showing leakage. R ace defective parts if leakage continues. Clamps on self-sealing hose are tightened to 25 inch-pounds.

e. Replace cracked, hard, frayed, swollen, or worn hose connections.

f. Replace corroded hose clamps or those with loose or corroded screws.

g. Replace loose, broken, or corroded bonding.

h. Remove and replace clogged sections of fuel line.

4–765. REPLACEMENT OF SELF-SEALING FUEL LINES. All hose shall be inspected visually at each 30 hour check. Replacement shall be made whenever deterioration is evident or where doubt exists as to the condition of the hose. Fuel hoses ordinarily do not need to be replaced because of weather checking unless distortion reveals inner fabric through the cracks in the cover. End cracking of hose need not be cause for replacement unless the cracks extend back to the hose clamps. Weather checking may be inhibited by the application of a coat of Buna-Vinylite lacquer (U. S. Rubber Co. No. 7313 or Goodyear Tire and Rubber Co. No. 5073C) applied to the ends and exterior of the hose. Replace hose, if necessary, as follows:

a. Replace all sections of the line which contain any punctures, blisters, cracks, pits, seepage, leakage, or collapsed side walls.

b. Replace 1 1/4 inch ID tubing when a steel ball with a diameter of 1 3/32 inches cannot pass through it freely.

4–766. REMOVING. To remove any of the fuel lines proceed as follows, using care to avoid bending or denting the metal lines.

a. Drain the fuel from the lines.

b. Turn the fuel selector valve "OFF."

c. Remove the bottom cover from the fuel strainer.

d. Disconnect the inlet side of the line to be drained to admit air into the line.

e. Disconnect attaching equipment which may interfere with removal of the line.

f. Remove the attaching clamps and hose connector clamps.

g. Disconnect the hose connectors.

h. Remove the line.

4–767. INSTALLING. When installing hose, observe the following precautions:

a. Install hose in a manner that will not impose longitudinal stresses.

b. Install hose through openings in structures only when such openings are greater in diameter than the hose itself. AN931 grommets shall be used wherever hose passes through a structure. Hose supports shall not restrict motion of hose or cause undue load tending to deform the hose.

c. Install self-sealing hose in such a manner that any bend will have a radius at least 12 times the inside diameter of the hose.

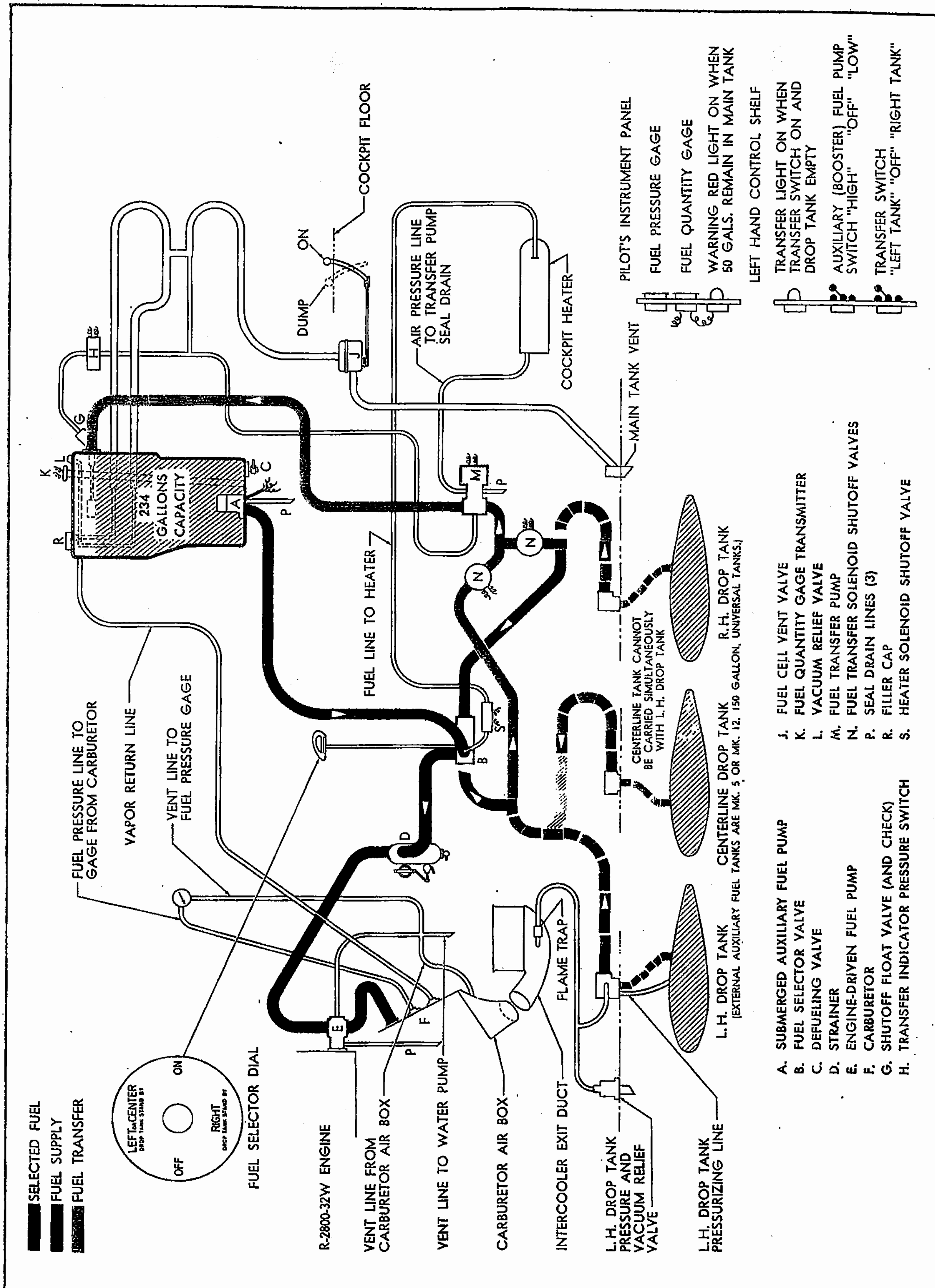


Figure 4—86. Fuel System Schematic.

d. Install self-sealing hose without the use of oil or any other lubricant. Other hose installed with hose clamps may be lubricated with a soap-water solution, if such is held to a minimum. The use of oil as a lubricant on hose installed with hose clamps may result in "blow off" of the hose.

e. Support self-sealing hose at least every 18 inches.

f. Place an identifying red band on each tube at a point 2 1/8 inches (plus zero or minus 1/16 inch) from the bead.

g. Install hose connectors and clamps so that the minimum distance from the edge of the clamp to edge of hose is 1/8 inch (plus or minus 1/16 inch), and from inner edge of clamp to red marking band or shoulder of nipple is 1 7/8 inches (plus or minus 1/16 inch).

h. Hose clamps should be tight but AVOID OVER TIGHTENING. Approximately 25 inch-pounds torque in tightening the clamps is considered to be sufficient. Where torque wrenches are unavailable and in inaccessible spots, the clamps may be tightened finger tight plus ONE MORE COMPLETE TURN to accomplish an approximately correct torque. Do not safety wire clamp adjusting screws. Deletion of safety wire will facilitate inspection and will permit retightening of the clamps as they become loose due to "cold flow" of the hose. However, do not repeatedly retighten clamps to the point where the hose is excessively distorted.

4–768. OPERATIONAL CHECK. After installing the fuel lines, make the following operational check for proper fuel flow as follows:

a. Operate the engine.

b. See that fuel pressure indicated on gage on instrument panel is normal (24-26 psi at 1500 rpm, propeller in low pitch).

c. Check all connections for leakage.

4–769. MAIN FUEL CELL.

4–770. DESCRIPTION. *(See figure 4–87.)* The main fuel cell, manufactured by the U. S. Rubber Company of Mishawaka, Indiana, has a capacity of 234 U. S. gallons. It is constructed of several plies of buna "N" type synthetic rubber, natural rubber and rubberized cord fabric. The inside ply is resistant to both ordinary and aromatic fuels. The tank is covered on the outside with reinforcing material which increases its rigidity and protects it against wear. When the non-fuel resistant rubber sealing plies are punctured by gunfire, fuel coming in contact with them will cause immediate swelling and seal the openings. The main fuel cell is located between the firewall and the forward bulkhead of the cockpit.

4–771. Openings are provided in the cell for the installation of operating parts. The submerged auxiliary (booster) fuel pump and the fuel system defueling valve are installed in the bottom of the cell while a Liquidometer, vacuum relief valve, and manhole cover are installed on the top of the cell. Connections for the vent line and the fuel transfer shutoff float valve are located on the aft side. The vapor return line from the carburetor enters the cell at the top of the forward side. The cell is fastened to the walls of the fuel cell cavity by fittings on the cell exterior.

4–772. LOCATION AND ACCESS.

4–773. Access to the top of the main fuel cell is through the manhole on top of the cowling at station 112. The manhole cover, contains the filler cap through which the main tank is serviced.

4–774. The Liquidometer access door provides access to the Liquidometer and the vacuum relief valve mounted on the top of the aft end of the fuel cell. This door, locked by Dzus fasteners, is located on top of the fuselage just aft of manhole cover and just forward of the windshield.

4–775. The two rectangular fuel cell hanger doors, one on either side of the fuselage, between stations 107 1/4 and 120 1/2 provide access to the fuel cell support tabs.

4–776. Access to the submerged auxiliary (booster) fuel pump and the fuel tank outlet is through the auxiliary pump lines access door on the under side of the fuselage between stations 112 and 119 3/4. The door contains a shielded outlet for the auxiliary pump drain tube.

4–777. The hinged fuel drain access door is located on the under side of the fuselage just aft of the auxiliary pump lines access door at station 127. Access to the defueling valve for operation and maintenance is through this door.

4–778. PRECAUTIONS IN FUEL CELL HANDLING. The following precautions should be observed when handling the main fuel cell:

a. Remove shoes before entering the cell.

b. Only safety lights should be used inside the cell.

c. Do not lift cell by the fittings.

d. Do not allow cell to remain distorted after removing. Always support cell to retain its original shape.

e. Keep all cell openings closed when it is out of the airplane.

f. Check that cell is clean when the installation is complete.

g. Do not pry on rubber fittings or on the cell itself with sharp instruments of any kind.

h. Check that hose clamps are tight but not tight enough to injure the hose. Turn finger tight and then one extra turn to 25 inch-pounds.

i. Apply the proper torque of 30 inch-pounds to the fittings. Do not retighten. Repeated retightening will cause fitting failure.

Note

Do not apply more than 30 inch pounds of torque to studs which attach fittings to the cell or to the cavity structural ribs. These studs should not be retightened after the normal torque has been applied. Check that molded threaded metal inserts are clean and in good condition.

j. Safety wire in accordance with service specifications.

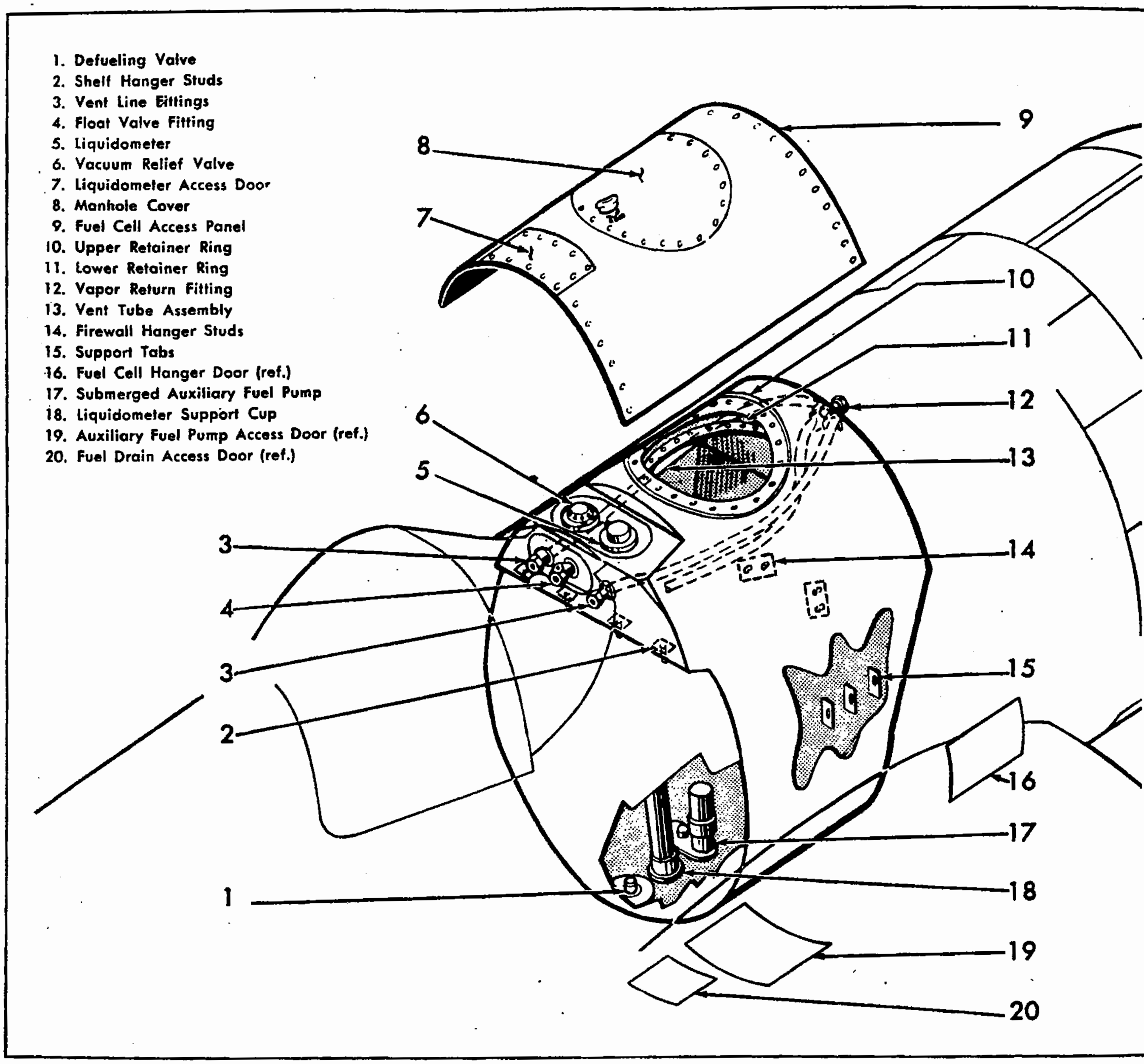


Figure 4–87. Main Fuel Cell Installation.

4–779. REMOVING. Before starting to remove the main cell, the airplane must be grounded at the grounding jack in the Liquidometer access door on top of the fuel cell or by other approved methods. The airplane must be defueled and if possible, the cell should be aerated for a minimum of 72 hours. The cell is then removed as follows:

WARNING

The vapors from aircraft fuel, rubber cement and solvent are dangerously toxic, even if inhaled for only a short time. Before work is begun, drain the fuel from the cell and dry, using a low-pressure compressed air hose. DO NOT USE AN ELECTRIC FAN. Sparks created by an electric motor are dangerous as fuel vapor is easily ignited. When it is necessary to work on the inside of the cell, two persons should be assigned the job. The individual working inside the tank must wear a rescue breather. The second workman will remain outside the cell in such a position that he can observe any sign of distress shown by the person inside the cell.

a. Remove the defueling valve; see paragraph 4–824.

b. Remove the submerged auxiliary (booster) fuel pump; see paragraph 4–817.

c. Detach the manhole cover by removing the screws which attach it to the upper cowling. Remove the cover and the locking ring beneath it.

d. Remove the Liquidometer; see paragraph 4—807.

e. Remove the cockpit instrument access doors located on each side of the fuselage aft of the fuel cell.

f. Remove fuel cell access panel.

g. On the outside of the tank at the rear, loosen the hose clamps and remove the vent lines hose couplings from the two vent line fittings.

h. Within the cell, remove the nuts and washers from the vapor return fitting located on the upper forward wall.

i. Within the cell, loosen the hose coupling clamps at the two aft ends of the vent tube assembly, and remove the vent tube assemblies.

j. Detach the aft vent terminal by breaking the lockwire and removing the two fillister head screws and washers.

k. Work the tube assembly aft until the forward end is free of the vapor return fitting.

l. Pull the hose coupling from the vent fittings and remove the tubes from the cell.

m. Cut the lockwire on the vent fitting and remove the bolts, washers and fittings.

n. Remove the two washers and nut from the vapor return fittings on the firewall.

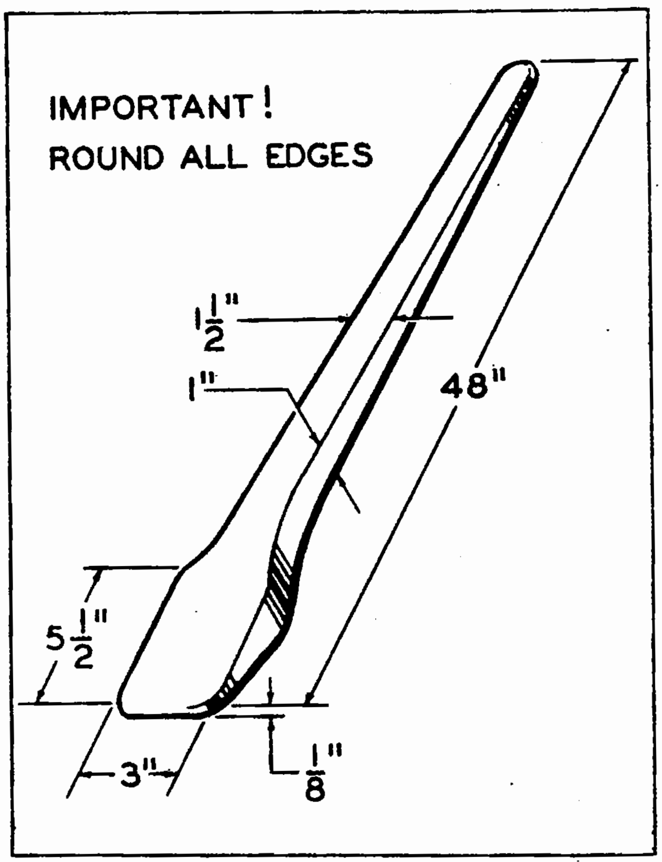


Figure 4—88. Fuel Cell Handling Paddle.

o. Disconnect the vapor return line back of the oil tank in the accessory compartment.

p. Remove the nuts holding the vapor return line fitting to the firewall.

q. Remove the screws holding the retainer ring to the cowl, and remove ring.

r. Open the Camloc fasteners and remove the top cowl deck.

s. Push the top forward end of the cell in and remove the vapor return line fitting from the cell.

t. Remove the fuel transfer shutoff float valve; see paragraph 4—896.

u. Remove the lockwires and bolts holding the vacuum relief valve to the top of the tank and lift off the valve.

4—780. SUPPORTING STUDS. The cell is fastened to the walls of the cavity by studs which are part of the fuel cell assembly. The main attaching points are in the shelf on the aft end of the cavity and in the receding side of the firewall. These tabs on each side of the cell fasten to the cell cavity ribs. These are reached through access doors.

4—781. REMOVAL OF THE CELL. To remove the fuel cell from the airplane proceed as follows:

Note

An easily made paddle, similar to that shown in figure 4—88 will be of considerable assistance in removing the cell.

a. Insert the paddle between the cell and the cavity, and work the paddle around the cell to loosen it from the cavity walls.

b. Using the paddle as a lever, collapse the side wall of the cell.

c. Working on one side of the center section, reach down and grasp the cell where it is bolted to the firewall. Jostle the cell until it is dislodged.

d. Lift the cell with a steady upward pull until the attaching bolts are released from the walls of the cavity. The cell will have a tendency to roll out of the cavity.

4—782. REPAIRING.

WARNING

A fuel cell is "self-sealing but not self-healing," therefore, an" fuel cell which has been ruptured so that gasoline is in contact with the sealant material must be repaired as soon as possible, within 72 hours maximum.

4-783. PREPARATION OF CELL FOR REPAIR. In order to make permanent repairs, the damaged cell must in most cases, be removed from the airplane. Repair work must be done in a dry place as dampness and moisture will make a satisfactory repair impossible.

a. Cells should be drained and thoroughly dried as soon as possible after injury. Aerate the cell for a minimum of 72 hours. Circulating the air with an air hose reduces the drying time to 1/2 hour.

b. The cells shall not be kept warm for a long period of time, however, and shall never attain a temperature over 49°C (120°F). Higher temperatures will not only dry out the gasoline-soaked sealant next to the injury, but will also trap gasoline farther in the cell wall. If gasoline in the sealant is trapped in this manner, it will cause ply separation and break down the sealant material. To prevent this, the edges of the injury shall be spread open slightly with a small stick or pencil during drying to allow all gasoline to escape from the sealant material. Drying may require several days.

c. Repair work may begin as soon as the sealing gum has resumed its normal appearance and is no longer swollen. Circulate a stream of low pressure air through the tank.

d. Repairs on the inside of the cell shall be made before those on the outside. Inside injuries may be reached through the cell access doors or openings. In some cases it may be necessary to use a mirror and a safety light inside the cell to see the injury.

4—784. MAINTENANCE REPAIR. The following maintenance repairs can be made to the fuel cell without removing it from the airplane.

a. If fuel discoloration is found around the access doors on the bottom of the tank, remove the door and locate the source of leakage. If the leak is between the fitting and the tank, tighten the bolts one extra turn beyond finger tight.

b. If the leak is in the fuel line, tighten the fittings and the hose clamps.

c. If the defueling valve is leaking, tighten the mounting bolts. If it continues to leak, replace it.

4—785. Repairs to small cuts and holes in the fuel cell which may be necessary as a result of gunfire or cell deterioration may be accomplished in accordance with approved service methods.

4—786. The forward part of the interior vent tubes are taped to prevent rubbing. Should this tape require replacement, apply EC-613 cement (Minnesota Mining and Manufacturing Co.) followed by neoprene tape and another coat of cement over the tape. Allow the cement to dry thoroughly before installation.

4—787. INSTALLING. To install the main fuel cell proceed as follows:

a. Tape all sharp edges of the cavity to prevent damage during installation.

b. Inspect the cavity and check that sheathing is in place and in good condition.

c. Clean the cavity of debris, tools, etc.

d. Sprinkle soapstone within the cavity and on the bottom and sides of the cell.

e. Lift the cell and place it on the wing butt.

f. Two operators must lift the cell from the wing butt and position it on the open cavity.

g. Working on both sides of the airplane, collapse the cell in the lower mid-section.

h. Continue the collapsing of the cell at its mid-section working upward while the cell is jostled downward into the cavity.

i. The bolt attachments on the receding ends of the cell must be fitted into the holes in the cavity walls as the cell is lowered into the cavity.

j. Attach fittings in reverse of removal procedures given in paragraph 4—779.

4—788. PRESSURE TEST. The cell shall be tested to 12 inches of mercury (six psi) on installation. A drop of 1/10 inch of mercury per half hour is acceptable providing that this small leakage is around the manhole cover or the filler neck as determined by bubbling through a soap solution. Leakage at any other point is not permissible. To make the pressure test:

a. Plug all openings except the vapor return line from the carburetor and the right hand vent line fitting in the forward cockpit bulkhead.

b. Fasten the pressure line to the vent line fitting.

c. Fasten manometer air line to vapor return fitting.

d. Admit air gradually tc the tank until a pressure of 12 inches of mercury (six psi) is attained.

e. Wait for the manometer reading to stabilize.

f. Soap all fittings with a mild soap solution to test for bubbling leaks.

g. No leakage is permitted around any of the fittings.

h. Slight leaks around the manhole cover and filler neck are permitted to the extent of 1/10 inch of mercury in 30 minutes.

4—789. FUEL CELL VENTING AND PRESSURIZING SYSTEM.

4—790. DESCRIPTION. The main fuel cell venting system consists of the following: forward and aft vents and lines within the main cell, external line and fittings, and vent lines from the fuel transfer shutoff valve and fuel transfer pump. All of these lines tee into a main vent line which relieves overboard through a vent chamber installation in the right wing. To retard boiling and to prevent excessive loss of fuel through vaporization, the vapor pressure of the fuel is utilized to pressurize the main fuel cell at altitudes above 18,000 feet. This is accomplished by the action of an automatic vent valve in the main overboad line, which is normally open. At 18,000 feet, the valve regulates the pressure within the main fuel cell at 2.25 (plus or minus .25) psi. This valve can be controlled manually from the cockpit so that the pilot can vent the main cell to atmospheric pressure before going into combat. A vacuum relief valve on top of the main cell relieves fuel cell vacuum which results from a rapid loss of altitude. Pressurizing of the left hand external auxiliary tank is covered in paragraph 4—858.

4–791. FUEL CELL VENT VALVE.

4–792. DESCRIPTION. *(See figure 4–85.)* The fuel cell vent valve is located in the overboard line from the main fuel cell. The valve itself is bolted to a plate under the floor on the right hand side of the cockpit at approximately station 135. It is linked by a rod which extends aft underneath the cockpit floor to a control lever, the handle of which protrudes into the cockpit and is accessible to the pilot. The valve, which is manufactured by the Aerotec Co. of White Plains, N. Y., their part number B-1002 and by Aircraft Controls Co. of Stamford, Conn., their part number B-1001, consists of three operating valves enclosed in a housing vented to the atmosphere and to the main fuel cell. The housing is separated into two parts by a partition on which the pressurizing, safety and vacuum relief valves are mounted.

4–793. The pressurizing valve is normally open, but closes at 18,000 feet. It consists of a sealed bellows and a spring-loaded valve fastened by a strap bracket to the center partition of the valve housing.

4–794. The safety valve is closed normally, but opens under a pressure of 2.25 (plus or minus .25) psi, preventing the fuel cell from being pressurized beyond this value.

4–795. The vacuum relief valve is closed normally but opens when atmospheric pressure is 0.2 psi greater than fuel cell pressure. This valve will open when the airplane loses altitude rapidly, preventing the formation of a partial vacuum in the cell. The valve can be opened manually from the cockpit by moving the control lever to the combat position. This operation moves a cam over the vacuum relief valve plunger, forcing the valve to the open position and dumping the fuel cell pressure.

4–796. REMOVING. Access to the vent valve is through the lower cockpit access door in the underside of the fuselage. Remove the valve as follows:

a. Working in the cockpit, remove the hose clamps and the hose connection and disconnect the fuel pressure vent line from the fitting on top of the valve.

b. Working underneath the cockpit floor, disconnect the control rod at the valve.

c. Remove the hose clamps and hose connections and disconnect the overboard line.

d. Remove the screws which hold the valve to the mounting plate and remove the washers, spacers and nuts.

e. Remove the vent valve.

f. Remove the control lever arm, control rod, and bearing by disconnecting the spring and removing the eye bolt and nut holding it to the bracket.

4–797. INSTALLING. Install the vent valve as follows:

a. Position valve on mounting plate so that mounting holes on valve are aligned with those in the plate.

b. Install three mounting screws. Install washers and nuts and tighten.

c. In the cockpit, replace and reclamp the pressure vent line. Below the floor, replace and reclamp the overboard line to the valve.

d. Bolt the control rod to the control arm on the bottom of the control valve. The bolt is inserted through the arm and the rod from the cockpit with a washer between the arm and bearing. Place a washer under the head of the rod and install nut and cotter pin.

e. Place the spacer in the hole in the cockpit control lever arm and insert arm from the cockpit through the floor into its bracket.

f. Bolt lever to bracket.

g. Fasten the lever to the flattened end of the rod with the eyebolt and cotter the nut.

h. Place the ends of the spring through the holes in the floor bracket and the eyebolt on the control rod.

Note

The cockpit control lever should be kept in the aft position except during combat or whenever else it is desired to dump the pressure in the fuel cell.

4–798. VACUUM RELIEF VALVE.

4–799. DESCRIPTION. *(See figure 4–85.)* The vacuum relief valve, manufactured by Chance Vought Aircraft, their part number VS-13361, is a double-disc riveted assembly in which the center parts are pressed out to form a cover and housing for the valve chamber. A round neoprene disc serves as a valve seat in the cover, and a grommet type neoprene valve is fastened in the middle of a spring-loaded diaphragm so that it presses against the seat in the cover. When fuel cell pressure is equal to or greater than atmospheric, the valve remains closed, but when, during a dive, atmospheric pressure becomes greater than internal fuel cell pressure, the diphragm opens the spring-loaded valve. This vents the fuel cell to atmospheric pressure and prevents the formation of a vacuum within the cell. The valve is bolted to the top of the main fuel cell and is accessible through the Liquidometer access door.

4–800. REMOVING. Remove the lockwires and bolts holding the vacuum relief valve to the top of the cell and lift off the valve.

4–801. REPAIRING. There are no instructions for repairing this valve. If it is found to be defective, replace it. This valve prevents the pressure within the main fuel cell from becoming less than atmospheric, a condition which might occur with a rapid loss of altitude. Failure of the valve to relieve under such a condition will probably go unnoticed by the pilot unless the pressure drop between the exterior and interior becomes great enough to collapse the walls of the tank. Collapse of the cell would probably cause it to leak, in which case the cell would have to be replaced or repaired. Should tank repair or replacement become necessary for this reason, the valve should be replaced at the same time. The valves have been designed to conform to the following specification.

a. Valve to withstand a pressure of seven psi on housing side without leakage.

b. Valve to withstand a pressure of 0.20 psi on the cover side without leakage.

c. With a pressure 0.70 psi on cover side, the valve is to pass not less than 35 cubic feet of air per minute (density = 0.0767 pounds per cubic foot).

4—802. Should the valve leak, either internally or around the mounting, it will probably cause fuel fumes in the cockpit. Should the pilot report such a condition, the vacuum relief valve should be checked.

4—803. INSTALLING. Position valve on top of fuel cell, install bolts and washers. Tighten bolts and secure them with safety wire.

4—804. FUEL QUANTITY INDICATOR TRANSMITTER.

4—805. DESCRIPTION. *(See figure 4—89.)* The quantity of fuel in the main fuel cell is indicated to the pilot by a remote indicating system. It consists of a transmitter in the fuel cell which is connected electrically to a dial on the instrument panel. A low level warning switch is incorporated on the transmitter which illuminates a warning light on the instrument panel when the quantity of fuel in the main cell drops to 50 U. S. gallons. For a functional description of the transmitter, refer to paragraph 4—1447. The electrical circuits are described in paragraph 5—83. The gage transmitter is manufactured by the Liquidometer Corporation of Long Island City, N. Y., their part number is EA-67W (Stock No. R88-T-2677-600). The transmitter is a long cylindrical tube of aluminum alloy mounted vertically in the main fuel cell and extending the depth of the tank. The bottom of the tube rests on the floor of the fuel cell in a cup which is supported by studs on the tank bottom. A float within the tube measures the fuel level.

4—806. LOCATION AND ACCESS. The top of the tube extends out of the top of the fuel cell and accessible through the Liquidometer access door just forward of the windshield.

4—807. REMOVING. After draining the fuel from the main cell, proceed as follows:

a. Working through the Liquidometer access door, detach the electrical conduit from the disconnect plug on top of the transmitter.

b. Remove the lockwires and screws and lift the transmitter unit from the tank.

c. Remove the Liquidometer by lifting it straight out of the cell.

Note

Be careful not to damage the float mechanism and the tube by striking it against the side of the opening. Any change in the shape of the long support tube will cause the float to stick, giving erratic readings on the cockpit gage.

d. The Liquidometer cup support can be removed from fuel cell working through the submerged auxiliary (booster) fuel pump opening in the bottom of the cell. Remove the two nuts holding the cup to the studs on the tank bottom. It should be noted however, that the transmitter tube can be removed from the fuel cell, or the fuel cell from the airplane without removing the cup.

4—808. INSTALLING. To install the transmitter in the fuel tank proceed as follows:

a. If support cup is not mounted on the cell floor it must be installed working through the submerged auxiliary (booster) fuel pump opening in the bottom of the cell. The cup is supported by two studs in the floor of the cell and held in place by installing nuts on the studs.

b. Clean mounting faces of transmitter and tank.

c. Use a new gasket; no cement is recommended.

d. Place the bottom of the transmitter in the cup on the bottom of the tank. A string should be attached temporarily to the floor and bought up through the support tube and out of the tank.

e. Place the mounting screws in position, tighten them evenly, and install the safety wires.

f. After installing the Liquidometer as described above, check the operation of the instrument as follows:

Note

Be sure that all switches in cockpit are "OFF." *1.* Turn on battery switch. *2.* Note position of the fuel quantity indicator; with the main cell empty, the indicator should point to the "0" gallon mark. *3.* Raise the transmitter float. *4.* When indicator is at approximately 50 gallon mark, note whether or not the fuel reserve warning light goes out. *5.* Continue raising transmitter float to the top of the cell; the indicator should point to "230" gallons when the float is in the uppermost position.

4—809. ADJUSTING. *(See figure 4—89.)* If the gage reads incorrectly, the transmitter should be adjusted as follows:

a. Working through Liquidometer access panel, unfasten cover of transmitter unit by removing the three capstan-head screws which hold cover in place.

b. If the pointer is off travel, i.e. its 300° range of motion does not correspond to the "0" gallon and "230" gallon marks which are 300° apart, then the range of pointer travel must be shifted. To do this, shift the position of the shoe (11). The shaft is held to the molded part (6) by a friction fit, and it can be adjusted easily to shift the range of pointer travel.

c. Move the float from the bottom to the top of the cell and note the pointer travel. Should the pointer travel past the "0" gallon and "230" gallon marks, the stroke is too long and it should be shortened to within 1/16 inch of each mark by moving screw (5) away from

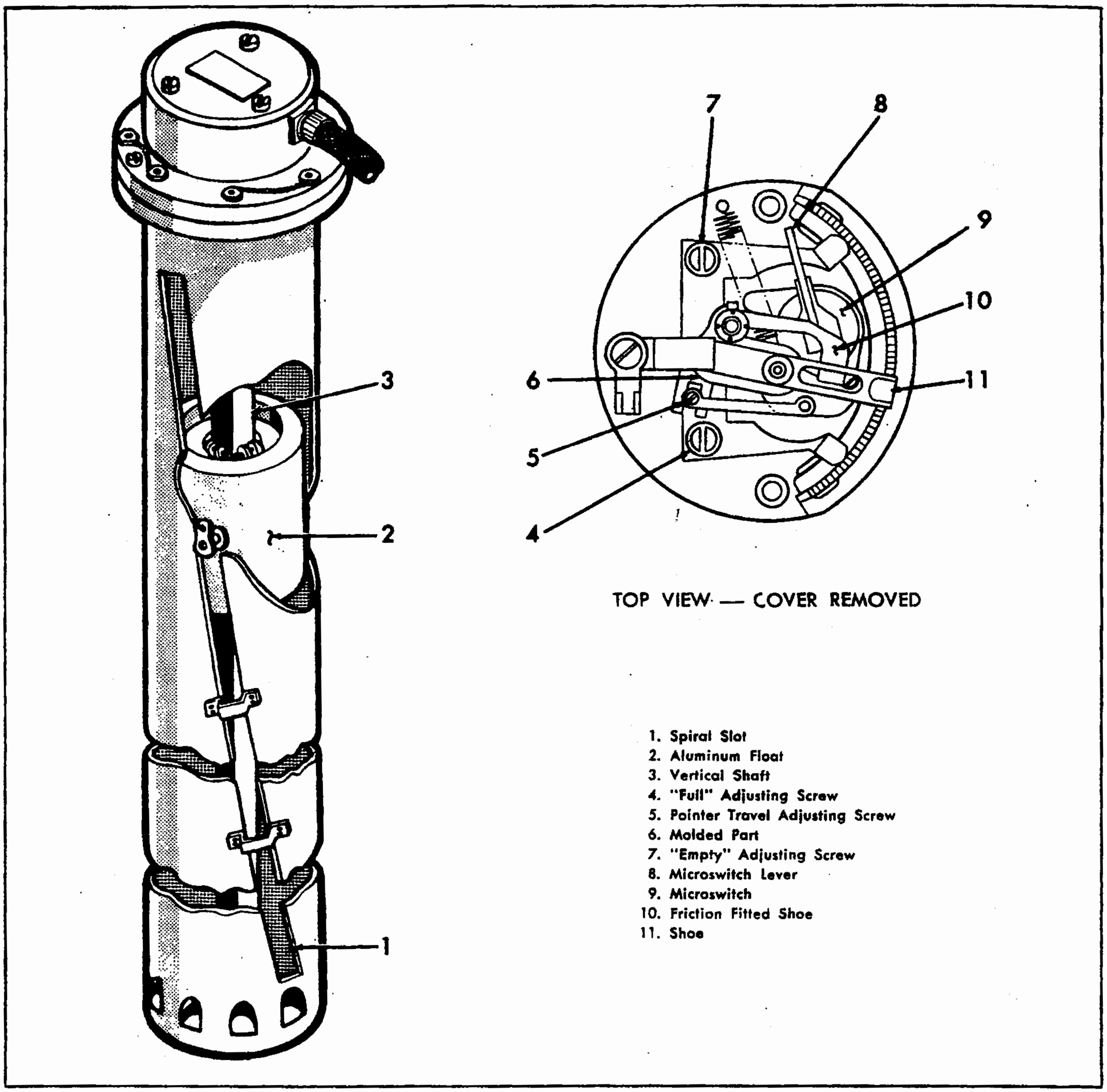


Figure 4—89. Fuel Quantity Indicator Transmitter.

center of molded part (6). To adjust, back off the screw just enough to permit movement, then insert and turn a screwdriver between the screw and molded part.

Note

This is a sensitive adjustment. The screw should be moved a small amount at a time. Always tighten the screw before checking the float in order to prevent separation of the screw and slotted arm.

Should the pointer travel fall short of both the "0" gallon and "230" gallon marks, the stroke is too short and should be lengthened to within 1/16 inch of each mark by moving the screw (5) towards the center of the molded part (6). The final adjustment necessary is to bring the dial pointer to each mark. With the float at the bottom of the tube, turn screw (7) until the pointer is directly over the "0" gallon mark. With the float held lightly at top position, turn screw (4) until the pointer is directly over the "230" gallon mark.

4—810. FIFTY GALLON RESERVE ADJUSTMENT. *(See figure 4—89.)* The fifty gallon low level warning is adjusted as follows:

a. With the fuel quantity indicator transmitter in the main fuel cell, the airplane in the level flight position and fifty measured gallons in the main fuel cell, adjust the friction fitted shoe (10) so that it contacts the microswitch lever (8) on the microswitch (9), thereby causing the warning lamp to light.

b. With the indicator transmitter removed from the main fuel cell adjust by holding the float at a position 14 1/2 (plus or minus 1/4) inches from the bottom of the tube, and adjust the friction fitted shoe (10) so that it contacts the microswitch lever (8) on the microswitch (9), thereby causing the warning lamp to light. Move the float to warning level three times to check the correctness of the setting.

4—811. SUBMERGED AUXILIARY (BOOSTER) FUEL PUMP.

4—812. DESCRIPTION. *(See figure 4—85.)* The submerged auxiliary (booster) fuel pump is an electrically-driven centrifugal pump mounted on bottom of fuel cell so that pump and motor are completely submerged. The pump is installed to provide fuel of reduced vapor content and to provide fuel pressure in event of failure of engine-driven fuel pump. The motor is explosion-resistant, designed to operate on airplane's 28 volt dc system. The unit is manufactured by Thompson Products, Inc., Cleveland, Ohio, part number TFG-31000-1.

4—813. The pump and motor assembly is supported by channels and angles attached to lower fuselage frames forward of cockpit. It is accessible through auxiliary (booster) pump lines access door on bottom of fuselage dircetly below pump. A tube attached to seal drain next to electrical leads, conveys any fuel that may leak into drain passage to a shielded outlet in access door. Electrical connection is provided by a lead which passes through casting from mounting flange of pump end frame directly to motor. The lead wire entrance is sealed by a gasket to prevent liquid from entering motor. The motor is designed to operate in a temperature range of −54°C (−65°F) to 74°C (165°F).

4—814. FUNCTION. The pump is operated at two speeds by a three-position toggle switch located on the left hand control shelf in the cockpit. The "LOW" position is used for starting and for all normal engine operation. The "HIGH" position is for use during take-off and landing and as an emergency fuel pump in the event of engine-driven fuel pump failure. In the low position, the pump speed is about 5800 rpm. Under high pressure emergency operation, the pump speed is about 8000 rpm. The direction of rotation of the motor is counterclockwise, viewing the pump from the flange end. In the event of failure of the auxiliary pump, the fuel is drawn through it in a normal manner by the engine-driven fuel pump. The auxiliary pump is designed so that there will be a very low pressure loss under this condition. This pump also supplies fuel pressure to the cockpit heater and to the oil dilution system.

4—815. When the oil dilution switch is held "ON," the auxiliary pump operates in high. Electrical connection (refer to electrical circuit diagram, paragraph 5—69) is provided by continuous leads, wired directly to the motor through the casting. Pump leads are identified as "A," "B," and "C," and are colored as follows for indentification: lead "A," red; lead "B," black; lead "C," white. The motor is of the compound wound, tapped field type. Normal duty operation is obtained by applying current source to "B" with "C" grounded. Emergency duty operation is obtained by applying current source to "A" and "C" grounded. A variable resistor in auxiliary pump electrical circuit permits adjustment of "HIGH" pump pressure output. The resistor is located just below cockpit floor at station 134 just to left of centerline of airplane. It is accessible through lower cockpit access door.

4—816. TROUBLE SHOOTING.

Trouble	Probable Cause	Suggested Remedy
Seal leak.	*a.* Failure of seal assembly.	*a.* Replace pump.
Pump noisy.	*a.* Loose mounting.	*a.* Tighten mounting bolts and fuel line connections if found to be loose.
Pump fails to operate.	*a.* Wiring not properly connected or loose or high resistance in connection.	*a.* Remove electrical connections from connector and clean connecting lead thoroughly. Replace, making sure connection is tight. Check that voltage applied to pump is correct and check that wiring is properly hooked up.
Unsteady or erratic pressure.	*a.* Loose connection; voltage variation.	*a.* Same remedy as above.

Trouble	Probable Cause	Suggested Remedy
	b. Pump screen clogged.	*b*. Remove pump. Remove pump screen and clean, removing all foreign matter. Replace screen and install pump.
Pressure too low.	*a*. Low voltage.	*a*. Check voltage at pump.
	b. Wiring not properly connected.	*b*. Remove electrical connections from connector and clean connecting lead thoroughly. Replace, making sure connection is tight. Check that voltage applied is correct. Check that wiring is properly hooked up.
	c. Armature shaft binding.	*c*. Replace and forward for overhaul.
	d. Gasoline in motor (indicates possible bearing failure).	*d*. Remove vent plug and inspect. If flooded, replace and forward for overhaul.
Volute cover leak.	*a*. Volute cover gasket failure.	*a*. Replace gasket or forward pump for overhaul.

Minor adjustment of "HIGH" pump pressure can be made through the variable resistor; see paragraph 4—820.

4—817. REMOVING. To remove the pump proceed as follows:

a. Drain the main fuel cell and remove auxiliary pump lines access door on the bottom of the fuselage.

b. Disconnect main discharge line by removing hose connector.

c. Remove overflow tube from the drain port.

d. Remove three anchor bolts holding pump to angle support.

e. Remove the supporting bolts, angle and channel.

f. Disconnect electrical lead.

g. Detach the pump mounting frame by removing the nine mounting bolts.

h. Remove pump from the bottom of the cell.

4—818. PRE-INSTALLATION TEST. Before auxiliary (booster) fuel pump is installed, it should be bench tested to insure that it is functioning properly. The following check under "no flow" conditions can be made with a minimum of test equipment. All that is needed is a tank for submerging pump under at least eight inches of fuel, a power source capable of providing 28 volts, and a hose connection which is plugged and provided with a fuel pressure gage to be connected to pump outlet. The pump should meet following specification:

a. At "LOW" speed at 28 volts, fuel pressure should be 10 psi minimum.

b. At "HIGH" speed at 28 volts, fuel pressure should be 30 psi minimum.

c. Check for seal leakage by running the pump at low speed for two minutes. There should be no leakage. If there is slight leakage, run the pump for 15 minutes at low speed. If the leakage persists, reject pump.

Note

In no case should the auxiliary pump be run dry for more than three minutes.

4—819. INSTALLING.

a. Clean mounting faces of cell and pump. Be careful not to scratch or damage them.

b. Insert pump in cell with outlet nipple pointing to the right aft side of the airplane.

c. Insert nine mounting bolts (all bolts except those which go through the supporting structure). Tighten them evenly by applying a torque of 30 inch-pounds. Safety wire bolts.

d. Insert three supporting bolts, through the angle, channel supports and spacers under the bottom of the tank and start them into the mounting holes.

e. Fasten angle and channel supports.

f. Tighten and lockwire supporting bolts.

g. Attach fuel line hose of pump outlet.

h. Attach overflow tube.

i. Tighten and lockwire water drain plug.

j. Reconnect electrical connection.

k. Replace auxiliary fuel pump access door.

4—820. TESTING. After the pump has been installed, test for operation as follows:

a. With engine off and mixture control in "IDLE CUT-OFF," 28 volts, auxiliary pump in "LOW," the pressure should be not less than 10 psi.

b. With auxiliary pump "OFF," and engine running at 2200 rpm, full low pitch, and mixture control in "RICH," fuel pressure should be 25 1/2–26 1/2 psi; see paragraph 4–839.

c. With auxiliary pump "HIGH," fuel pressure should be 27 1/2–29 1/2 psi.

d. If the pressure does not reach this value, adjust the variable resistor until it does; see paragraph 4–815.

4–821. DEFUELING VALVE.

4–822. DESCRIPTION. *(See figure 4–85.)* The defueling valve is manufactured by the Saval Company, 1915 East 51st St., Los Angeles 11, California, their part number 5368. It consists of two castings bolted together so that they form an operating chamber for a handle-controlled metal disc. There is an inlet hole in the top or tank side of the valve which aligns with a nipple outlet on the bottom of the valve. When the valve handle is in the closed position, the disc cuts off fuel flow. When the handle is turned 45 degrees to its open position, a hole in the disc aligns with the inlet and outlet holes allowing the fuel cell to drain. The valve chamber is sealed from leaking by a neoprene seal.

4–823. LOCATION AND ACCESS. The valve is mounted on the aft end of the underside of the main fuel cell on the centerline of the airplane. Access to it is through the fuel drain access door. The valve is bolted to an adapter plate which in turn is bolted to the fuel cell. When the access door is closed, the outlet nipple of the valve contacts a cup and seal assembly on the door which collects any valve leakage. A drain hole in the door within the cup and seal allows any seepage from the valve to drip overboard. A block on the access door prevents door from being closed when valve handle is in open position. The four valve mounting bolts also support two fuel cell retainers. These retainers are mounted on cell to strengthen cell wall against any collapsing tendencies due to external tank pressures exceeding internal pressure such as might occur in a rapid dive.

4–824. REMOVING. To remove the defueling valve proceed as follows:

a. Connect suitable defueling hose to valve connection.

b. Open valve and drain all fuel from the main cell.

c. Remove the four bolts which attach the valve and retainers to the adapter plate.

d. Remove valve and two retainers.

e. Remove neoprene gasket from around valve inlet nipple.

f. Remove eight screws attaching valve adapter to fuel cell.

4–825. INSTALLING. To install the defueling valve reverse the removing procedure described above.

4–826. TANK SELECTOR VALVE.

4–827. DESCRIPTION. *(See figure 4–85.)* The fuel tank selector valve is the valve by which the pilot directs fuel to the carburetor from either the main fuel cell, or from the external auxiliary tanks. It is located at station 173 approximately two feet below the fuel tank selector grip on the left hand control shelf. The valve is bolted to a bracket riveted to fuselage frames. It is a four port selector valve manufactured by the Hydro Aire Company of Los Angeles, Calif., their part number 1208. Access to it is through the lower cockpit access door in the underside of the fuselage. The valve consists of a machined housing with three entrance ports on the sides and one exit port on the bottom. One entrance port is fitted with an adapter to accommodate the line from the right hand auxiliary tank, while elbow fittings connect with lines from the left hand or center auxiliary tank and the main cell. The exit port is fitted with an elbow which connects with the main fuel line to the strainer. The top of the valve is equipped with an Air Corps No. 06759P yoke which controls the valve settings. The position of the valve control in any one of its four positions is accompanied by a definite "click" of the valve which can be felt by the operator. The control handle is located on the left hand control shelf in the cockpit. It is connected to the yoke on the valve by a universal joint and a rod.

4–828. REMOVING. The airplane must be defueled before the tank selector valve is removed. When the tanks have been drained, proceed as follows:

a. Disconnect the fuel lines by loosening the clamps and detaching the hose from the fittings.

b. Remove the mounting bolts.

c. Remove the cotterpin and disconnect the control shaft at the yoke.

d. Remove valve.

e. The control shaft is removed by removing the screws which attach the dial assembly to the top of the left hand control panel.

4–829. INSTALLING. Before installing the valve, clean it thoroughly with clear gasoline.

a. Place the valve in position so that the yoke on the shaft engages the control fitting. Fasten yoke.

Note

Check that both the valve and the selector handle in the cockpit are in "OFF" position before connecting control shaft to valve yoke.

4–830. MAIN ENGINE-DRIVEN FUEL PUMP.

4–831. DESCRIPTION. *(See figure 4–90.)* The engine-driven fuel pump is a Navy Type H7E4, rotary, positive displacement pump. This pump, made in accordance with Specification AN-4102, is produced by several manufacturers. One of the pumps made in accordance with Specification AN4102 is manufactured by Thompson Products, Inc., Cleveland, Ohio, their number

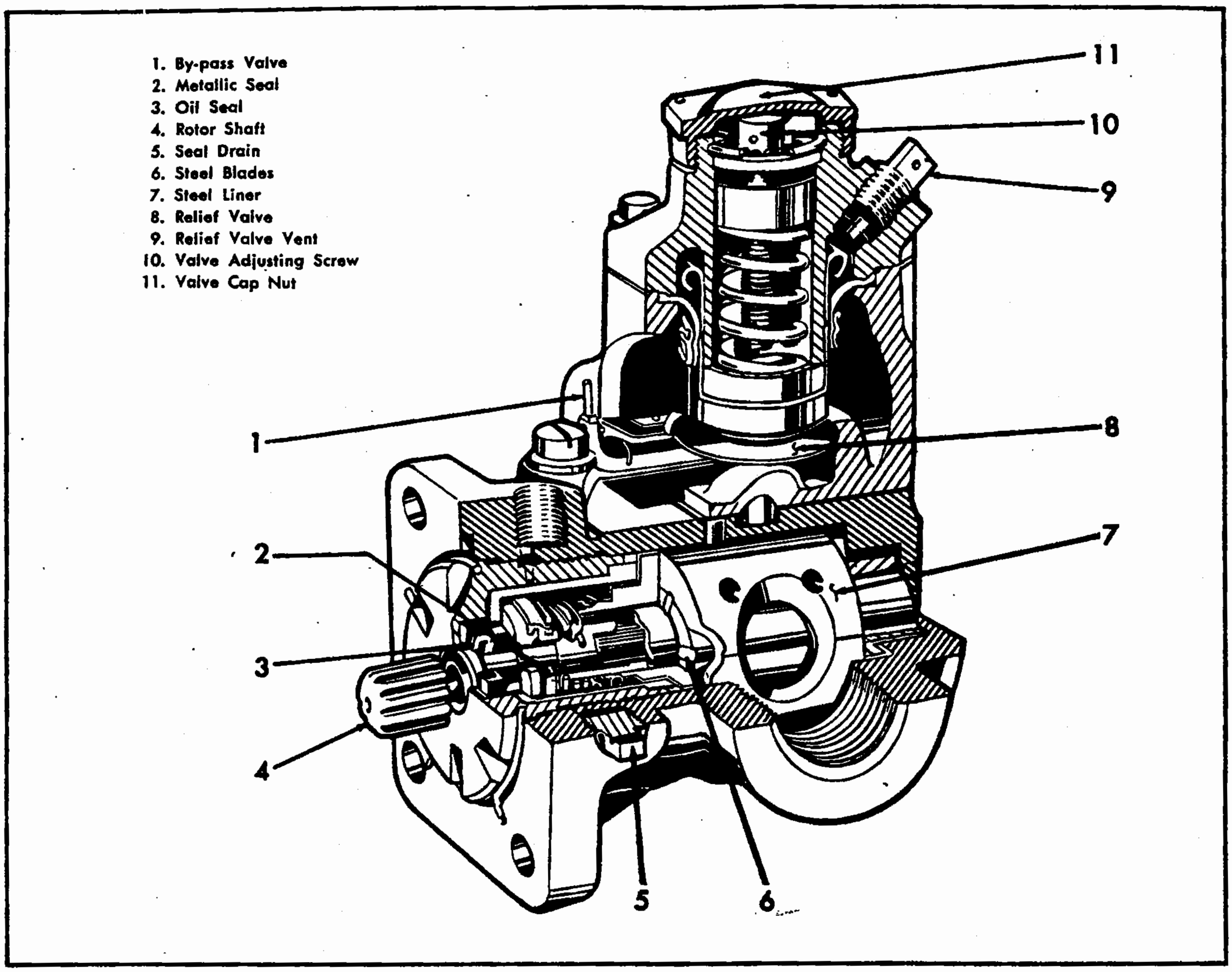


Figure 4—90. Main Engine-Driven Fuel Pump.

TFD-2100. This pump will pump 650 gallons per hour at a pump speed of 2000 rpm.

4—832. The pump consists of a body with a steel liner (7) having an eccentric bore, and a rotor with three pairs of sliding steel blades (6). Leakage around the rotor shaft (4) is prevented by a metallic seal (2). This seal has no connection with the driving coupling and therefore misalignment of these parts cannot cause leakage. An oil seal (3) prevents engine oil from leaking into the pump. A seal drain (5) is also provided.

4—833. FUNCTION. An adjustable relief valve (8) carries excess fuel from the discharge port back to the intake port whenever the discharge pressure exceeds the valve setting. A supercharger connection to the relief valve vent (9) is provided by a vent line to the carburetor. Thus, fuel pressure is maintained relative to the carburetor deck pressure rather than to atmospheric pressure and the fuel-air mixture in the carburetor is kept uniform. Some pumps are equipped with more than one vent line connection port. The vent line connection ports which are not used should be plugged with solid plugs. A by-pass valve (1) is located in the lower relief valve body. The hinged flapper-type valve opens when fuel is forced through by the auxiliary (booster) fuel pump. The pump is driven from the accessory drive of the engine by an internally splined shaft. The engine fuel pump drive shaft is driven in a counterclockwise direction looking at the pad. The pump inlet port for this direction of rotation is indicated by arrows on the pump nameplate. In this installation the fuel pump assumes an upside down (relief valve body on the underside) position. No lubrication of the pump is required since the vanes are lubricated by fuel, and the drive shaft and coupling parts by engine oil.

4—834. LOCATION AND ACCESS. The pump is mounted on the rear face of the engine accessory drive housing by four mounting studs. It is accessible through the intercooler flap.

4–835. TROUBLE SHOOTING. *(Refer to figure 4–90.)*

Trouble	Probable Cause	Suggested Remedy
Unidentified leak.	*a.* Fuel lines, damaged or improperly attached to pump.	*a.* Locate source of leakage and repair or tighten.
	b. Relief valve not secure on pump.	*b.* Tighten screws.
Seal leak.	*a.* Failure of seal assembly.	*a.* Replace pump and forward for overhaul.
Pump fails to rotate.	*a.* Pump run dry and allowed to overheat and jam.	*a.* Replace and forward for overhaul.
	b. Spline driver shaft (4) sheared due to foreign matter jamming the pump.	*b.* Replace and forward for overhaul.
Pump fails to pump when rotor starts turning.	*a.* Foreign matter holding the relief valve (8) open.	*a.* Replace and forward for overhaul.
	b. Air leak in intake line.	*b.* Locate leak and repair.
	c. By-pass valve (1) held in open position by foreign matter.	*c.* Replace and forward for overhaul.
Discharge pressure too low.	*a.* Valve cap nut (11) loose allowing adjustment screw locking arm to come unlocked and turn.	*a.* Readjust to proper pressure setting; see paragraph 4–839e. Lock the arm in position and tighten valve cap nut, securing it with lock wire.
	b. Adjustment screw locking arm broken.	*b.* Forward for overhaul.
Discharge pressure surges.	*a.* Obstruction on inlet side of fuel pump.	*a.* Trace each fuel line to the tanks and remove obstruction when located.
	b. Faulty by-pass valve (1).	*b.* Forward for overhaul.
	c. Faulty relief valve (8).	*c.* Forward for overhaul.
Gasoline leakage through supercharger vent plug.	*a.* Defective relief valve diaphragm.	*a.* Forward for overhaul.
Improper increase of discharge pressure when supercharger pressure is applied.	*a.* Loose valve cap nut (11).	*a.* Tighten valve cap nut and lockwire.

4–836. REMOVING. Remove the pump in the following manner:

a. Turn the fuel selector valve in the cockpit to the "OFF" position.

b. Drain fuel at the fuel strainer.

c. Disconnect fuel lines from the pump.

d. Disconnect the drain line.

e. Disconnect the carburetor air box vent line.

f. Remove the nuts and washers from the four mounting studs.

g. Lift pump straight out from the accessory drive shaft case until the shaft and mounting studs are completely disengaged.

4–837. REPAIRING. If leakage is found at the mounting face and persists after the studs have been tightened by applying a torque of 450 inch-pounds, replace the gasket.

4–838. INSTALLING. Install the pump as follows:

a. Clean all foreign substances from the engine mounting pad.

b. Check the rotation direction of the shaft which engages the fuel pump drive shaft. The inlet port is marked by arrows on the pump nameplate.

c. Install a new gasket on the mounting studs.

d. When installing a new pump, remove the shipping plugs, drain out the excess oil, flush with clean gasoline and test for free operation. If the shaft does not move freely after rewashing, reject the pump and select one in good condition.

e. Install pipe fittings on pump.

f. Place the pump in the position which is necessary to make the required fuel connections. Lift it up so that it slips over the mounting studs. Move it straight inward to engage the spline connection on the engine.

CAUTION

Care must be taken to avoid damaging the mounting gasket.

g. Tighten the mounting nuts to a torque of 450 inch-pounds and lockwire them.

h. Install the fuel lines and fittings as follows. Connect the suction line from the submerged auxiliary (booster) fuel pump. Connect the pump drain to the bottom of the pump as installed. Connect the vent line from the static pressure port provided on the carburetor to one of the three vent ports on the pump. Plug the other two vent ports on the pump with solid plugs.

CAUTION

Do not apply thread lubricant or sealing compound to female fittings.

i. Check that the three extra drain plugs are tightened and lockwired.

4—839. TESTING. After the pump has been installed, check it for operation as follows:

a. Turn the fuel selector valve "ON."

b. Inspect all fuel line connections to the pump for leakage.

c. Check the fuel flow and pressure. The fuel pressure during the ground run should be between 24 and 26 psi at 1500 rpm in full low pitch, rich mixture control, auxiliary fuel pump "OFF."

d. Inspect the pump for excessive heat after it has run for ten minutes.

Note

If excessive heat is noted, check the alignment of the mounting.

e. *(See figure 4—90.)* If discharge pressure adjustment is necessary, remove the hex valve cap nut (11) and insert a screwdriver in the slot to lift the valve adjustment screw lever clear of the locking slots on the thrust washer. Turn the valve adjustment screw (10) clockwise to increase the pressure and counterclockwise to decrease the pressure. When the adjustment is correct, push the lever into a locking slot in the thrust washer and screw the hex valve cap nut on tightly.

4—840. STRAINER.

4—841. DESCRIPTION. *(See figure 4—85.)* The fuel strainer is a heavy-duty screen type strainer manufactured by the Aero Supply Manufacturing Co. Inc. Corry, Penna. their part number 104244-4-1. Its function is to strain foreign matter from the fuel entering the engine and to provide a means of draining or removing it from the system. The strainer body is an aluminum casting. The removable bottom cover supports the screen and serves as a sump to catch water and other foreign matter. It also serves as a mounting for the bottom drain cock. It is held to the body by a pressed yoke and a wing bolt, and is sealed against leakage by a rubber gasket around the mounting face of the lower end of the body.

CAUTION

Tighten wing bolt by hand only.

The screen can be removed with the bottom cover to which it is held by the friction of one ring pressed inside another. Fuel enters the strainer through a fitting on the side and exits through one on top of the strainer. The strainer also serves as the source of gasoline for oil dilution, the oil dilution line being tapped into the lower side of the strainer. The oil dilution solenoid valve is clamped to the fuel entrance fitting on the side of the strainer.

4—842. LOCATION AND ACCESS. The strainer is installed in the main fuel line between the fuel selector valve and the engine driven fuel pump. It is mounted on a bracket attached to the lower firewall in the accessory compartment. Access is through the intercooler flap on the underside of the airplane.

4—843. TROUBLE SHOOTING.

Trouble	Probable Cause	Suggested Remedy
Leakage around strainer.	*a.* Leakage around bottom cover cover gasket.	*a.* Tighten wing bolt and if necessary replace gasket.
	b. Leakage around threads and at outlet of drain cock.	*b.* Remove drain cock and coat threads with AN-C-53 anti-seize compound. Reinstall and tighten cock by applying a torque of approximately 15 inch pounds.
	c. Leakage around cracked or corroded strainer body.	*c.* Replace strainer.
	d. Leakage of port bushings where they are attached to strainer body.	*d.* Replace strainer.

Trouble	Probable Cause	Suggested Remedy
	e. Leakage around threads and at base or bushing of drain plug inside of strainer body.	e. Remove drain cock and coat threads with AN-C-53 anti-seize compound. Reinstall and tighten cock by applying a torque of approximately 15 pounds.
Loose strainer.	*a.* Loose mounting bolts.	*a.* Tighten or replace mounting bolts.
Strainer passing foreign particles.	*a.* Broken, corroded, dirty or loose screen.	*a.* Remove screen and inspect. Clean with clear gasoline and dry with light blast of air. Replace screen if necessary.
Damaged strainer.	*a.* Cracked lugs which support bottom of strainer body.	*a.* Replace strainer.
	b. Cracked, corroded or deeply dented body.	*b.* Replace strainer.
	c. Failure of spotwelding or brazing.	*c.* Replace strainer.
	d. Warped or cracked yoke.	*d.* Replace strainer.
	e. Pressure end of wing bolt cracked or mushroomed.	*e.* Replace strainer. **Note** When the pressure end of the wing bolt is mushroomed or damaged, file off the threads around the end before removing it from the yoke.

4—844. REMOVING. Remove the strainer as follows:

a. Turn the fuel tank selector valve in the cockpit to the "OFF" position.

b. Drain the strainer by opening the drain cock.

c. Disconnect the fuel lines.

d. Remove the mounting bolts by holding the stop nuts located on the back side of the mounting bracket and then unscrewing the bolts from the nuts.

e. Lift up the strainer to remove it from the bracket.

4—845. INSTALLING. Install the strainer as follows:

a. Turn the two fillister head screws counterclockwise to loosen the mounting clamp.

b. Screw the fuel line fittings in the top and side ports, but do not tighten them.

c. Place the strainer in the correct position against the mounting pad. Turn the fitting nipples in the correct position to point in the direction necessary for connection with the fuel lines. Mark these positions on the fitting and strainer.

CAUTION

Leave the fitting turned in the right direction and do not align it by "backing it up" or turning it counterclockwise.

d. Hold the strainer with a strap wrench around the bottom. Tighten the top fitting by applying a torque of approximately six to ten inch-pounds.

e. Install the side fitting in the same way but hold the strainer on the mounting pad after tightening the mounting clamp.

f. Place the strainer against the mounting bracket and install the spacers and bolts. Tighten the bolts evenly to insure a firm mounting.

g. Connect the fuel lines by slipping the hose connections over the nipples and tightening the clamps.

4—846. TESTING. After the strainer has been installed perform the following operational check on it:

a. Check that all connections are tight and that the drain cock is closed.

b. Turn the fuel selector valve to the "ON" position.

c. Check the strainer for leakage after it has been filled with fuel for 20 minutes.

4—847. EXTERNAL AUXILIARY FUEL TANKS.

4—848. DESCRIPTION. An auxiliary supply of fuel can be carried in 150 gallon universal Mk. 5 external auxiliary tanks hung on the right, left, and centerline pylons. *(See figure 4—91.)* The Mk. 5 is a streamlined

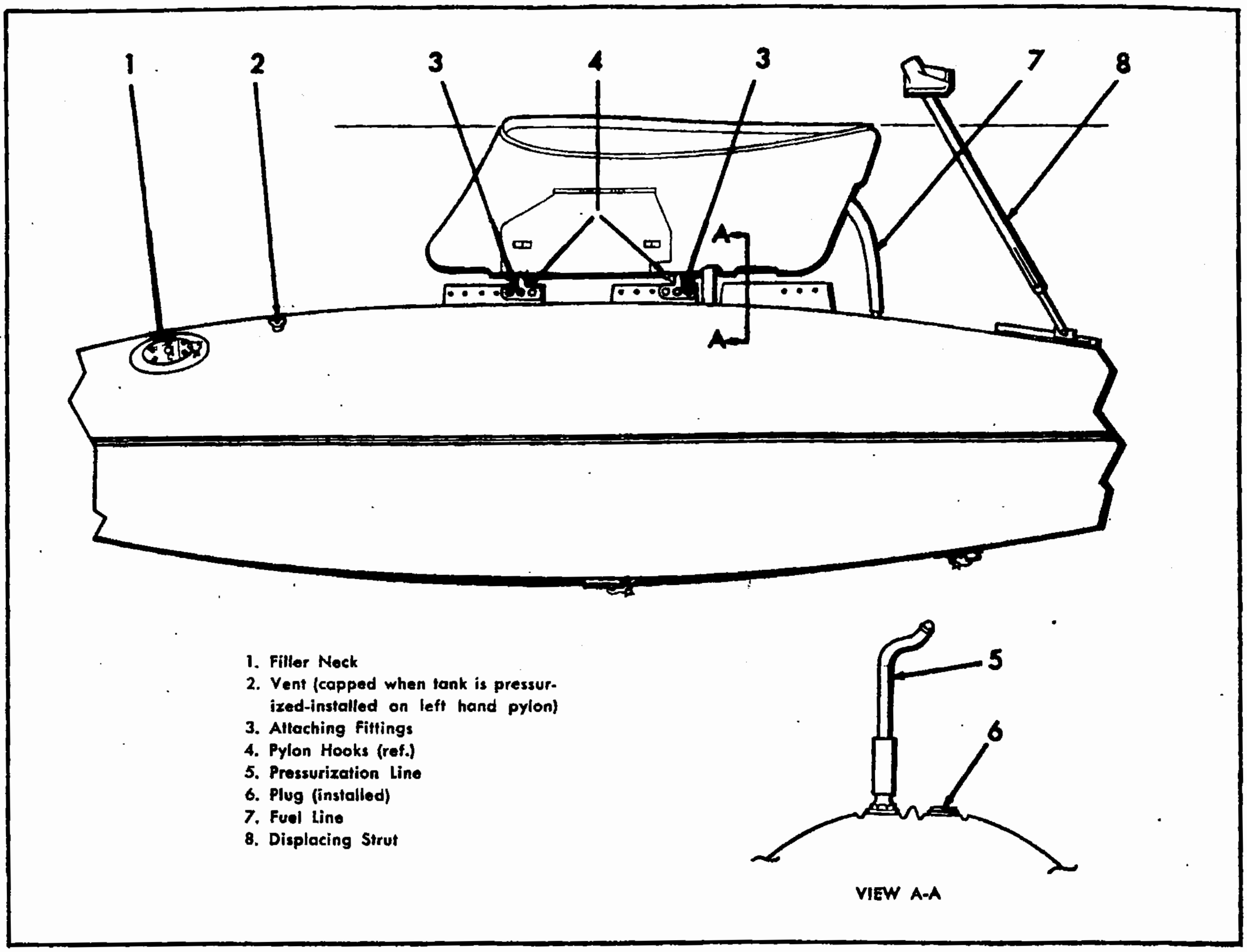


Figure 4—91. Mark 5 External Auxiliary Fuel Tank.

tank approximately 11 feet long containing the following inlets and outlets. The filler cap is located on the top of the tank just left of the centerline. The tank vent tube protrudes from the tank less than a foot aft of the filler hole. This tube is closed by a rubber cap which should be removed when the tank is installed on either the centerline or right hand pylon. When the tank is to be hung on the left pylon and pressurized, the cap should be left on. On top of the tank approximately midway back there are two plugged holes, one on each side of the centerline. The one on the right is a fuel line pressure fitting to accommodate the fuel line on previous F4U installations. This should be kept plugged on this installation. The hole on the left accommodates the pressure line fitting. When the tank is to be installed on the left hand pylon, the plug should be removed and an AN840-8 one-half inch nipple fitting should be installed to accommodate the tank pressurizing line. If the tank is to be installed on either the centerline or right hand pylon, this hole should remain plugged. The fuel line fitting protrudes from the top of the tank on the centerline just aft of the rear suspension angle. The sump strainer is on the bottom centerline of the tank approximately midway aft. A plugged drain fitting is on the bottom centerline of the tank approximately three feet aft of the sump strainer. There are three separate vertical webs along the top centerline of the tank. These webs contain holes through which the hanger lugs are bolted to the tank.

4—849. Permanent provisions have been made for drawing fuel from the right hand tank at all times when installed. In addition, either the left or centerline pylon tanks can be carried, although not simultaneously. Upon installation of the desired tank, the necessary fuel lines within the airplane are connected while those not used are plugged. The external auxiliary tank installation is such that when the left hand tank is installed, it is pressurized to approximately four psi. The pressurizing line is tapped into the left hand intercooler exit duct and is equipped with a fire trap and a check relief valve to regulate the tank pressure. The auxiliary tanks are filled through the filler hole in the tank. See paragraph 4—761 for filling procedure and precautions.

4—850. LEFT HAND EXTERNAL AUXILIARY FUEL TANK.

4—851. DESCRIPTION. It has been noted previously that the left hand and centerline auxiliary tanks cannot be carried simultaneously as lines from both tanks are connected with the same port on the selector valve. Therefore, it is necessary when installing the left hand auxiliary tank, to plug the centerline tank lines and when installing the centerline tank to plug the left hand tank lines. This is done with an aluminum alloy plug designed and installed in one of the lines for that purpose.

4—852. The left hand auxiliary tank and the centerline tank use a common tee in the fuel system. One side goes to the selector valve and the other to the transfer solenoid shutoff valve. When the left hand tank is installed, the centerline tank hose outlet is plugged and the section of hose and the elbow connecting it to the tee are taped to the main fuel line which connects the selector valve and the fuel strainer.

4—853. The left hand auxiliary tank fitting which is mounted in the left hand center section above the tank installation position, is a double fitting providing for the attachment of both the fuel and tank pressurizing air lines. It is accessible through the left hand wheel well. Plugs are provided for plugging the holes in the wing skin when the tank is not installed.

4—854. The pressure end of the pressurizing line is connected to a pipe fitting screwed into a boss riveted to the inboard side of the intercooler exit duct just forward of the main beam. Riveted over the inlet opening of the pressure line is a No. 60 mesh copper wire screen which serves as a flame trap. The pressure line extends aft through the main beam and then outboard to the left hand pylon. There is a pressure reducer in the line just aft of the main beam. Just aft of the left hand pylon tank pressure and fuel outlet, the line tees to a pressure and vacuum regulating valve. (See paragraph 4—858.)

4—855. REMOVING. To remove the left hand external auxiliary tank proceed as follows:

a. Pull the fuel line hose from both tne pylon and the tank connection and remove.

b. With two men supporting the tank, one at the forward and one on the aft end, have a third man in the cockpit to operate the drop tank manual release handle. As the tank is released, the displacing strut will disengage.

Note

The emergency bomb and drop tank release handle is located on the aft end of the left hand control shelf. Placing the handle in the left, right, or center slot releases the corresponding external auxiliary tank.

c. Remove pressure line fitting and install plug.

d. If the auxiliary tank is not to be reinstalled immediately, remove the two hanger lugs by removing the three bolts in each lug.

e. Insert plug in fuel inlet line in pylon assembly.

f. If a bomb is to be carried on the next flight instead of an auxiliary tank, reverse the forward sway brace to its rear position. For airborne release of the tanks and bombs and for complete information on the pylon installations, refer to paragraphs 4—1663 through 4—1705.

4—856. INSTALLING. To install, proceed as follows:

a. Install two short type suspension lugs on the suspension webs on the top centerline of the tank. Align the holes in the lugs with the holes on the web, insert bolts, install nuts and tighten.

Note

The three holes in the forward lug should align with the rearmost three holes on the forward web. The three holes in the rear lug should align with the rearmost three holes in the center web. *(See figure 4—91.)*

b. Remove plug from pressure line hole. This hole is the left hand hole of the two holes on the top centerline of the tank approximately midway back.

c. Insert an AN840-8 one-half inch nipple to accommodate the tank pressurizing line.

d. Check that rubber cap is on vent tube protruding from the top of the tank slightly aft of the filler cap.

e. Remove rubber plug from fuel line inlet in pylon.

f. Check that front sway brace on pylon is in its forward position and that pads are backed off sufficiently to accommodate tank.

g. Open door in side of pylon, at the same time checking that bomb rack hooks are in their tripped position.

4—857. From this point on, four men will be required to install the tank, two to support the tank (one on each end), one to install the displacing strut, and one to work the release pawl latching pin which protrudes from the side of the rack. As the tank is lifted into position so that the supporting hooks engage the suspension lugs, the third man should install the displacing strut. Simultaneously, the fourth man should press the pawl latching pin upward. A small amount of tank jiggling will probably be necessary before the release pawl seats fully on the release lever within the bomb rack mechanism, allowing hooks to snap into cocked or tank carrying position.

a. Tighten sway brace pads with either a screwdriver or wrench so that tank will not sway. Do not overtighten the sway braces as this will overload the tank. Tighten jam nuts so that sway brace pads cannot back off.

b. Install the 15 inch length of fuel hose by pushing the ends securely over the inlet fitting in the pylon and the outlet on the tank.

WARNING

Before installing fuel and/or pressurizing tube: *1.* Be sure tubes are free from burrs. *2.* Lubricate tubes with oil. Use extreme caution when installing tubes to prevent damage to internal packing rings.

4—858. PRESSURE AND VACUUM RELIEF VALVE.

4—859. DESCRIPTION. *(See figure 4—85.)* Pressure in the left hand external auxiliary tank is regulated by a pressure and vacuum relief valve teed into the pressurizing line from the intercooler air exit duct to the auxiliary tank. The valve is located somewhat aft and outboard of the left hand auxiliary tank inlet approximately 6 1/2 inches inboard of the inboard interbeam rib and 6 1/2 inches forward of the rear beam. It is mounted on a phenolic block which holds a protective screen over the inlet opening gaskets and a vent chamber in place. The entire assembly is bolted to the upper side of the lower wing skin.

4—860. The valve may be purchased from the Standard Aircraft Products, Inc., of Dayton, Ohio. It is similar to their valve No. SA-3802-C but does not contain a bleed hole. The valve contains two springs, one to control outlet and one to control inlet pressures of the tank. It is so constructed that the outlet valve will open when the tank pressure reaches four psi. The inlet valve opens under a pressure of one psi.

4—861. REMOVING. To remove the valve and vent chamber assembly, proceed as follows:

a. Disconnect the tank pressure outlet line to the valve.

b. Remove the four mounting bolts which hold the valve and vent chamber in position. The bolts must be removed from the outside.

c. Remove the valve and after removal, remove the reducer and elbow fitting from the top of the valve.

d. Remove the phenolic mounting block, screen assembly, gaskets and vent chamber from the opening in the wing skin.

4—862. INSTALLING. To install the valve and vent chamber assembly, reverse the procedure described above making certain that the threaded side of the valve is on top to accommodate the reducer and elbow fitting.

4—863. RIGHT HAND EXTERNAL AUXILIARY FUEL TANK.

4—864. DESCRIPTION. The right hand auxiliary tank installation is identical to the left hand tank except that this tank and pylon are not equipped with tank pressurizing facilities. The right hand tank can be carried in combination with either the left or centerline tanks. It should be noted that the left and centerline tanks cannot be carried simultaneously.

4—865. REMOVING. The right hand tank removing procedure is identical with that of the left hand tank as described in paragraph 4—855, with the exception that the drop tank manual release control handle in the cockpit is placed in the right hand slot instead of the left. After the tank is removed, the rubber cap should be replaced on the vent tube.

4—866. INSTALLING. The right hand auxiliary tank installation procedure is identical with that of the left hand tank described in paragraph 4—856 except that there is no tank pressurizing line to be connected.

Note

When installing the Mk. 5 universal tank on on the right hand pylon: check that the pressure inlet port on the tank is properly plugged, and check that the rubber cap has been removed from the vent tube.

4—867. CENTERLINE EXTERNAL AUXILIARY FUEL TANK.

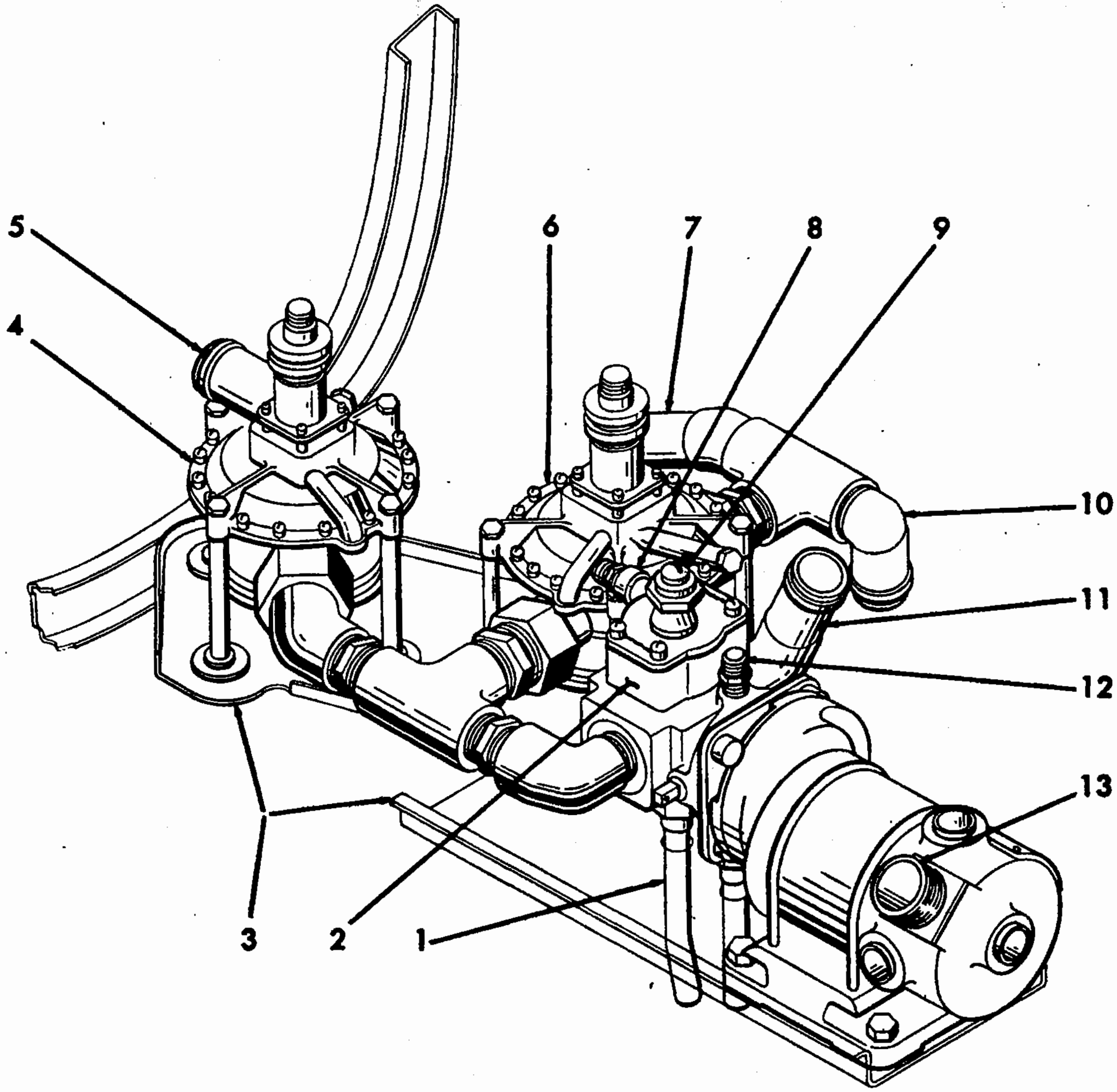
4—868. DESCRIPTION. The centerline auxiliary tank installation is identical to the left hand tank except that this tank and pylon are not equipped with tank pressurizing facilities. The centerline tank can be carried in combination with the right hand tank but NOT with the left. The centerline tank and the left hand tank utilize the same port on the tank selector valve. Therefore, it is necessary when installing the centerline tank to plug the left hand tank line with the aluminum alloy plug provided for this purpose. (See paragraph 4—856 for installation of left hand tank.)

4—869. REMOVING. The centerline tank removing procedure is identical with that of the left hand tank as described in paragraph 4—855 with the exception that the drop tank manual release control handle in the cockpit is placed in the center position. After the tank is removed, the rubber cap should be replaced on the vent tube.

4—870. FUEL TRANSFER PUMP.

4—871. DESCRIPTION. *(See figure 4—92.)* The fuel transfer pump is an electrically driven unit manufactured by the Chandler-Evans Corp., South Meriden, Connecticut, their pump and motor assembly No. 3412 or 3413. (Assembly No. 3412 utilizes a 1/8 h.p. Black & Decker motor No. 1555, while assembly No. 3413 utilizes a 1/8 h.p. Delco Motor No. 577.) The pump is a four-vane, rotary, positive displacement type with a relief and bypass valve and is driven by a 24 volt dc motor through spur gears enclosed in a grease tight housing. (Refer to paragraph 5—71 for wiring diagram information.) The housing is bolted to the motor and serves the dual purpose of a mounting for the pump and an adapter between the pump and the motor.

4—872. The pump consists of a cast aluminum alloy body bored to receive a stainless steel liner and a carbon bearing at each end. The liner is shrunk into the body and in addition is fastened by a line set screw. A stainless steel rotor carries four carbon vanes. Carbon vanes are used in place of the conventional steel vanes to allow the pump to withstand dry operation at 2000 rpm for 300 hours without excessive wear. The internal assembly is held in place by a rotor shut-off seal. It consists of a metal seal on the rotor drive shaft which contacts the metal seal attached to a neoprene gasket. There is an aligning washer between the gasket and the rear seal plate which prevents minor misalignment. A spring provides sufficient thrust to keep the seal in contact and make it effective.



1. Drain Line
2. Fuel Transfer Pump
3. Supporting Plates
4. Left Hand Tank Solenoid Shutoff Valve
5. Fuel Line (from left external fuel tank)
6. Right Hand Tank Solenoid Shutoff Valve
7. Fuel Line (from right external fuel tank)
8. Vent Line
9. Adjusting Screw
10. Line to Selector Valve
11. Transfer Line
12. Pressure Inlet from Heater
13. Electrical Receptacle

Figure 4—92. Fuel Transfer Pump and Solenoid Valves Installation.

4—873. An integral pressure relief and regulating valve capable of by-passing the entire 180 gallons per hour at 2000 rpm without excessive increase in pump outlet pressure is contained in a separate housing mounted on the pump. The pump is vented to the main cell vent line between the cell and the check relief valve. Electrical connections are brought to a receptacle provided with prongs for a plug type connector.

4—874. The motor is a 1/8 hp, 24 volt, dc series wound motor and is coupled to the pump by a gear reduction unit and a spline drive. Four brushes on the commutator end of the unit are accessible through the screw cover cap.

4—875. The pump is provided with fuel inlet and outlet fittings, a fitting for a line which vents the pump to the main fuel cell vent line between the cell and the check relief valve, two overboard drain lines, and a fitting to accommodate a line from the air inlet side of the cockpit heater to the pump seal drain ports to provide a pressure high enough to insure that the pump drains overboard.

4—876. LOCATION AND ACCESS. The transfer pump and the two solenoid shutoff valves are mounted adjacent to each other as a unit on a bracket assembly under the floor of the cockpit just to the right of the centerline of the airplane at station 171. Access is through the lower cockpit access door.

4—877. REMOVING. The pump and shutoff valves *(see figure 4—92)* are removed as one unit as follows:

a. Drain the fuel transfer line.

b. Remove the electrical connections to the shutoff valves (4) and (6) and the fuel transfer pump (2).

c. Disconnect the hose and clamp connections from fuel lines (7) and (5) on the right (6) and left (4) shutoff valves, on the fuel transfer pump line (11) and on the line to the selector valve (10).

d. Disconnect the vent line (8), the line from the heater (12), and the two drain lines.

e. Remove four bolts holding pump, and six bolts holding the solenoid valves to their supporting plates (3).

f. Remove the pump and valves from the airplane.

4—878. DISASSEMBLY. The pump is disassembled from the solenoid valves as follows:

a. Disconnect pipe thread nipple which connects solenoid valves with elbow fitting on pump.

b. After the pump has been disconnected from valves, remove the two elbow fittings, the three vent and drain line fittings, and the restricted pipe fitting which accommodates the line from the heater.

4—879. ADJUSTING. In checking the setting of the pump on the bench after the repair and reassembly of the entire unit, the pressure should be adjusted to 7 psi (plus .5, minus 0 psi) at "no flow" with 24 volts applied to the motor. Pressure adjustments should be made with the adjustment screw (9) which should be locked securely by the friction nut directly underneath. After being tightened securely, the friction nut should be safetied in place with safety wire.

4—880. ASSEMBLING. To assemble the pump to the solenoid valves, reverse the procedure described in paragraph 4—878.

4—881. INSTALLING. To install the pump and solenoid shutoff valves, reverse the removal procedure as directed in paragraph 4—877. After assembly and check on all connections, the installation in the airplane should be checked by operating the transfer system with an external auxiliary tank installed on the airplane. The pressure line at the transfer indicator switch should be disconnected and the transfer switch turned to "LEFT TANK" or "RIGHT TANK" depending upon which tank is attached to the airplane. If the system is connected correctly, fuel should flow from the line after a short time.

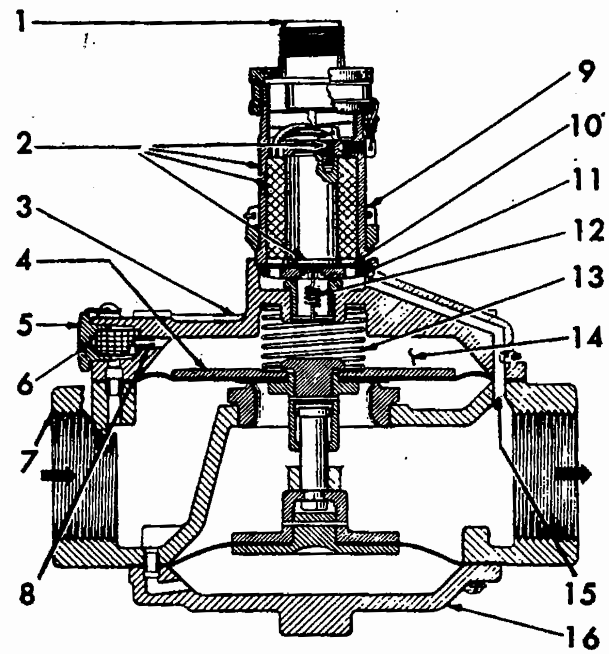
Note

When drawing fuel from centerline tank, turn switch to "LEFT TANK."

CAUTION

Use some absorbent material such as a rag to absorb the escaped fuel.

If no fuel flows after a reasonable time, the pump inlet may be connected wrong or the motor may be turning over in the wrong direction. First, check that the relief valve assembly on the pump is installed correctly. The plate on the relief valve assembly which reads "This end of the valve must be on discharge side of pump" should be on the outboard side of the pump when installed in the airplane, and in this position will be above the discharge port of the pump. Secondly, check the direction of pump rotation. Turn the transfer switch to the "OFF" position, disconnect the electrical leads, and reverse and resolder the leads on the connection plug. Reconnect the leads and repeat the above procedure.



1. Cable Connector
2. Magnet Assembly
3. Diaphragm Cover Assembly
4. Upper Diaphragm
5. Strainer Retaining Cap
6. Strainer
7. Valve Housing
8. Orifice
9. Magnet Flange Retaining Screws
10. Pilot Valve Diaphragm
11. Pilot Valve Armature
12. Pilot Valve Tension Spring
13. Diaphragm Compression Spring
14. Diaphragm Pressure Chamber
15. By-pass
16. Bottom Cap

Figure 4—93. Fuel Transfer System Solenoid Shutoff Valve.

4–882. TESTING. The pressure setting on the pump may be checked readily while it is installed on the airplane by disconnecting the fuel pressure line, between the fuel shutoff float valve and the transfer indicator switch from the transfer indicator switch. The correct pressure setting should be 6.0 (plus 0.5 minus 0.0) psi under "no flow" conditions. In order to obtain a "no flow" condition, the transfer switch should be on "LEFT TANK" or "RIGHT TANK," depending upon which tank is attached to the airplane. The main fuel cell should be full so that the shutoff float valve prevents fuel flow. The battery should be fully charged or an external power source should be used. If the transfer pump is set too high, the shutoff float valve will be forced open, and the tank will overflow out the vent line.

4–883. FUEL TRANSFER SYSTEM SOLENOID SHUTOFF VALVES.

4–884. DESCRIPTION. *(See figure 4–92.)* Two magnetic shutoff valves in the fuel transfer system control the flow of fuel from the external auxiliary fuel tanks through the fuel transfer pump. The valves are located in the intake lines from the right and left or centerline tanks. They are operated by a three-position toggle switch located on the left hand shelf in the cockpit. The fuel transfer pump is operated by the same switch when it is thrown to either of its two transfer positions. These positions are "LEFT TANK" and "RIGHT TANK." With the switch in the "OFF" position, both shutoff valves are closed.

4–885. The valves *(see figure 4–93)* are made by General Controls Co. of Glendale, California, their part No. 40R610, Type AV-5 or equivalent. They are diaphragm actuated and regulated to the open or closed position by an integral magnetic pilot valve. The valves close on current failure and are designed for continuous duty.

4–886. The valve mechanisr alloy housing (7) and is c The valve consists of a magnet ates a pilot valve (10), (11), (12), diaphragm (4) which opens and closes The diaphragm pressure chamber (14) which in the top of the valve receives pressure through an o (8) from the inlet side of the fuel line. It is released through the pilot valve to the by-pass (15) which leads to the outlet of the main valve. The inlet and outlet chambers are divided by the spring-loaded diaphragm (4). The valves require a 24 volt dc system. (For electrical diagram information, see paragraph 5–71.)

4–887. FUNCTION. The valve opens when the electrically energized magnet (2) lifts the pilot valve (10), (11) and (12). The fuel is drawn through this port by the action of the transfer pump and by-passes into the outlet side of the main valve. The orifice (8) does not permit fuel to flow into the diaphragm chamber (14) as fast as it flows out. This creates an unbalanced pressure condition and the greater pressure under the diaphragm assembly (4) lifts it from the valve seat permitting fuel to flow directly through the valve. The valve closes when the transfer switch is in the "OFF" position or the current fails. The magnet assembly is de-energized and the pilot valve tension spring (12) returns the pilot valve to its seat, closing the pilot valve port. Pressure is equalized on both sides of the diaphragm assembly and the main valve port is closed by the diaphragm compression spring (13).

4–888. TROUBLE SHOOTING. The following trouble shooting chart is based on the valve's failure either to open or close. The failure of the valve to open may be one of the reasons for failure of external auxiliary fuel tank to transfer.

Trouble	Probable Cause	Suggested Remedy
Valve fails to open.	*a.* Low voltage due to discharged battery.	*a.* Change or replace battery.
	b. Connectors or wiring not attached.	*b.* Check wiring and tighten connectors; see paragraph 5–71.
	c. Fuel transfer switch open or inoperative.	*c.* Check switch or contacts.
	d. Gasoline fluid pressure too low for valve operation.	*d.* Check transfer pump and fuel lines.
	e. Ruptured diaphragm assembly.	*e.* Replace diaphragm.
Valve fails to close.	*a.* Fuel transfer switch not breaking circuit to magnet.	*a.* Check wiring, switch position or contacts; see paragraph 5–71.
	b. Foreign matter or dirt on pilot valve seat.	*b.* Disassemble and clean.
	c. Foreign matter or dirt on main valve seat.	*c.* Disassemble and clean.
	d. Inlet orifice plugged.	*d.* Disassemble and clean.
	e. External leak around diaphragm.	*e.* Tighten cover screws or replace diaphragm assembly.

4—889. REMOVING. Refer to paragraph 4—877 for removal of transfer pump and valve removal as a unit.

4—890. DISASSEMBLY. Refer to paragraph 4—878 for disassembly of shutoff valves from the fuel transfer pump and then disassemble further as follows:

a. Disassemble the two valves by removing the three nipples, the two tee fittings, and three elbow fittings.

4—891. ASSEMBLING. To reassemble the valves as a unit prior to installing them in the airplane, reverse the steps described in paragraph 4—890.

4—892. INSTALLING. To install the valves and the fuel transfer pump, reverse the procedure given in paragraph 4—877.

4—893. FUEL TRANSFER SHUTOFF FLOAT VALVE.

4—894. DESCRIPTION. *(See figure 4—85.)* The shutoff float valve is a float-actuated valve installed at the upper rear of the main fuel cell. The valve is manufactured by the Aerotec Company of White Plains, N. Y. and consists of two valves, a pivoted disc valve actuated by a float lever arm, and a spring-loaded check valve which prevents loss of pressure from the fuel cell when operating at high altitudes. The valve is installed on the inside of the fuel cell and is accessible within the main cell, working through the manhole in the top of the cell. The external fittings are accessible through the left hand instrument panel access door. Two lines are connected to this valve, one leading from the fuel transfer pump and the other from the transfer indicator switch.

4—895. FUNCTION. The function of the fuel transfer shutoff valve is to close the transfer feed line whenever the fuel in the main fuel cell approaches the full level. This is accomplished through the action of the float-actuated lever which forces the disc valve over the orifice of the fuel transfer feed line. At altitudes above 18,000 feet, when the main cell is not full and the disc valve does not close the transfer line orifice, the loss of pressurization of the main fuel cell is prevented by the action of a spring-loaded check valve.

4—896. REMOVING. Remove the float shutoff valve as follows:

a. Drain the main fuel cell; see WARNING in paragraph 4—779.

b. Working through the instrument panel access door, disconnect the fuel line from the float valve fitting.

c. Detach the transfer indicator line from the fitting.

d. The fuel transfer hose is connected by a hose clamp to the fitting. Loosen the clamp and remove the hose.

e. Working within the tank, remove the lockwires and remove the float valve.

4—897. TESTING. At major overhaul or if leakage of the fuel transfer shutoff valve is suspected, remove it from the airplane and test as follows:

a. Fill the valve with "SOVASOL" or equivalent petroleum solvent by holding the pivoted disc valve closed and filling the fuel inlet port. Use a small blunt probe to unseat the spring loaded check valve before making the test to insure its freedom of action. Apply varying pressures from 0.2 to 3.0 psi to the small outlet for the indicator line. There should be no leakage.

b. Check the float arm movement for freedom from binding in its bearing.

4—898. INSTALLING. To install the valve, reverse the steps in paragraph 4—896. After the valve has been installed:

a. Check the security of the valve attaching screws.

b. Check the attaching lines for leaks.

4—899. FUEL TRANSFER INDICATOR PRESSURE SWITCH.

4—900. DESCRIPTION. *(See figure 4—85.)* The fuel transfer indicator pressure switch operates the fuel transfer warning light which notifies the pilot when the fuel transfer system has emptied the external auxiliary tank being used. When the tank is empty, there is no pressure in the line. The fuel transfer switch closes and the warning light goes on.

4—901. The differential pressure switch is located on the aft face of the cockpit forward bulkhead, just below the windshield. The switch is connected between the float valve at the main fuel cell and the main cell vent line. The switch consists of two metallic bellows and a microswitch installed in such a manner that the switch remains closed below a differential pressure of 1.5 psi (plus or minus .25 psi). The switch must be replaced, if faulty, and cannot be adjusted in the field. The switch is manufactured by the Aerotec Co. of White Plains, N. Y. It is manufactured for operation in the 28 volt dc system. (See paragraph 5—71 for wiring diagram information.)

4—902. REMOVING. Remove the switch as follows:

a. Working under the instrument panel, disconnect the electrical plug and the two pressure lines.

b. Unscrew the switch from the wall.

4—903. INSTALLING. To install the switch, reverse the steps described above making certain that the fitting labeled "HIGH PRESSURE" is on top when the valve is installed. Connect the line from the fuel shutoff float valve to this fitting. The "LOW PRESSURE" fitting on the bottom of the switch, as installed, accommodates the line from the main vent system.

4—904. FUEL SYSTEM LINES AND TUBING.

Note

Tubing cut in lengths for replacement purposes shall be 10% longer than actual length required.

TUBING CHART — FUEL SYSTEM

(Refer to Figure 4—94)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-57881-23 Tube Assem.	1	1/4	.035	33 7/16	Al. Alloy Tube Spec. WW-T-787	CV-25391-33 Restricted Pipe Fitting
VS-57881-25 Tube Assem.	2	1/4	.035	12 11/16	Al. Alloy Tube Spec. WW-T-787	AN816-4D Nipple
VS-57881-17 Tube Assem.	3	1/4	.035		Al. Alloy Tube Spec. WW-T-787	CV-25391-35 Fitting AN822-4D Elbow
CVC-1810-16-380 Hose	4	1 ID		38	Self-Sealing Hose Spec. AN-H-27	VS-59685 Fitting Assem. AN748-56 Clamp (2)
CVC-1810-16-040 Hose	5	1 ID		4	Self-Sealing Hose Spec. AN-H-27	VS-46956 Plug (2) (ref.)
CVC-1810-16-282 Hose	6	1 ID		28 1/2	Self-Sealing Hose Spec. AN-H-27	VS-59685 Fitting Assem. AN748-56 Clamp (2) AN844-17D Elbow
CVC-1810-16-202 Hose	7	1 ID		20 1/2	Self-Sealing Hose Spec. AN-H-27	VS-46610 Fitting Assem.
CVC-1810-20-820 Hose	8	1 1/4 ID		82	Self-Sealing Hose Spec. AN-H-27	AN748-66 Clamp (2) AN842-21D Elbow AN844-21D Elbow
VS-57932-17 Tube Assem.	9	1/4	.035	10 1/16	Al. Alloy Tube Spec. WW-T-787	AN824-8D Tee
VS-57932-37 Tube Assem.	10	1/2	.035	13 1/2	Al. Alloy Tube Spec. WW-T-787	AN914-4D Elbow AN912-4D Reducer Bushing AN822-8D Elbow
VS-57932-11 Tube Assem.	11	1/2	.035	9 1/4	Al. Alloy Tube Spec. WW-T-787	AN822-8D Elbow
CVC-1810-16-470 Hose	12	1 ID		47	Self-Sealing Hose Spec. AN-H-27	VS-34394 VS-59685 Fitting Assem. AN748-56 Clamp (2)
VS-48817 Tube	13		.065	11 1/4	Al. Alloy Tubing Spec. WW-T-787	
VS-59212 Tube	14	1/2	.042	9	Al. Alloy Tubing Spec. WW-T-787	CVC-1813-8-11 Hose (2) VS-59211 Tube
VS-57932-19	15	1/4	.035	39 9/16	Al. Alloy Tube Spec. WW-T-787	AN919-10D Reducer AN832-4D Union
AN6260-4-14 1/2 Hose Assem.	16	3/16 ID		14 1/2	Hose Assem. Spec. AN-H-6	AN837-4D Elbow AN924-4D Nut AN960-D 716 Washer
VS-57932-29 Tube Assem.	17	1/4	.035	10 3/16	Al. Alloy Tube Spec. WW-T-787	

TUBING CHART — FUEL SYSTEM (Continued)

(Refer to Figure 4—94)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-57881-29 Tube Assem.	18	¼	.035	6¼	Al. Alloy Tube Spec. WW-T-787	
AN6270-4-13½ Hose Assem.	19	¼ ID		13½	Low Pressure Hose Spec. AN-H-30	
VS-57932-35 Tube Assem.	20	¼	.035	41⅜	Al. Alloy Tube Spec. WW-T-787	
VS-57932-33 Tube Assem.	21	¼	.035	16 15/16	Al. Alloy Tube Spec. WW-T-787	AN815-4D Union
VS-57932-31 Tube Assem.	22	¼	.035	5 13/16	Al. Alloy Tube Spec. WW-T-787	AN824-4D Tee AN823-4D Elbow
VS-57932-23 Tube Assem.	23	¼	.035	8⅝	Al. Alloy Tube Spec. WW-T-787	CV-25391-33 Restrictor
VS-53608 Special Tube	24	1¼	.049		1010 St. Tube AMS 5050	AN824-21D Elbow AN4038-5 Connection VS-34336 Gasket
VS-57932-27 Tube Assem.	25	¼	.035	18¼	Al. Alloy Tube Spec. WW-T-787	AN823-4D Elbow
CVC-1810-20-370 Hose	26	1¼ ID		37	Self-Sealing Hose Spec. AN-H-27	AN748-66 Clamp (2) AN844-21D Elbow (2)
VS-57932-25 Tube Assem.	27	¼	.035	8 5/16	Al. Alloy Tube Spec. WW-T-787	AN824-4D Tee (2)
AN6270-4-19½ Hose Assem.	28	¼ ID		19½	Low Pressure Hose Spec. AN-H-30	AN822-4D Elbow AN815-4D Union
VS-43272 Tube Assem.	29	¾	.049	40	Al. Alloy Tube Spec. WW-T-787	
VS-43271 Tube Assem.	30	¾	.049	85	Al. Alloy Tube Spec. WW-T-787	
VS-57932-21 Tube Assem.	31	⅜	.035	46¼	Al. Alloy Tube Spec. WW-T-787	AN919-6D Reducer AN927-6D Elbow AN815-6D Union
CVC-1813-12-15 Hose (1 R.H., 1 L.H.)	32	¾ ID		3¾	Synthetic Hose Spec. M-709	AN748-38 Clamp (4)
VS-56640 Main Fuel Cell Vent Line Fitting Assem. (1 R.H., 1 L.H.)	33					
CVC-1813-12-25 (2) Hose	34	¾ ID		8¼	Synthetic Hose Spec. M-709	AN844-12D Elbow (2) AN748-38 Clamp (4)

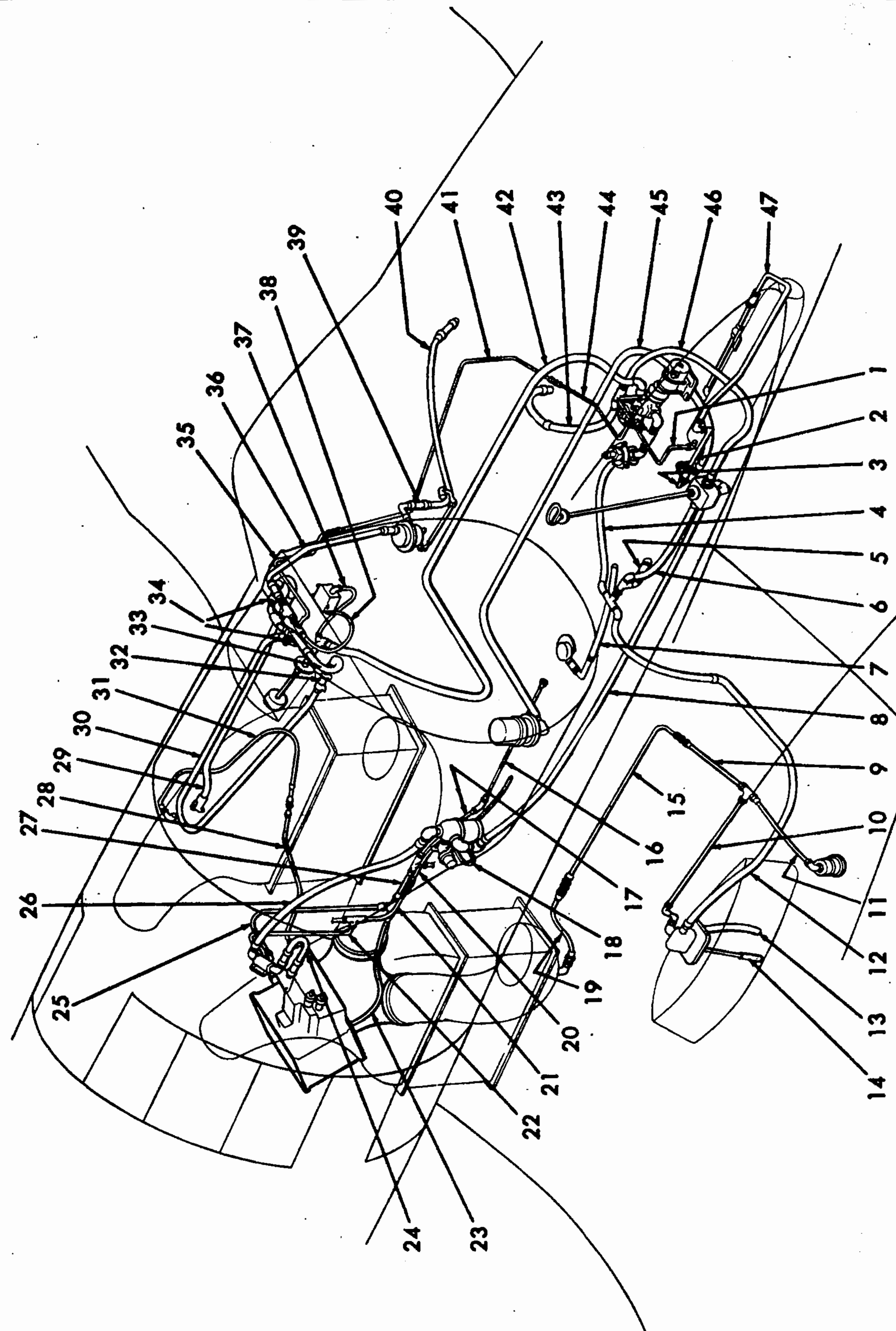


Figure 4—94. Fuel System Tubing Diagram.

TUBING CHART — FUEL SYSTEM (Continued)

(Refer to Figure 4—94)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-57881-5 Tube Assem.	35	¼	.035	31	Al. Alloy Tube Spec. WW-T-787	AN826-4D Tee AN814-4D Union
VS-57932-1 Tube	36	¾	.049	33$^{13}/_{16}$	Al. Alloy Tube Spec. WW-T-787	CVC-1813-12-14 (2) AN748-38 (4)
AN6270-4-15 Hose Assem.	37	¼ ID		15	Low Pressure Hose AN-H-30	AN816-4D Nipple AN822-4D Elbow
AN6270-4-15 Hose Assem.	38	¼ ID		15	Low Pressure Hose AN-H-30	AN822-4D Elbow
CVC-1813-12-14 Hose (2)	39	¾ ID		3½	Synthetic Hose Spec. M-709	AN748-38 Clamp (4) AN848-12D Elbow
VS-57932-3 Tube	40	¾	.049	32$^{13}/_{16}$	Al. Alloy Tube Spec. WW-T-787	CVC-1813-12-13 Hose AN748-38 Clamp
VS-57881-7 Tube Assem.	41	¼	.035	23	Al. Alloy Tube Spec. WW-T-787	AN815-4D Union
CVC-1810-12-1120 Hose	42	¾ ID		112	Self-Sealing Hose Spec. AN-H-27	AN748-48 Clamp (2) AN915-6D Elbow AN842-12D Elbow VS-56641 Float Valve
CVC-1810-16-672 Hose	43	1 ID		67½	Self-Sealing Hose Spec. AN-H-27	AN748-56 Clamp (2) VS-38314 Fitting AN844-16D Elbow
VS-57881-9 Tube Assem.	44	¼	.035	44	Al. Alloy Tube Spec. WW-T-787	AN815-4D Union AN816-4D Nipple
CVC-1810-20-970 Hose	45	1¼ ID		97	Self-Sealing Hose Spec. AN-H-27	AN748-66 Clamp (2) VS-59629 Elbow AN840-56 Clamp (2)
CVC-1810-16-400 Hose	46	1 ID		40	Self-Sealing Hose Spec. AN-H-27	AN748-56 Clamp (2) AN840-16D Adapter AN844-17D Adapter
VS-57881-27 Tube Assem.	47	¼	.035	30⅞	Al. Alloy Tube Spec. WW-T-787	VS-59669 Check Valve AN842-4D Elbow

4–905. HYDRAULIC SYSTEM.

4–906. DESCRIPTION. (*Refer to figure 4–95.*) The 1500 psi hydraulic system in this airplane is supplied with power by an engine-driven, variable displacement pump. The seven hydraulically actuated sub-systems are the wing flaps, intercooler flap, landing gear (main and tail), cockpit canopy, wing fold, oil cooler doors, and gun chargers. The complete system, including reservoir, holds approximately 7.7 gallons of AN-O-366 (red fluid). The fluid is drawn from the reservoir by the pump, fed to the sub-systems under 1500 psi, and then returned to the reservoir. Both rigid aluminum alloy tubing (52SO) and flexible hose (AN6264) are used in the hydraulic system. Proper torque values must be applied to all connections to prevent malfunctions; see paragraph 4–908. All hydraulic lines (including air lines) have conventional coding, in addition to "up" and "down" line designations to facilitate maintenance. The hydraulic pressure gage is located on the horizontal control panel to the left of the cockpit. Location and operation of cockpit handles and switches for the various sub-systems are discussed in the following paragraphs dealing with each sub-system. The hydraulic panel, secured to the right hand side of the engine mount, provides quick-disconnects for the use of external power. Emergency compressed air systems are provided for both the landing gear and the cockpit canopy, while an auxiliary, electrically-driven hydraulic pump, operated by the wing flap control handle, provides emergency operation of wing flaps in flight (see paragraph 4–1087). The schematic layout of the entire hydraulic system (figure 4–95) gives basic information on the system in tabular form. All tubing and flex line diameters may be determined from this figure as well as flow throughout the system. The following text deals in turn with general hydraulic system information, the main pressure, supply and return system, and the seven sub-systems, including emergency provisions for landing gear, cockpit canopy and wing flap actuation.

4–907. HYDRAULIC SYSTEM—GROUND ACTUATION. The four methods by which the hydraulic system may be operated on the ground are: engine driven pump operation, auxiliary pump operation (with external electric power source), an external source of hydraulic power with an external reservoir, or an external pump using the airplane's hydraulic reservoir. Ground actuation of the hydraulic system is used to fold and unfold wings, open or close cockpit canopy, check all sub-systems, and drain, flush, or fill the system.

4–908. HYDRAULIC FITTING WRENCH TORQUE VALUES.

4–909. DESCRIPTION. The procedure for installation of universal fittings is as follows:

a. Assemble nut AN924 on fitting AN832, AN833, AN834, or AN837, as applicable. Run the nut all the way back on the fitting to clear the gasket groove.

b. Place gasket AN902 in the gasket groove and screw the fitting into the boss until the gasket contacts the boss.

c. Unscrew the fitting not more than 360° to the approximate position desired.

d. Tighten the lock nut lightly.

e. Assemble the hydraulic line to the fitting.

f. Tighten the lock nut against the boss.

WRENCH TORQUE VALUES—HYDRAULIC FITTINGS

TUBING O.D. INCHES	ALLOWABLE ASSEMBLY WRENCH TORQUE (POUND-INCHES) ALUMINUM ALLOY TUBING	
	Minimum	*Maximum*
3/16	....	....
1/4	40	65
3/8	75	125
1/2	150	250
1	500	700

4–910. PROTECTING SYSTEM FROM FOREIGN MATTER. Whenever mechanical repair is to be done, on or near the hydraulic system, which involves removing lines or units, all open lines must be capped, and exposed parts must be covered as a protection from corrosion and dirt. It is very important that the proper hydraulic fluid (AN-O-366) be used and that no foreign matter enters the system. Storage and transportation of hydraulic fluid must be carefully watched to keep the fluid clean and free from water. Fluid containing water must not be put into the system, for freezing or corrosive action may cause serious damage. If water is found in the system, it must be drained in accordance with paragraph 4–913, but packings need not be changed. When storing hydraulic fluid, containers that have been previously used for acids, lyes, or other chemicals should not be used.

4–911. FILLING SYSTEM.

4–912. DESCRIPTION. For rapid filling, it is recommended that an external source of hydraulic power capable of delivering 1500 psi be used to fill the system. Note that the system, including reservoir, holds approximately 7.7 gallons. The pressure and return quick-disconnects for externally filling the system are located on the hydraulic panel on the right hand side of the engine mount below the reservoir. These disconnects screw into the pump side of the main relief valve. To prevent discharging the battery when cycling the solenoid operated intercooler doors, oil cooler doors, and gun charging systems, an external source of electrical power is used. The electric external power receptacle is located on the right hand side of the fuselage at station 150 and may be identified by a decal reading

"EXTERNAL POWER RECEPTACLE," adjacent to the access door. Proceed as follows to fill the system:

a. Jack up airplane; see paragraph 3-23.

b. Remove upper right hand wing gap cover; see paragraph 4-480.

c. Connect external pressure and return lines to quick-disconnects located at pump side of main relief valve on the hydraulic panel; see figure 4-97.

d. The gun charging system must be bled to relieve air pockets. This is done by loosening the coupling at the charger until it leaks slightly. Operate the system until all air bubbles disappear from the leaking oil. Tighten coupling.

CAUTION

Before bleeding gun charging system, be sure the breech block bolt of gun is forward.

e. After all systems have been filled and cycled, disconnect external pressure and return lines and reconnect system lines to main relief valve.

f. Fill reservoir in accordance with paragraph 4-931.

g. Check variable displacement pump located below the hydraulic reservoir for full level.

h. Lower airplane to ground and cycle all systems, except landing gear.

4-913. DRAINING AND FLUSHING SYSTEM.

4-914. DESCRIPTION. If the hydraulic system operates sluggishly due to foreign matter or the use of improper hydraulic fluid, drain and flush the system using the following procedure:

a. Jack up airplane (see paragraph 3-23) so that landing gear may be cycled.

b. Drain all hydraulic fluid from reservoir (see paragraph 4-932 b).

c. Completely drain system by opening all lines at pumps, cylinders, valves, etc., allowing fluid to drain from all hydraulic units.

d. If fluid with a vegetable oil base (Lockheed type) has been used, all synthetic rubber packings must be replaced.

e. Reconnect system and fill with a flushing compound (kerosene or petroleum naphtha).

f. Using the quick-disconnects at the main relief valve, connect lines to an external source of hydraulic power; connect the external return to an overboard container, and provide an electric power source for solenoid selector valve operation.

g. With the external pump running, operate all controls and valves so that the whole system is flushed. Cycle all sub-systems at least five times adding as much flushing compound as necessary to keep the system filled.

h. Remove and flush reservoir unit and replace filter.

i. Remove, drain, and flush the engine-driven pump and housing.

j. Drain system completely and reconnect all lines excepting return line to reservoir.

k. Fill reservoir with AN-O-366 (red fluid) and lead return line to an overflow container. Using an external source of hydraulic power, add fluid until 20 gallons have circulated through the system. Do not re-use this fluid.

l. Reconnect system and replace filter unit, making sure system pump has fluid, and fill system in accordance with paragraph 4-911.

4-915. EXTERNAL LEAKS. External leaks in the hydraulic system where fluid is escaping from cylinders, valves, or fittings may, as a rule, be found by a visual check. A leak in the system usually causes an accumulation of hydraulic fluid which is both a fire hazard and a menace to the crew. It may happen that the actual leak does not occur over the accumulation of fluid, since hydraulic fluid tends to follow structure and tubing to a sharp edge or bend before dropping off. The most efficient method of locating leaks is to wipe and clean the system and then cycle it. Leaks occur most frequently around fittings, around piston rods and valve handles, in porous flex hose, or at pin holes in castings. Replacements must be made upon discovery of a pin hole leak or a leaky flex hose. Very slight leaks are difficult to locate, but for the safety of the pilot on subsequent flights, they should be found and repaired. The use of external 1750 psi hydraulic source may enable the mechanic to more easily locate the leak. The main relief valve should be set to crack at above 1750 psi until leak is located and then must be reset. External leaks may be caused by:

a. Application of improper wrench torque values.

b. Ill-fitting parts.

c. Careless system assembly.

d. Poor flare on tubing.

e. Excessive vibration due to poor support of system.

f. Denting or bending of system parts.

4-916. INTERNAL LEAKS. Internal leaks are caused by fluid under pressure slipping past a valve seat or a packing ring into the return line of the reservoir. The indications of internal leakage are sluggish operation of a sub-system or a drop-off in system pressure. A drop in gage pressure or an indication of insufficient pressure on the gage may be caused by an internal leak. One method of locating an internal leak is to block off a sub-system by removing and capping the pressure line to the system. Using an external hydraulic power source, cycle the remaining sub-systems. If the hydraulic gage maintains 1500 psi, the internal leak is in the blocked sub-system. By repeating this procedure, the sub-system containing the leak should be isolated. If no sub-system shows leakage, the main relief valve should be checked. After isolating the leak to one sub-system, each unit in that system should be checked. The schematic for each sub-system should be studied, paying attention to the direction of hydraulic flow and referring to allowable

NON-ACTUATING UNITS

ZONE	UNIT	NO. REQ.	DWG. NO.	VENDOR	AN OR VENDOR NO.	WT. LB.	AN PACKINGS	QTY. PKNGS.	REMARKS	
8E	RESERVOIR ASSEMBLY	1	VS-55006			8.95	AN6230-38 AN6227-27 AN6227-17 AN6227-12 AN6227-10 AN6227-37 AN6238-1 AN6227-6	1 1 1 3 1 1 2 1	TOTAL RESERVOIR VOL. NORMAL VOLUME AIR SPACE RESERVE VOLUME PRESSURE TESTED TO FILTER RELIEF CRACKING PRESS.	743 CU. IN. 461 CU. IN. 330 CU. IN. 65 CU. IN. 31 PSI 11 (+2, —1) PSI
7C	MAIN RELIEF VALVE	1	VS-78025	HYDRO-AIRE ADEL	1048 11800	2.97			RELIEVE AT 6 GPM CRACKING RESEAT	1925 PSI 1750 PSI 1575 PSI
9E	PRESSURIZATION VALVE	1	VS-54106	AIREX	81062 MOD 45	.30			CHECK VALVE INLET TO RESERVOIR CRACKING VENT TO RESERVOIR CRACKING RELIEF—RESERVOIR TO VENT —CRACKING	 .25 (+ .00,—.15) PSI .25 (+ .00,—.15) PSI .12 (+0,—1) PSI
4D, 6E 6C, 7E	THERMAL RELIEF VALVE	4	VS-58274	BENDIX (PACIFIC)	404517-2	.25			RELIEVE	2050 (+ or — 50) PSI
5E	INTERCOOLER RELIEF VALVE	1	VS-58279-1	HYDRO-AIRE ADEL	1176-1 B-10278-5	.59			RELIEVE AT 1.2 GPM CRACKING RESEAT	1265 PSI 1150 PSI 1035 PSI
6C	AUTO. TEMP. CONTROL	1	VS-43726	GENERAL CONTROLS	43R133	3.75			TEMPERATURE RANGE	167°(+ or —3.6°)F. TO 203 (+ or — 5.4°) F.
3D	LANDING GR. SEL. VALVE	1		ADEL NO. B-11809	AN6211-2					
6D	SOLENOID PRESSURE SHUTOFF	1	VS-58290	ADEL	13701-24	1.70			NORMALLY OPEN	
5D	INTERCOOLER SEL. VALVE	1	VS-78046	ADEL	13802	2.43				
6D	WING FLAP SEL. VALVE	1	VS-58240	ELECTROL	265CV1	1.94				
4C	WING FOLD SEL. VALVE	1			AN6213-2					
6E	WING FLAP BY-PASS VALVE	1	VS-44914	AIR ASSOCIATES	HC-2380-MS	.50				
8D	CHECK VALVE	1			AN6207-8					
2C,6D	CHECK VALVE	2			AN6207-4					
1C,1F	VENT CHECK VALVE	2	VS-24256 or VS-54224	WALTER KIDDE	66097	.10			CLOSE AT 45 (+ or —15) PSI	
2B	SHUTTLE VALVE—CPY.	1	VS-58394	HYDRO-AIRE	1510	.28				
1E,3E	SEQUENCE VALVE—L.G.	2	VS-37801	BENDIX (PACIFIC)	402004	.57				
4B	SEQUENCE VALVE—W. FOLD	2	VS-12802	VICKERS	AA-17003, AA-17002	1.05				
8D	PUMP ASSEMBLY	1	VS-58262	VICKERS	DWG. NO. 103283 PART NO. AA-20334	18.70			MAX. DISPLACEMENT MAX. REC. CONTIN. RPM MAX. FLOW IN GPM VOLUMETRIC EFF. PRESSURE RANGE IN WHICH DISPLACEMENT VARIES	.60 CU. IN. PER REV. 3750 9.25 95% 1300-1500 PSI
7D	AUXILIARY PUMP	1	VS-58300	PESCO	S-1467	8.00			CAPACITY 24 VOLT CONTINUOUS MOTOR	.25 GPM AT 1500 PSI
1E,3E	SHUTTLE VALVE—L. G.	2	VS-58378	HYDRO-AIRE	1416	.38				
7B	SWIVEL JOINT—G. C.	2	VS-14666-2	CHICKSAN	R68D2	.29				
4B	SWIVEL JOINT—WING FOLD	2	VS-54146	CVA		2.06				
4C	FUSE—WING FOLD	1	VS-48974	AEROQUIP CORP.	702	1.60				
2E	FUSE—TAIL WHEEL	2	VS-42358	UNITED AIRCRAFT PRODUCTS SIMMONDS	UC4480-D-6-80 D45-6-202-80	.29			CAPACITY 80 CU. IN.	
2C,5D	RESTRICTOR	2	VS-12805	ADEL	A10003	.15				
7B 8B	PRESSURE SWITCH—G. C.	2		R94-BX-84012 Mk1, MOD. 1(GFE)		1.90			PRESSURE RANGE	750 TO1025 PSI
7C	SOLENOID SEL. VALVE—G. C.	1		BENDIX (SO. BEND)	83803 (GFE)					
5D	PRESSURE GAGE	1			AN5771-4B					
5D	SNUBBER	1	VS-12279	OPERATING AND MAINT. SPEC. CO.	11D	.08				
1B,2F	AIR GAGE AND FILLER	2	CV3-402241	KENYON INSTR.	7-8000					
2F	AIR BOTTLE—L.G.	1	CV4-601162-1	WALTER KIDDE	840026 33825, 24716	5.35				
1B	AIR BOTTLE—CPY.	1	CV4-601165	WALTER KIDDE	5840027 33825	2.80				
1F	EMERG. VALVE—L.G.	1	VS-54121	WALTER KIDDE	800124					
1B,1F	EMERG. VALVE—CPY.—L.G.	2	VS-58393	WALTER KIDDE	800124	.45				
5D 6C	FILTER—OIL COOLER	4	VS-48987	PUROLATOR	32037 MOD. G-187M-9	.30				
8D	QUICK—DISCONNECT	1			AN6220-16					
7D	QUICK—DISCONNECT	1			AN6241-4					
7C,7D	QUICK—DISCONNECT	3			AN6241-8					
7C	QUICK-DISCONNECT	1			AN6243-8					
5C	FILTER	2	VS-48148	PUROLATOR CUNO	31585 12199 CHG. B	.25				
2C	CANOPY CONTROL VALVE		CV6-401033	CVA OR ELECTROL	ELE-604	1.40	AN6227-6 AN6227-14 AN6227-18 AN6246-6	2 4 1 4	5 POSITION VALVE CLOSE, STOP, OPEN, MANUAL (BY-PASS), EMERGENCY	
7C	CHECK VALVE	1			AN6207-6					
	ALT. THERMAL RELIEF			SAVAL	44154X1	1.72				
2E,3E	RESTRICTOR VALVE ASSEM.	2	VS-24228	BENDIX	401856-3	.30				

ACTUATING UNITS

ZONE	CYLINDER	DWG. NO.	UNITS REQD.	WT. PER UNIT	MAX. WORK LOAD LB.	EST. WORK PRESS. PSI	EST. TIME SEC.	AN PACKINGS	QTY.	USED ON
1E 3E	LANDING GEAR RETRACTING CYLINDER	VS-46648	2	8.81	3500	1070	EXT. 7.6 RET. 5.1	AN6227-33 AN6246-33 AN6227-13 AN6230-6 AN6227-21 AN6246-21 AN6231-11 AN6232-C3 ½ AN6227-1	1 2 1 1 1 2 1 1 1	PISTON PISTON ROD CAP CAP CAP CAP CAP OILER
2D	LANDING GEAR INBOARD DOOR CYLINDER	VS-58256	2	2.23	900	1250	EXT. 7.6 RET. 5.1	AN6227-27 AN6246-27 AN6227-7 AN6227-12 AN6246-12 AN6231-3 AN6232-C2 ⅛ AN6227-1	2 2 1 1 2 1 1 1	CAP AND PISTON PISTON ROD CAP CAP CAP CAP OILER
1D 3D	LANDING GEAR OUTBOARD DOOR CYLINDER	VS-58307	2	2.37	587	1250	EXT. 7.6 RET. 5.1	AN6227-27 AN6246-27 AN6227-7 AN6227-12 AN6246-12 AN6231-3 AN6232-C2 ⅛ AN6227-1	2 2 1 1 2 1 1 1	CAP AND PISTON PISTON ROD CAP CAP CAP CAP OILER
2E	TAIL WHEEL CYLINDER	VS-54183 or VS-54185	1	10.79	388	1325	EXT. 7.6 RET. 5.1	AN6246-30 AN6246-15 AN6230-6 AN6227-30 AN6227-15 AN6227-10	2 4 1 1 2 1	PISTON PISTON CAP PISTON PISTON CAP
5B 6B	OIL COOLER DOOR CYLINDER	VS-58252	2	.73	860	1500		AN6227-23 AN6227-17 AN6246-17 AN6227-7 AN6246-7 AN6232-C 3/16	2 1 2 1 2 1	CAP PISTON PISTON CAP CAP CAP
3A 4A	WING FOLD CYLINDER	VS-58232	IL and IR	16.45	13600	1460	SPREAD 18.16 FOLD 13.00	AN6227-42 AN6246-42 AN6230-17 AN6227-35 AN6246-35 AN6227-22 AN6230-15 AN6246-22 AN6231-12 AN6232-C4 ⅛	1 2 1 1 2 2 1 2 1 1	CYLINDER CYLINDER CAP PISTON PISTON CAP AND PISTON CAP CAP CAP CAP
3B 5B	PIN PULLING CYLINDER	VS-48999	IL and IR	3.59	600	1300	SPREAD 18.16 FOLD 13.00	AN6227-11 AN6230-5 AN6227-6 AN6227-9 AN6227-29	1 2 1 1 1	CAP CAP CAP PISTON PISTON
6E 7E	WING FLAP CYLINDER	VS-58317	IL and IR	2.21	1930	1350	1.81	AN6227-27 AN6246-27 AN6227-7 AN6227-12 AN6246-12 AN6231-3 AN6232-C2 ⅛	2 2 1 1 2 1 1	CAP AND PISTON PISTON ROD CAP CAP CAP CAP
4E	INTERCOOLER FLAP CYLINDER	VS-48105	1	1.87	1730	1400	10.00	AN6227-23 AN6227-10 AN6231-1	2 1 1	CAP AND PISTON CAP CAP
2B	CANOPY CYLINDER	VS-58231 or VS-54221	1	3.3	2465	1380	CLOSE .328 OPEN .3 CLOSE .35 OPEN .33	AN6227-5 AN6232-C1 15/16 AN6227-9 AN6231-7 AN6232-C3 ½ AN6227-17 AN6246-17 AN6227-27 AN6227-4 AN6227-15 AN6246-27 AN6227-14 AN6227-20 AN6227-7 AN6227-27 AN6227-12 AN6246-12 AN6246-27	2 1 1 1 1 1 2 2 1 1 2 2 1 1 2 1 2 2	SLIDER SLIDER ROD CAP CAP CAP CAP CAP AND PISTON SLIDER ROD PISTON PISTON CAP PISTON ROD PISTON AND CAP CAP CAP PISTON
7A 8A	GUN CHARGING CYLINDER	VS-59219	4			1000		B.O. 630527—Mk5		

Figure 4–95. (Sheet 1 of 2 Sheets). Hydraulic System Schematic Reference Diagram.

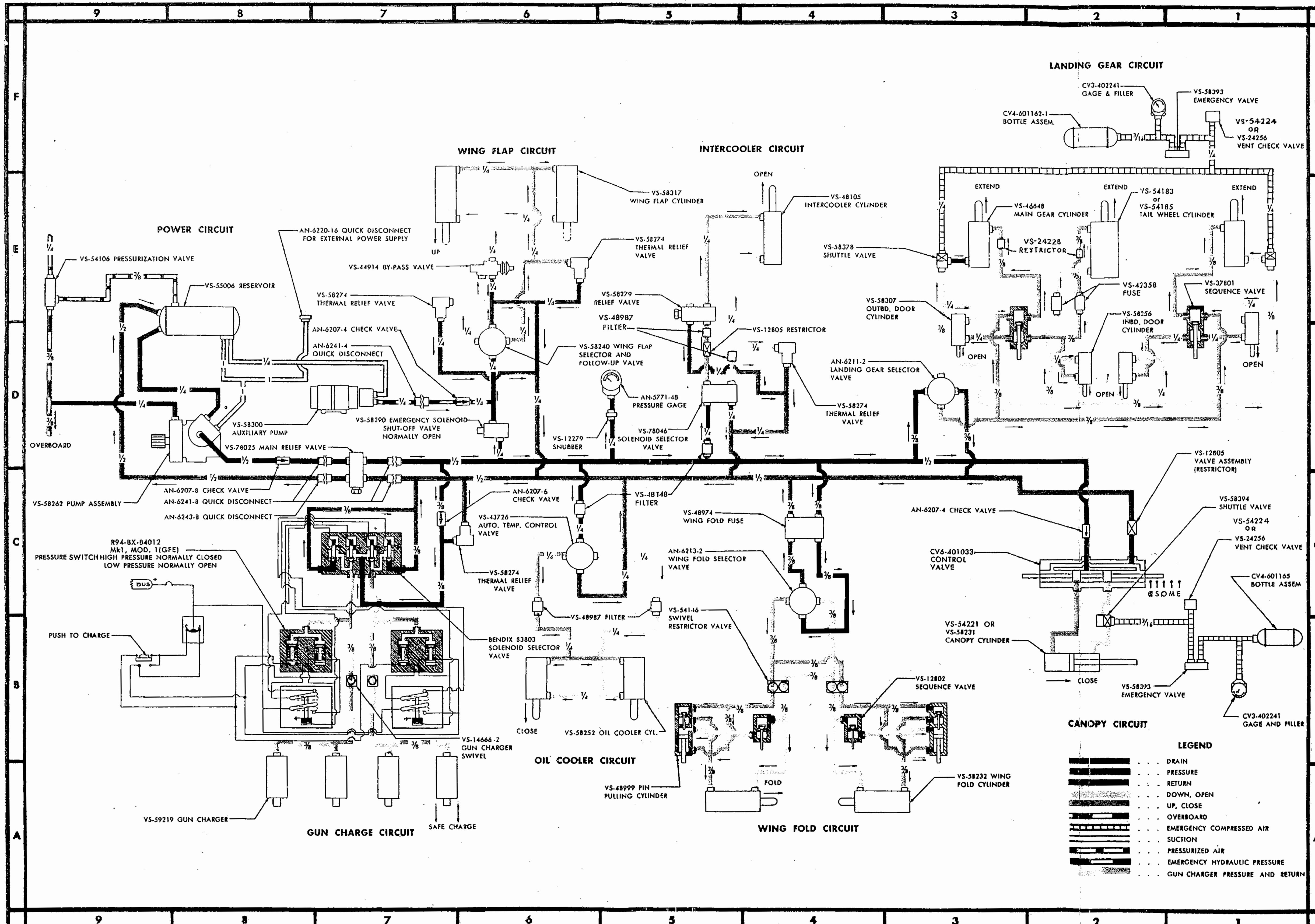


Figure 4–95. (Sheet 2 of 2 Sheets). Hydraulic System Schematic Reference Diagram.

leakage given in the test of the unit. The following general instructions will aid in isolating internal leaks.

a. Leaks due to faulty cylinder packings may be determined by removing the return line at the cylinder and applying hydraulic pressure. There must be no leakage from the return port of the cylinder. If the return line shoots oil when the selector valve is in the "extend" position, the selector valve return poppet may be stuck open.

b. Actuate sequence valves by hand. If a sequence valve poppet is stuck open, the pin plunger will be loose when actuated by hand.

c. Shuttle valves may be checked by removing the air line and applying 1500 psi to valve. There should be no leakage at air port. All other units in any sub-system where internal leakage is present should be studied and checked thoroughly by following applicable test procedures given in the text.

4—917. TYPICAL CYLINDER.

4—918. DESCRIPTION. The general design of hydraulic cylinders used in the F4U-5 airplane is represented by the typical cylinder shown in figure 4—96. These are one cap cylinders with the piston rod passing through the cap end (4) which is secured to the cylinder (2) by means of a clamp (3). The piston (1) will move in either direction depending on the flow of hydraulic fluid. The end cap through which the piston rod moves is provided with a packing (9) to seal off leakage, and a leather back-up ring (10) installed on the side of the packing nearest the piston rod end.

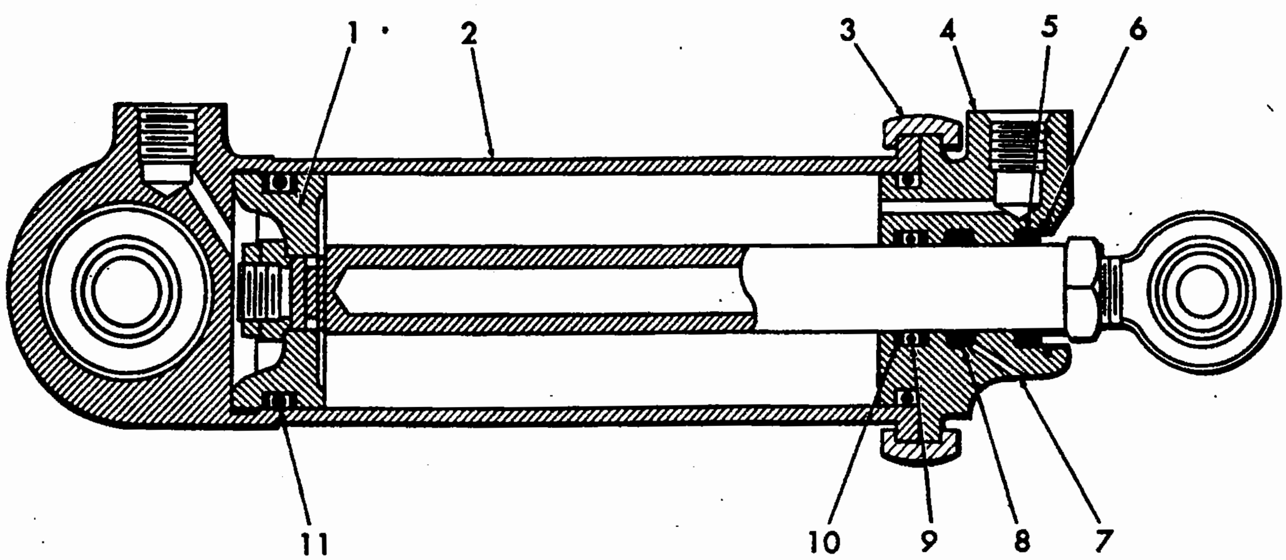
CAUTION

When only one leather back-up ring is used, it must be installed on the side of the packing which is not subjected to cylinder pressure.

There is also a felt wiper (8) and a bronze wiper (5) held by a lock ring (6) which keeps dirt from entering and damaging the packing. Cylinders are equipped with oil holes (7) for lubrication of the felt wiper. There is also a packing (11) on the piston which prevents internal leakage. This description is applicable to the landing gear door cylinders, main landing gear actuating cylinders, wing flap cylinders, and intercooler flap cylinder. The intercooler flap cylinder does not incorporate an oil hole, however the variations in other cylinders will be taken up in the applicable text.

4—919. DISASSEMBLY.

a. Remove the clevis or other fittings from the piston rod end.



1. Piston
2. Cylinder
3. Clamp
4. Cap End
5. Wiper
6. Lock Ring
7. Oil Hole
8. Felt Wiper
9. Packing
10. Leather Back-up Ring (two)
11. Packing

Figure 4—96. Typical Hydraulic Actuating Cylinder.

b. Remove the clamp which secures the cylinder and end cap and remove cap.

c. Withdraw piston and rod from cylinder. All packings and gaskets are now accessible.

4–920. REPAIRING. The repairing of hydraulic cylinders is limited to the replacement of packings and gaskets. A list of packings and gaskets is given with each cylinder as it is treated and may also be found in the field of the Hydraulic System Schematic, figure 4–95.

Note

Long nose pliers may be used in removing the wiper lock ring.

4–921. ASSEMBLING. The assembly of the hydraulic cylinder is the reversal of the disassembly. The installation of the leather back-up rings must be on the side of the "O" ring away from hydraulic pressure; when only one ring is used, see figure 4–96 for correct position of leather back-up ring.

4–922. TESTING. The following test applies to the intercooler flap cylinder, oil cooler door cylinders, the main wheel door cylinders, the main gear actuating cylinders, the tail wheel cylinder, wing flap actuating cylinders, and wing fold cylinders.

a. Cycle cylinder five times at 1500 psi. There shall be no external leakage.

b. Apply 2250 psi pressure at each port for four minutes, leaving the opposite port open and filled to the top with fluid. There is to be no overflow from either port after two minutes. No external leakage is permitted.

4–923. HYDRAULIC SYSTEM—SUPPLY, PRESSURE AND RETURN.

4–924. DESCRIPTION. (*See figure 4–97.*) The basic components of the system are the reservoir and filter combination, the variable displacement pump, and a main relief valve. Operational efficiency of the system is increased by the pressurization of the reservoir up to 12 psi. This air pressure is drawn from the right hand intercooler air duct on through the pressurization valve to the vent port on the top forward end of the reservoir pressurizing the reservoir to from 10-13 psi. There is a check valve in the pressure line from the pump, and a quick-disconnect between the check valve and the main relief valve. Quick-disconnects are located in all four lines leading from the main relief valve to allow for engine change and external power use. Two of these are located on the firewall. The hydraulic pressure gage located in the cockpit, tees from the main pressure line. A snubber prevents fluid surges from damaging the gage. The main relief valve allows fluid from the pressure line to go directly to the return line, should the pressure exceed 1750 psi. An auxiliary electric pump located in the engine accessory compartment allows emergency operation of the wing flaps in flight; this pump may also be used for ground operation of other sub-systems if an external source of hydraulic power is not available. For information on the auxiliary pump see paragraph 4–1089. Various sizes of tubing used in the main supply, pressure, and return system may be obtained from figure 4–95. Main pressure and return lines are ½ inch diameter and may be identified by conventional coding. All tubing in the main pressure, supply, and return system is aluminum alloy.

4–925. PRESSURE AND RETURN FLOW. (*See figure 4–97.*) The flow of hydraulic fluid starts at the suction line to the pump at a pressure of 3 to 12 psi. It flows into the pump where it is introduced to the low pressure cylinder port. As the cylinder fills, it turns 180° and a piston compresses the charge to 1500 psi. This flow passes through a check valve to the main relief valve, on to the hydraulic pressure gage and sub-systems. Returning from the system, fluid passes through the relief valve in the main return line, thence back to the reservoir where it passes through a filter (3), over a baffle (5), and into the aft compartment (4) of the reservoir. (See figure 4–98.)

4–926. TROUBLE SHOOTING. The following chart should be used to isolate troubles which may occur in the main pressure, supply, and return hydraulic system:

Trouble	Probable Cause	Suggested Remedy
No hydraulic system pressure, hydraulic pressure gage at zero, and systems fail to operate.	*a.* Pump turning backwards. Note drive arrow on mounting flange.	*a.* Reverse pump assembly to drive as arrow shows.
	b. Fluid level in reservoir too low.	*b.* Add fluid to bring reservoir to proper level.
	c. Shear section of pump coupling shaft broken.	*c.* Install new coupling shaft after making sure pump turns freely by hand.
	d. Pressure control setting too low.	*d.* Adjust pressure control setting to proper point (see paragraph 4-946f).
	e. Check valve in main pressure lines improperly installed.	*e.* Reverse installation.
Pressure control not functioning properly (indicated by excessive pressure and overheating).	*a.* Pressure control installed for opposite direction of rotation.	*a.* Reverse position of pressure control body.

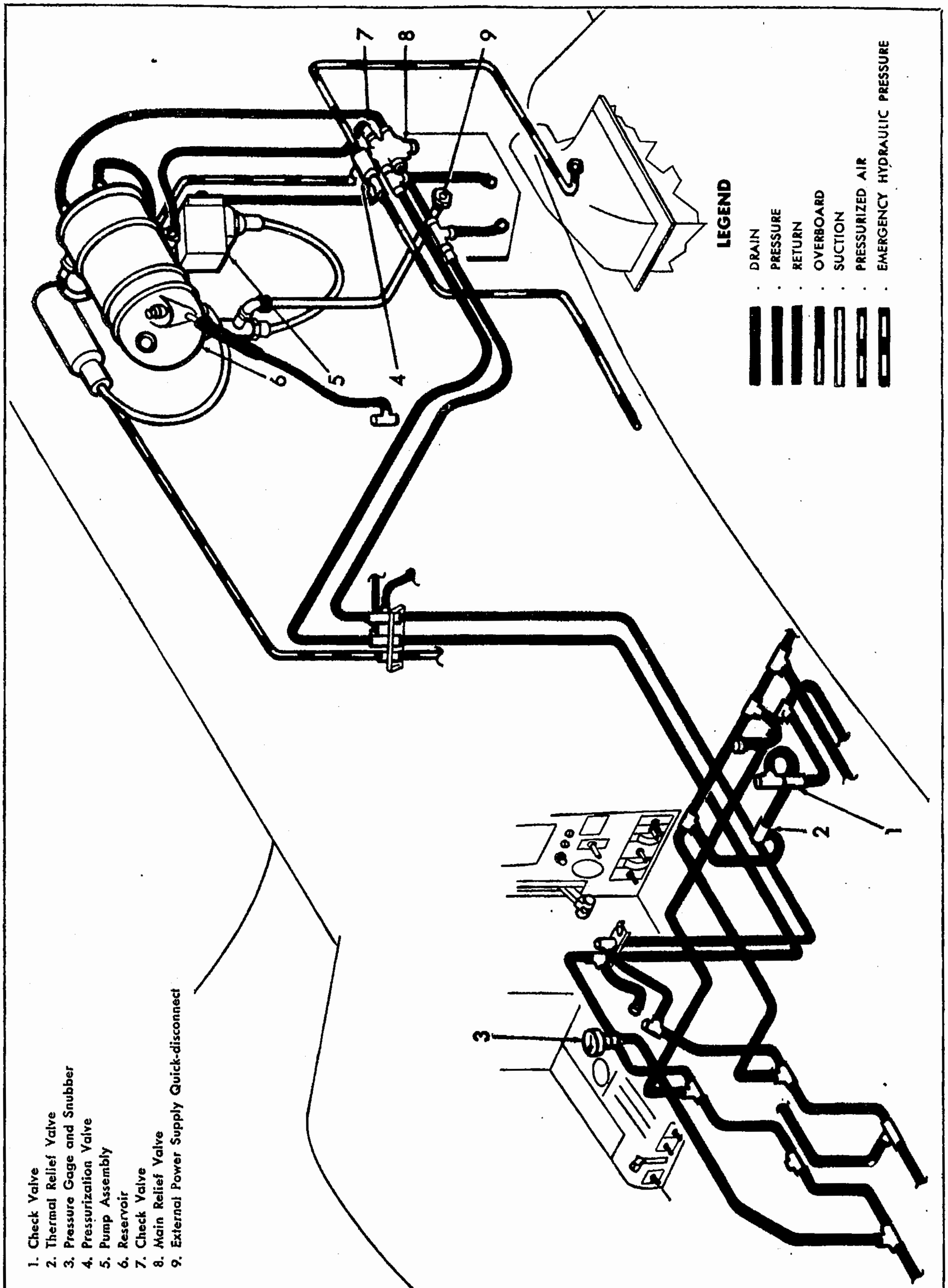


Figure 4-97. Hydraulic System—Main Pressure, Supply and Return.

Trouble	Probable Cause	Suggested Remedy
Pressure control not functioning properly (indicated by excessive pressure and overheating). Continued.	*b.* Foreign matter between pilot valve and bushing causing valve to stick.	*b.* Disassemble pressure control body, check for damaged parts, and clean thoroughly.
Air in hydraulic system (indicated by noise and low delivery).	*a.* System not properly bled.	*a.* Bleed system (see paragraph 4-911).
	b. Leakage at pump inlet line.	*b.* Check all connections for air tightness.
Poppet stuck open on main relief valve (indicated by squealing noise).	*a.* Foreign matter within valve.	*a.* Remove and clean valve.
		b. Check reservoir filter.
External leakage found at reservoir during visual check.	*a.* Defective "O" ring packings at fittings.	*a.* Replace packings.
	b. Faulty welding at ports.	*b.* Reweld according to instructions contained in General Manual for Structural Repair (AN 01-1A-1).
Emergency air system fails to operate.	*a.* No air bottle pressure.	*a.* Refill air bottle to 1800 psi and check for air leakage around bottle connection.
	b. Vent check relief valve failure.	*b.* Remove, clean, and reinstall valve.
Hydraulic system pressure below normal (hydraulic pressure gage reading low and systems slow in operation or fail to operate).	*a.* Relief valve setting too low.	*a.* Raise relief valve to proper cracking point. (1750 psi).
	b. Excessive leakage from fittings, seals, and connections.	*b.* Check all seals and tighten fittings and connections.

4–927. TESTING. To test the supply, pressure and return system, start engine of aircraft.

a. Hydraulic gage in cockpit should read 1500 psi steadily. Note that snubber failure will cause indicator to oscillate. Replace snubber if necessary.

b. If indicator in gage drops off, see paragraph 4–915 or 4–916 for possible cause.

c. After stopping engine, check to see that the fluid in reservoir is at the full level mark.

4–928. HYDRAULIC RESERVOIR AND FILTER.

4–929. DESCRIPTION. (*See figure 4–98.*) The hydraulic reservoir, which contains an integral filter unit, is located at the top of the engine accessory compartment on the right hand side of the airplane forward of the oil tank. Access for removing the hydraulic reservoir is provided by removing the top engine accessory compartment cowl panel. Access for filling the hydraulic reservoir is gained through a filler door located on the right hand side of the top engine accessory compartment cowl panel. The door is hinged at its left hand side and is provided with three flush, push-type latches. Adjacent to the hinge is an identifying decal which reads as follows:

HYDRAULIC RESERVOIR
F4U-5 TYPE AIRPLANE

Use only hydraulic oil conforming with Spec.

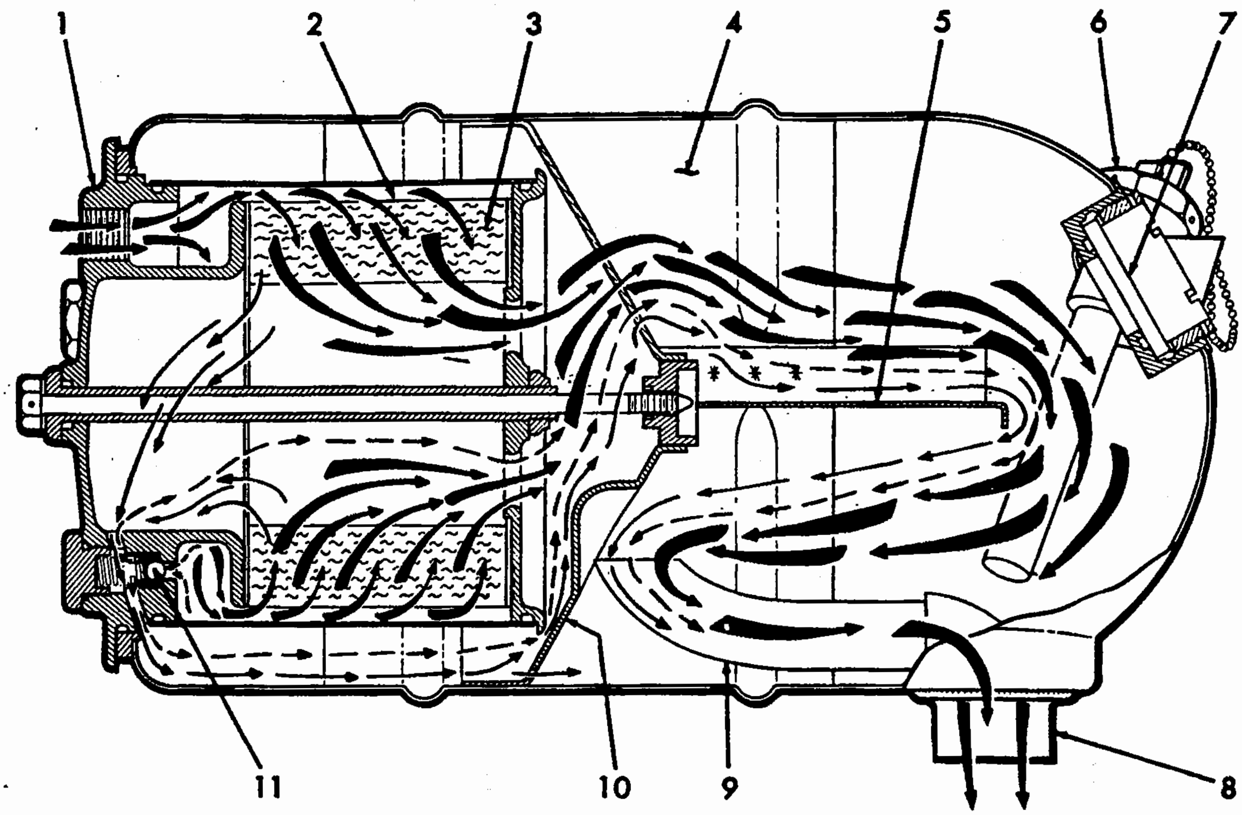
AN-VV-0-366b RED FLUID

Fluid level must be to "FULL" with airplane in 3 point attitude, with no pressure in hydraulic system and with the wings folded.

RESERVOIR DATA
Total volume 743 cu. in.

Oil Capacity: LOW—8¼ quarts, FULL—8¾ quarts

The tank is mounted on two tube supports which are secured by clamps to the upper right and left hand tubes of the engine mount. The tank is secured to these tube supports by forward and aft strap assemblies. The forward strap assembly consists of two metal strips which are bolted together on the top of the reservoir. The aft strap assembly is a single metal strip which passes under the aft end of the tank and is secured to the tube support by a lock-wired bolt. Callouts used in the following text will be found in figure 4–98. The hydraulic reservoir is a welded assembly consisting of two major compartments: a forward compartment (2) containing unfiltered fluid and the removable filter assembly and an aft compartment (4) containing the filtered fluid supply for the pump, a fixed cone assembly (10), a fixed horizontal baffle (5), the filler neck and 100 x 90 mesh Monel screen strainer (6), and a sight gage (7). The filter assembly (3) incorporates three spring and ball relief valves (11) which permit unfiltered fluid to bypass the filter, should it become clogged, and flow through the cone into the aft reservoir compartment. Adjacent to the filler neck on the aft end of the tank, a glass window with "FULL" and "LOW" indications gives visual check of fluid level in the tank. The filler neck is located so as to prevent overfilling the reservoir. Should fluid be spilled alongside the filler neck during



1. Inlet Port
2. Forward Compartment
3. Filter
4. Aft Compartment
5. Horizontal Baffle
6. Filler Neck and Strainer
7. Sight Gage
8. Outlet Port
9. Standpipe
10. Cone Assembly
11. Relief Valves

MAIN FLOW (NORMAL)
PARTIAL FLOW (NORMAL)
RELIEF FLOW (CLOGGED FILTER)

Figure 4–98. Hydraulic Reservoir

filling, a scupper is provided with a drain line attached, which leads the spilled fluid out of the airplane. Nameplates on the top of the hydraulic reservoir identify the tank itself, the vent port and the filler neck. Nameplates on the bottom aft end of the reservoir identify the suction ports for both main and auxiliary hydraulic pumps. A one inch suction line to the main hydraulic pump is attached to a tee on the bottom of the reservoir. From this tee, a second line runs to a quick-disconnect on the hydraulic panel (on the right hand side of engine accessory compartment) for attachment of external power supply. The quick-disconnect is also used for draining the hydraulic reservoir while it is installed in the airplane. A second suction line runs from the bottom of the reservoir to the auxiliary pump. The main pump housing drain line and the main system return line are connected to the forward end of the reservoir. A line from the port labelled "VENT" on the forward top end of the reservoir leads to a pressurization valve adjacent to the hydraulic panel.

4–930. FUNCTION. For operation of the hydraulic system at various altitudes, the reservoir is pressurized to a maximum of 12 psi. Pressurization is accomplished by air delivered through a line from the intercooler air duct to the pressurization valve located adjacent to the hydraulic panel and thence to the vent port on the top forward end of the reservoir. The pressurization valve also relieves excessive pressures within the reservoir. For further information on the pressurization valve, see paragraph 4–948. Callouts used below will be found on figure 4–98. The reservoir supplies the pump with pressurized, filtered fluid. The fluid enters the inlet port (1), flows from the forward tank compartment (2) through the paper filter (AN6236-2) (3), over the horizontal baffle (5), to the aft compartment (4) where it goes through the standpipe (9) to the outlet port (8) from which it is drawn by the main hydraulic pump for distribution to the hydraulic system. Should the filter become clogged, three relief valves located on the forward face of the tank allow the fluid to by-pass the filter and supply the pump with unfiltered oil.

4–931. FILLING. With the airplane in the three-point attitude and with the wings folded, fill the combination hydraulic reservoir and filter unit as follows:

a. Open the hydraulic filler access door on the top of the engine accessory cowling, by pushing the flush latches. The door is hinged at the left hand side.

b. Break safety wire and remove the cap from the filler neck.

c. Pour AN-O-366 red hydraulic fluid into the filler neck until the sight gage indicates "FULL." If the reservoir tends to fill slowly and gage indication is sluggish, loosen the nut on the air vent line at the top of the tank.

d. When the gage indicates "FULL," cycle the system and observe fluid level indication after a two-minute interval with the vent port open. If the gage shows a drop in fluid level, pour additional fluid into the tank until "FULL" indication is attained.

e. After filling, make sure that the cap and packing are properly replaced to prevent fluid leakage. Then replace the safety wire.

Note

The fluid level in the hydraulic reservoir should be checked before each flight. At 120 hour inspections, the filter element should be replaced.

4–932. REMOVING. To remove the hydraulic reservoir, observe the following procedure:

Note

It is not necesary to r^move the hydraulic reservoir in order to replace the filter element; see paragraph 4–933.

a. Remove the top engine accessory compartment cowl panel by loosening the Camloc fasteners along the top of both the diaphragm and firewall and by loosening the Dzus fasteners and removing the keyways along the sides of the panel.

b. Drain hydraulic reservoir by removing cap at quick-disconnect on the hydraulic panel; thread mating half to quick-disconnect, with extra hose length attached, and allow tank to drain into bucket. This drains oil down to standpipe level in tank. To drain oil below standpipe level, disconnect pump end of auxiliary pump suction line; cap line temporarily with thumb and move line over bucket. Pump end of line should be reconnected to pump after draining is complete.

c. Disconnect the pump housing drain line and the main return line from the forward end of the reservoir.

d. Disconnect the vent line from the vent port at the top of the reservoir.

e. Disconnect the main suction line at the tee fitting on the underside of the reservoir.

f. Disconnect the auxiliary pump suction line from the bottom aft end of the reservoir.

g. Slip hose from scupper drain.

h. Cap all lines not immediately reconnected.

i. Unsafety and remove the bolt securing the strap assembly at the forward top side of the reservoir.

j. Unsafety and remove the bolt which secures the aft strap assembly to the right hand tube support.

CAUTION

Be sure to support the aft end of the reservoir while removing the aft strap assembly.

k. After disconnecting the strap assemblies, lift and remove the reservoir from the airplane.

4–933. DISASSEMBLY.

Note

The filter element may be removed while the reservoir is installed in the airplane by draining the reservoir and observing the procedure given in steps a. through c.

To disassemble the hydraulic reservoir and filter unit, observe the following procedure:

a. Unsafety and remove the center bolt from the forward face of the tank to free the cover and filter assemby unsafetying and turning out the securing nut.

b. Pull the cover and filter assembly from the reservoir.

c. Remove the cover from the filter by taking off the nut at the base of the filter and removing the bolt which passes through the center of the cover and filter.

d. If broken, the glass window gage may be removed by unsafetying and turning out the securing nut.

e. To take out the strainer from the filler neck, unsafety and remove the filler plug and pull the strainer out.

4–934. CLEANING. At 120-hour inspections, clean the strainer in the filler neck by washing in kerosene Spec. VV-K-211 or Stoddard Dry Cleaning Solvent, Spec. P-S-661a.

4–935. REPAIRING. Replace the filter element when it is too dirty to allow proper oil passage. In the event of breakage, the gage window may also be replaced. If it is suspected that a relief valve in the filter housing is defective, causing leakage around the filter (i.e., broken spring, indicated by rattling), the spring, retainer and ball may be removed by removing the plug which secures each valve within the filter housing, and the defective valve replaced. (See paragraph 4–938d for test procedure.)

4–936. ADJUSTING. Adjust the filter relief valves to crack at 10-13 psi.

4–937. ASSEMBLING. To assemble the hydraulic reservoir, reverse the disassembly procedure given in paragraph 4–933.

CAUTION

Use care when tightening special hollow bolt through filter. Pull up until adjacent parts are snug with each other.

Note

Replace all "O" ring packings when assembling the reservoir. Before installing the filter element, soak the gaskets in AN-O-366 red hydraulic fluid. After installation make sure that they are properly seated.

4–938. TESTING. To bench-test the hydraulic reservoir for leakage, observe the following procedure:

a. Fill the reservoir almost to capacity with hydraulic fluid. Then attach a pressure line to the return port on the forward face of the reservoir after plugging all other ports.

b. Build up air pressure in the reservoir to 26 psi and hold the pressure for five minutes.

c. Immerse the reservoir in a tank of water. Then rotate the tank slowly; there must be no external leakage.

d. If necessary to determine that reservoir relief valves are cracking at proper pressure, the following bench test procedure must be observed:

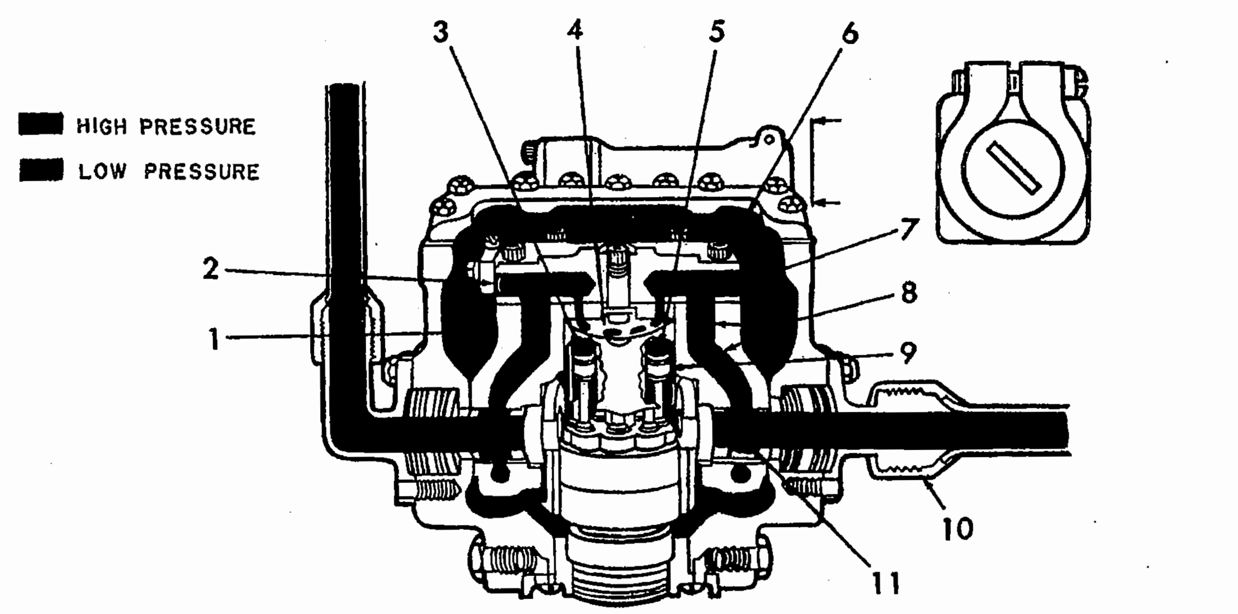
e. Install a wooden dummy filter in the filter housing which will prevent fluid flow to the storage section of the tank.

f. Using a hydraulic power pump apply pressure to reservoir with relief valves installed. Valves should crack at 10-13 psi.

4–939. INSTALLING. To install the hydraulic reservoir, reverse the removing procedure given in paragraph 4–932, installing aft strap assembly first.

4–940. MAIN ENGINE-DRIVEN HYDRAULIC PUMP.

4–941. DESCRIPTION. This unit of the hydraulic system is a variable displacement, nine cylinder, engine driven pump manufactured by Vickers Inc. of Detroit, Michigan (their part No. AA-20334). It is mounted at the top right of the rear face of the engine accessory drive section and is accessible through the top engine accessory compartment cowl panel. A pressure control mounted directly on the housing of the pump, regulates the pressure output of the pump. A relief valve in the pump keeps the output from exceeding the operational limit of the system. The cylinder block rotates with the drive shaft and at an angle to it. As the angle between the cylinder block and the drive increases, the de-



1. Yoke
2. Valve Block—Pressure Side
3. Cylinder Bore
4. Valve Plate
5. Cylinder Bore
6. Housing
7. Valve Block—Inlet
8. Inlet Passages
9. Pistons
10. Inlet Union
11. Pintle

Figure 4–99. Main Hydraulic Pump Flow

livery of fluid increases. This angle (30° maximum stroke angle) is regulated by the pressure control. The dównstroke or intake of each of the nine cylinders occurs when it is opposite the intake port. On the compression or upstroke, each cylinder is opposite to the outlet to the main pressure line. The direction of pump rotation is indicated by an arrow on the mounting flange. If a new pump is installed and the direction of rotation is opposite to the direction of the engine drive spline, it will be necessary to turn the valve plate over, reverse the position of the valve block, the inlet union, outlet elbow, and the pressure compensator. Whenever it is necessary to disassemble the pump, be sure on assembly to fill the pump housing with fluid (.22 gallons) before operation. Filling is done by removing uppermost filler plug from housing. Pump need not be removed from airplane. A drain is connected from one of the pump housing drain ports to the reservoir and another drain line is attached between the lowest mounting pad drain port and the reservoir overboard line for drainage of hydraulic fluid and engine oil. The pump (dry) weighs approximately 19 pounds.

4–942. FLOW THROUGH PUMP. (*See figure 4–99.*) In normal operation, fluid is drawn from the reservoir and enters the suction port of the pump under 12 psi pressure. It is discharged at the pressure required to operate any sub-system up to a maximum of 1500 psi. The operation of the pump is fully automatic and will maintain 1500 psi at zero flow when no sub-systems are being operated. The pump will start to feather (decrease flow) at 1350 psi and will be completely cut out (no flow) at 1500 psi. The maximum speed in this airplane is 3920 rpm and the flow at this speed is 9.65 gpm. Assume that pump is delivering maximum volume and that pump housing (6) has been checked for full level.

a. When the engine is running, the pump draws hydraulic fluid under pressure to the inlet union (10) of the pump. The fluid enters the pump as the pistons move away from the valve plate on the intake stroke. Fluid passes from the inlet union through the pintle (11) and through the inlet passages (8) of the yoke (1) into the inlet side of the valve block (7).

b. Since the pistons (9) are moving away from the valve block and plate at this point, they draw the fluid past the valve plate (4) and into the cylinder bore (5).

c. The rotating parts of the pump are being driven by the airplane engine so that each piston and its respective cylinder bore is constantly changing position. As each cylinder fills with fluid, it turns 180°, at the end of which time the piston begins its pressure stroke. The fluid is driven from the cylinder bore (3) through the opposite side of the valve plate (4) and into the pressure side of the valve block (2). It then flows into the outlet pintle and thence to the outlet elbow which connects to the main pressure line.

4–943. REMOVING.

a. Remove upper cowl panel and upper right hand wing gap cover panel (see paragraph 4–480).

b. Disconnect the engine vent oil line return located on the top side of the oil tank.

c. Drain hydraulic reservoir by removing cap as quick disconnect on hydraulic panel; thread mating half to quick disconnect with extra hose length attached, and allow tank to drain into bucket. This drains oil to standpipe level in tank. To complete draining, disconnect the suction line to the auxiliary pump at the pump end, cap line with thumb, move over bucket, and then allow final drainage. Reconnect line to auxiliary pump.

d. Disconnect the vent line from vent port on top of reservoir.

e. Disconnect the pump housing drain line and the main return line from the forward end of the reservoir.

f. Disconnect the main suction line at the tee fitting on the underside of the reservoir.

g. Disconnect the auxiliary pump suction line from the bottom aft end of the reservoir.

h. Slip hose from scupper drain.

i. Remove two reservoir support clamps attached to the left hand engine mount.

j. Swing reservoir up allowing access to hydraulic pump.

k. Remove vent line from top of pump.

l. Remove suction, drain and pressure lines from pump.

m. Cap all open ends of tubing to prevent contamination of fluid in system.

n. Cut and remove the lock wire at the pump mounting flange. Remove nuts which attach pump to the engine mounting pad.

o. Remove pump and place on clean bench.

4–944. CLEANING. Use kerosene or any other approved mineral oil solvent. All seals that are removed must be replaced with new ones; therefore, it is not necessary to wash them. However, if it is ever necessary to reuse a seal, wash it in clear hydraulic fluid only.

4–945. LUBRICATING. The splined coupling shaft should be lubricated with graphite grease Spec. AN-G-6 prior to installing a new pump.

4–946. TESTING AND ADJUSTING. Prior to installing a new pump the following test and adjustment must be made:

a. Pump case must be filled with hydraulic oil before operation.

b. Pump shaft must be free enough for hand rotation.

c. Run pump for five minutes at 2400 rpm (plus or minus 50 rpm) with the fluid temperature at 150°F (plus or minus 5°F.); outlet pressure at 1250 psi (plus 0 minus 50 psi) and the inlet pressure at 25 psi absolute. There shall be no binding. The flow shall not be less than 5.8 gpm at the end of run. Shut off pressure line from pump. Pressure at outlet port must not exceed 1500 psi.

d. Run pump for one hour at 3950 rpm (plus or minus 50 rpm) with the fluid temperature at 150°F (plus or minus 5°F); the outlet pressure 1250 psi (plus zero, minus 50 psi) and the inlet pressure at 25 psi absolute. The flow shall not be less than 9.6 gpm at the end of the run. Shut off pressure line from pump. Pressure at outlet port must not exceed 1500 psi.

e. There shall be no external leakage during test except at mounting pad drain ports. Leakage at any drain port shall not exceed two drops per minute. Let pump stand at least five hours after test. The shaft must be free enough to rotate by hand.

f. To regulate the pressure control valve the pump should be turning at approximately 3600 rpm and fluid temperature should be at about 50°C (120°F). Close the volume control valve in the outlet line. Loosen the lock screw at the pressure control adjusting screw. Then turn the pressure control adjusting screw (see view A-A on figure 4–99) in to raise, or out to lower, until the reading on the test gage indicates the correct pressure. Tighten the locking screw. Open the volume control valve slowly while watching the pressure gage. The pressure hand will flutter slightly when the pressure drops to the cut-in point of the pressure control. The pressure control setting for cut-out is 1500 psi plus or minus 25 psi.

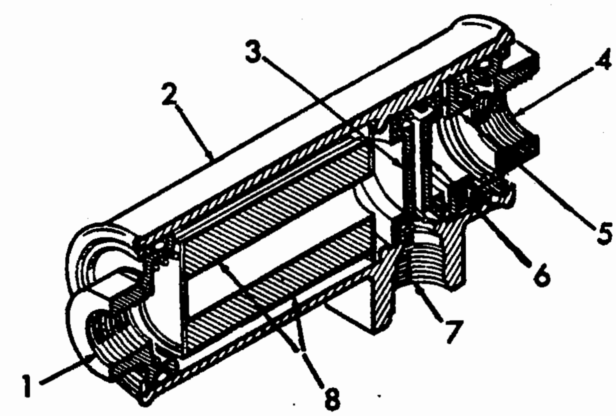
4–947. INSTALLING. The variable displacement pump is installed by reversing the procedure directed in paragraph 4–943. Rotation is clockwise facing shaft end of pump.

4–948. PRESSURIZATION VALVE.

4–949 DESCRIPTION. *(See figure 4–100.)* This valve may be purchased from the Airex Mfg. Co. Their part No. is B1062, Model 45. It combines a filter and relief valve and is installed in the air line between the intercooler air duct and the hydraulic reservoir. It is located just above the hydraulic panel in the engine accessory section. Access to the panel may be gained by removing the upper right hand wing gap cover. The function of this valve is the pressurization of the reservoir to 12 psi (plus 0, minus 1 psi) and the relief of either insufficient or excessive pressures due to either less or more oil returning to the reservoir from the system than is drawn by the pump. In the event that more oil returns from the system than the pump draws, this valve has an overboard outlet (4) to relieve the pressure. The valve consists of a three port housing (2), a filter unit (8), and three poppets, one (5) of which is set to open to the overboard line should pressure in the reservoir exceed 12 psi and one of the other poppets (3 and 6) will open should pressure in the reservoir be less than atmospheric. The third poppet will open if pressure in the reservoir is less than intercooler air duct pressure.

4–950. REMOVING. It is necessary to remove the upper right hand wing gap cover to reach the pressurization valve. It is located directly above the hydraulic panel on the right hand engine mount tube and is secured by two clamps.

a. Disconnect the three lines which lead from the



1. Intercooler Air Duct Port
2. Housing
3. Poppet
4. Overboard Outlet
5. Poppet
6. Poppet
7. Reservoir Port
8. Filter

Figure 4–100. Pressurization Valve.

pressurization valve to the intercooler air duct, the reservoir, and overboard.

b. Cap all open lines to prevent foreign matter from entering system.

c. Remove the screws that secure the clamps and remove the valve.

4–951. TESTING. Prior to installing a new valve, the following test must be made:

a. With overboard port and inlet port open, apply 10 psi (20.3 inches mercury) gage air pressure to reservoir port with 300 cubic inches of air in line between pressure source and reservoir port of valve. Pressure in reservoir should not drop below 9 psi (18.3 inches mercury) after two minutes.

b. Increase pressure in system (see step a). Relief valve should crack at a pressure of 12 psi (plus 0 or minus 1 psi) or 24 (plus 0 minus 2) inches of mercury.

4–952. INSTALLING. Install the pressurization valve by reversing the procedure for removal given in paragraph 4–950.

4–953. CHECK VALVE.

4–954. DESCRIPTION. *(See figure 4–97.)* This is an AN6207-8 valve which is located adjacent to the reservoir on the right hand engine mount tube, and is accessible by removing the upper engine accessory compartment cowl panel. The purpose of this check valve is to prevent back pressure through the pump and the reduction of system pressure when the pump is not running. It is a simple spring loaded valve which allows flow in one direction only (indicated by arrow).

4–955. REMOVING.

a. Relieve main system pressure.

b. Disconnect and cap two lines leading to valve.

c. Take off clamp screw and remove valve.

4–956. TESTING. Prior to installing a new check valve, observe the following test procedure:

a. Apply five psi pressure against direction of arrow and allow time for port to drain. Internal leakage shall not exceed six drops in three minutes. Repeat test using 1500 psi pressure. Leakage shall not exceed three drops in one minute.

b. Increase pressure to 2250 psi for two minutes. There is to be no external leakage.

4–957. INSTALLING. Install the check valve by reversing the removal procedure given in paragraph 4–955.

Note

Arrow on check valve must be pointing in the direction of flow in the line.

4–958. MAIN RELIEF VALVE.

4–959. DESCRIPTION. (*See figure 4–97.*) This valve (AN6200-8AB) may be purchased from Hydro-Aire, Beverly Hills, California (their part No. 1048-2), or from Adel Precision Products Corp. (their part No. 11800). It is mounted on the forward upper corner of the hydraulic panel. It consists of a housing with two internal chambers. A passage between the two chambers is normally closed by a spring seated poppet which will crack at 1750 psi, relieve below 1925 psi with a flow of 6 gpm and will reset above 1575 psi. This allows excessive fluid pressure to return to the reservoir rather than damaging the sub-systems.

4–960. REMOVING.

a. Relieve main system pressure by operating wing flaps until gage in cockpit reads zero.

b. Remove right hand upper wing gap cover panel.

c. Disconnect and cap the four lines leading to valve; remove four bolts which secure valve to hydraulic panel, and remove valve.

4–961. TESTING. Prior to installation, the following test should be made:

a. Plug outlet ports and one pressure port. Apply 3100 psi to opposite pressure port for two minutes. There shall be no external leakage.

b. Remove outlet plugs, apply slowly increasing pressure to inlet port. There shall be no leakage from outlet port below 1750 psi.

c. After outlet has cracked, increase flow to 6 gpm. Pressure should not exceed 1925 psi. Slowly decrease flow until a minimum pressure of 1575 psi has been reached. Hold this pressure constant for one minute. Valve should reseat at 1575 psi or above. The return line must be short and free from restrictions. If restrictions cannot be eliminated, determine back pressure developed at 6 gpm flow and subtract this value from maximum relief pressure in order to obtain correct reading.

4–962. INSTALLING. Installing the main relief valve is the reverse of the procedure directed in paragraph 4–960.

4–963. HYDRAULIC PRESSURE GAGE AND SNUBBER.

4–964. DESCRIPTION. (*See figure 4–97.*) The pressure gage (AN5771-4B) and the snubber which is made by Operating & Maintenance Specialties Co. of Charlotte, N. C. (their drawing No. 11D) make up an assembly which is located in the cockpit on the left hand control panel. It is connected to the main pressure line by a straight section of tubing at station 154 approximately. The gage is a Bourdon tube type with a range from 0 to 2000 psi. When pressure enters the gage, it tends to straighten the tube, the motion of which is magnified through linkages to the indicator on the dial. When the hydraulic system is operating, the indicator should read 1500 (plus or minus 100) psi. Oscillation or noticeable change in dial reading when no unit is in operation indicates a malfunction in the system. The snubber is screwed into the pressure gage and prevents pressure surges from damaging the hydraulic pressure gage.

4–965. REMOVING. Relieve main system pressure by operating wing flaps until the hydraulic gage reads zero. Access to the gage and snubber is gained through the access panel on the vertical portion of the left hand control shelf.

a. Disconnect and cap the line leading to the gage and snubber assembly.

b. Remove screws securing gage to forward horizontal section of left hand panel and remove gage.

4–966. TESTING. Prior to the installation of the gage, the following test should be made:

a. Apply 0, 400, 800, 1200 and 2000 psi test pressures successively on gage. At each pressure increment, reading should not differ from test pressure by more than 50 psi.

b. Without changing the pressure, tap gage gently. The pressure reading should not change more than 50 psi.

c. Repeat procedure with constantly decreasing pressures from 2000 psi to 0 psi.

d. No leakage should occur throughout test.

4–967. INSTALLING. Installation of the pressure gage and snubber is the reversal of the removal procedure given in paragraph 4–965.

4–968. QUICK-DISCONNECTS.

4–969. DESCRIPTION. (*See figure 4–97.*) There are six quick-disconnects in the hydraulic system. Two of them are attached to the main relief valve on the hydraulic panel. The upper is an AN6241-8 and the lower is an AN6243-8. When an external power source is used these two disconnects provide union joints. When the airplane hydraulic reservoir is used in testing, the upper relief valve disconnect and the disconnect (AN6220-16) located in the center of the hydraulic panel are attached to the external power source. There are two quick disconnects in the main pressure and return lines; both AN6241-8 parts which are located on the right hand bracket installation (firewall) and are used in engine change procedure. There is also a quick-disconnect (AN6241-4) on the left hand bracket (firewall) in the auxiliary pump pressure line.

4—970. REMOVING. Relieve main system pressure by operating wing flaps until hydraulic gage in cockpit reads zero. Loosen nuts and remove quick-disconnects.

4—970A. TESTING. Prior to installation, the following test should be made:

a. Apply a load of 30 inches of oil on both ends of the quick-disconnect. Separate the two halves. The poppet shall seal the oil in the quick-disconnect.

b. Connect and disconnect the quick-disconnect twice. Oil should be sealed in the coupling each time.

c. Apply a pressure of 5 psi on each half of the coupling for two and one-half minutes. The internal leakage shall not exceed one drop. If leakage during first two and one-half minutes of test is excessive, continue for an additional five minutes. Leakage during this time is not to exceed two drops.

d. Plug one end of the coupling assembly and apply 2250 psi for one minute and 5 psi for two minutes at the other end. There should be no external leakage.

4—971. INSTALLING. Installing the quick-disconnects is the reverse of the removal instructions given in paragraph 4—970.

4—972. TUBING CHART. Figure 4—101 must be used as a reference key in conjunction with the following table:

TUBING CHART — MAIN PRESSURE, SUPPLY, AND RETURN HYDRAULIC SYSTEM

(Refer to Figure 4—101)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
AN6264-8D-20 Hose Assem.	1	13/32 ID		20	Spec. AN-H-24	AN6207-8 Check Valve AN928-8D Elbow AN6227-12 Packing (2 req.) AN6221-8 Coupling
VS-58278-35	2	1/4	.035	38 15/16	CVC-1813-4-13 Hose AN-748-22 Clamp (2 req.)	AN814-4D AN819-4Z CVC-1813-4-13 Hose AN748-22 Clamp (2 req.)
AN6264-8D-27½ Hose Assem.	3	13/32 ID		27½	Spec. AN-H-24	AN815-8D Union AN927-8D Elbow AN6222-8 Coupling Half AN775-8D Bolt AN901-8A Gasket (2 req.) AN6227-12 Packing (3 req.) AN6221-8 Coupling Half AN6224-8 Nut AN833-8D Elbow AN924-8D Nut
AN6264-4-13 Hose Assem.	4	3/16 ID		13	Spec. AN-H-24	AN833-4D Elbow (2 req.) AN924-4D Nut (2 req.) AN6227-7 Packing (2 req.)
AN6264-6-34	5	5/16 ID		34	Spec. AN-H-24	AN837-6D Elbow (2 req.) AN924-6D Nut (2 req.) AN6227-9 Packing (2 req.)
AN6264-4-18½	6	3/16 ID		18½	Spec. AN-H-24	AN901-4A Gasket AN833-4D Elbow (2 req.) AN924-4D Nut AN6227-7 Packing

TUBING CHART — MAIN PRESSURE, SUPPLY, AND RETURN HYDRAULIC SYSTEM (Continued)

(Refer to Figure 4—101)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
AN6264-4-29½	7	³⁄₁₆ ID		29½	Spec. AN-H-24	AN837-4D Elbow AN924-4D Nut AN6227-7 Packing AN919-6D Reducer AN6227-9 Packing
AN6264-4-22	8	³⁄₁₆ ID		22	Spec. AN-H-24	AN833-4D Elbow (2 req.) AN924-4D Nut (2 req.) AN6227-7 Packing (2 req.)
AN6264-16D-20	9	⅞ ID		20	Spec. AN-H-24	AN832-16D Union AN926-16D Tee AN815-16D Union AN924-16D Nut AN6227-22 Packing (4 req.)
AN6264-16D-25	10	⅞ ID		25	Spec. AN-H-24	AN928-16D Elbow AN815-16D Union AN6227-22 Packing AN833-16D Elbow AN924-16D Nut VS-41216 Cap Assem. AN6220-16 Coupling AN6223-16 Flange VS-58325 Insulator AN3-3A Bolt (6 req.) AN365-1032 Nut (6 req.) AN960-D10 Washer (6 req.)
AN6264-6-39	11	⁵⁄₁₆ ID		39	Spec. AN-H-24	AN815-6D Union AN926-6D Tee AN832-6D Union AN924-6D Nut AN6227-9 Packing (3 req.) AN815-6D Union
VS-58278-39	12	⅜	.035	38¾	Spec. WW-T-787	AN818-6D Nut AN819-6Z Sleeve
VS-58278-17	13	½	.042	7	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN926-8D Tee AN815-8D Union (2 req.) AN919-10D Reducer AN6227-9 Packing (3 req.)
VS-58278-9	14	¼	.035	9	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN6227-7 Packing AN804-4D Tee AN924-4D Nut
VS-58278-5	15	¼	.035	10	Spec. WW-T-787	VS-48148 Filter AN6227-7 Packing AN919-10D Reducer AN818-4D Nut (2 req.) AN6227-12 Packing AN819-4Z Sleeve (2 req.)

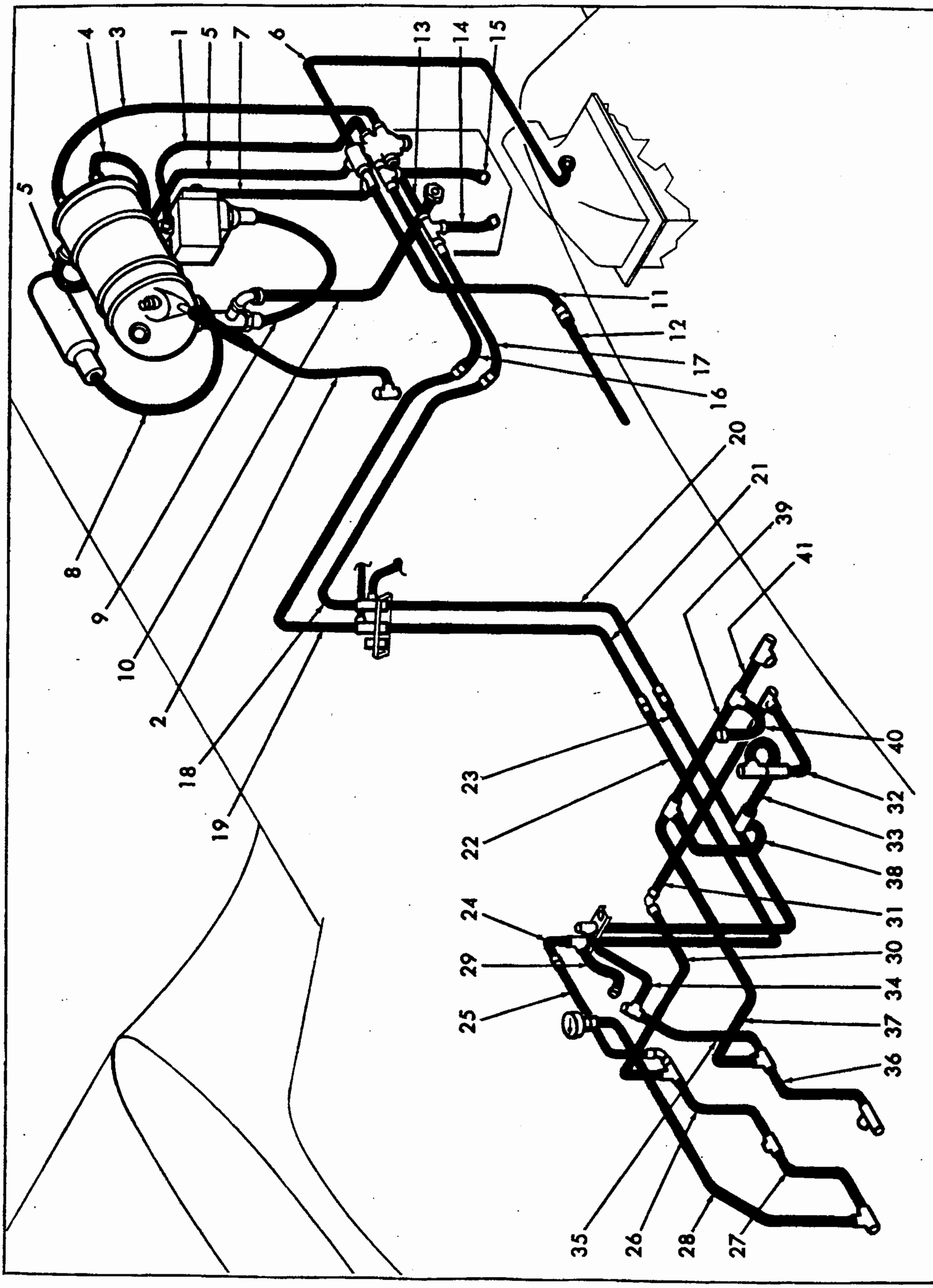


Figure 4—101. Hydraulic System—Main Pressure, Supply and Return Tubing Diagram.

TUBING CHART — MAIN PRESSURE, SUPPLY, AND RETURN HYDRAULIC SYSTEM (Continued)

(Refer to Figure 4—101)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
AN6264-8D-17	16	13/32 ID		17	Spec. AN-H-24	AN832-8D Union AN926-8D Tee VS-78012-1 Nameplate AN815-8D Union (2 req.) AN927-8D Elbow AN6227-12 Gasket (5 req.) AN6220-8 Coupling Half AN6221-8 Coupling Half AN6224-8 Nut AN924-8D Nut (2 req.)
AN6264-8D-13	17	13/32 ID		13	Spec. AN-H-24	VS-78012-2 Nameplate AN815-8D Union AN927-8D Elbow AN6227-12 Gasket (2 req.) AN6220-8 Coupling Half AN6221-8 Coupling Half AN6224-8 Nut AN924-8D Nut
VS-58278-29	18	½	.042	44	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) VS-78012-2 Nameplate AN919-10D Reducer AN6227-12 Gasket (3 req.) AN924-8D Nut AN832-8D Union AN926-8D Tee AN815-8D Union

TUBING CHART — MAIN PRESSURE, SUPPLY, AND RETURN HYDRAULIC SYSTEM (Continued)

(Refer to Figure 4—101)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-58278-27	19	½	.042	44	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) VS-78012-1 Nameplate AN919-10D Reducer AN6227-12 Gasket (3 req.) AN832-8D Union AN924-8D Nut AN926-8D Tee AN815-8D Union
AN6264-8D-35	20	13/32 ID		35	Spec. AN-H-24	AN832-8D Union AN924-8D Nut
AN6264-8D-24	21	13/32 ID		24	Spec. AN-H-24	AN832-8D Union AN924-8D Nut
VS-58312-11	22	½	.042	52	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN804-8D Tee AN960-D1216 Washer AN924-8D Nut
VS-58312-13	23	½	.042	52	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN833-8D Elbow AN960-D1216 Washer AN924-8D Nut
VS-58312-27	24	½	.042	5	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN919-12D Reducer
VS-58312-117	25	⅜	.035	17	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN926-6D Tee AN833-6D Elbow AN815-6D Union AN919-6D Reducer AN6227-9 Packing (3 req.) AN924-6D Nut
VS-58312-31	26	¼	.035	8	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN834-4D Tee AN924-4D Nut AN6227-7 Packing
VS-58312-107	27	¼	.035	18	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN824-4D Tee
VS-58312-115	28	¼	.035	34	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.)
VS-58312-37	29	½	.042	11	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN837-8D Elbow AN6227-12 Packing AN924-8D Nut
VS-58312-29	30	⅜	.035	32	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN833-6D Elbow

TUBING CHART — MAIN PRESSURE, SUPPLY, AND RETURN HYDRAULIC SYSTEM (Continued)

(Refer to Figure 4—101)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-58312-113	31	3/8	.035	21	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN824-6D Tee
VS-58312-63	32	3/8	.035	9	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN6207-6 Check Valve
VS-58312-61	33	3/8	.035	6	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN926-6D Tee AN832-6D Union AN924-6D Nut AN6227-9 Packing (4 req.) AN919-6D Reducer AN6227-7 Packing
VS-58312-35	34	1/2	.042	13	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN804-8D Tee AN6227-12 Packing AN924-8D Nut
VS-58312-47	35	1/2	.042	16	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN926-6D Tee AN919-12D Reducer AN815-6D Union AN6227-9 Packing (3 req.) AN919-6D Reducer
VS-58312-99	36	1/4	.035	8	Spec. WW-T-787	AN804-4D Tee AN924-4D Nut AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN815-4D Union AN6227-7 Packing (2 req.)
VS-58312-9	37	3/8	.035	9	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN824-6D Tee
VS-58312-143	38	3/8	.035	12	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN6227-7 Packing AN919-6D Reducer
VS-58312-51	39	3/8	.035	12	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN824-6D Tee
VS-58312-53	40	3/8	.035	3	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN815-6D Union AN6227-9 Packing
VS-58312-103	41	3/8	.035	6	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN926-6D Tee AN815-6D Union (2 req.) AN924-6D Nut AN6227-9 Packing (3 req.) AN833-6D Elbow

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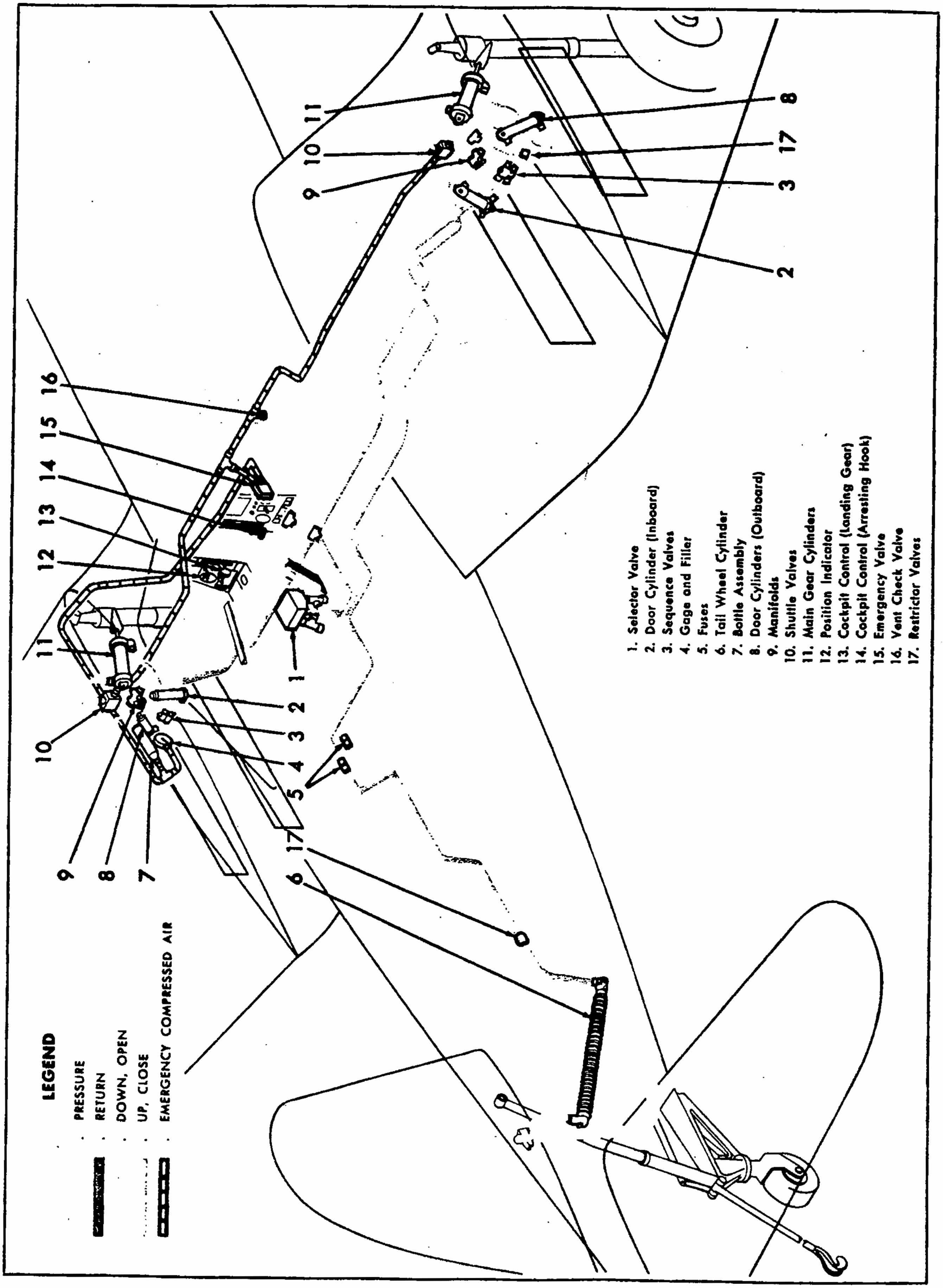


Figure 4–102. Hydraulic System—Landing Gear.

4-973. HYDRAULIC SYSTEM—LANDING GEAR.

4-974. DESCRIPTION. (*See figures 4-102 and 4-95.*) The main landing gear, landing gear doors and tail gear are hydraulically actuated. The arresting hook derives its motion mechanically from the action of the tail gear when the latter is retracted; refer to paragraph 4-377. The main landing gear, landing gear doors and tail gear operate simultaneously in extension but in retraction, due to a sequence valve in the retract line, the main landing gear doors and tail gear lag until the main wheels are completely retracted. Information on mechanical operation of the main gear may be found in paragraph 4-304 and of the tail wheel in paragraph 4-340. Provision is made to lower the gear in an emergency by the operation of a compressed air system; refer to paragraph 4-1027. The landing gear control lever is located on the left hand inclined portion of the cockpit control panel and connects to the selector valve by means of an aluminum alloy rod. This lever controls the hydraulic flow to the main gear, tail gear, and landing gear doors. When the hydraulic system is operative, the landing gear cylinders are under pressure and when the system is inoperative the gear is mechanically locked in an up or down position.

4-975. FUNCTION — RETRACTING. (*See figure 4-102.*) When the landing gear control handle is raised to the "UP" position, the selector valve retract poppets are opened. This allows a flow of hydraulic fluid through the sequence valve to the "retract" side of the main gear cylinders. As the main wheels complete their retraction, the shock strut contacts the actuating pin on the sequence valves, located on the aft side of the main beam in each wheel well, which causes fluid to flow to the "close" side of the main landing gear doors. At the same time, fluid goes to the "retract" port of the tail gear actuating cylinder from the left hand landing gear door line. The main gear and tail gear are thus completely retracted, and main landing gear doors closed.

4-976. FUNCTION — EXTENDING. (*See figure 4-102.*) When the landing gear control handle is lowered to the "DOWN" position, the selector valve "extend" poppets open. This allows hydraulic fluid to flow through the shuttle valve to the landing gear door actuating cylinders and main gear cylinders as well as through a return-flow type fuse to the tail gear cylinder "extend" port. The main gear and tail gear are thus extended with landing gear doors opened.

4-977. TROUBLE SHOOTING. The following chart will aid in isolating troubles which may occur in the landing gear hydraulic system.

Trouble	Probable Cause	Suggested Remedy
Landing gear fails to extend or retract.	*a.* Main relief valve stuck open.	*a.* Remove and clean valve.
	b. Mechanical failure.	*b.* See paragraph 4-304.
	c. Shuttle valve leaking.	*c.* Replace packings.
	d. Poppets on selector valve sticking open.	*d.* Remove and clean or repair valve.
	e. Selector valve binds in turning.	*e.* Replace packing and clean valve.
Door hits gear on retraction.	*a.* Pressure sequence valve open.	*a.* Clean and adjust valve.
Main gear retracted, landing gear doors and tail wheel fail to retract.	*a.* Sequence valve shaft insufficiently compressed by main gear shock strut.	*a.* Check landing gear adjustment; see paragraph 4-320.
Landing gear fails to retract with control handle in "UP" position after takeoff.	*a.* Landing gear control handle inadvertently moved to, and left in "UP" position while airplane was on ground prior to take-off	*a.* Instruct pilot to move control handle after takeoff to "DOWN" position momentarily to relieve hydraulic pressure, and then return handle to "UP" position. DO NOT MOVE LANDING GEAR CONTROL HANDLE TO "UP" POSITION WHEN AIRPLANE IS ON GROUND.
Tail wheel fails to extend or retract.	*a.* Return-flow fuse closed.	*a.* Check lines and cylinder for leaks and reset fuse.

4-978. LANDING GEAR SELECTOR VALVE.

4-979. DESCRIPTION. *(See figure 4-102.)* This is an AN 6211-2 four-port, four-way, selector valve manufactured by Adel Precision Products Corporation of Burbank, California. Their part number is B-11809. The purpose of valve is to regulate the direction of hydraulic flow to either extend or retract the landing gear. It is actuated by the landing gear control lever through a straight rod and lever assembly, and is located beneath the cockpit floor just aft of the control lever installation at station 143. It is accessible through the lower cockpit access door. The flow through the valve is controlled by two spring-loaded, cam actuated poppets. When the camshaft is turned 45° clockwise from neutral (view looking into shaft) one pressure poppet and one return poppet are opened. One cylinder port opens and the other closes, allowing flow in one direction. When the shaft is turned counterclockwise 45° from neutral, the poppets reverse position allowing flow in the opposite direction.

4—980. REMOVING. The selector valve is attached to a bracket on the bottom side of the cockpit floor at station 143 (left hand side) and is accessible through the lower cockpit access door. Relieve main system pressure until hydraulic gage in cockpit reads zero.

a. Remove the nut which attaches the rod to the valve lever.

b. Remove lockwire and take off the four bolts.

c. Remove valve and lay on a clean bench.

d. To remove the rod and arm from the landing gear control handle, remove the attaching bolt.

4—981. TESTING. *(See figure 4—103A.)* Prior to installation of the landing gear selector valve, the following test must be made:

a. With valve in neutral, apply 1500 psi to pressure port for three minutes. Check leakage from both cylinder ports and return port after first minute of test. Leakage shall not exceed one drop per minute per port.

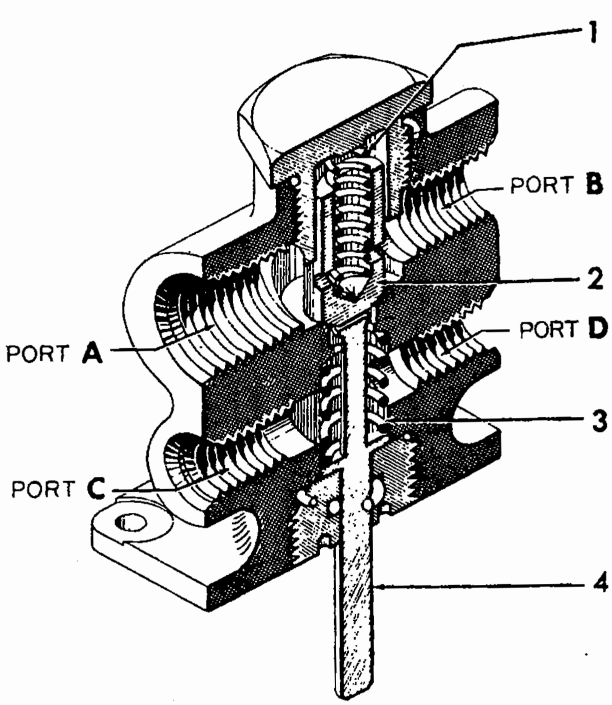


Figure 4—103. Landing Gear Sequence Valve.

b. Plug both cylinder ports. With shaft rotated clockwise, apply 2250 psi to pressure port for two minutes. Reduce pressure to zero psi. Cycle valve and return to clockwise position. Increase pressure to 2250 psi for two minutes. There should be no external leakage during test. Repeat test with shaft rotated counterclockwise.

c. Plug both cylinder ports. Apply 1500 psi to pressure port. Torque required to rotate shaft in either direction shall not exceed 60 pound-inches.

d. Using set-up shown in Figure 4—103A (detail B), supply 6.0 gpm to pressure port. With shaft rotated 20 degrees counterclockwise from neutral, pressure gradient from pressure to one cylinder port plus pressure gradient from second cylinder port to return port shall not exceed 120 psi. Repeat test rotating shaft 20 degrees clockwise.

e. Supply low flow to return port. With shaft rotated clockwise, there must be free flow from cylinder port "B." With shaft rotated counterclockwise, there must be free flow from cylinder port "A."

f. With all ports plugged, apply 150 psi to return port for two minutes. There shall be no external leakage at shaft or end plates. Increase pressure to 750 psi for two minutes. Reduce pressure to zero psi and cycle valve. Increase pressure to 750 psi for two minutes. There is to be no external leakage during test.

4—982. INSTALLING. Install the selector valve by reversing the procedure directed in paragraph 4—980.

4—983. SEQUENCE VALVES.

4—984. DESCRIPTION. *(See figures 4—102 and 4—103.)* The sequence valves are four port valves which are manufactured by the Bendix Aviation Corporation of North Hollywood, California. Their drawing numbers are 40204-0-1 for the left hand valve and 4020004-1-1 for right hand valve. The valves are located in the wheel wells just aft of the main beam and are mounted on the lower main beam flange. Their purpose is to delay the closing of the landing gear doors until the main gear is retracted. In the retracted position, the shock struts contact the sequence valve pins and open the valves, allowing system pressure to flow to the landing gear door cylinders and the tail wheel cylinder. Thus, the landing gear doors close and the tail wheel retracts after the main wheels have retracted. Each valve consists of an aluminum housing with four ports, a protruding spring-loaded shaft (4) and a spring-loaded poppet valve (2). Flow occurs normally between the ports A and B preventing flow to ports C and D until pin is depressed and poppet opens; callouts may be found on figure 4—103.

4—985. REMOVING. To remove either sequence valve, relieve main system pressure until hydraulic gage in cockpit reads zero, and proceed as follows.

a. Disconnect and cap the four hydraulic lines at the valve.

b. Remove the two bolts and the two spacers which attach the valve to the beam and remove the valve.

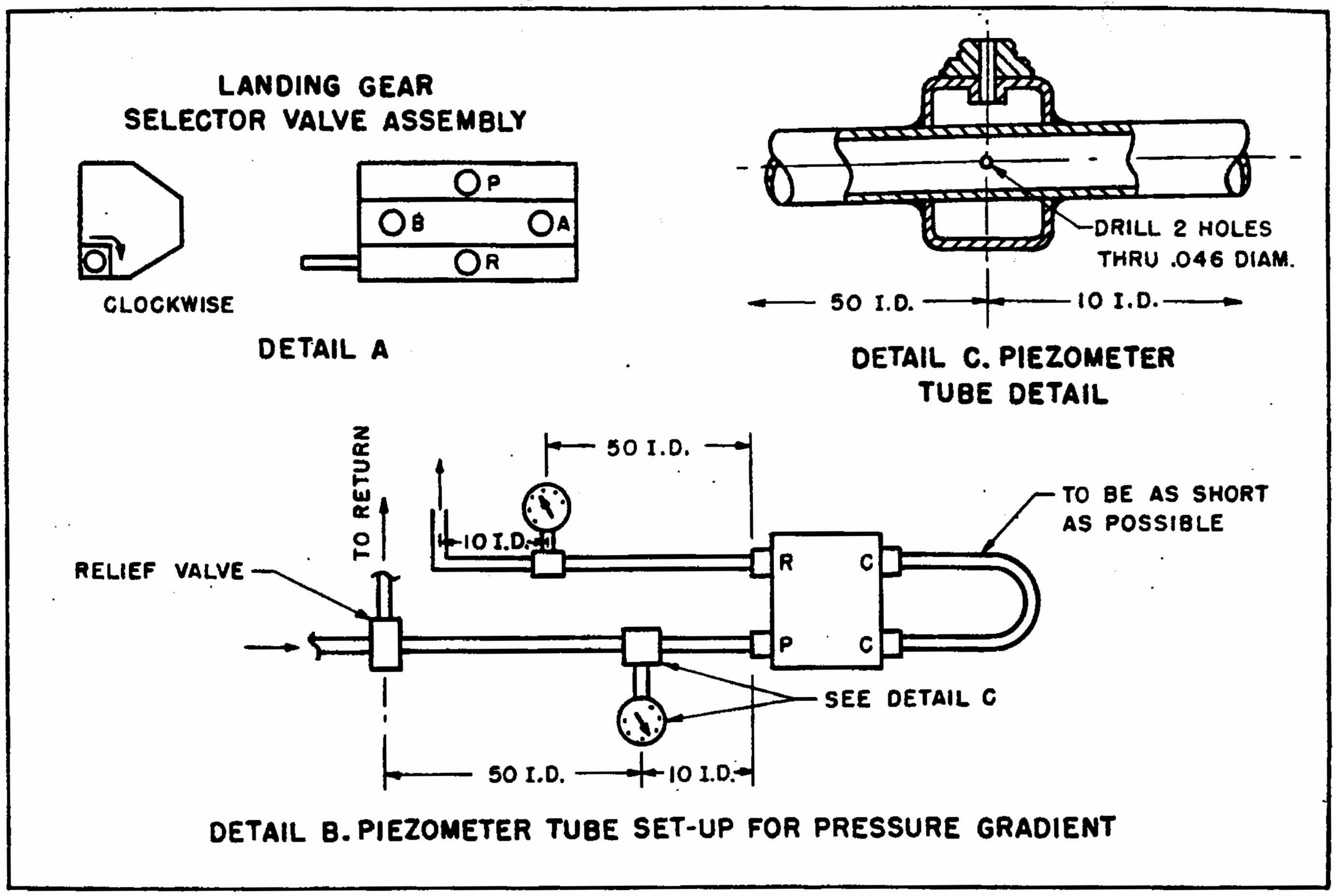


Figure 4—103A. Test Setup for Landing Gear Selector Valve.

Note

Replacement of packings AN6227-6 and AN-6227-13 is accomplished by removing the plug from the pin side of the valve. Use special wrench VS-34573 to remove plug.

4—986. TESTING. Prior to the installation of this valve, the following test is made.

a. Plug ports A, B, and D (see figure 4—103). Valve must hold 2250 psi applied at port C for two minutes without external leakage.

b. Plug port A; apply 1500 psi to port B for two minutes. Leakage past the poppet is not to exceed ten drops per minute.

c. Reduce pressure to 100 psi. Actuate pin several times. Check of fluid flow must be rapid and positive.

d. Pin must return freely when force is released.

4—987. INSTALLING. The landing gear sequence valve is installed by reversing the removal procedure given in paragraph 4—985. It is to be noted that two CVC-354-D12 spacers are required to position the pin properly. The pin has a 9/32 inch travel; however, 5/32 inch travel will provide full opening of the valve.

4—988. MAIN GEAR ACTUATING CYLINDERS.

4—989. DESCRIPTION. *(See figure 4—102.)* The main landing gear cylinders are designed by Chance Vought Aircraft. Their drawing number is VS-46648. The unit consists of a one-cap cylinder which is attached to a fitting on the main wing beam at the cylinder end, and to a yoke at the piston rod end. The yoke attaches to a ring on the landing gear shock strut through a pair of lock links. The cylinder has a port at each end, one of which attaches to the "extend" hydraulic line and the other to the "retract" hydraulic line. When the landing gear selector valve is in the "retract" position, fluid enters the cylinder on the piston rod end and fluid on the extend side of the piston returns to the system; this retracts the gear. When the selector valve is in the "extend" position, fluid is reversed, and gear extends. For a more detailed description, refer to paragraph 4—917.

4—990. REMOVING. Relieve main system pressure until hydraulic gage in cockpit reads zero.

a. Disconnect and cap the two hydraulic lines leading to the cylinder.

b. Detach the forward end of the cylinder by removing the two bolts at the yoke, and the aft end by removing one bolt on the main beam fitting.

c. Remove cylinder from wheel well.

4—991. DISASSEMBLY. For disassembly of cylinder, see paragraph 4—919.

4—992. LUBRICATING. An oil hole is provided on the head for lubricating the felt wiper with hydraulic fluid every 30 hours. More frequent lubricating of the wiper may be necessary in dry climates.

4—993. REPAIRING. The repair of the main gear actuating cylinder is limited to the replacement of worn gaskets, packings and broken wipers. See the following table for replacement part designations.

CYLINDER	PACKING GASKET OR WIPER	NO. REQ.	LOCATION
Main Landing Gear	AN6227-33	2	Piston
	AN6246-33	2	Piston
	AN6227-13	1	Piston Rod
	AN6227-21	1	Cap
	AN6246-21	2	Cap
	AN6232-3½	1	Cap
	AN6231-11	1	Cap
	CVC-996-22	1	Cap

4—994. ASSEMBLING. The assembly procedure is the reverse of the disassembly procedure given in paragraph 4—919 and special attention is called to the fact that there are two leather back-up rings, one on either side of packing AN6227-21.

4—995. TESTING. For testing of main gear actuating cylinders, turn to paragraph 4—922.

4—996. INSTALLING. Installing the main gear actuating cylinders is the reverse of the removing procedure given in paragraph 4—990.

4—997. OUTBOARD LANDING GEAR DOOR ACTUATING CYLINDERS.

4—998. DESCRIPTION. *(See figure 4—102.)* The outboard landing gear door cylinders are manufactured by Chance Vought Aircraft. Their drawing number is VS-58307. Each is attached to a bracket on the aft face of the main beam in the wheel well on both left and right hand sides of the airplane. The rod end attaches to the outboard landing gear door. Their purpose is to open and close the outboard doors. The general design features of the cylinder may be found in paragraph 4—917. These units are accessible when the landing gear doors are open.

4—999. REMOVING. Relieve main system pressure until hydraulic gage in the cockpit reads zero. With landing gear doors open, remove cylinders as follows:

a. Remove and cap the two hydraulic lines.

b. Remove bolt which secures cylinder to beam and bolt which secures rod end to door. Remove cylinder.

4—1000. DISASSEMBLY. The disassembly procedure in paragraph 4—919 applies to this cylinder.

4—1001. LUBRICATING. An oil hole is provided on the head for lubricating the felt wiper with hydraulic fluid every 30 hours. More frequent lubricating of the wiper may be necessary in dry climates.

4—1002. REPAIRING. Repairing of the cylinder is limited to replacing packings, gaskets, and broken wipers. The following table lists these parts.

CYLINDER	PACKING GASKET OR WIPER	NO. REQ.	LOCATION
Outboard Landing Gear Door Cylinder	AN6246-27	2	Piston
	AN6227-27	1	Piston
	AN6227-27	1	Cap
	AN6227-7	1	Piston Rod
	AN6246-12	2	Cap
	AN6227-12	1	Cap
	AN6232-C2⅛	1	Cap
	AN6231-3	1	Cap
	CVC-996-14	1	Cap

4—1003. ASSEMBLING. To assemble outboard door cylinder, reverse disassembly directed in paragraph 4—919.

4—1004. TESTING. The testing of this cylinder conforms with paragraph 4—922.

4—1005. INSTALLING. The installation of the outboard landing gear door cylinder is the reverse of removing procedure given in paragraph 4—999.

4—1006. INBOARD LANDING GEAR DOOR ACTUATING CYLINDERS.

4—1007. DESCRIPTION. *(See figure 4—102.)* This cylinder (VS-58256) is identical in every respect, except for length of stroke, to the outboard landing gear door actuating cylinder. The inboard cylinder is installed with the cylinder end attached to a bracket on the main beam and the piston rod end secured to a bracket on the inboard landing gear door. Access to each cylinder is gained when the inboard landing gear doors are open. Maintenance procedures outlined in paragraph 4—999 through 4—1005 apply to the cylinder. The list of packings, gaskets and wipers is identical to the list for the outboard cylinder.

4—1008. METERING FUSE—RETRACT LINE.

4—1009. DESCRIPTION. *(See figure 4—102.)* This fuse may be purchased from United Aircraft Products, Dayton, Ohio (their part number UC4480-D-6-80) or from Simmonds Aerocessories, Inc. of New York. Their part number is D45-6-202-80. It consists of a two port casing, which houses a passage for hydraulic fluid, and a poppet valve. This poppet runs in an internal cylinder which, due to a metering hole, slowly fills with fluid while the main volume passes through the main flow passage. When sufficient fluid enters the cylinder, the poppet seats and stops all flow through the fuse. The fuse is accessible through the lower cockpit access door and is located on the side of the fuselage at station 165. It is installed in the main retract line to the tail gear. The purpose of the fuse is to shut off the flow to the system after a specified volume of fluid has passed through the fuse. It protects the system in the case of a broken tail wheel line.

4—1010. REMOVING. Relieve main system pressure until the hydraulic gage in cockpit reads zero. This fuse is accessible through the lower cockpit access door.

a. Remove and cap the two lines attached to the fuse.

b. Remove the clip which secures the fuse to the side panel at station 165 1/2 and remove fuse.

4—1011. TESTING. Prior to installing the fuse, the following bench test is made:

a. Set hydraulic pump to deliver two to two and one-half gpm.

b. Supply flow to valve in direction of arrow. Must fuse after passing 1330 to 1920 cc. Repeat test.

c. With fuse closed, apply 1500 psi to inlet end for two minutes. There shall be no leakage from outlet port. Increase pressure to 2250 psi for two minutes. There shall be no external leakage.

d. Reduce pressure to five to ten psi for two minutes. Leakage from outlet port shall not exceed five drops per minute. There shall be no external leakage.

4—1012. INSTALLING. The installation of the metering fuse is the reverse of the removing procedure given in paragraph 4—1010.

4—1013. METERING FUSE—EXTEND LINE.

4—1014. DESCRIPTION. *(See figure 4—102.)* This fuse is identical to the fuse in the retract line; see paragraph 4—1008. It is located adjacent to the retract fuse and has an 80 cu. in. capacity. It is manufactured by United Aircraft Products of Dayton, Ohio, their part No. UC4480-D-80 or by Simmonds Aerocessories, Inc. of New York, their part number D45-6-202-80.

4—1015. REMOVING. Removing extend line fuse is the same procedure as that given for retract line fuse removal; refer to paragraph 4—1010.

4—1016. TESTING. The testing of the extend fuse is identical to the retract fuse test procedure; see paragraph 4—1011.

4—1017. INSTALLING. Installing procedure is identical with installing procedure for the retract fuse; see paragraph 4—1012.

4—1018. TAIL GEAR ACTUATING CYLINDER.

4—1019. DESCRIPTION. *(See figure 4—102.)* This cylinder is designed by Chance Vought Aircraft. Their drawing number is VS-54185. This unit is located in the tail wheel well and is connected to the scissors on one end and to a support between station 253 and station 260 on the other end. The purpose of this cylinder is to extend or retract the tail wheel. For a description of the operation of this cylinder refer to figure 4—104 and the following text. With the landing gear control in the extend position, hydraulic fluid enters the port (11) and seats the floating piston (7) against the lug (6). Since the piston and rod (10) are now stationary, hydraulic pressure acts on the end cap (9) extending the cylinder. When the landing gear control is in the retract position, hydraulic fluid enters port (2) and flows through the hollow rod to the ports (5) thus seating the piston against the rod nut (8). Since the piston and rod are stationary, the pressure acts on the surfaces (3) and retracts the cylinder. The spring (4) on the cylinder provides emergency tail wheel extension. Refer to paragraph 4—1034 for information on emergency landing gear extension.

4—1020. REMOVING. Relieve main system pressure until hydraulic gage in cockpit reads zero. To remove the tail wheel actuating cylinder, jack up tail of airplane.

a. Remove hydraulic lines from the cylinder, cap lines.

b. Remove the bolt which secures the cylinder to the special scissors bolt.

c. Remove the bolt which secures lock arm to cylinder.

d. Remove the bolt which secures the lower cylinder cap to the airplane structure.

4—1021. DISASSEMBLY.

a. With the cylinder end cap (9) (see figure 4—104) in a vise, compress the spring and tighten a strap wrench about the outer cylinder assembly between the spring and the cylinder cap.

b. Unscrew the cap and carefully remove the strap wrench, allowing the spring to expand slowly.

c. Remove the retainer and spring from the cylinder.

d. Holding the cylinder with a strap wrench remove the cap and nut on the other end.

e. Separate the two cylinder tubes.

f. Remove the spacer from one end of the rod assembly and the nut from the other end.

g. Remove the rod and piston from the inner cylinder half.

h. All gaskets and packings are now accessible for repair or replacement.

4—1022. LUBRICATING. The threads on caps are to be lubricated with anti-seize compound on assembly to the barrel and rod. The piston should be lubricated with Spec. AN-G-25 grease on assembly.

4—1023. REPAIRING. The repair of the tail wheel actuating cylinder is limited to the replacement of worn gaskets and packings. See the following table for replacement part designations.

CYLINDER	PACKING OR GASKET	NO. REQ.	LOCATION
Tail Wheel Actuating	AN6227-10	1	VS-47391 Cap Assembly
	AN6227-15	1	VS-48397 Barrel Assembly
	AN6246-15	2	VS-48397 Barrel Assembly
	AN6227-30	1	Piston
	AN6246-30	2	Piston
	AN6227-15	1	Piston
	AN6246-15	2	Piston
	AN6230-6	1	VS-54186 Cap Assembly

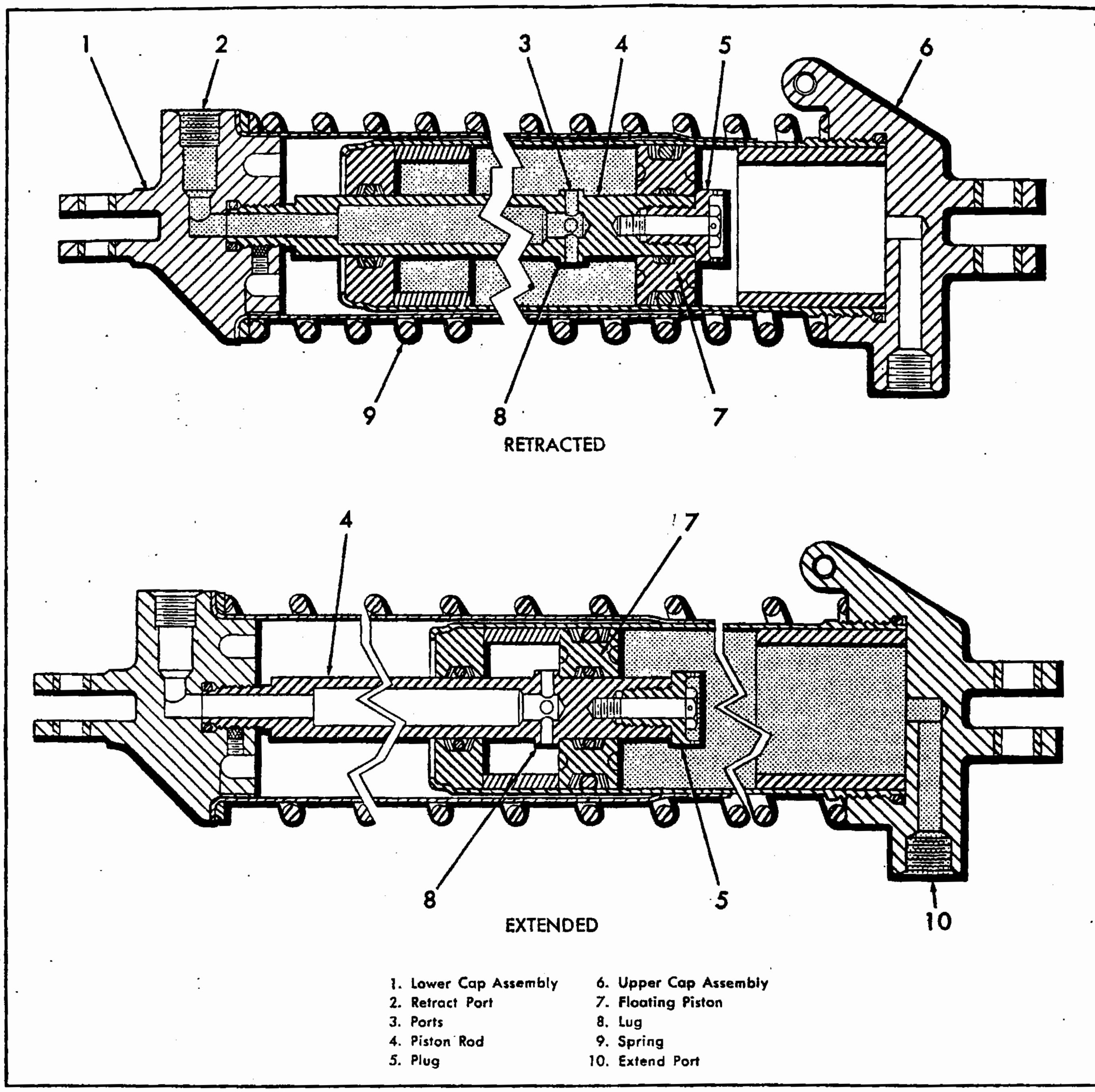


Figure 4—104. Tail Gear Actuating Cylinder.

4—1024. ASSEMBLING. The assembly of the tail wheel actuating cylinder is the reverse of the disassembly procedure given in paragraph 4—1021.

4—1025. TESTING. Refer to paragraph 4—922 for the testing of this cylinder.

4—1026. INSTALLING. The installation of the tail wheel cylinder is the reverse of the procedure given in paragraph 4—1020.

4—1027. LANDING GEAR EMERGENCY SYSTEM.

4—1028. DESCRIPTION. *(See figure 4—102.)* In the event that normal hydraulic actuation of the landing gear is impossible, an emergency compressed air system is used to extend the wheels. The main units in this emergency system are the air bottle which supplies the necessary pressure for actuation, a gage which indicates air bottle pressure, the emergency valve which is operated by putting the landing gear control lever in the "EMERGENCY" position, the vent check valve which carries oil that leaks into the air lines from the system to the atmosphere, and the shuttle valves which allow compressed air to enter main gear actuating cylinders.

4—1029. EMERGENCY EXTENSION OF LANDING GEAR. Emergency landing gear extension is initiated by moving the landing gear control lever to the "EMERGENCY" position. When the control lever is in this position, the landing gear selector valve allows oil on the retract side of the main wheel and tail wheel cylinders to return to the reservoir. Since the tail wheel cylinder is spring-loaded, the tail wheel will extend. This position of the control handle also opens the emergency valve, allowing air pressure to flow from the bottle through the shuttle valves to the extend port on the main wheel cylinders, lowering the main gear.

4—1030. EMERGENCY VALVE.

4—1031. DESCRIPTION. *(See figure 4—102.)* This is a two port, single poppet valve which is manufactured by the Walter Kidde and Co., Inc., Bloomfield, New Jersey. Their drawing number is 800124. This valve is located just forward of the landing gear selector valve beneath the left hand control shelf and is actuated by an arm on the landing gear control handle rod. It is accessible through the lower cockpit access door. When the landing gear control is put in the "EMERGENCY" position, the arm on the rod engages a button on the emergency valve and opens the spring-loaded poppet in the valve. Air pressure passes through the emergency valve, through the shuttle valve, and thence to the landing gear cylinder extend port. After emergency air has been used, it is necessary to bleed the system. This is done by depressing the bleed button on the vent check and bleeder valve; see paragraph 4—1047.

4—1032. REMOVING. The emergency valve is attached to a bracket on the underside of the cockpit floor at station 137 on the left hand side, and is accessible through the lower cockpit access door. Relieve main system pressure until hydraulic gage in cockpit reads zero.

a. Remove air line from air bottle.

b. Remove and cap the two hydraulic lines from the valve.

c. Remove the three bolts which secure the valve to the bracket and remove the valve.

4—1033. TESTING. Prior to the installation of a valve, the following test is made.

a. Cycle valve at least five times before applying pressure.

b. Apply 1800 psi to filler port. Immerse valve in hydraulic fluid (AN-O-366) and maintain pressure for five minutes minimum. There shall be no external leakage from outlet port.

4—1034. INSTALLING. The procedure for installation is the reverse of the removing instructions given in paragraph 4—1032.

4—1035. AIR BOTTLE AND VALVE ASSEMBLY.

4—1036. DESCRIPTION. *(See figure 4—102.)* The air bottle and valve assembly is manufactured by Walter Kidde and Co., Inc., Bloomfield, N. J. The air bottle is a gunfire-resistant, lightweight cylinder, AN part number 6025-3 and Walter Kidde part number ICC-3A-1000-24716. The self-opening valve which is screwed into the air bottle is a Walter Kidde Product; their part number 840026. This assembly is mounted in the left hand wheel well and secured to the interbeam end rib by two bolted straps. It supplies compressed air for emergency landing gear operation.

4—1037. FILLING—AIR BOTTLE INSTALLED.

WARNING

Do not use oxygen to fill air bottle.

The air bottle assembly can be filled while installed in the airplane or can be removed for filling. The follow precedure will explain filling when the air bottle is installed in the airplane.

Note

Air bottle must be filled after each use of the landing gear emergency system. Always check gage for proper air bottle pressure prior to take off.

a. Unscrew the valve cap on the Schrader air valve which is located on the top of the air pressure gage.

b. Depress lever on bottom of gage housing, and with outside air line fill bottle to 1800 psi. Since temperature changes will result in pressure changes, the following limits should be adhered to:

DECK TEMPERATURE	MIN. PRESSURE	MAX. PRESSURE
Above freezing	1600 psi	2000 psi
Below freezing	1400 psi	1900 psi

It is not necessary to bleed or fill air bottle if the above conditions are met.

c. Release lever and replace valve cap.

4—1038. FILLING—AIR BOTTLE REMOVED. The following procedure applies when filling air bottle after removal from airplane.

a. Connect the bottle to an outside air line with a Kidde coupling nut No. 33825. Fill the bottle to 1800 psi (see paragraph 4—1037 b. for allowable clearances) and remove coupling nut.

b. Install bottle and reconnect emergency air line.

4—1039. REMOVING. The following procedure applies when removing the air bottle from the left hand wheel well.

a. Disconnect the Kidde coupling nut (part number 33825) which attaches air line to self-opening valve.

b. Remove the two bolts which secure the air bottle in the clamps. Remove bottle.

4—1040. TESTING. Prior to installing an air bottle and valve assembly, the following test is made.

a. Using set-up noted below, fill bottle to 1800 psi air pressure.

b. Break test pressure line at disconnect on bottle.

c. Immerse bottle in hydraulic fluid for five minutes minimum. There shall be no evidence of leakage.

Note

Set-up for air pressure application uses CV4-601021-6 Tube Assembly on the discharge end of pressure line from the air pressure source.

4—1041. INSTALLING. The installation is the reverse of the removal procedure in paragraph 4—1039.

4—1042. AIR FILLER GAGE.

4—1043. DESCRIPTION. *(See figure 4—102.)* The air filler gage is manufactured by the Kenyon Instrument Co., Huntington Station, Long Island, N. Y. Their part number is 60005. The gage is installed just aft of the air bottle on the interbeam end rib. It is accessible through the left hand wheel well. This gage gives an indication of air bottle pressure and has a Schrader air valve mounted on the housing for refilling the air bottle. There is a lever on the bottom of the gage which must be depressed when filling the bottle or reading gage pressure. The gage face reads up to 3000 psi in increments of 100 psi and has an arrow at the 1800 psi mark.

4—1044. REMOVING.

WARNING

Release air pressure from bottle before removing gage.

To remove air gage, disconnect air line and unscrew the three bolts which secure gage to the interbeam end rib in left hand wheel well. Remove gage.

4—1045. TESTING. Prior to installing the air pressure gage, the following test is made.

a. The gage is to be tested at room temperature, and at increasing, and then decreasing, pressures shown in table below.

b. Test pressures are to be applied to the Schrader port with the open port plugged. As each test pressure is applied, depress plunger. Force required to depress plunger is not to exceed 15 lbs.

c. Check pressure recorded on gage. Gage errors shall not exceed those shown in table.

d. Tap gage gently and again check recorded pressure. The difference of any two such readings shall not exceed 75 lbs.

e. After such pressure application release plunger. Pressure reading must return to zero.

TEST PRESSURE PSI	TOLERANCE AT ROOM TEMPERATURE PSI
0	plus or minus 45
1000	plus or minus 75
2000	plus or minus 75
3000	plus or minus 75

4—1046. INSTALLING. The installation of the air pressure gage is the reverse of the removal procedure given in paragraph 4—1044.

4—1047. VENT CHECK AND BLEEDER VALVE.

4—1048. DESCRIPTION. *(See figure 4—102.)* The vent check valve is manufactured by the Walter Kidde and Co., Inc., Bloomfield, N. J. Their part number is 840119. The valve is installed forward of the landing gear emergency valve at station 123 approximately, and is accessible through the lower cockpit access door. The purpose of the valve is to drain any hydraulic fluid which may enter the emergency air lines. The valve will remain open for drainage from zero to 25 psi; it closes from 25 to 80 psi. It is of the single poppet construction with the poppet held open by a spring. When the emergency system is operated, the air pressure (1800 psi) closes the valve and prevents air leakage. A manual plunger on the next check and bleeder valve is used to facilitate bleeding residual air pressure after the emergency system is used. To release the air it is only necessary to depress the bleed button on the side of the valve.

4—1049. REMOVING. To remove the vent check and bleeder valve, loosen the end fitting nut and unscrew the valve from the tubing connection.

4—1050. TESTING. Prior to installation of the valve, the following test is made.

a. Valve shall close at 25 to 80 psi air pressure.

b. With valve submerged in oil, apply 1500 psi air pressure to valve for one half minute. Reduce pressure to 200 psi for one half minute. There shall be no internal or external leakage at either pressure.

c. Apply 1500 psi air pressure for 15 seconds and repeat three times. At last application, allow pressure to remain in valve for one minute. No leakage shall be permitted. Valve must return to open position when pressure is relieved.

d. AN-O-366 (red) fluid shall flow through valve with one inch head at minimum rate of one drop per minute (test at fluid temperature of approximately 70°F).

e. Apply 1500 psi air pressure to valve. Force required to depress bleed button shall not exceed 15 lbs.

4—1051. INSTALLING. The installation of the vent check valve is the reverse of the removal procedure given in paragraph 4—1049.

4—1052 SHUTTLE VALVES.

4—1053. DESCRIPTION. *(See figure 4—102.)* This valve (AN6209-6) may be purchased from Hydro-Aire, of Los Angeles, California. Their part number is 1416. The valves are located in the left and right hand wheel wells, mounted on the forward face of the main wing beam. The purpose of these valves is to seal off the hydraulic lines to the landing gear cylinders when the emergency air system is used. Each valve consists of a three port housing and a shuttle, which, depending on its position, seals off either the air line or the oil line to the cylinder. A spring-loaded ball which rolls on the shuttle holds it in either position. The shuttle normally seals off the air line from the landing gear cylinder. When the emergency handle is pulled, compressed air flows to the shuttle valve and forces the shuttle to shut off the oil line allowing compressed air to actuate the landing gear cylinders.

4—1054. REMOVING. Relieve main system pressure until hydraulic gage in cockpit reads zero. To remove the shuttle valve which is installed on a bracket at the forward face of the main wing beam in the landing gear wheel well, disconnect and cap the three lines attached to the valve. Remove the two bolts which secure the valve to the bracket and remove the valve.

4—1055. TESTING. Prior to installing the shuttle valves the following test is made.

a. Plug outlet port.

b. Apply five psi to one inlet port for five minutes. Increase to 1500 psi for five minutes. There is to be no leakage from the opposite inlet port at either pressure.

c. Increase pressure to 2250 psi for one minute. Reduce pressure to zero psi and unseat shuttle. Increase pressure to 2250 psi for one minute. There is to be no external leakage during test.

d. Repeat steps a. and b. applying pressure to opposite inlet port.

4—1056. INSTALLING. Reverse removal procedure given in paragraph 4—1054.

4—1057. TUBING CHART. Use Figure 4—105 as a reference key in conjunction with the following table.

TUBING CHART—LANDING GEAR HYDRAULIC SYSTEM

(Refer to Figure 4—105)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
AN6260-6-18¾	1	5/16 ID		18¾	Spec. AN-H-24	AN815-6D Union AN6227-9 Packing AN833-6D Elbow AN924-6D Nut AN960-D916 Washer
VS-58311-5	2	⅜	.035	64	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN833-6D Elbow AN924-6D Nut AN960-D916 Washer
VS-58311-3	3	⅜	.035	26	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN933-6D Elbow AN924-6D Nut AN960-D916 Washer
VS-58311-1	4	⅜	.035	36⅛	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN833-6D Elbow AN924-6D Nut AN960-D916 Washer
AN6260-6-23½	5	5/16 ID		23½	Spec. AN-H-24	AN833-6D Elbow AN924-6D Nut AN6227-9 Packing (2 req.) AN960-D916 Washer VS24228 Restrictor Valve AN815-6D Union
VS-58311-53	5A	⅜	.035	7	Spec. WW-T-787	AN818-6D Nut AN819-6Z Sleeve AN832-6D Union AN924-6D Nut AN960-D916 Washer

TUBING CHART—LANDING GEAR HYDRAULIC SYSTEM—(Continued)

(Refer to Figure 4—105)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-58311-9	6	⅜	.035	48	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN833-6D Elbow AN924-6D Nut AN960-D916 Washer
VS-58311-7	7	⅜	.035	33	Spec. WW-T-787	AN818-6D Nut (2 req.) AN818-6Z Sleeve (2 req.) AN833-6D Elbow AN924-6D Nut AN960-D916 Washer
VS-58312-81	8	⅜	.035	9	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.)
VS-58312-109	9	⅜	.035	36	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN815-6D Union
VS-58312-69	10	⅜	.035	40	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN815-6D Union
VS-58312-43	11	½	.042	13	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.)
VS-58312-141	12	⅜	.035	18	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.)
VS-58312-97	13	⅜	.035	19	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN919-12D Reducer
VS-58312-139	14	½	.042	24	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN804-8D Tee AN6227-12 Packing AN924-8D Nut
VS-58312-45	15	½	.042	13	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN815-8D Union AN6227-12 Packing
VS-58312-7	16	½	.042	29	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN834-8D Tee AN815-8D Union
VS-58312-87	17	½	.042	32	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN834-8D Tee AN815-8D Union
AN6264-8D-21	18	13/32 ID		21	Spec. AN-H-24	AN837-8D Elbow AN960-D1216 Washer AN924-8D Nut

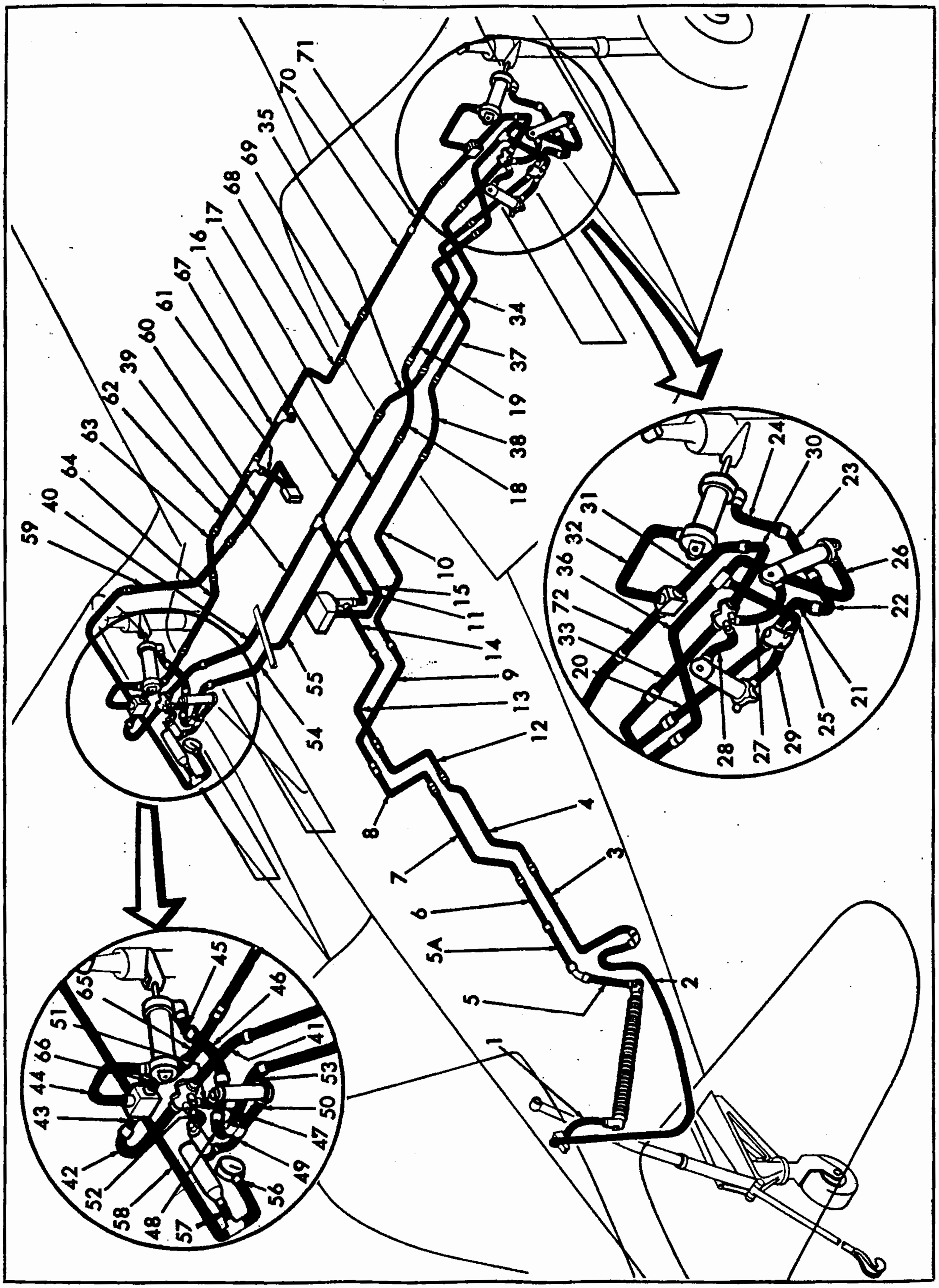


Figure 4—105. Hydraulic System—Landing Gear Tubing Diagram.

TUBING CHART—LANDING GEAR HYDRAULIC SYSTEM—(Continued)

(Refer to Figure 4—105)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-48147-47	19	1/2	.042	36 7/8	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN832-8D Union AN924-8D Nut
VS-48147-45	20	1/2	.042	14 3/8	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN815-8D Union AN6227-12 Packing
VS-16101-199	21	3/8	.035	6	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6D Sleeve (2 req.) AN815-6D Union (2 req.) AN6227-9 Packing (2 req.) VS-24228 Restrictor Valve
VS-16101-201	22	3/8	.035	13 3/4	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN821-6D Elbow
AN6264-6-13 1/2	23	5/16 ID		13 1/2	Spec. AN-H-24	AN821-6D Elbow
VS-58313-7	24	3/8	.035	8	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN833-6D Elbow AN924-6D Nut AN6227-9 Packing
VS-58313-5	25	1/4	.035	16	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN815-4D Union (2 req.) AN6227-7 Packing (3 req.) AN926-4D Tee AN919-6D Reducer AN837-4D Elbow AN924-4D Nut
AN6264-4-10	26	3/16 ID		10	Spec. AN-H-24	AN833-4D Elbow AN924-4D Nut AN6227-7 Packing
AN6264-4-6	27	3/16 ID		6	Spec. AN-H-24	AN833-4D Elbow AN6227-7 Packing AN776-4D Elbow AN775-4 Bolt AN901-4A Gasket (2 req.) AN924-4D Nut
AN6264-4-6	28	3/16 ID		6	Spec. AN-H-24	AN833-4D Elbow AN924-4D Nut AN6227-7 Packing AN776-4D Elbow AN775-4 Bolt AN901-4A Gasket (2 req.)
AN6264-4-10	29	3/16 ID		10	Spec. AN-H-24	AN815-4D Union AN6227-7 Packing (2 req.) AN833-4D Elbow AN924-4D Nut

TUBING CHART—LANDING GEAR HYDRAULIC SYSTEM—(Continued)

(Refer to Figure 4—105)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-37268-115	30	3/8	.035		Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6D Sleeve (2 req.) AN815-6D Union (2 req.) AN6227-9 Packing
VS-58313-3	31	3/8	.035	12	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.)
AN6264-6-13½	32	5/16 ID		13½	Spec. AN-H-24	AN833-6D Elbow AN815-6D Union AN6227-9 Packing (2 req.) AN924-6D Nut
VS-48147-41	33	½	.042	12 13/16	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN815-8D Union AN6227-12 Packing AN832-8D Union AN924-8D Nut
VS-48147-43	34	½	.042	37⅜	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN837-8D Elbow AN960-D1216 Washer AN924-8D Nut
AN6264-8D-21	35	13/32 ID		21	Spec. AN-H-24	
VS-58313-11	36	3/8	.035	30	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN832-6D Union AN924-6D Nut
VS-58313-9	37	3/8	.035	30	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN832-6D Union AN924-6D Nut AN960-D916 Washer
AN6264-6-25	38	5/16 ID		25	Spec. AN-H-24	
AN6264-8D-26	39	3/16 ID		26	Spec. AN-H-24	AN837-8D Elbow AN960-D1216 Washer AN924-8D Nut
VS-48147-3	40	½	.042	38 5/16	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN832-8D Union AN924-8D Nut
VS-48147-1	41	½	.042	13 3/16	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN815-8D Union AN6227-12 Packing
VS-37268-109	42	3/8	.035		Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6D Sleeve (2 req.) AN815-6D Union (2 req.) AN6227-12 Packing
VS-58313-21	43	3/8	.035	12	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.)

TUBING CHART—LANDING GEAR HYDRAULIC SYSTEM—(Continued)

(Refer to Figure 4—105)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
AN6264-6-13½	44	5/16 ID		13½	Spec. AN-H-24	AN815-6D Union AN6227-9 Packing (2 req.) AN833-6D Elbow AN924-6D Nut
VS-58313-7	45	⅜	.035	8	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN833-6D Elbow AN924-6D Nut AN6227-9 Packing AN821-6D Elbow
AN6264-6-13½	46	5/16 ID		13½	Spec. AN-H-24	AN821-6D Elbow
VS-58313-1	47	⅜	.035	8	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN815-6D Union
VS-58313-23	48	⅜	.035	10	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN815-6D Union AN6227-9 Packing
AN6264-4-11	49	3/16 ID		11	Spec. AN-H-24	AN815-4D Union AN6227-7 Packing (2 req.) AN924-4D Nut AN833-4D Elbow
AN6264-4-10	50	3/16 ID		10	Spec. AN-H-24	AN815-4D Union AN6227-7 Packing (2 req.) AN833-4D Elbow AN924-4D Nut
AN6264-4-6	51	3/16 ID		9	Spec. AN-H-24	AN837-4D Elbow AN924-4D Nut AN6227-7 Packing AN776-4D Elbow AN775-4 Bolt AN901-4A Gasket (2 req.)
AN6264-4-13	52	3/16 ID		13	Spec. AN-H-24	AN833-4D Elbow AN6227-7 Packing AN776-4D Elbow AN775-4 Bolt AN901-4A Gasket (2 req.) AW924-4D Nut
VS-48147-5	53	½	.042	14¾	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN815-8D Union AN6227-12 Packing AN832-8D Union AN924-8D Nut
VS-48147-7	54	½	.042	39⅞	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN837-8D Elbow AN960-D1216 Washer AN924-8D Nut
AN6264-8D-26	55	13/32 ID		26	Spec. AN-H-24	

TUBING CHART—LANDING GEAR HYDRAULIC SYSTEM—(Continued)

(Refer to Figure 4—105)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-58399-9	56	1/4	.035	16	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN926-4D Tee AN919-2D Reducer (2 req.) AN815-4D Union AN6227-7 Packing (3 req.) AN833-4D Elbow AN924-4D Nut AN6227-7 Packing
VS-54130	57	3/16	.035	18	Spec. WW-T-799	AN818-3D Nut AN819-3Z Sleeve Walter Kidde Coupling Nut No. 33825
VS-58399-13	58	3/16	.035	35	Spec. WW-T-787	AN837-3D Elbow AN818-3D Nut (2 req.) AN819-3Z Sleeve (2 req.) AN960-D616 Washer (2 req.) AN924-3D Nut
VS-58399-17	59	3/16	.035	27	Spec. WW-T-787	AN818-3D Nut (2 req.) AN819-3Z Sleeve (2 req.) AN815-3D Union
VS158399-19	60	3/16	.035	10	Spec. WW-T-787	AN815-3D Union AN818-3D Nut (2 req.) AN819-3Z Sleeve (2 req.) AN6227-6 Gasket
VS-58399-23	61	1/4	.035	5	Spec. WW-T-787	AN6227-7 Gasket AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN824-4D Tee AN815-HD Union
VS-58399-21	62	1/4	.035	6	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN815-4D Union
AN6264-4-18½	63	3/16 ID		18½	Spec. AN-H-24	AN832-4D Union AN924-4D Nut
VS-58399-15	64	1/4	.035	48	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN837-4D Elbow AN960-D716 Washer (2 req.) AN924-4D Nut
VS-58399-33	65	1/4	.035	18	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN832-4D Union AN960-D716 Washer (2 req.) AN924-4D Nut
VS-58399-35	66	1/4	.035	11	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN894-D6-4 Bushing AN6227-9 Packing

TUBING CHART—LANDING GEAR HYDRAULIC SYSTEM—(Continued)

(Refer to Figure 4—105)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-58399-37	67	¼	.035	3	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN926-4D Tee AN815-4D Union (2 req.) AN6227-7 Packing (3 req.) AN919-6D Reducer AN6227-9 Packing (1 req.)
VS-58399-25	68	¼	.035	39	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN815-4D Union
AN6264-4-24	69	3/16 ID		24	Spec. AN-H-24	AN832-4D Union AN924-4D Nut
VS-58399-27	70	¼	.035	48	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN837-4D Elbow AN960-D716 Washer (2 req.) AN924-4D Nut
VS-58399-31	71	¼	.035	18	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN832-4D Union AN960-D716 Washer (2 req.) AN924-4D Nut
VS-58399-29	72	¼	.035	11	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN894-D6-4 Bushing AN6227-9 Packing

305 Blank

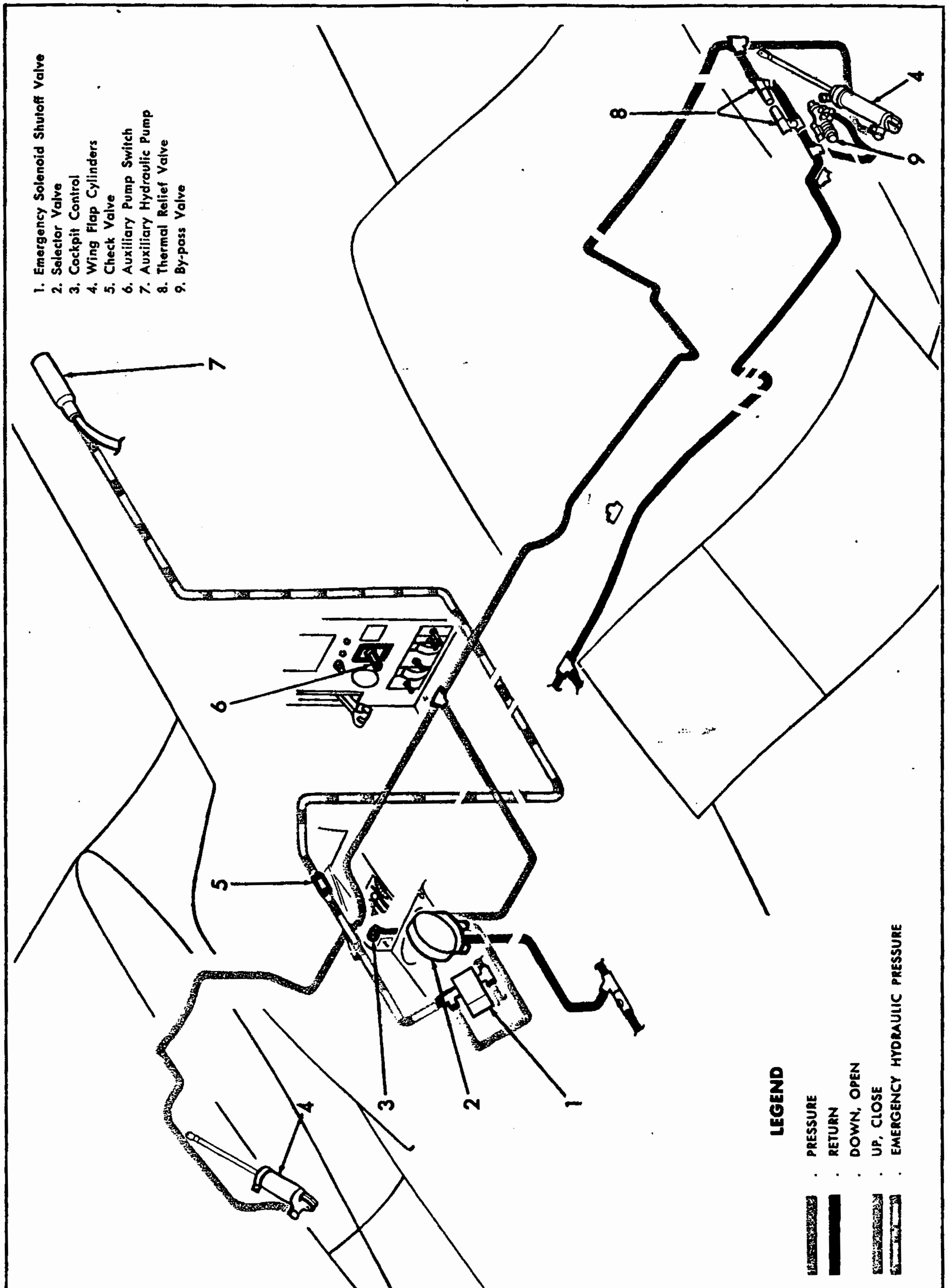


Figure 4–106. Hydraulic System—Wing Flaps.

4–1058. HYDRAULIC SYSTEM—WING FLAPS.

4–1059. DESCRIPTION. (*Refer to figures 4–95 and 4–106.*) The wing flaps are actuated by two, double action hydraulic cylinders which, through the use of mechanical linkage, operate the center section and outer panel flap sections on both left and right hand sides of the airplane. The control lever for this system is mounted on the forward portion of the left hand control shelf and will raise or lower the flaps in increments of 10°, up to a maximum of 50° deflection in the "down" position. The maximum speed at which the flap will hold a 50° deflection is 110 knots. Beyond this speed, a by-pass valve in the flap "down" line allows the flaps to blow up. The wing flap selector valve has a follow-up attachment which shuts off flow to the flap cylinder when the flap reaches an angle corresponding to the control handle setting. In the event of hydraulic failure, an emergency electric hydraulic pump, which is energized by lowering the wing flap cockpit control handle to the "EMERGENCY" down position, will lower the flaps. The main units in this system are the actuating cylinders, a by-pass valve, two thermal relief valves, and the wing flap selector valve. For detailed mechanical operation of wing flaps, see paragraph 4–191.

4–1060. FUNCTION—LOWERING. When the wing flap control handle is put in the "DOWN" position, a linkage from the handle opens the selector valve sending fluid to the retract ports of each wing flap cylinder; this lowers the flaps. A mechanical follow-up system attached to the selector valve shuts off fluid flow when the indicated control lever setting for the flaps is reached. A thermal relief valve in the line to each actuating cylinder prevents expanding fluid, due to increase in temperature, from damaging system.

4–1061. FUNCTION—RAISING. When the wing flap control handle is raised to the "UP" position the selector valve extend poppets open and fluid goes to the extend side of the actuating cylinder. At the same time fluid on the retract side is allowed to return to the system. The flaps in the full up position are held by hydraulic pressure, and a thermal relief valve is installed in the retract line to prevent expanding fluid due to temperature changes from causing damage.

4–1062. TROUBLE SHOOTING. This chart should be used as an aid in isolating troubles which may occur in the wing flap hydraulic system.

Trouble	Probable Cause	Suggested Remedy
Flaps fail to extend or retract.	*a.* No system pressure. External or internal leaks.	*a.* Refer to paragraphs 4–915 and 4–916.
Flaps fail to return to desired setting after "blow-up."	*a.* By-pass valve stuck open.	*a.* Remove and clean or replace valve.

4–1063. WING FLAP SELECTOR VALVE.

4–1064. DESCRIPTION. (*See figure 4–106.*) The wing flap selector valve is manufactured by Electrol Inc., Kingston, N. Y. Their part number is 265-CV1. It consists mainly of a housing with four ports. When the wing flaps are inoperative, the valve is normally closed. Four poppets within the housing are actuated by a double cam on a single shaft. The shaft is interconnected to two valve handles, the motion of which either seats or unseats the poppets which control the hydraulic flow to the actuating cylinder. One valve handle, through a rod assembly, is connected to the cockpit control and the other handle through another rod assembly to the wing flap hinge. When the control handle is moved, the selector valve opens sending fluid to the actuating cylinder. As the flap moves to the desired setting, the movement is transferred to the follow-up valve handle which shuts off flow through the selector valve. The valve is located on the left hand side of the fuselage at station 149 just below the cockpit floor.

4–1065. REMOVING. Relieve main system pressure until hydraulic gage in cockpit reads zero. Access for removing the selector valve is gained through the lower cockpit access door.

a. Remove and cap four hydraulic lines at valve.

b. Remove the two bolts and nuts which secure the rod assemblies to the valve.

c. Remove the four bolts and nuts which secure the valve to the bracket. Remove the valve.

Note

Do not attempt to repair this valve and especially do not adjust poppet retaining plugs.

4–1066. TESTING. (*See figure 4–107.*) Prior to the installation of the wing flap selector valve, the following test is made.

a. With handle (B) held rigidly, and flow supplied to pressure port, move handle (A) clockwise; flow shall occur from cylinder port No. 2.

b. With handle (B) held rigidly, move handle (A) clockwise; flow shall occur from cylinder port No. 1.

c. With valve in neutral and cylinder ports open, apply 1500 psi to pressure port for two minutes. There must be no leakage from cylinder or return ports.

d. Plug cylinder ports; apply 2250 psi to pressure port for two minutes. Actuate handles (A) and (B) together. There must be no external leakage. Reduce pressure to 1500 psi; turn handle (A) in both directions, with handle (B) fixed; torque shall not exceed 20 inch pounds in either direction.

e. Connect the two cylinder ports with flexible hose. Using handle (A) and with handle (B) fixed, cycle valve several times to be sure valve and hose are free of air.

f. Apply 10 psi to pressure port for two minutes with valve in neutral. There must be no external leakage or leakage at return port.

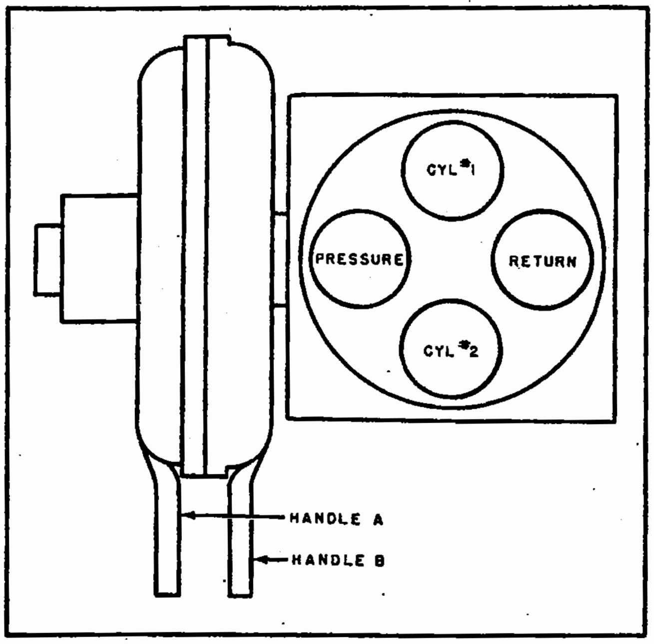


Figure 4–107. Wing Flap Selector Valve.

g. With valve in neutral and cylinder ports open, apply 1500 psi to return port for two minutes. There must be no leakage from cylinder or pressure ports. There is a notch in the camshaft which indicates the neutral position of the shaft. When the notch is on the bottom centerline of the shaft, the valve handles should be straight up.

4–1067. INSTALLING. The installation of this valve is the reverse of the removal procedure given in paragraph 4–1065, and the method of adjusting linkages will be found in paragraph 4–201b.

4–1068. WING FLAP ACTUATING CYLINDER.

4–1069. DESCRIPTION. (*See figure 4–106.*) This cylinder is designed by Chance Vought Aircraft and their drawing number is VS-58317. The purpose of this cylinder is to raise and lower the wing flaps. There are two cylinders located on the left and right hand center section end ribs, which are accessible when the wings are in the folded position. For a more complete description of this type of cylinder, refer to paragraph 4–917.

4–1070. REMOVING. Relieve main system pressure until hydraulic gage in cockpit reads zero. These cylinders are accessible for removal by folding the wings and securing them with jury struts. They are mounted on the center section end ribs.

a. Remove and cap the two hydraulic lines attaching to each cylinder.

b. Remove the bolts at both ends of each cylinder and remove the cylinders.

4–1071. DISASSEMBLY. Refer to paragraph 4–919 for complete disassembly procedure of this cylinder.

4–1072. LUBRICATING. An oil hole is provided on the head for lubricating the felt wiper with hydraulic fluid every 30 hours. More frequent lubricating of the wiper may be necessary in dry climates.

4–1073. REPAIRING. Since repairing of hydraulic cylinders is limited to the replacement of worn packings and gaskets, the following table lists these parts.

CYLINDER	PACKING OR GASKET	NO. REQ.	LOCATION
Wing Flap Actuating	AN6227-27	1	Piston
	AN6246-27	2	Piston
	AN6227-7	1	Piston Rod
	AN6227-27	1	Cap
	AN6227-12	1	Cap
	AN6246-12	2	Cap
	AN6232-C-2⅛	1	Cap
	AN6231-3	1	Cap
	CVC996-14	1	Cap

4–1074 ASSEMBLING. Refer to paragraph 4–921 for complete assembling procedure.

4–1075. TESTING. Refer to paragraph 4–922 for the test of this cylinder.

4–1076. INSTALLING. Reverse the removal procedure given in paragraph 4–1070.

4–1077. WING FLAP BY-PASS VALVE.

4–1078. DESCRIPTION. (*See figure 4–106.*) This valve is manufactured by the Air Associates Inc., Bendix, N. J. Their part number is HC-2380-M3. The purpose of this valve is to allow the wing flaps to blow up, should speeds cause excessive air loads on the flaps. It is installed on the right hand flap "blow-up" strut and is actuated when the strut is compressed by excessive air loads on the flap. This allows oil on the "down" side of the wing flap cylinders to return to the main system, raising the flaps, and relieving the excessive air loads.

4–1079. REMOVING. This by-pass valve is mounted on the flap "blow-up" strut which is installed on the right hand center section end rib. It is accessible with the wings folded. Relieve main system pressure until hydraulic gage in cockpit reads zero.

a. Remove and cap the three hydraulic lines attached to the valve.

b. Remove the two bolts which secure the valve to the bracket and remove the valve.

4–1080. TESTING. The following test is made prior to installing the valve.

a. Place valve in a jig similar to the flap "blow-up" strut.

b. With valve in a neutral position, check for free flow from cylinder port (marked inlet) to pressure port (nearest plunger).

c. Plug pressure port; apply 1500 psi pressure to cylinder port for one minute. Check leakage from by-pass port. If leakage is in excess of 15 drops per minute, repeat check during fifth minute of test. Leakage is not to exceed 15 drops per minute. Increase pressure to 2250 psi for two minutes. There is to be no external leakage.

d. Remove plug from pressure port. Stroke valve. At no time should flow cease simultaneously from both ports. When fully stroked, there should be free flow from cylinder port to by-pass port.

e. With plunger stroked, plug by-pass port; apply 1500 psi pressure at cylinder port for one minute. Leakage from pressure port must not be too rapid to count drops. Increase pressure to 2250 psi for two minutes. There is to be no external leakage.

f. Release plunger. There shall be no binding as plunger extends.

4–1081. INSTALLING. Reverse removal procedure. Note that the centerlines of the valve piston and of the hook head should be coaxial. Spacing between adjusting nuts and hook should be at least .005 inches and no more than .125 inches.

4–1082. THERMAL RELIEF VALVE.

4–1083. DESCRIPTION. (*See figure 4–106.*) This valve is manufactured by Adel Precision Products Inc., Burbank, California, their part No. 17837. The purpose of these valves is to prevent the expanding of locked hydraulic fluid, due to temperature changes, from damaging the system. As the fluid expands, it forces the spring loaded poppet open allowing enough fluid to return to the main system to relieve dangerous pressure in the wing flap system. These valves are located on the right hand side of the center section, inboard of the center section end rib.

4–1084. REMOVING. These valves are accessible through the right wheel well and each is secured to the center section end rib by two bolts. Relieve main system pressure until hydraulic gage in cockpit reads zero.

a. Remove and cap the hydraulic lines.

b. Remove two attaching bolts, and remove valve.

4–1085. TESTING. The following test is made prior to the installation of a thermal relief valve.

a. Plug outlet ports. Apply 3100 psi to the pressure port for two minutes. There shall be no external leakage.

b. Apply pressure to inlet port. Valve should crack at a pressure of 2050, plus or minus 50, psi. Relieve one to two cubic inches of fluid through valve. Decrease pressure slowly. Valve should reseat at a minimum pressure of 1850 psi.

4–1086. INSTALLING. The installation of the thermal relief valve is the reverse of the removing procedure given in paragraph 4–1084.

4–1087. WING FLAPS EMERGENCY SYSTEM.

4–1088. DESCRIPTION. (*See figure 4–106.*) In the event that normal hydraulic actuation of the wing flap system is impossible, an emergency source of hydraulic power is provided to operate the wing flaps. The system includes an auxiliary electric hydraulic pump, a solenoid shut-off valve (which is energized by the flap control in the "EMERGENCY DOWN" position), allowing flow from the auxiliary pump to the wing flap system only, and a check valve which shuts off the auxiliary pump line during normal hydraulic operation. When the flap control lever is put in the "EMERGENCY DOWN" position, the auxiliary electric pump starts and the shut-off valve closes. The flaps will go to a full "extend" position at which time, due to the position of a lever on the follow-up rod, a switch will shut off the pump. Refer to paragraph 5–135 for information on the auxiliary hydraulic pump electrical circuit.

4–1089. AUXILIARY HYDRAULIC PUMP.

4–1090. DESCRIPTION. (*See figure 4–106.*) This pump is manufactured by the Pesco Products Company of Cleveland, Ohio. Their part No. is 11046-020-01. It is a gear type pump which is integral with an electric motor and is supplied with hydraulic fluid from the airplane reservoir. The pump is located in the engine accessory section to the left of the hydraulic reservoir and is mounted on the support assembly which secures the reservoir. The electric motor which drives the pump is a 24 volt continuous duty type and the pump will deliver .25 gpm at 1500 psi. For actuation of any sub-system, the pump may be energized by a toggle switch located on the inclined portion of the right hand control panel.

CAUTION

The auxiliary hydraulic pump should be turned "ON" only when it is needed to operate a subsystem and turned "OFF" immediately thereafter. If repeated use of the pump is anticipated, an external source of electric power should be used.

4–1091. FLOW THROUGH PUMP. This pump is a conventional gear type which consists of two meshed gears rotating in a two port housing. Hydraulic fluid enters the inlet port near a point where the gears unmesh and fills the spaces between the gear teeth. The fluid is then carried around to the point where the gears mesh again and is forced through the outlet port.

4–1092. REMOVING. Access to the auxiliary pump is gained by removing the upper accessory compartment cowl panel.

a. Remove and cap the two hydraulic lines leading to the pump; disconnect electrical leads.

b. Remove the four bolts which secure the pump to the reservoir support assembly and remove pump.

4–1093. TESTING. The following test is made prior to installing the auxiliary pump.

a. With 24 volts dc supplied to electric pump, run pump for three minutes at 1500 psi. Pump delivery is to be no less than .25 gpm. There is to be no external leakage during test run.

4–1094. INSTALLING. The installation of the auxiliary pump is the reverse of the removal procedure given in paragraph 4–1092.

4–1095. CHECK VALVE.

4–1096. DESCRIPTION. (*See figure 4–106.*) This check valve (AN6207-4) is located on the left hand side of the airplane at approximately station 140 in the auxiliary pump line. It is accessible through the lower cockpit access door. For a further description, removal, testing, and installation, refer to paragraph 4–953 through 4–957.

4–1097. SOLENOID SHUT-OFF VALVE.

4–1098. DESCRIPTION. (*See figure 4–106.*) This valve is manufactured by the Adel Precision Products Corporation, Burbank, California; their part No. 13701-24. It is a single-poppet, two-port valve which is actuated by a lever connected to the solenoid core. When the wing flap control lever is put in the "EMERGENCY DOWN" position, the solenoid is energized which shuts off flow from the main pressure line and sends auxiliary pump flow to the wing flap system only. Under normal conditions, the valve is open to the main pressure line for actuation of the wing flaps. The valve is located on the left side of the fuselage at station 149 near the wing flap selector valve in the main pressure line.

4–1099. REMOVING. Access to the solenoid shut-off valve is gained through the lower cockpit access door. Relieve main system pressure until hydraulic gage in cockpit reads zero.

a. Remove and cap the two hydraulic lines from the valve and remove the electrical plug.

b. Remove the two bolts which secure the valve to the bracket on frames at station 149 and station 143½. Remove the valve.

4–1100. TESTING. Prior to installing the shut-off valve, the following test is made.

a. With solenoid de-energized, supply a low flow to "in" port. There should be free flow from "out" port. Energize solenoid. Flow should shut off. De-energize solenoid. Free flow should resume from "out" port.

b. Repeat step a. using manual operation lever.

c. With solenoid energized, apply 1500 psi to "in" port for three minutes. Leakage from "out" port must not exceed three drops per minute after second minute of pressure application. No external leakage is permitted during test.

d. With solenoid de-energized and "out" port plugged, apply 2250 psi to "in" port for two minutes. Decrease pressure to 0 psi. Energize and de-energize solenoid and apply 2250 psi to "in" port again for two minutes. There shall be no external leakage during test.

4–1101. INSTALLING. The installation of the solenoid shut-off valve is the reverse of the removing procedure given in paragraph 4–1099.

4–1102. TUBING CHART. Figure 4–108 should be used as a reference key in conjunction with the following table.

TUBING CHART—WING FLAP HYDRAULIC SYSTEM

(Refer to figure 4–108.)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
AN6264-4-38	1	3/16 ID		38	Spec. AN-H-24	AN833-4D Elbow AN924-4D Nut AN6227-7 Packing AN924-4D Nut VS-78012-4 Nameplate
AN6264-4-36	2	3/16 ID		36	Spec. AN-H-24	AN832-4D Union AN924-4D Nut
VS-58312-133	3	¼	.035	50⅜	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN832-4D Union AN960-D716 Washer AN924-4D Nut
VS-58312-33	4	¼	.035	13⅝	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.)

TUBING CHART—WING FLAP HYDRAULIC SYSTEM (Continued)

(Refer to figure 4–108.)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-58312-73	5	1/4	.035	5 13/16	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN804-D4 Tee AN924-4D Nut AN6227-7 Packing
VS-58312-57	6	1/4	.035	8 3/4	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN933-4D Elbow AN6227-7 Packing AN924-4D Nut
VS-58312-55	7	1/4	.035	16 13/16	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN804-D4 Tee AN924-4D Nut AN6227-7 Packing (2 req.) AN815-4D Union
VS-58312-41	8	1/4	.035	33 3/4	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN815-4D Union AN6227-7 Packing AN833-4D Elbow
VS-58312-39	9	1/4	.035	31 3/4	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN815-4D Union AN6227-7 Packing AN834-4D Tee
VS-58312-111	10	1/4	.035	5 3/8	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN815-4D Union
VS-58312-3	11	1/4	.035	22 1/2	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN815-4D Union
VS-58312-5	12	1/4	.035	21 5/8	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN815-4D Union
VS-58312-95	13	1/4	.035	27 1/16	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN815-4D Union (2 req.)
AN6264-4-25	14	3/16 ID		25	Spec. AN-H-24	AN832-4D Union AN960-D716 Washer AN924-4D Nut
VS-48147-33	15	1/4	.035	32 5/8	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4D Sleeve (2 req.) AN815-4D Union
VS-48147-31	16	1/4	.035	18 1/4	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4D Sleeve (2 req.) AN833-4D Elbow AN924-4D Nut

TUBING CHART — WING FLAP HYDRAULIC SYSTEM (Continued)

(Refer to figure 4—108.)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-48147-29	17	¼	.035	43⅝	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4D Sleeve (2 req.) AN833-4D Elbow AN924-4D Nut AN960-D716 Washer
AN6264-4-14½	18	3/16 ID		14½	Spec. AN-H-24	AN776-4D Elbow AN775-4 Bolt AN901-4A Gasket (2 req.)
AN6264-4-11	19	3/16 ID		11	Spec. AN-H-24	AN833-4D Elbow AN924-4D Nut AN6227-7 Packing AN833-4D Elbow AN924-4D Nut AN960-D716 Washer
VS-58313-39	20	¼	.035		Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN833-4D Elbow AN924-4D Nut
VS-48147-25	21	¼	.035	21¼	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN815-4D Union
VS-48147-27	22	¼	.035	33⅝	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4D Sleeve (2 req.) AN832-4D Union AN960-D716 Washer AN924-4D Nut
AN6264-4-25	23	3/16 ID		25	Spec. AN-H-24	
AN6264-4-29	24	3/16 ID		29	Spec. AN-H-24	AN832-4D Union AN960-D716 Washer AN924-4D Nut
VS-48147-75	25	¼	.035	29 7/16	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4D Sleeve (2 req.) AN815-4D Union
VS-48147-73	26	¼	.035	21	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4D Sleeve (2 req.) AN833-4D Elbow AN924-4D Nut
VS-48147-71	27	¼	.035	35¼	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4D Sleeve (2 req.) AN834-4D Tee
VS-58313-41	28	¼	.035		Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN833-4D Elbow AN924-4D Nut AN960-D716 Washer
AN6264-4-14½	29	3/16 ID		14½	Spec. AN-H-24	AN777-4D Elbow AN775-4D Bolt AN901-4A Gasket (2 req.)

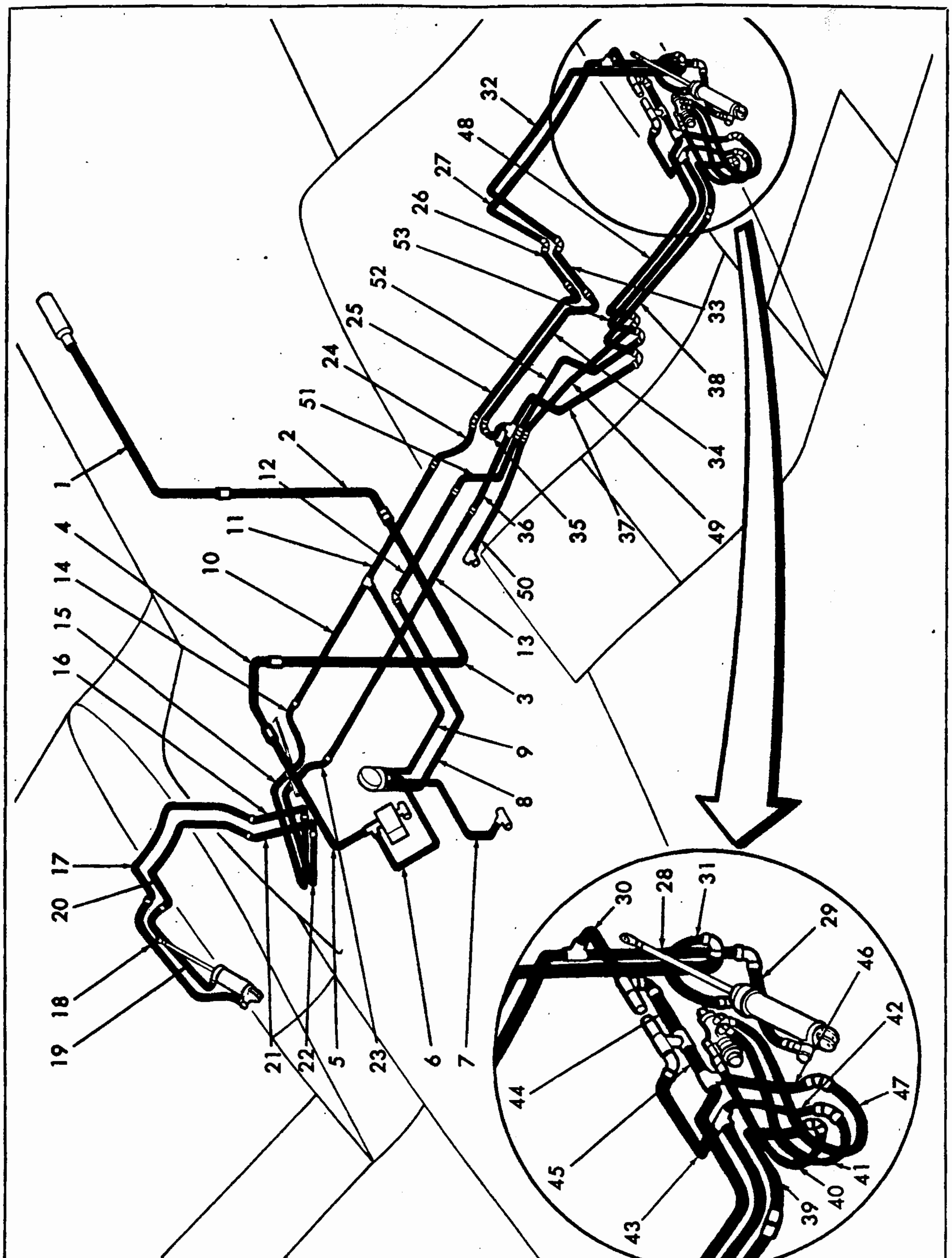


Figure 4–108. Hydraulic System—Wing Flap Tubing Diagram.

TUBING CHART—WING FLAP HYDRAULIC SYSTEM (Continued)

(Refer to figure 4-108.)

PART NO.	REF. ON FIGURE	O D INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-58313-65	30	1/4	.035	8 1/8	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN815-4D Union AN6227-7 Packing
AN6264-4-11	31	3/16 ID		11	Spec. AN-H-24	AN833-4D Elbow (2 req.) AN924-4D Nut (2 req.) AN6227-7 Packing AN960-D716 Washer
VS-58313-43	32	1/4	.035		Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN833-4D Elbow AN924-4D Nut
VS-48147-65	33	1/4	.035	24 1/2	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4D Sleeve (2 req.) AN815-4D Union
VS-48147-67	34	1/4	.035	30 1/6	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4D Sleeve (2 req.) AN837-4D Elbow AN960-D716 Washer AN924-4D Nut
VS-48147-169	35	1/4	.035	6 3/8	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4D Sleeve (2 req.) AN926-4D Tee AN815-4D Union AN837-4D Elbow AN924-4D Nut (2 req.) AN6227-7 Packing (3 req.) AN832-4D Union
AN6264-4-25	36	3/16 ID		25	Spec. AN-H-24	
VS-48147-101	37	1/4	.035	19 5/16	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4D Sleeve (2 req.) AN833-4D Elbow AN924-4D Nut
VS-48147-99	38	1/4	.035	32 3/16	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4D Sleeve (2 req.) AN815-4D Union
VS-48147-97	39	1/4	.035	16 13/16	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4D Sleeve (2 req.) AN833-4D Elbow AN924-4D Nut AN960-D716 Washer
AN6264-4-14 1/2	40	3/16 ID		14 1/2	Spec. AN-H-24	AN776-4D Elbow AN775-4 Bolt AN901-4A Gasket (2 req.)
AN6264-4-15 1/2	41	3/16 ID		15 1/2	Spec. AN-H-24	AN776-4D Elbow AN775-4 Bolt AN901-4A Gasket (2 req.) AN833-4D Elbow AN924-4D Nut AN960-D716 Washer

TUBING CHART—WING FLAP HYDRAULIC SYSTEM (Continued)

[Refer to figure 4-108.]

PART NO.	REF. ON FIGURE	O D INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-48147-91	42	1/4	.035	10 5/16	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4D Sleeve (2 req.) AN834-4D Tee
VS-48147-89	43	1/4	.035	10 15/16	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4D Sleeve (2 req.) AN833-4D Elbow AN924-4D Nut AN6227-7 Packing
VS-58313-67	44	1/4	.035	4	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4D Sleeve (2 req.) AN833-4D Elbow AN924-4D Nut (2 req.) AN6227-7 Packing (2 req.) AN834-4D Tee
VS-58313-33	45	1/4	.035		Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN834-6D Tee VS-34216 Adapter (2 req.)
VS-58313-35	46	1/4	.035		Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN833-4D Elbow AN924-4D Nut AN960-D716 Washer
AN6264-4-19	47	3/16 ID		19	Spec. AN-H-24	AN777-4D Elbow AN775-4 Bolt AN901-4A Gasket (2 req.))
VS-58313-37	48	3/8	.035		Spec. WW-T-787	AN818-6D Bolt (2 req.) AN819-6Z Sleeve (2 req.) AN833-6D Elbow AN924-6D Nut
VS-48147-87	49	3/8	.035	19 3/4	Spec. WW-T-787	AN818-6D Bolt (2 req.) AN819-6D Sleeve (2 req.) AN837-6D Elbow AN924-6D Nut AN960-D916 Washer
AN6264-6-22	50	5/16 ID		22	Spec. AN-H-24	
AN6264-4-23	51	3/16 ID		23	Spec. AN-H-24	AN832-4D Union AN924-4D Nut
VS-48147-95	52	1/4	.035	19 3/16	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4D Sleeve (2 req.) AN833-4D Elbow AN924-4D Nut
VS-48147-93	53	1/4	.035	42	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4D Sleeve (2 req.)

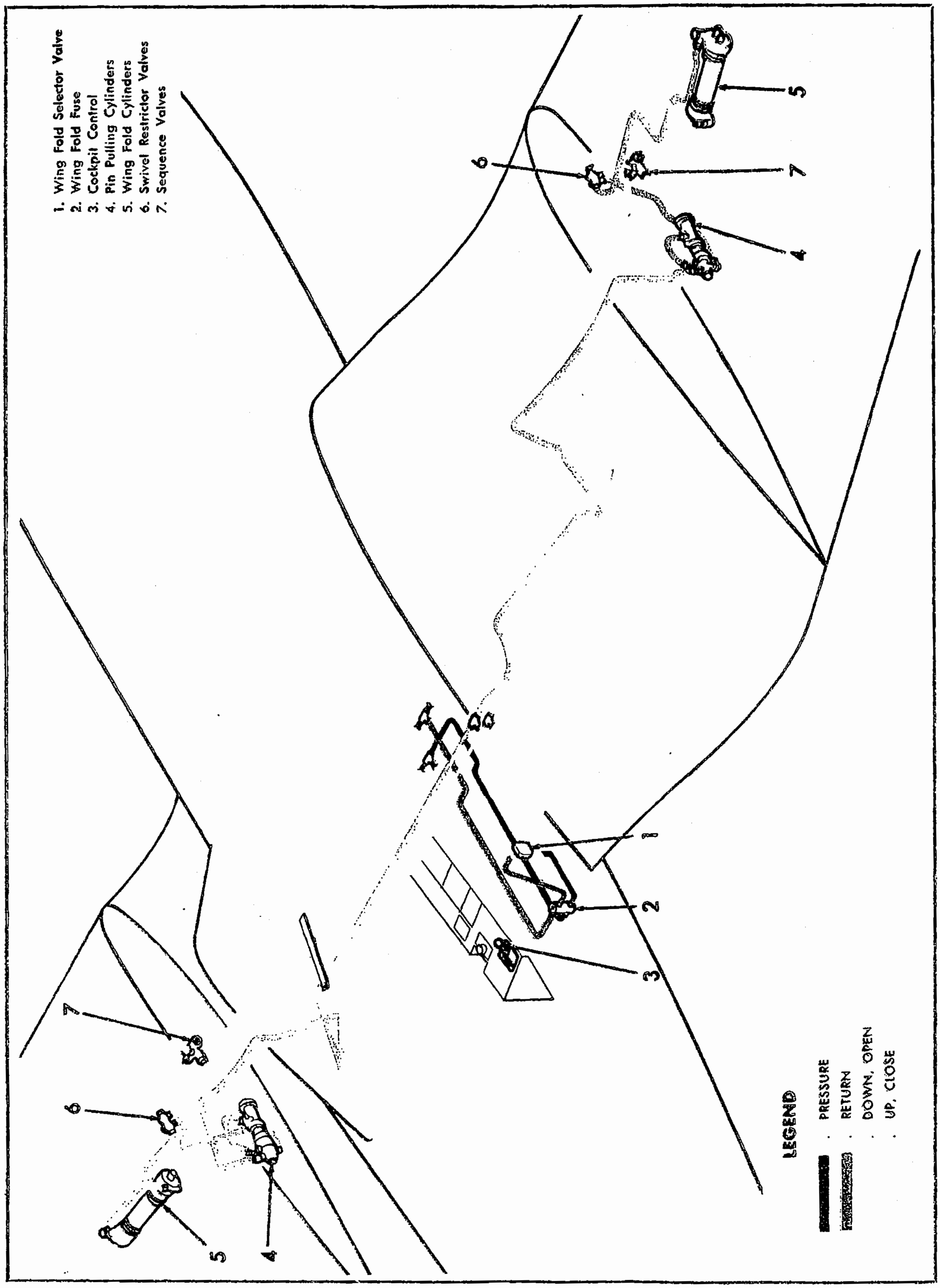


Figure 4-109. Hydraulic System—Wing Fold.

4–1103. HYDRAULIC SYSTEM–WING FOLD.

4–1104. DESCRIPTION. *(Refer to figures 4–95 and 4–109.)* The essential operating components of this system are the wing fold cylinders, pin pulling cylinders, wing fold fuse, selector valve, swivel restrictor valves, and sequence valves. The cockpit control lever is located on the aft portion of the right hand console and has four positions which are "WING HINGE PIN LOCKED," "SPREAD," "PARK," and "FOLD." Indicator flags which are located on the upper skin of the wings adjacent to the hinges raise when the wings are unlocked and are pulled flush with the skin when the wings are spread and locked.

4–1105. FUNCTION – FOLDING. Move the wing fold control handle aft to the "FOLD" position. The control lever is mechanically connected to the selector valve and to the wing fold fuse so that when the lever is put in the "FOLD" position, the selector valve pressure and return poppets are opened and the wing fold fuse is reset. The hydraulic flow goes from the selector valve, through the swivel restrictor valves, to the pin pulling cylinders. It enters the unlock side of the pin pulling cylinder causing the piston, to which the hinge pin is attached, to withdraw the hinge pin. As the piston bottoms, it actuates a poppet which starts flow to the fold port of the wing fold cylinder, thus bringing the wings to a folded position. The "PARK" position locks hydraulic fluid in the wing fold cylinders, and thus holds the wings folded even though leakage occurs in other subsystems. The wing fold fuse is mechanically held open in both the "FOLD" and "SPREAD" conditions. In the "WING HINGE PIN LOCKED" condition, the fuse returns to its normal position.

4–1106. FUNCTION–SPREADING. Move the control lever into the "SPREAD" position. Hydraulic fluid goes from the selector valve through the swivel restrictor to the spread port of the wing fold cylinders. As the wings complete their spreading action, fittings, attached to rib number two of both outer panels, contact the pins on the wing fold sequence valves causing them to open. Hydraulic fluid enters the lock ports on the pin pulling cylinders and moves the pins through the hinges. By moving the control lever to the "WING HINGE PIN LOCKED" position, a pull is exerted on two Teleflex cables that attach to the lock pins on the pin pulling cylinders. This action forces the lockpins downward, locking each hinge pin in place. In this position of the control lever, the wing fold fuse is returned to normal operating position.

4–1107. WING FOLD FUSE.

4–1108. DESCRIPTION. *(See figure 4–109.)* This unit is manufactured by Aeroquip Corporation of Jackson, Michigan. Their part number is 702. In event of a failure in the wing fold system, this unit will isolate that system so that the other sub-systems may be operated. When the cockpit control is in the "WING HINGE PIN LOCKED" position, the fuse is in a normal operating position. In all other positions, the fuse is

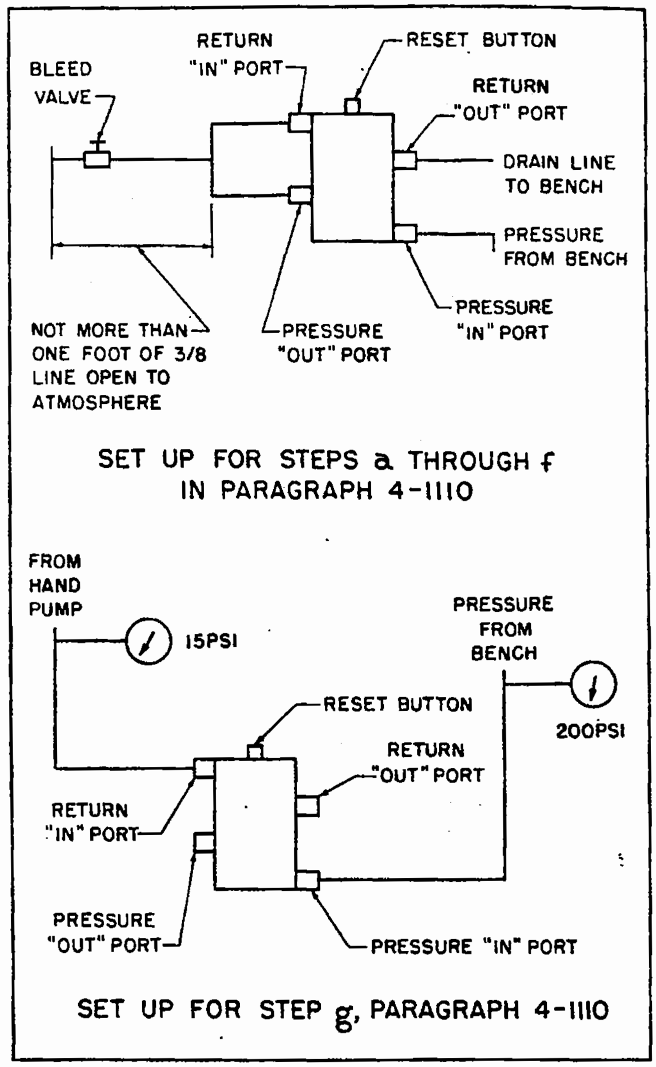


Figure 4–109A. Wing Fold Fuse Test Setup.

mechanically held open. The unit consists of a two chamber housing with four ports: "pressure in," "pressure out," "return in," and "return out." The larger chamber contains a spring loaded piston and the smaller has a check valve, push rod, and piston. When a small amount of fluid enters the larger chamber, it displaces an equal amount through the selector valve to the actuating cylinder. As the actuating cylinder moves, it sends a small amount of fluid back to the fuse which causes the piston in the smaller chamber to move, thus opening the check valve. With the check valve open, normal flow occurs through the fuse unless a failure causes less flow entering the "return in" port than is required to keep the pressure poppet open. When this happens, the fuse will close, thus isolating this system and allowing normal operation of all other systems. The fuse is located just below and forward of the cockpit control handle, and is mechanically linked to it so that when the handle is in any position except "WING HINGE PIN LOCKED," the fuse is held open. The fuse is accessible through the lower cockpit access door.

4–1109. REMOVING. Relieve main system pressure by cycling wing flaps until hydraulic gage in cockpit reads zero. Access to the fuse is gained through the lower cockpit access door.

a. Remove and cap the four hydraulic lines at the fuse.

b. Remove the cotter pin from the pin which holds the pivoting arm to the bracket on top of the fuse. Remove the pin.

c. Remove the four bolts which secure the fuse to the support and remove the fuse.

4–1110. TESTING. *(See figure 4–109A.)* The following test is made prior to the installation of the wing fold fuse.

a. Connect both the "pressure out" and "return in" lines to a single line containing a bleed valve.

b. Supply pressure at "pressure in" port. With reset depressed and bleed valve closed, there shall be free flow through the valve.

c. Release manual reset. Flow shall continue.

d. Open bleed valve. Fuse shall shut off and the pressure will increase to 1500 psi. Leakage from the "pressure out" port shall not exceed ten drops per minute. Reduce pressure to 300 psi. Leakage from "pressure out" port shall not exceed 20 drops per minute. There shall be no external leakage from plate. Increase pressure to 1500 psi. Reset fuse. There shall be free flow from bleed which is still open. Load required to reset fuse shall not exceed 13 pounds. Release reset. Fuse shall shut off.

e. Drop pressure to zero psi. Close bleed valve and after one minute, repeat step b. without touching reset.

f. With "return out" port plugged, apply 2250 psi and then 50 psi. Actuate reset several times at each pressure. There shall be no external leakage at plate or reset.

g. Apply a dynamic pressure of fifteen psi at "return in" port and a static pressure of 200 psi at the "pressure in" port. There must be a free flow of oil from the "return out" port.

4–1111. INSTALLING. Reverse the removal procedure given in paragraph 4–1109.

4–1112. WING FOLD SELECTOR VALVE.

4–1113. DESCRIPTION. *(Refer to figure 4–109.)* This valve is an AN6213-2 part. It controls pressure and return flow to and from the pin pulling cylinders and wing fold cylinders and is mechanically attached to the cockpit control handle through a Teleflex control system. When the control handle is in the "SPREAD" or "WING HINGE PIN LOCKED" position, the selector valve opens, allowing fluid to flow to the spread port of each wing fold cylinder and to the extend port of each pin pulling cylinder. When the control handle is in the "FOLD" position, the port to the "FOLD" side of each wing fold cylinder and to the retract port of each pin pulling cylinder is open. The valve has four cam operated poppets which are spring loaded. The cam is attached to a shaft which is linked to the cockpit control handle. This unit is located forward of the fuse under the right hand console panel and is accessible through the lower cockpit access door.

4–1114. REMOVING. Relieve the main system pressure by cycling the wing flaps until the hydraulic gage in the cockpit reads zero. Access to the selector valve is gained through the lower cockpit access door.

a. Remove and cap the four hydraulic lines at the selector valve.

b. Remove the nut and lever from the shaft.

c. Remove the three bolts which secure the valve to the bracket. Remove valve.

4–1115. TESTING. The following test is made prior to the installation of the selector valve. The ports reading clockwise and starting from the top when facing the side of the valve from which the shaft extends are as follows: "return," cylinder "A," "pressure," and cylinder "B."

a. Plug cylinder port "B." With handle rotated counterclockwise, apply 1500 psi to the pressure port for two minutes. Check for leakage from return port and cylinder port "A." Leakage must not exceed six drops per minute total from both ports. Increase pressure to 2250 psi for two minutes. There is to be no external leakage.

b. Unplug cylinder port "B" and plug cylinder port "A." With handle rotated clockwise, apply 1500 psi to pressure port for two minutes. Check for leakage from return port and cylinder port "B." Leakage must not exceed six drops per minute total from both ports. Increase pressure to 2250 psi for two minutes. There is to be no external leakage.

c. Plug both cylinder ports. Apply 1500 psi at pressure port. Torque required to rotate shaft in either direction is not to exceed 60 inch pounds.

d. With all ports unplugged, supply low flow to pressure port. With handle rotated clockwise, there must be free flow from cylinder port "A." With handle rotated counterclockwise, there must be free flow from cylinder port "B."

e. Supply low flow to return port. With handle rotated clockwise, there must be free flow from cylinder port "B." With handle, rotated counterclockwise, there must be free flow from cylinder port "A."

4–1116. INSTALLING. The installation of the wing fold selector valve is the reverse of the removal procedure given in paragraph 4–1114.

CAUTION

If Teleflex controls to the valves have been removed, the installation procedure given in paragraphs 4–602 through 4–604G must be followed exactly. Refer also to paragraph 6–6T.

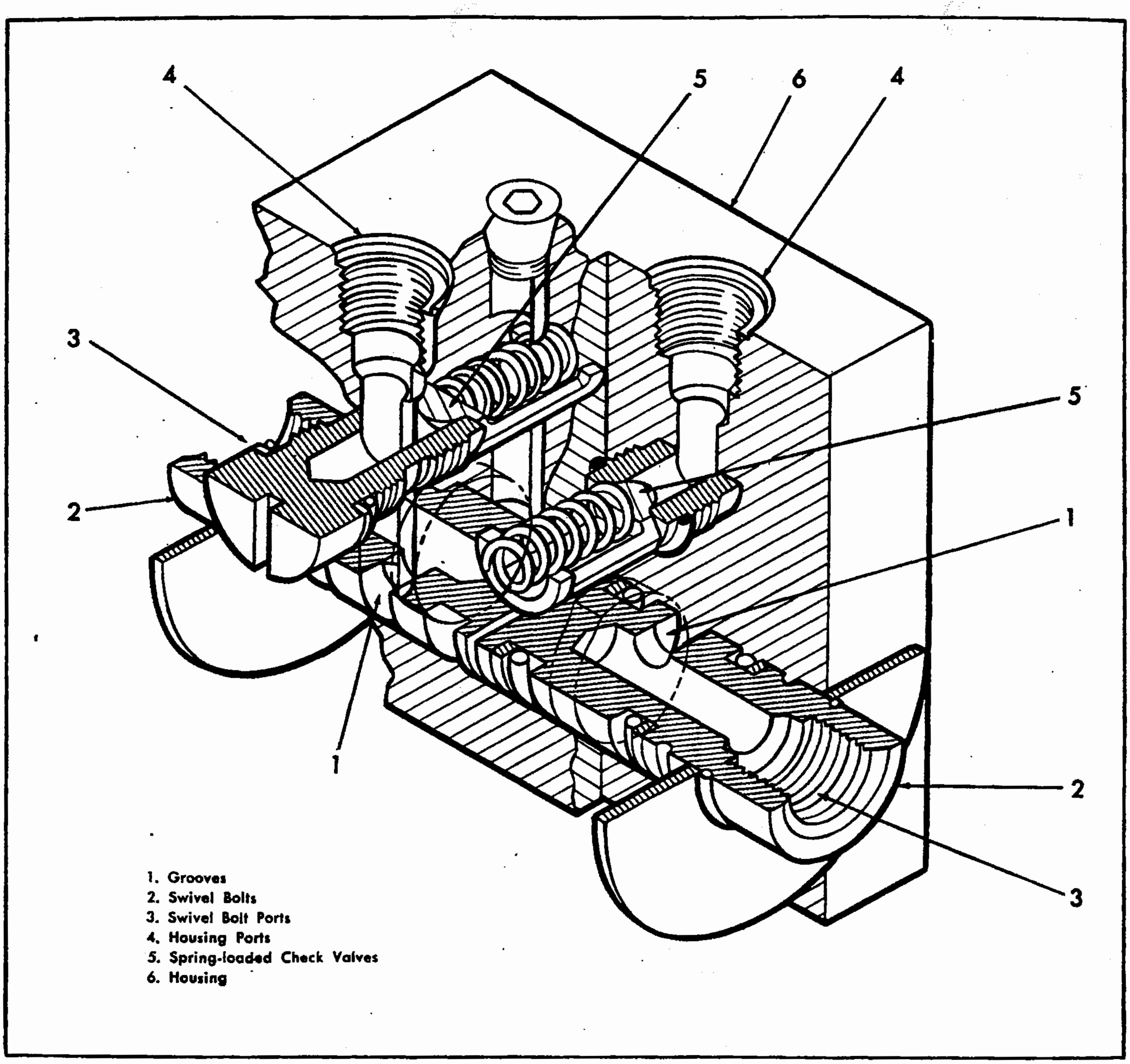


Figure 4—110. Wing Fold Swivel Restrictor Valve.

4—1117. SWIVEL RESTRICTOR VALVE.

4—1118. DESCRIPTION. *(Refer to figure 4—110.)* This unit is manufactured by Aircraft Engineering Co. of Clifton, N. J. The Chance Vought drawing number is VS-54146. It consists of a four port housing (6), two internal swivel bolts (2), and two spring-loaded check valves. The swivel bolts are secured to the outer panel with clamps. This valve is mounted on the end rib of the outer panel and is accessible when the wing is in the folded position. The swivel bolts (2) rotate inside the housing (6) as the wing folds or unfolds. An eccentric groove (1) cut in each swivel bolt allows free flow during the main portion of the wing movement, but restricts the hydraulic return flow as the wing panel nears the folded or unfolded position. A spring-loaded check valve allows for flow passage to the wing fold cylinder when the restrictor has shut off normal pressure flow. It is used primarily to allow full flow at the start of a wing movement. The flow through the valve is as follows. Fluid in the pressure line enters the housing port (4), goes to the swivel bolt restrictor slot (1), and out through the swivel bolt port (3). If, as is the case when wing movement is initiated, the swivel bolt slot is closed off from the housing port, the spring and ball valve will open allowing full flow through the valve. This will continue in a lessening amount as the rotating slot opens the passage to the housing port until the spring-loaded check valve passage is closed off. During this time, the return oil from the wing fold cylinder enters the opposite swivel bolt, flows through the eccentric passage, and out through the housing port and back to the reservoir. The outer panel approaches the limit of its travel and the end of the eccentric slot gradually restricts the flow from bolt to housing. This restriction builds up return line pressure between the wing flap cylinder and the restrictor high enough to retard the motion of the outer panel, thus bringing the outer panel slowly and safely to its final position.

4–1119. REMOVING. Relieve the main system pressure by cycling the wing flaps until the hydraulic gage in the cockpit reads zero. Access to the unit is gained with the wings folded.

a. Remove and cap the four hydraulic lines at the valve.

b. Remove the four clamp bolts which secure the valve.

4–1120. DISASSEMBLY.

a. To disassemble this unit, hold the unit over a container and remove the two bolts which go to the ball bearing race. These bolts are located on one face of the housing in line with the centerline of the swivel bolts. To complete ball bearing removal, rotate the swivel bolts and pull lightly on them. When all bearings have left the race, the swivel bolts can be pulled from the housing, marking or tagging the bolts so that, on assembly, each bolt will be installed in its correct bore in the housing.

b. Remove the two larger slotted plugs which secure the spring and poppet valves.

c. Remove the poppets and springs. All packings and gaskets are now accessible for replacement.

4–1121. LUBRICATING. No lubrication is required for this unit.

4–1122. REPAIRING. The following table lists the parts such as packings and gaskets which may be replaced in this unit.

UNIT	PACKING OR GASKET	NO. REQ.	LOCATION
Wing Fold	AN6227-15	4	Swivel Bolts
Swivel Restrictor	AN6246-15	4	Swivel Bolts
	AN6227-12	4	Plugs
	AN6246-12	2	Plugs

4–1123. ASSEMBLING. Reverse procedure given in paragraph 4–1120, making sure there are 25 ball bearings in each of the two races before securing bolts.

4–1124. TESTING. The following test is made prior to the installation of the wing fold swivel restrictor.

a. Plug both swivel bolt ports; apply 2250 psi to both housing ports for two minutes. Reduce pressure to zero psi. Increase pressure to 2250 psi for two minutes. There is to be no external leakage during test.

b. Supply 1.7 gpm to one swivel bolt port. Rotate swivel bolt in a clockwise direction, looking at port to which flow is supplied. The flow should be 1.7 gpm at 1500 psi when the mark on the index plate lines up with the right hand index mark on housing. Rotate swivel bolt counterclockwise until index on bolt lines up with left hand index on housing. There should be free flow from housing port.

c. Repeat step b., supplying flow to opposite swivel bolt port.

4–1125. INSTALLING. The installation of the swivel restrictor is the reverse of the removal procedure given in paragraph 4–1119 and the following adjustment is made. If, after installing the swivel bolt, the wing retards too soon in either spreading or folding, loosen the applicable swivel bolt clamp, rotate the bolt clockwise slightly, and tighten the clamp. If retarding occurs too late, use the same procedure, but rotate the bolt counterclockwise.

4–1126. PIN-PULLING CYLINDERS.

4–1127. DESCRIPTION. *((Refer to figures 4–109 and 4–110A.)* These pin-pulling cylinders are designed by Chance Vought Aircraft. Their drawing number is VS-48999. The purpose of this unit is to move the hinge pin into position and lock it; or to remove the pin so that the wings may be folded. In this same unit, there is a valve which prevents flow to the wing fold cylinders until after the pins have been removed from the hinge. This prevents binding of the pin. As the cockpit control is moved from the "WING HINGE PIN LOCKED" position to the "SPREAD" position, the mechanical pin lock is pulled allowing free movement of the hinge pin. As the cockpit control is moved to the "FOLD" position, hydraulic fluid enters the pin-pulling cylinders and moves the piston, thus removing the pin from the hinge. As the piston bottoms, it opens a poppet which sends hydraulic flow to the fold port of the wing fold cylinder. In spreading the wings, a sequence valve prevents extension of the hinge pin until the wings are in the spread position and then allows fluid to enter the extend port of the pin pulling cylinder. This unit is mounted on the end rib of the center section and is accessible with the wings in a folded position.

4–1128. REMOVING. Relieve the main system presure by cycling the wing flaps until the hydraulic gage in the cockpit reads zero. The pin-pulling cylinders located on the center section end ribs are accessible with the wings in a folded position.

a. Remove the teleflex cable from the lock fitting.

b. Remove and cap the four hydraulic lines at the cylinder.

c. Remove the two bolts which secure the pin end of the cylinder to the lower hinge fitting.

d. Remove the two bolts which secure the cap end of the cylinder to the end rib bracket. Remove the cylinder.

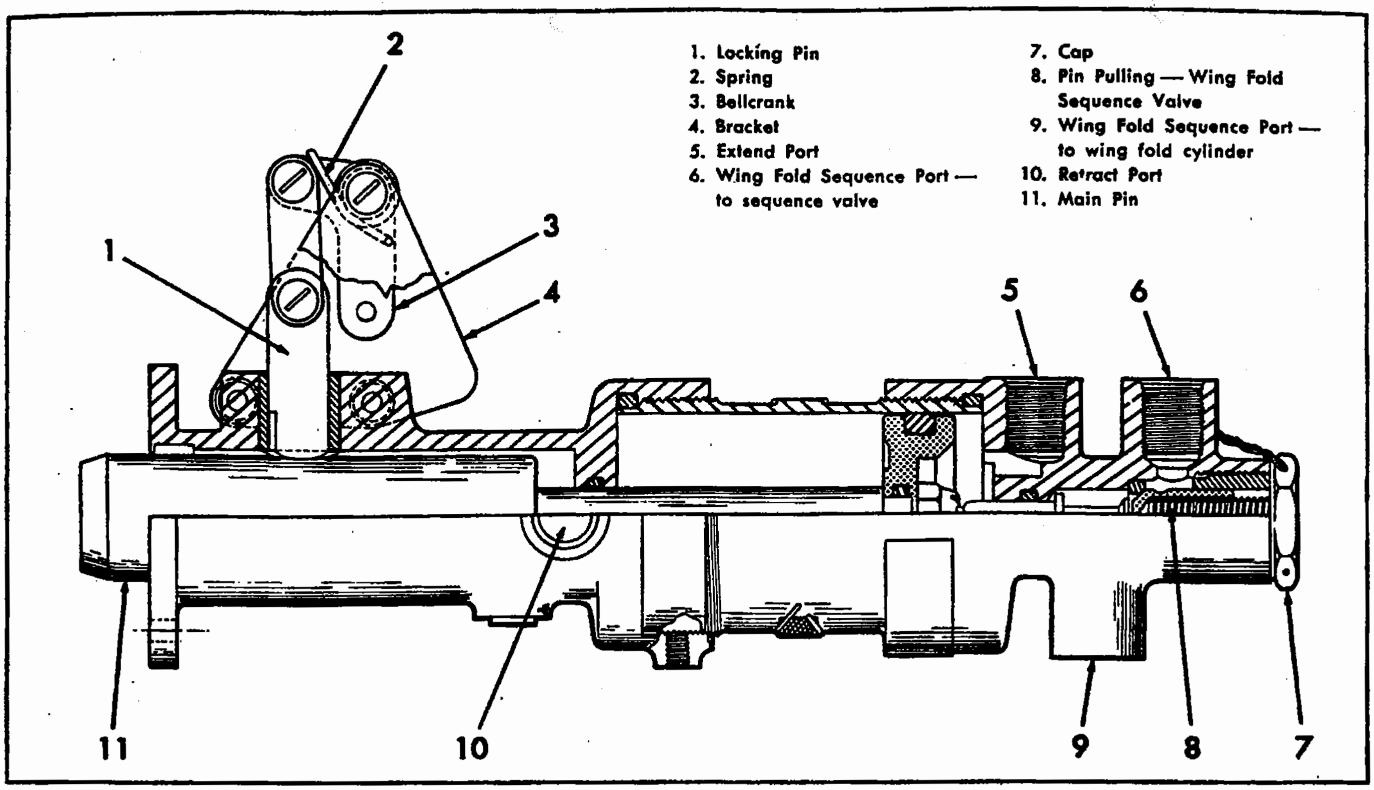


Figure 4—110A. Pin Pulling Cylinder.

4—1129. DISASSEMBLY.

a. Remove the two cap ends from the cylinder section by hand or with the use of a strap wrench.

b. Remove the nut from the piston rod and remove the piston. The pin may now be withdrawn from its housing.

c. Remove the hexagonal cap from the end cap.

d. Remove the spring and the poppet and spring which are secured by the hexagonal cap. All gaskets and packings are now accessible.

4—1130. LUBRICATING. Threads shall be well lubricated with anti-seize compound when assembling caps to cylinder. Soak packings and gaskets in mineral oil (Spec. AN-O-366) prior to assembly. Apply grease (Spec. AN-G-25) on pin.

4—1131. REPAIRING. Since the repair of hydraulic cylinders is limited to the replacement of packings and gaskets, listed below are those which are used in this unit.

UNIT	PACKING OR GASKET	NO. REQ.	LOCATION
Wing Hinge	AN6227-11	1	Cap
Pin Pulling	AN6227-9	1	Piston
Cylinders	AN6227-29	1	Piston
	AN6230-5	2	Cylinder
	AN6227-6	1	Cap

4—1132. ASSEMBLING. To assemble this unit, reverse the disassembly given in paragraph 4—1129.

4—1133. TESTING. The following test is made prior to the installation of the wing hinge pin-pulling strut.

a. Operate piston for five complete cycles at 100 psi pressure and five cycles at 1500 psi. There shall be no external leakage at either pressure.

b. Apply 2250 psi pressure on each port separately for one and one-half minutes, leaving the opposite port open and filled to the top with fluid. Overflow shall not exceed five drops per minute after the first one-half minute of test.

c. Apply pressure at port "C" until pin is fully extended. Lock pin shall lock. Apply 1500 psi pressure to port "B." Hinge pin shall not move. One minute after the pin is extended, apply 1500 psi to port "D." Leakage from port "A" shall not exceed ten drops per minute.

d. Release lock pin and apply 1500-400 psi to port "B." When hinge pin is fully retracted, supply a small flow to port "D." Check free flow from port "A."

4—1134. INSTALLING. The installation of the wing hinge pin-pulling cylinder is the reverse of the removal procedure given in paragraph 4—1128.

4—1135. SEQUENCE VALVE.

4—1136. DESCRIPTION. *(See figure 4—109.)* These parts may be purchased from Vickers, Inc., Detroit, Michigan. Their part numbers are AA-17002 for the left hand part and AA-17003 for the right hand part. This unit consists of a two port housing with a spring loaded, pin actuated poppet which allows flow through the valve when the pin is depressed. The valve is mounted on the end rib of the center section and the fitting which actuates the pin is mounted on the outer panel rib number two. When the wing is in the spread position, this valve opens, sending fluid to the pin-pulling cylinder. In this way, the hinge pin does not move until the hinge holes are in line and then it travels through the holes, locking the wing in a spread position. These units are accessible with the wings folded.

4—1137. REMOVING. Relieve the main system pressure by cycling the wing flaps until the hydraulic gage in the cockpit reads zero. This part is accessible with the wings in a folded position.

a. Remove and cap the two hydraulic lines at the valve.

b. Remove the two bolts which secure the valve to the end rib bracket. Remove the valve.

4—1138. TESTING. Prior to installation of the wing fold sequence valve, the following test is made:

a. Apply flow to port whose centerline is perpendicular to the valve mounting holes. Check for free flow and for smooth operation of the plunger.

b. Plug the port parallel to the mounting holes and apply 2250 psi for one minute, and 20 psi for two minutes to the other port. There should be no external leakage at either pressure.

c. Apply 1500 psi for two minutes to the port parallel to mounting holes. Allow time for drainage, then check the internal leakage from the other port. The leakage should not exceed five drops per minute.

4—1139. INSTALLING. The installation of the sequence valve is the reverse of the removal procedure given in paragraph 4—1137.

4—1140. WING FOLD CYLINDERS.

4—1141. DESCRIPTION. *(Refer to figure 4—109.)* These cylinders are designed by Chance Vought Aircraft. Their drawing number is VS-58232. This unit is located in the outer panel, on both right and left hand sides, attached to a bracket at wing station 50 (approximately) and at the rod end to a rod and track assembly. Access to the cylinder is gained with the gun bay doors open and the inboard forward and outboard ammunition boxes removed. This unit consists of two actuating cylinders, one within the other. The large piston which forms the cap end for the inner cylinder, moves during the time that the greatest loads are acting on the cylinder. This piston has a small orifice at the center of its surface which acts as a restrictor and prevents the outer piston from momentarily reversing direction of motion when the outer panel passes through the vertical position, thus preventing erratic motion of the outer panel during travel. When the large piston bottoms, the inner piston is actuated and completes the wing movement. A slightly enlarged piston rod hole diameter also acts as a restrictor in the inner cylinder. When the cockpit control lever is put in the "FOLD" position, hydraulic fluid goes to the extend port of the cylinder and, operating through a rod linkage, folds the wings. In the "SPREAD" position, fluid is directed to the retract port of the cylinder; this compresses the cylinder and spreads the wings.

4—1142. REMOVING. Fold the wings to a vertical position and secure them with jury struts. To remove either cylinder, follow the procedure given below.

a. Remove the bolt which secures the track rod to the center section hinge bracket.

b. Relieve main system pressure by bringing the wing fold cylinder to the retract position.

c. Remove rear gun bay door and open forward gun bay door.

d. Working through the gun bay doors, remove the bolt securing the wing fold cylinder piston rod end to the lever and track.

e. Remove the piston rod clevis.

f. Remove the ammunition boxes from the top surface of the wing.

g. Remove the two hydraulic lines from the cylinder.

h. Remove the bolt which ties the cylinder to a universal which is mounted on a bracket near wing station 150.

i. With one mechanic on the outside and another working through the ammunition box bay, remove four screws from the lower wing surface just under the inboard cap of the cylinder.

j. Remove the forward ammunition box rollers by inserting a screw driver in the roller slot and depressing the roller axle.

k. By carefully moving the cylinder, it can be removed from the wing.

4—1143. DISASSEMBLY.

The following procedure applies when disassembling the wing fold cylinders.

a. Remove the larger cap assembly from the end of the cylinder.

b. Remove the rod end fitting from the rod.

c. Remove the smaller end cap.

d. Withdraw the internal cylinder assembly.

e. Remove the cap at the rod end of the internal cylinder.

f. Withdraw the piston and rod assembly from the internal cylinder.

g. Unscrew the nut on the piston rod and remove the piston.

4—1144. LUBRICATING. Packings should be soaked in hydraulic fluid (Spec. AN-O-366) before installing.

4—1145. REPAIRING. The repair of cylinders is limited to replacement of worn packings, gaskets, or wipers. The following table lists these parts:

	PACKING OR GASKET	NO. REQ.	LOCATION
CYLINDER Wing Fold Cylinder	AN6227-42	1	Large Piston
	AN6246-42	2	Large Piston
	AN6227-35	1	Small Piston
	AN6246-35	2	Small Piston
	AN6227-22	1	Small Piston
	AN6227-22	1	Cap
	AN6246-22	2	Cap
	AN6230-15	1	Cap
	AN6232-C-4 1/8	1	Cap
	AN6231-12	1	Cap
	AN6230-17	1	Cylinder
	CVC996-24	1	Cap

4—1146. ASSEMBLING. The assembling of this cylinder is the reverse of the disassembly directed in paragraph 4—1143. On assembling the cylinder, fill the slide chamber with hydraulic fluid.

4—1147. TESTING. Refer to paragraph 4—922 for complete test of the wing fold cylinder.

4—1148. INSTALLING. The installation of the wing fold cylinder is the reverse of the procedure given in paragraph 4—1142.

4—1149. TUBING CHART. Figure 4—111 should be used as a reference key in conjunction with the table shown below.

TUBING CHART — WING FOLD HYDRAULIC SYSTEM

(Refer to figure 4—111.)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-58312-101	1	3/8	.035	38 9/16	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN919-12D Reducer
VS-58312-71	2	1/2	.042	6 1/2	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN778-8D Elbow AN775-8D Bolt AN901-8A Gasket (2 req.)
VS-58312-17	3	3/8	.035	43 1/8	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN919-12D Reducer
VS-58312-1	4	1/2	.042	6 1/2	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN778-8D Elbow AN775-8D Bolt AN901-8A Gasket (2 req.)
VS-58312-85	5	1/2	.042	2 1/4	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN919-12D Reducer AN778-8D Elbow AN775-8D Bolt AN901-8A Gasket (2 req.)
VS-58312-25	6	3/8	.035	7 1/2	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN924-6D Nut AN6227-9 Packing AN833-6D Elbow
VS-58312-83	7	1/2	.042	2 1/4	Spec. WW-T-787	AN818-8D Bolt (2 req.) AN819-8D Sleeve (2 req.) AN778-8D Elbow AN775-8D Bolt AN901-8A Gasket (2 req.) AN919-12D Reducer

TUBING CHART — WING FOLD HYDRAULIC SYSTEM (Continued)

(Refer to figure 4—111.)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-58312-23	8	3/8	.035	7½	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN924-6D Nut AN6227-9 Packing AN833-6D Elbow
VS-58312-19	9	3/8	.035	39 5/16	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN924-6D Nut (2 req.) AN6227-9 Packing AN833-6D Elbow (2 req.) AN926-6D Tee AN815-6D Union (2 req.) AN6227-9 Packing (3 req.)
VS-58312-21	10	3/8	.035	43¾	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN837-6D Elbow AN6227-9 Packing AN924-6D Nut AN926-6D Tee AN815-6D Union (2 req.) AN924-6D Nut AN6227-9 Packing (3 req.) AN833-6D Elbow
VS-58312-93	11	3/8	.035	27½	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN815-6D Union
VS-58312-91	12	3/8	.035	27¾	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN815-6D Union
AN6264-6-28	13	5/16 ID		28	Spec. AN-H-24	AN832-6D Union AN960-D 916 Washer AN924-6D Nut
VS-48147-21	14	3/8	.035	28 5/16	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6D Sleeve (2 req.) AN815-6D Union
VS-48147-19	15	3/8	.035	21	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6D Sleeve (2 req.) AN833-6D Elbow AN924-6D Nut
VS-48147-17	16	3/8	.035	31 5/16	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6D Sleeve (2 req.) AN832-6D Union AN924-6D Nut AN960-D 916 Washer
VS-16101-103	17	3/8	.035	6¾	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6D Sleeve (2 req.) AN833-6D Elbow AN924-6D Nut AN960-D 916 Washer

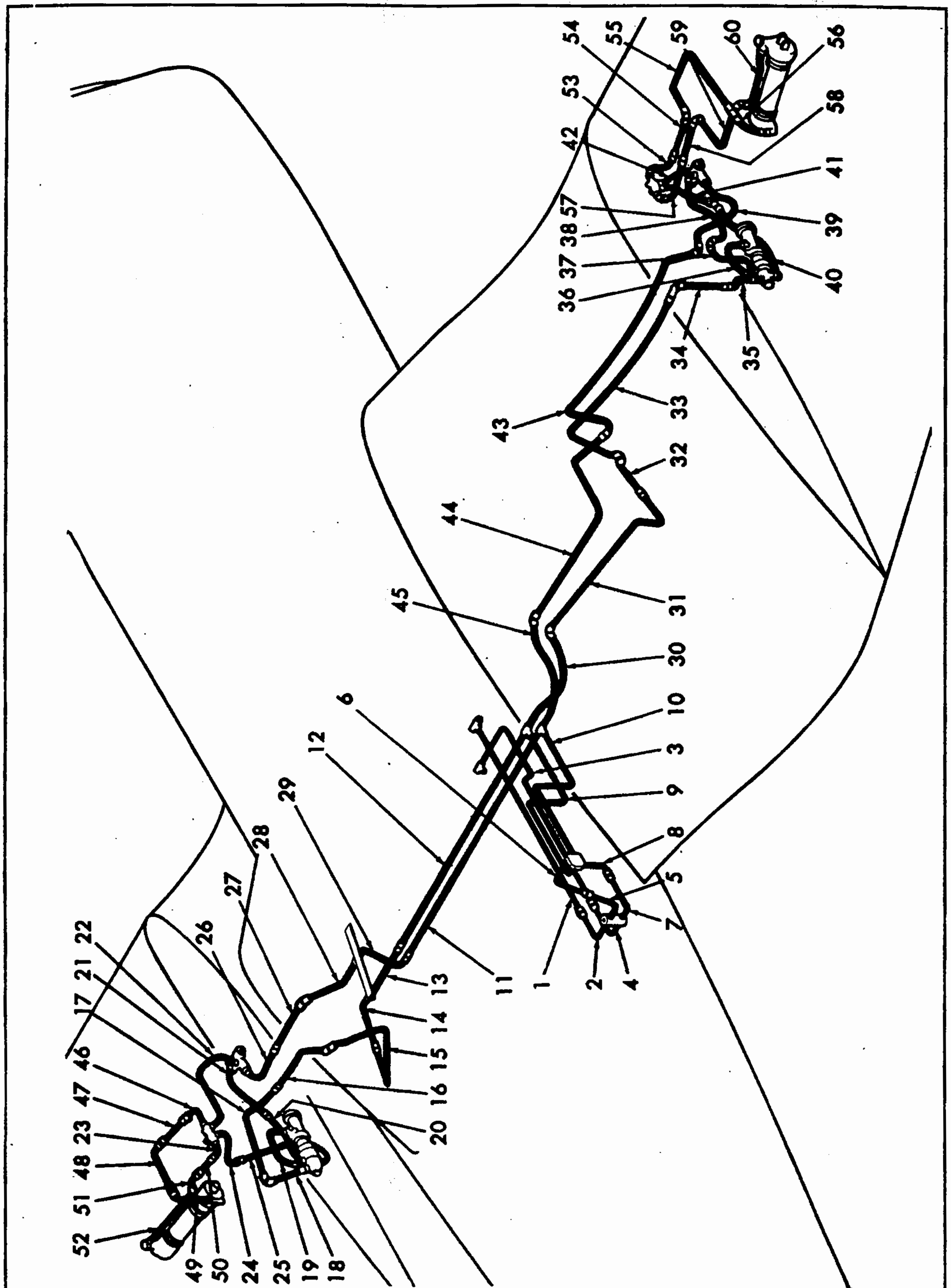


Figure 4-111. Hydraulic System—Wing Fold Tubing Diagram.

TUBING CHART — WING FOLD HYDRAULIC SYSTEM (Continued)

(Refer to figure 4—111.)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-16101-93	18	3/8	.035	5 13/16	Spec. WW-T-788	AN818-6D Nut (2 req.) AN819-6D Sleeve (2 req.) AN778-6D Elbow AN774-6 Bolt AN901-6A Gasket (2 req.)
VS-16101-91	19	3/8	.035	9 3/8	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6D Sleeve (2 req.) AN778-6D Elbow AN775-6D Bolt AN901-6A Gasket (2 req.)
VS-16101-89	20	3/8	.035	13	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6D Sleeve (2 req.) AN776-6D Elbow AN775-6D Bolt AN901-6A Gasket (2 req.) AN821-6D Elbow
VS-16101-147	21	3/8	.035	17 1/2	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6D Sleeve (2 req.) AN778-6D Elbow AN775-6D Bolt AN901-6A Gasket (2 req.)
VS-54266-1	22	3/8	.035	9	Spec. WW-T-855	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN776-6D Elbow AN774-6 Bolt AN901-6A Gasket (2 req.) AN6227-9 Packing AN815-6D Union
AN6264-6-12	23	5/16			Spec. AN-H-24	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN833-6D Elbow AN960-D 916 Washer (2 req.) AN924-6D Nut AN775-6D Bolt AN901-6A Gasket (2 req.) AN776-6D Elbow
VS-54166-3	24	3/8	.035	9	Spec. WW-T-855	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN837-6D Elbow AN815-6D Union AN6227-9 Packing
VS-16101-83	25	3/8	.035	17 3/4	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6D Sleeve (2 req.) AN776-6D Elbow AN775-6D Bolt AN901-6A Gasket (2 req.)
VS-16101-135	26	3/8	.035	19 3/8	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6D Sleeve (2 req.) AN832-6D Union AN924-6D Nut

TUBING CHART — WING FOLD HYDRAULIC SYSTEM (Continued)

(Refer to figure 4—111.)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-48147-13	27	3/8	.035	41 5/16	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6D Sleeve (2 req.) AN837-6D Elbow AN924-6D Nut
VS-48147-15	28	3/8	.035	39 1/16	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6D Sleeve (2 req.) AN837-6D Elbow AN960-D916 Washer AN924-6D Nut
AN6264-6-25	29	5/16 ID		25	Spec. AN-H-24	
AN6264-6-20	30	5/16 ID		20	Spec. AN-H-24	AN837-6D Elbow AN960-D916 Washer AN924-6D Nut
VS-48147-61	31	3/8	.035	28 11/16	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6D Sleeve (2 req.) AN815-6D Union
VS-48147-59	32	3/8	.035	21 3/4	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6D Sleeve (2 req.) AN833-6D Elbow AN924-6D Nut
VS-48147-57	33	3/8	.035	31	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6D Sleeve (2 req.) AN833-6D Elbow AN924-6D Nut AN960-D916 Washer
VS-16101-103	34	3/8	.035	6 3/4	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6D Sleeve (2 req.) AN832-6D Union AN924-6D Nut
VS-16101-15	35	3/8	.035	5 13/16	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6D Sleeve (2 req.) AN778-6D Elbow AN774-6 Bolt AN901-6A Gasket (2 req.)
VS-16101-13	36	3/8	.035	9 3/8	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6D Sleeve (2 req.) AN778-6D Elbow AN775-6D Bolt AN901-6A Gasket (2 req.)
VS-16101-9	37	3/8	.035	13	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6D Sleeve (2 req.) AN776-6D Elbow AN775-6D Nut AN901-6A Gasket (2 req.) AN821-6D Elbow
VS-16101-67	38	3/8	.035	17 1/2	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6D Sleeve (2 req.) AN778-6D Elbow AN775-6D Bolt AN901-6A Gasket (2 req.)

TUBING CHART — WING FOLD HYDRAULIC SYSTEM (Continued)

(Refer to figure 4—111.)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-16101-55	39	3/8	.035	19 9/16	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6D Sleeve (2 req.) AN776-6D Elbow AN774-6 Bolt AN901-6A Gasket (2 req.) AN837-6D Elbow
VS-16101-3	40	3/8	.035	17 5/8	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6D Sleeve (2 req.) AN776-6D Elbow AN775-6D Nut AN901-6A Gasket (2 req.) AN837-6D Elbow
VS-54166-7	41	3/8	.035	8	Spec. WW-T-855	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN815-6D Union AN6227-9 Packing
VS-54166-5	42	3/8	.035	8	Spec. WW-T-855	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN815-6D Union AN6227-9 Packing
VS-48147-53	43	3/8	.035	40 1/4	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6D Sleeve (2 req.) AN837-6D Elbow AN924-6D Nut
VS-48147-55	44	3/8	.035	37 3/4	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6D Sleeve (2 req.) AN837-6D Elbow AN960-D916 Washer AN924-6D Nut
AN6264-6-20	45	5/16 ID		20	Spec. AN-H-24	
AN6264-6-15	46	5/16 ID			Spec. AN-H-24	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN833-6D Elbow AN960-D916 Washer (2 req.) AN924-6D Nut AN776-6D Elbow AN775-6D Bolt AN901-6A Gasket (2 req.)
VS-58309-3	47	3/8	.035	22 9/16	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN833-6D Elbow AN924-6D Nut AN960-D916 Washer (2 req.)
AN960VS-58309-5	48	3/8	.035	19 9/16	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN924-6D Nut AN832-6D Union AN960-D916 Washer (2 req.)
AN6264-6-10	49	5/16 ID			Spec. AN-H-24	AN815-6D Union AN6227-9 Packing

TUBING CHART — WING FOLD HYDRAULIC SYSTEM (Continued)

(Refer to figure 4–111.)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-58309-17	50	3/8	.035	22 3/8	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN837-6D Elbow AN924-6D Nut
VS-58309-7	51	3/8	.035	12 15/16	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN837-6D Elbow AN924-6D Nut AN960-D916 Washer (2 req.)
VS-58309-9	52	3/8	.035	23 1/4	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN776-6D Elbow AN775-6D Bolt AN901-6A Gasket (2 req.)
AN6264-6-15	53	5/16 ID			Spec. AN-H-24	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN833-6D Elbow AN924-6D Nut AN960-D916 Washer (2 req.) AN777-6D Elbow AN775-6D Bolt AN901-6A Gasket (2 req.)
VS-58309-25	54	3/8	.035	23 3/8	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN837-6D Elbow AN924-6D Nut AN960-D916 Washer (2 req.)
VS-58309-27	55	3/8	.035	19 9/16	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN924-6D Nut AN832-6D Union AN960-D916 Washer (2 req.)
AN6264-6-10	56	5/16		10	Spec. AN-H-24	AN815-6D Union AN6227-9 Packing
AN6264-6-12	57	5/16 ID			Spec. AN-H-24	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN833-6D Elbow AN960-D916 Washer (2 req.)
VS-58309-37	58	3/8	.035	21 13/16	Spec. WW-T-787	AN924-6D Nut AN775-6D Bolt AN776-6D Elbow AN901-6A Gasket (2 req.)
VS-58309-29	59	3/8	.035	12 15/16	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN837-6D Elbow AN924-6D Nut AN960-D916 Washer (2 req.)
VS-58309-31	60	3/8	.035	23 1/4	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN776-6D Elbow AN775-6D Bolt AN901-6A Gasket (2 req.)

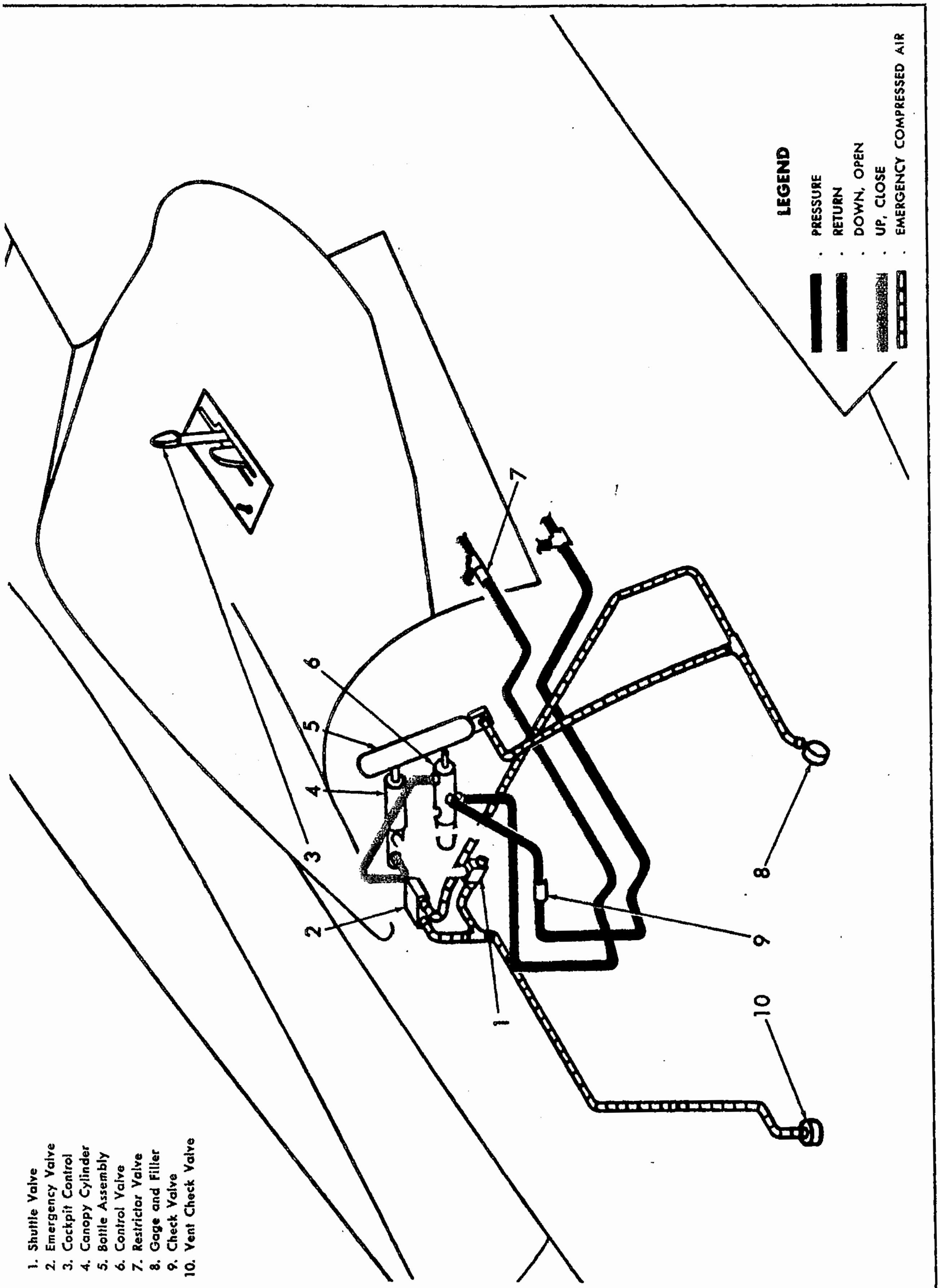


Figure 4–112. Hydraulic System—Cockpit Canopy.

4—1150. HYDRAULIC SYSTEM — COCKPIT CANOPY.

4—1151. DESCRIPTION. *(Refer to figures 4—95 and 4—112.)* The cockpit canopy on this airplane is opened and closed hydraulically. The units which make up the system are the canopy cylinder, control valve, shuttle valve, restrictor valve, and check valve. The cockpit control lever is located just above the inclined portion of the left hand control shelf and has five positions, "EMERGENCY," "MANUAL," "OPEN," "STOP," and "CLOSE." The control handle is connected to the canopy control valve through a Teleflex cable and jackshaft. Movement of the cockpit handle actuates the control valve piston rod which is linked to the jackshaft. The piston rod, depending on its position, controls the flow of hydraulic fluid to the actuating cylinder. As the cylinder changes position, the rack attached thereto turns a pinion and a drum on which is wound the cable which attaches to and moves the cockpit canopy. The emergency operation of the canopy may be found in paragraph 4—1168. For more information on the operating mechanism of the canopy, refer to paragraph 4—247.

4—1152. CANOPY ACTUATING CYLINDER.

4—1153. DESCRIPTION. *(Refer to figures 4—112 and 4—113.)* This part is designed by Chance Vought Aircraft and is installed in airplanes 121793 through 121902. This unit is mounted on the aft face of bulkhead 186 above the radio equipment installation and is accessible through the radio compartment access door. It is mounted in such a way that the piston rod is stationary and the cylinder moves. The rack, secured to the cylinder (4), turns the screw and pinion which controls the movement of the sliding canopy. The slider valve (3) inside the piston rod is pinned (12) and does not effect operation of the cylinder. When the cockpit control handle is put in the "MANUAL" position, both sides of the piston are connected to the main return line (through the control valve) permitting the cylinder to travel freely when the canopy is manually operated. When the control handle is brought to "OPEN," hydraulic fluid enters the retract side (6) of the piston (9), compressing the cylinder (4) and, through the attached mechanism, opening the canopy. When the control lever is at "STOP," the fluid is locked in the cylinder, thus holding the canopy at any desired position. Placing the control handle in the "CLOSE" position causes hydraulic fluid to enter the side of the piston which extends the cylinder. When the control handle is brought to "EMERGENCY," it mechanically opens the emergency air valve, allowing air to enter the retract side of the actuating cylinder through the hydraulic line and open the canopy. A shuttle valve located at the junction of the air and hydraulic lines prevents the air from passing into the control valve. The control handle simultaneously operates the control valve which connects both the open and close ports to the return line and blocks off incoming hydraulic pressure. This provides a return for the fluid on the extend (close) side of the actuating cylinder, and at the same time prevents hydraulic pressure from building up on the shuttle valve in the retract (open) line to the actuating cylinder.

4—1154. REMOVING. Relieve the main system hydraulic pressure by cycling the wing flaps until the hydraulic gage in the cockpit reads zero. Access to the canopy actuating cylinder is gained through the radio access door.

a. Remove and cap the two hydraulic lines at the cylinder.

b. Remove the nut which secures the housing to the bracket.

c. Remove the bolts which secure the rack to the cylinder and remove the cylinder.

4—1155. DISASSEMBLY. *(Refer to figure 4—113.)* The following instructions apply when disassembling the canopy cylinder.

a. Remove pin which immobilizes slider rod.

b. Remove the clamp which secures the end cap to the cylinder.

c. Remove the end cap and the spacer within the cylinder.

d. Withdraw the piston (9) from the cylinder.

e. Remove the end fitting from the slider rod.

f. Loosen the nut which secures the housing to the piston rod (1) and unscrew the housing.

g. Remove the end cap from the piston rod.

h. Remove the lock ring and cap from the slider valve assembly.

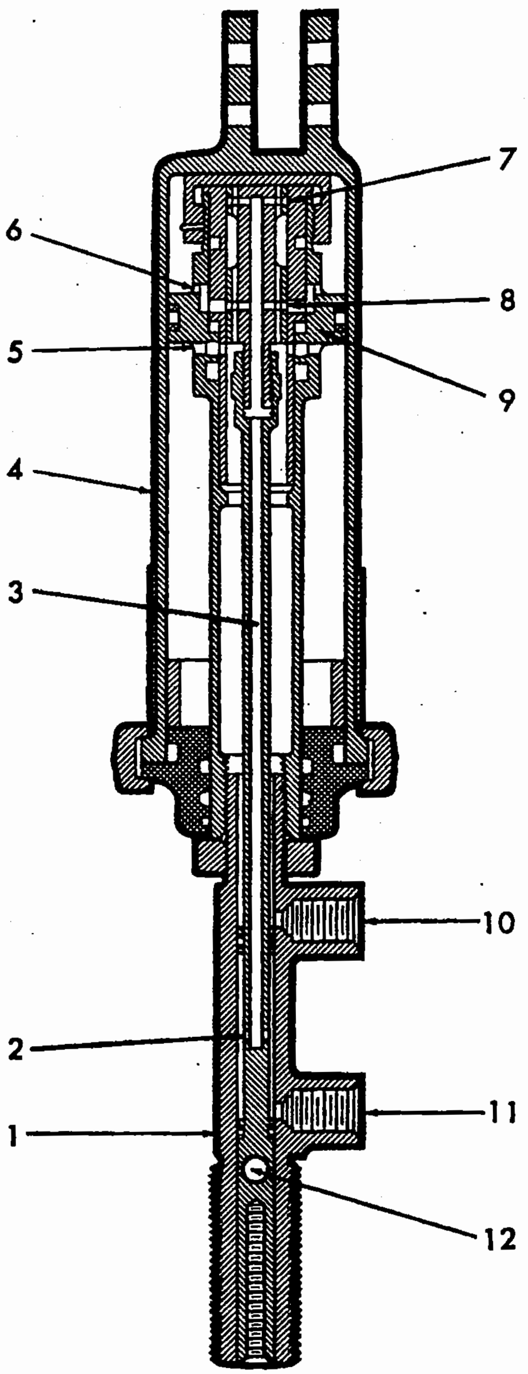
i. Unscrew the slider valve and remove slider valve and sleeve. All gaskets and packings are now accessible.

4—1156. LUBRICATING. All packings and gaskets should be dipped in hydraulic fluid prior to assembly.

4—1157. REPAIRING. The repair of hydraulic cylinders is limited to the replacement of packings and gaskets. See the following table for replacement part designations:

CYLINDER	PACKING, WIPER, OR GASKET	NO. REQ.	LOCATION
Canopy Actuating Cylinder	AN6227-5	2	Slider Rod
	AN6231-7	1	Cap
	AN6227-9	1	Housing
	AN6232-1 15/16	1	Housing
	AN6232-3 1/2	1	Cap
	AN6227-17	1	Cap
	AN6246-17	2	Cap
	AN6227-27	1	Cap
	AN6227-4	1	Slider Valve
	AN6227-15	1	Piston Rod
	AN6227-27	1	Piston
	AN6246-27	2	Piston
	AN6227-14	2	Cap
	AN6227-20	1	Cap

4—1158. ASSEMBLING. The assembly of the canopy cylinder is the reverse of the disassembly procedure given in paragraph 4—1155, and special attention is called to the fact that there are four leather back-up rings, one



1. Piston Rod
2. Port
3. Slider Rod
4. Cylinder
5. Port
6. Port
7. Port
8. Port
9. Piston
10. Return Port
11. Pressure Port
12. Pin-immobilizes slider rod

Figure 4—113. Canopy Actuating Cylinder.

on either side of AN6227-17 packing, and one on either side of AN6227-27 packing.

4—1159. TESTING. Prior to the installation of the unit, the following test is made.

a. Operate piston 5 cycles at 1500 psi pressure. There should be no external leakage.

b. Apply 2250 psi pressure on each port for 4 minutes, leaving the opposite port open and filled to the top with fluid. There should be no overflow from either port after the first two minutes. No external leakage is permitted.

4—1160. INSTALLING. The installation of the canopy cylinder is the reverse of the removal procedure given in paragraph 4—1154 and, if it is necessary to adjust the cylinder internally in the event that the cylinder stroke is incorrect, complete the cylinder disassembly as given in paragraph 4—1155 and proceed as follows: Remove the spacer on which the piston bottoms when the cylinder extends and either re-work or replace it to obtain the proper stroke.

4—1160A. CANOPY CONTROL VALVE.

4—1160B. DESCRIPTION. *(See figure 4—114.)* The canopy control valve is manufactured by Electrol, Inc., Kingston, N. Y. Their drawing number is 604. This unit is mounted on a beam located on the aft face of bulkhead 186. The control valve consists of a housing incorporating four ports which connect to internal passages within the housing. Hydraulic fluid flow within the housing is controlled by a slide valve. The slide valve is connected to the canopy cockpit control handle by means of a jack-shaft and Teleflex cable. Movement of the cockpit control handle causes the slide valve to change its position within the control valve housing. The control valve is connected by means of two ports to the main pressure and return lines. The other two ports permit fluid flow to the open and close sides of the canopy actuating cylinder. When the cockpit control handle is brought to "MANUAL," the slide valve moves to a position which simultaneously shuts off the main pressure port (2) and connects both the open (7) and close (8) ports together and to the return port (3). With this arrangement, both sides of the piston in the canopy actuating cylinder are connected to the main return line, (through the control valve) permitting the cylinder to travel freely when the canopy is manually operated. When the control handle is moved to "OPEN," the control valve connects the pressure port (2) to the open port (7) and the close port (8) to the return (3). This permits hydraulic fluid to enter the retract side of the piston in the canopy actuating cylinder and at the same time provide a return for the fluid on the other side of the piston through the close port (8). With the control handle in "CLOSE" the control valve connects the pressure port (2) to the close port (8) and the open port (7) to the return (3) thereby reversing the fluid flow with pressure now going to the extend side of the actuating cylinder. When the control handle is placed in the "STOP" position the slide valve blocks off the open (7) and close (8) ports from both the pressure (2) and return ports (3) so that the fluid is locked in the cylinder. This arrangement permits the canopy to be locked in any desired position. When the control handle is in "EMERGENCY" the control valve simultaneously shuts off the main pressure port (2) and connects both the open (7) and close (8) ports together and to the return port (3). Note that when in "EMERGENCY," the fluid flow in the control valve is identical to that in "MANUAL," with, however, the slide valve in a slightly different (extended) position to accommodate the control handle which must travel an additional amount (to "EMERGENCY" position) to mechanically open the emergency air valve.

4—1160C. REMOVING. Relieve the main system pressure by cycling the wing flaps until the hydraulic gage in the cockpit reads zero. The control valve is accessible through the radio compartment access door.

a. Remove and cap the four hydraulic lines at the control valve.

b. Disconnect the fork-end fitting at the end of the slide valve from the jackshaft by removing the cotter pin, bolt, nut and washer.

c. Remove the four bolts which secure the control valve to the mount on bulkhead 186 and remove the unit from the airplane.

4—1160D. TESTING. Prior to the installation of this unit, the following test is made. (Refer to figure 4—114.)

a. Valve shall be completely filled with oil before leakage tests.

b. With selector valve set at neutral position, apply 1500 psi to pressure port for 3 minutes. Check leakage from the open, close and return ports. Leakage from each port shall not exceed 3-1/2 cc during the third minute of the pressure application.

c. Plug both the close and open ports. With valve set at "close" position, apply 1500 psi to pressure port for 3 minutes. Check leakage from return port. Leakage shall not exceed 3-1/2 cc during the third minute. Increase pressure to 2250 psi for 2 minutes. Reduce pressure to 0 psi. Cycle valve and return valve to "close" position. Increase pressure to 2250 psi for 2 minutes. There shall be no external leakage during test.

d. Plug both cylinder ports. With valve set at "open" position, apply 1500 psi to pressure port for 3 minutes. Check leakage from return port. Leakage shall not exceed 3-1/2 cc during the third minute. Increase pressure to 2250 psi for 2 minutes. Reduce pressure to 0 psi. Cycle valve and return valve to "open" position. Increase pressure to 2250 psi for 2 minutes. There shall be no external leakage during test.

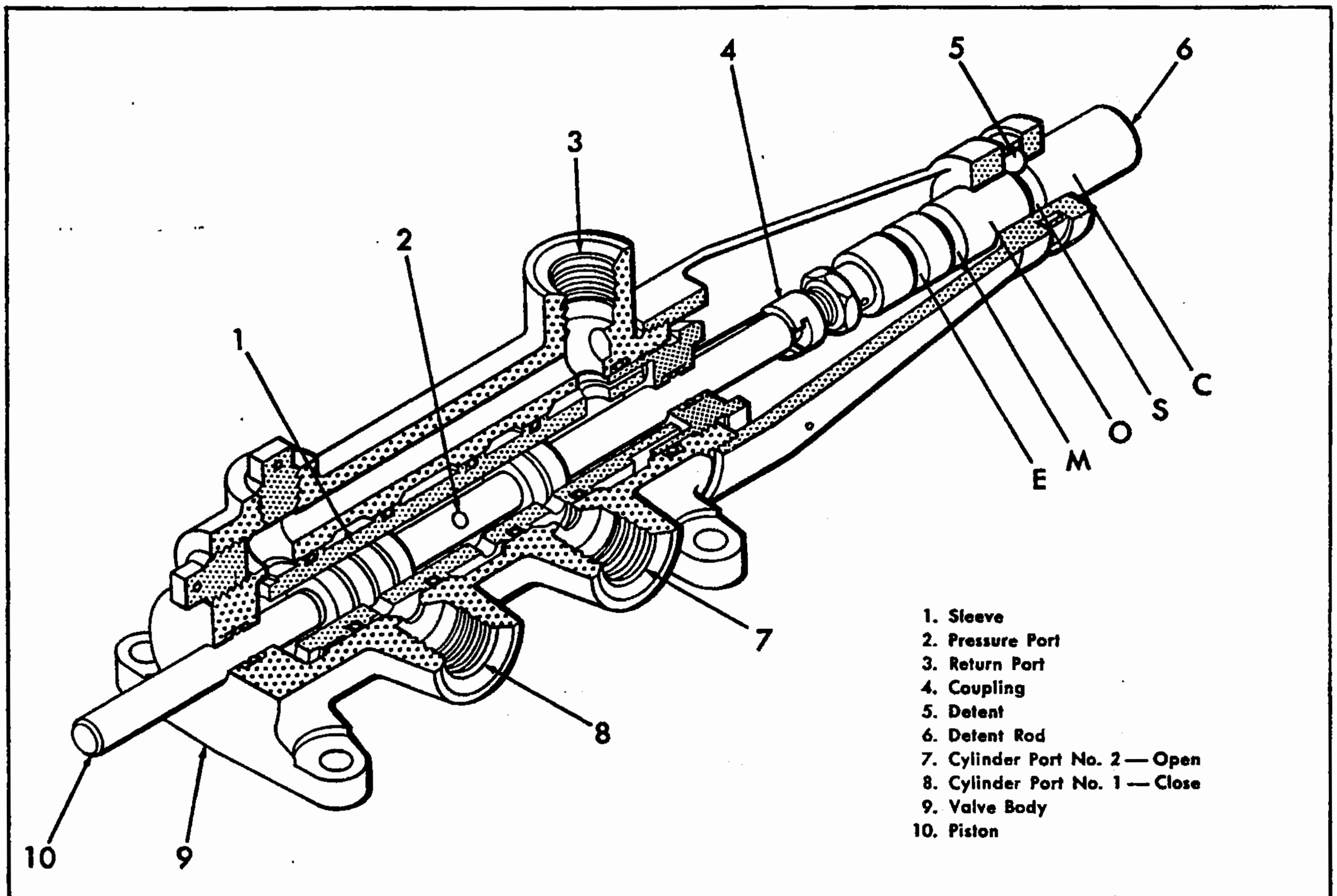


Figure 4—114 (Sheet 1 of 2 Sheets). Canopy Control Valve.

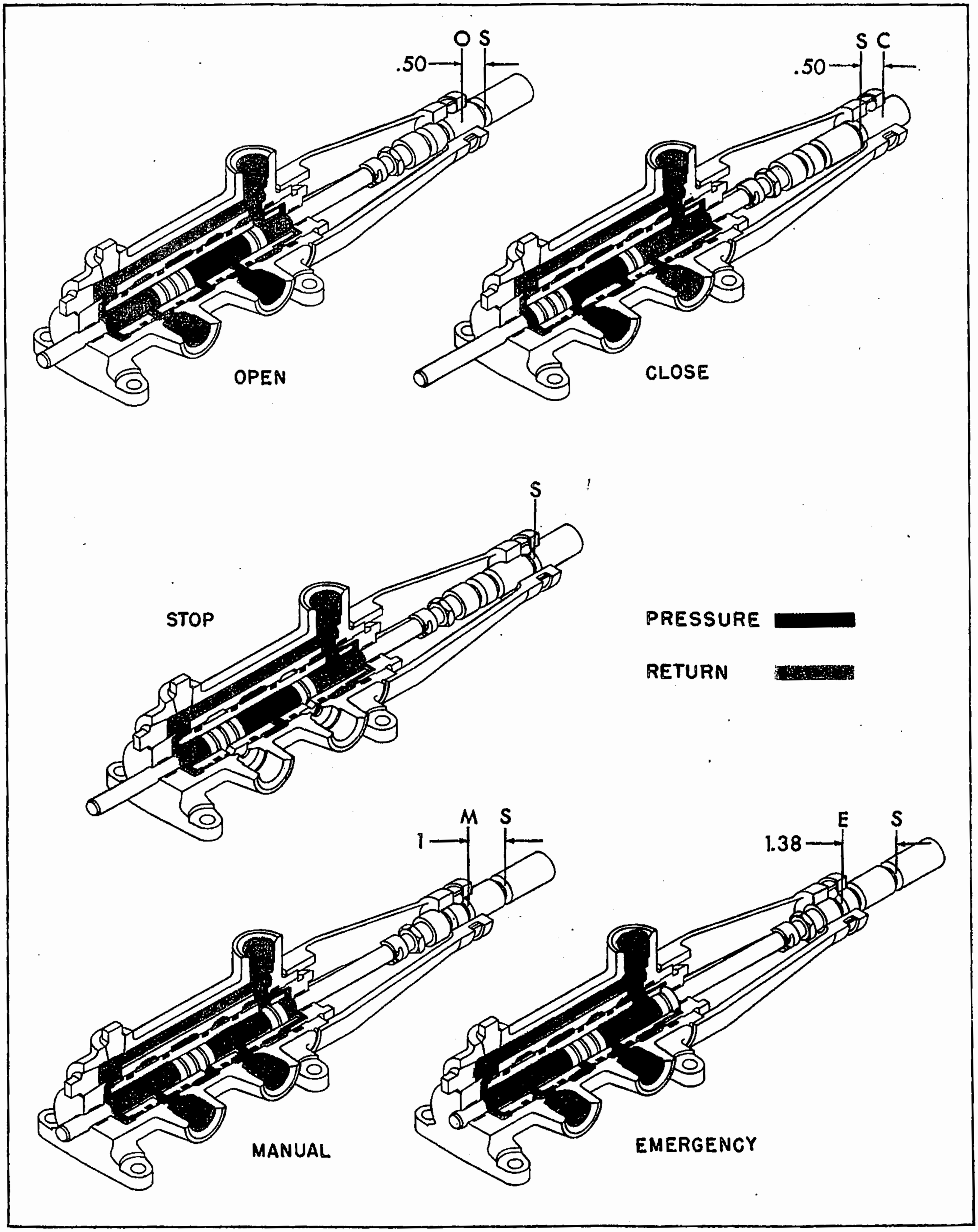


Figure 4—114 (Sheet 2 of 2 Sheets). Canopy Control Valve.

e. Plug both the open and close ports. Apply 1500 psi to pressure port. Force required to move valve from any one rod setting to any other shall be 16 pounds maximum of which approximately 10 or 11 pounds shall be detent force.

f. With all ports open and valve set at neutral, apply 750 psi to return port for 2 minutes. Reduce pressure to 0 psi. Cycle valve and return valve to neutral. Increase pressure to 750 psi for 2 minutes. There shall be no external leakage during test.

g. With all ports unplugged and valve set at "close" position, supply low flow to pressure port. There shall be flow from close port. With valve set at "open" position, there shall be flow from open port.

h. With valve set at "emergency" position, supply low flow to close port. There shall be flow from both return and open ports.

i. With return port plugged and valve set at "manual" position, supply low flow to close port. There shall be flow from open port.

4–1160E. INSTALLING. The installation of the control valve is the reverse of the removal procedure given in paragraph 4–1160C.

4–1161. CHECK VALVE.

4–1162. DESCRIPTION. *(Refer to figure 4–112.)* This valve is similar except for size to the check valve referred to in paragraphs 4–953 through 4–957. It is located at station 160 in the canopy pressure line and is accessible through the lower cockpit access door. The purpose of this unit is to hold canopy system pressure in the event that main system pressure is lost.

4–1163. RESTRICTOR VALVE.

4–1164. DESCRIPTION. *(Refer to figure 4–112.)* This unit is purchased from Adel Precision Products Corporation, Burbank, California. Their part number is A10003. This valve limits the speeds at which the canopy may open or close. The valve consists of a cast aluminum housing containing an adjusting screw which changes the amount of restriction. A locknut is provided to hold the adjusting screw in the desired position. This unit is located aft of station 186 below the canopy control valve in the return line and is accessible through the radio compartment access door.

4–1165. REMOVING. Relieve main system pressure until hydraulic gage reads zero.

a. Remove and cap the hydraulic lines at the restrictor valve. Remove the valve.

4–1166. TESTING. The following test is made prior to the installation of the valve.

a. Supply a flow to one port and check for free flow from other port. If adjustment screw is turned down completely, back off three or four turns.

WARNING

Do not continue to back off adjustment screw if no flow is obtained, as personal injury may result.

b. Plug one port and apply 10 psi at unplugged port for two minutes. Increase pressure to 2250 psi for one minute. There shall be no external leakage.

4–1167. INSTALLING. Reverse the removal procedure given in paragraph 4–1165. After installation of the restrictor valve, check operation of canopy with restrictor opened two turns. Final adjustment of restrictor should be made to cause canopy to open within five seconds.

4–1168. COCKPIT CANOPY EMERGENCY SYSTEM.

4–1169. DESCRIPTION. *(See figure 4–112.)* The emergency system for canopy opening is used when the canopy fails to open hydraulically. The units which make up the air system are the air bottle, the gage and filler, the emergency valve, the vent check and bleeder valve, and the shuttle valve. To operate the emergency air system, put the canopy control lever in the "EMERGENCY" position. This opens the emergency air valve, and air from the bottle passes through to the shuttle valve. From the shuttle valve, the air goes to the pressure port of the canopy cylinder, causing cylinder to retract, thus opening canopy in not more than three seconds.

4–1170. AIR BOTTLE AND VALVE ASSEMBLY.

4–1171. DESCRIPTION. *(Refer to figure 4–112.)* This assembly is manufactured by the Walter Kidde and Co., of Bloomfield, N. J. The air bottle is a gunfire-resistant, lightweight cylinder, AN6025-1. The self-opening valve which is screwed into the air bottle is a Walter Kidde product, their part No. MS870093. This valve opens when the coupling nut of the attaching air line depresses the poppet. This bottle and valve assembly is held by brackets on the upper right hand portion of the frame at station 193½. This unit has a decal which indicates the pressure to which the bottle is to be filled (1800 psi). The bottle may be filled either in the installed position, or when removed from the airplane.

4–1172. FILLING—AIR BOTTLE INSTALLED. The procedure for filling the canopy air bottle is identical with that directed in paragraph 4–1037.

4–1173. FILLING—AIR BOTTLE REMOVED. Refer to paragraph 4–1038 for filling procedure.

Note

Fill air bottle to 1800 psi. Since temperature changes will result in pressure changes, the following limits should be adhered to:

Deck Temperature	*Min. Pressure*	*Max. Pressure*
Above freezing	1600 psi	2000 psi
Below freezing	1400 psi	1900 psi

It is not necessary to bleed or fill air bottle if the above conditions are met.

4—1174. REMOVING. The following procedure applies when removing the air bottle from the airplane:

a. Disconnect the Kidde coupling nut, No. 33825, which attaches the air line to the self-opening valve.

b. Loosen the two nuts which secure the air bottle to the clamps. Remove the air bottle.

4—1175. TESTING. The following test is made prior to installing the bottle and valve assembly.

a. Using set-up noted below, fill bottle to 1800 psi. Break test pressure line at disconnect on bottle. Immerse bottle in hydraulic fluid for five minutes, minimum. There shall be no evidence of leakage.

Note

Make set-up for air pressure application using CV4-601021-6 tube assembly on the discharge end of pressure line from the air pressure source.

4—1176. INSTALLING. The installation of the air bottle is the reverse of the removing procedure given in paragraph 4—1174.

4—1177. GAGE AND FILLER.

4—1178. DESCRIPTION. *(Refer to figure 4—112.)* This part is manufactured by the Kenyon Instrument Co., Huntington Station, Long Island, N. Y. Their part number is 60005. The gage is installed on a bracket at the right hand side of the airplane between stations 205.5 and 211.5. This unit is accessible through the radio compartment access door. The gage gives an indication of air bottle pressure and has a Schrader air valve mounted on the housing for refilling the air bottle. To fill air bottle or read air bottle pressure, the gage lever must be depressed. This gage is a Bourdon tube type with a face reading up to 3000 psi.

4—1179. REMOVING. Access to this unit is gained through the radio compartment access door.

a. Remove the air line from the gage.

b. Remove the three screws which secure the gage to the brackets. Remove gage.

4—1180. TESTING. Refer to paragraph 4—1045 for complete test of this gage.

4—1181. INSTALLING. The installation of the air gage is the reverse of the removing procedure directed in paragraph 4—1179.

4—1182. VENT CHECK AND BLEEDER VALVE.

4—1183. DESCRIPTION. *(Refer to figure 4—112.)* The vent check valve is manufactured by Walter Kidde & Co., Inc., Bloomfield, N. J. Their part number is 66097. The valve is installed just forward of station 223 on the left hand side of the airplane. It is accessible through the radio compartment access door. A manual bleed button on the valve permits bleeding of the system after use of emergency air. This unit is identical to the valve used in the landing gear system. For a description and test of this valve refer to paragraphs 4—1048 and 4—1050.

4—1184. REMOVING. To remove the valve, loosen the end fitting nut and unscrew the valve from the tubing connection.

4—1185. INSTALLING. The installation of the vent check valve is the reverse of the removal procedure.

4—1186. EMERGENCY VALVE.

4—1187. DESCRIPTION. *(Refer to figure 4—112.)* This valve is identical to the one used on the emergency landing gear system. Refer to paragraph 4—1031 for description and 4—1033 for the test of this unit. This valve is installed adjacent to the canopy actuating cylinder, and is opened through a mechanical connection by putting the cockpit control in the "EMERGENCY" position.

4—1188. REMOVING. Access to this unit is gained through the radio compartment access door.

a. Remove the two air lines at the valve.

b. Remove the two bolts which secure the valve to the beam. Remove the valve.

4—1189. INSTALLING. The installation of the emergency valve is the reverse of the removing procedure.

4—1190. SHUTTLE VALVE.

4—1191. DESCRIPTION. *(Refer to figure 4—112.)* This valve, (AN6209-4, Hydro Aire part no. 1510) is identical to the valve used in the landing gear emergency system except for size. For a description of the valve, refer to paragraph 4—1053 and for the test of this unit, refer to paragraph 4—1055. It is located just below the canopy actuating cylinder.

4—1192. REMOVING. Access to the shuttle valve is gained through the radio compartment access door.

a. Remove and cap the three lines at the valve.

b. Remove the two bolts which secure the valve to the bracket. Remove the valve.

4—1193. INSTALLING. The installation of the shuttle valve is the reverse of the removal procedure given in paragraph 4—1192.

4—1194. TUBING CHART. Figure 4—115 should be used as a reference key in conjunction with the following table.

TUBING CHART—CANOPY HYDRAULIC SYSTEM

(Refer to Figure 4—115)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-58312-79	1	¼	.035	33 13/16	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN832-4D Union AN924-4D Nut
VS-58312-75	2	¼	.035	32¾	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN832-4D Union AN924-4D Nut
VS-58311-19	3	¼	.035	17	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN832-4D Union AN924-4D Nut AN833-4D Elbow
VS-58311-17	4	¼	.035	12⅛	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN832-4D Union AN924-4D Nut
VS-58311-45	5	¼	.035	9⅝	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN919-6D Reducer AN6227-9 Packing
VS-58311-31	6	¼	.035	4 13/16	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN6207-4 Hydraulic Check
VS-58311-43	7	¼	.035	10¾	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN6227-9 Packing AN919-6D Reducer
VS-58311-49	8	¼	.035	5 7/16	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN833-6D Elbow AN924-6D Nut AN6227-9 Packing VS-34216 Adapter
VS-58311-51	9	¼	.035	11	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN6227-7 Packing (1 req.) VS-34216 Adapter AN833-4D Elbow AN924-4D Nut AN833-6D Elbow AN924-6D Nut AN6227-9 Packing (1 req.)
VS-58311-39	10	¼	.035	8 13/16	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN815-4D Union AN6227-7 Packing

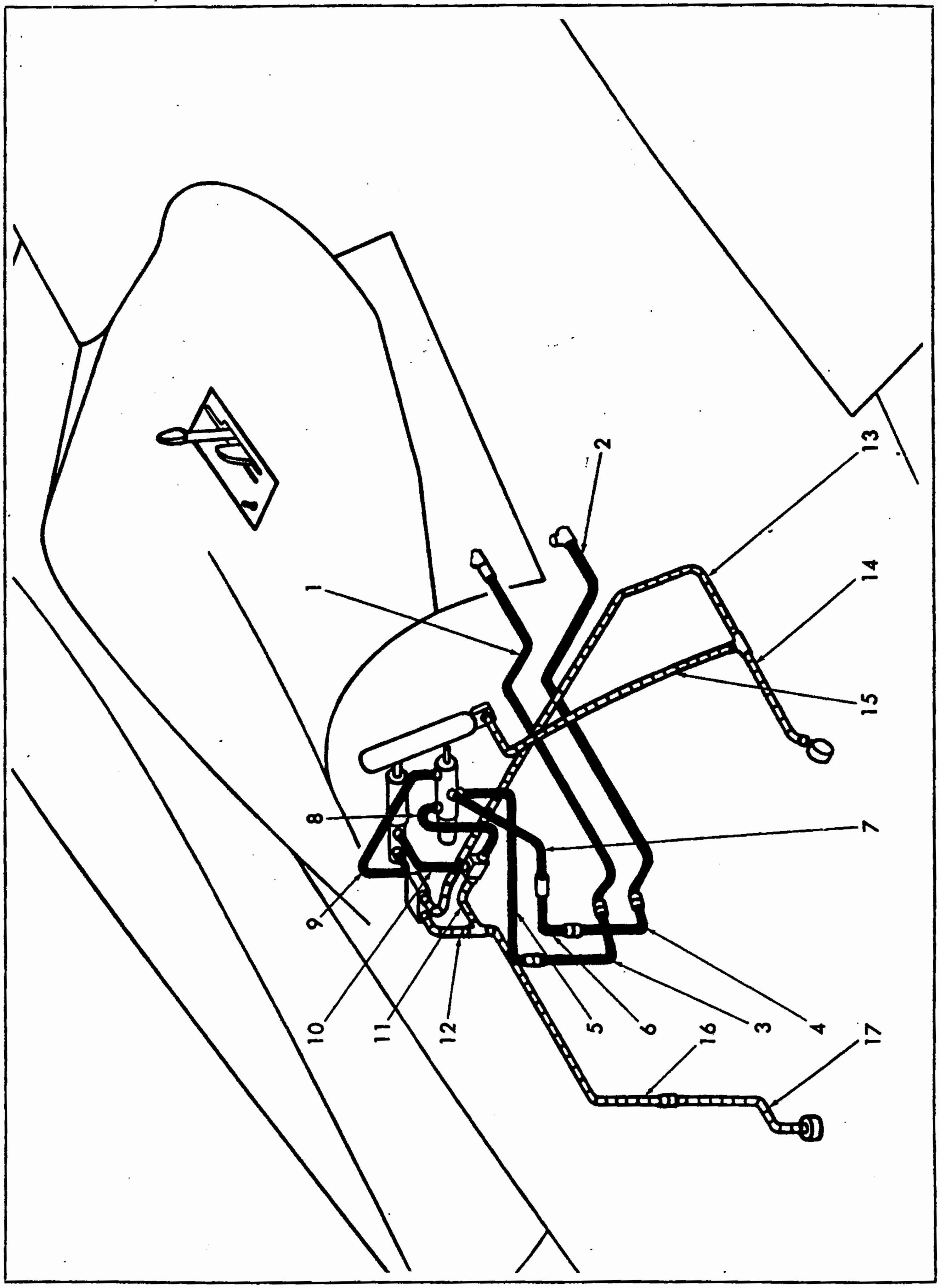


Figure 4-115. Hydraulic System—Cockpit Canopy Tubing Diagram.

TUBING CHART — CANOPY HYDRAULIC SYSTEM (Continued)

(Refer to Figure 4–115.)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-58399-51	11	¼	.035	5¼	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN926-4D Tee AN924-4D Nut AN815-4D Union AN833-4D Elbow (2 req.) AN6227-7 Packing (3 req.)
VS-58399-39	12	¼	.035	1⅞	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN833-4D Elbow AN6227-7 Packing
VS-58399-3	13	3/16	.035	45	Spec. WW-T-787	AN818-3D Nut AN819-3Z Sleeve AN804-3D Tee AN924-3D Nut AN815-3D Union
VS-58399-47	14	3/16	.035	8 13/16	Spec. WW-T-787	AN818-3D Nut (2 req.) AN819-3Z Sleeve (2 req.) AN919-2D Reducer AN6227-7 Packing
VS-54015	15	3/16	.035	22	Spec. WW-T-799	AN818-3D Nut AN819-3Z Sleeve Walter Kidde Coupling Nut 33825
VS-58399-53	16	¼	.035	29	Spec. WW-T-787	AN815-4D Union AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.)
VS-58399-55	17	¼	.035	15½	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN919-6D Reducer AN6227-7 Packing

4–1195. HYDRAULIC SYSTEM — INTERCOOLER FLAP.

4–1196. DESCRIPTION. *(Refer to figures 4–95 and 4–116.)* The units which make up the intercooler system are the actuating cylinder, selector valve, relief valve, thermal relief valve, and a restrictor. The volume of air which passes through the intercoolers is controlled by a flap on the underside of the engine accessory section. The flap is opened or closed by the actuating cylinder, the flow to which is controlled by a solenoid selector valve. This selector valve is automatically controlled by a pressure differential switch installed on the forward section of the left hand intercooler. The switch is actuated by the pressure drop of the air passing through the intercooler; refer to paragraph 4–492 for further information on the switch. A flexible diaphragm, within the switch, varies as the pressure differential between the air entrance and that of the accessory compartment changes. When the pressure differential reaches a point where more air is needed through the intercooler, the diaphragm contacts a microswitch which energizes a solenoid valve, thus sending flow to the actuating cylinder and opening the flap. Since the intercoolers are not required when the dual auxiliary stage blowers are not functioning, an override microswitch actuated by the propeller control lever is provided in the engine control unit which causes the intercooler flap to close when the propeller is governed at 2300 rpm and below. A toggle switch on the center control panel, wired directly to the solenoid valve, permits the pilot to override all other settings and fully open or close the intercooler flap. Refer to paragraph 5–81 for electrical wiring diagram information.

4–1197. SELECTOR VALVE.

4–1198. DESCRIPTION. *(Refer to figure 4–116.)* The solenoid controlled selector valve is manufactured by Adel Precision Products, of Burbank, California. Their drawing number is 13802. It is installed on the hydraulic panel and controls the flow of hydraulic fluid to the intercooler flap actuating cylinder. This valve is electrically connected to the automatic control switch, the double pole, double throw switch at the pilot's control box, the propeller control unit, and a circuit-breaker. The valve consists of a four port housing with four solenoid operated poppets held closed normally and opened by energizing the solenoid.

4–1199. REMOVING. This unit is accessible by removing the right hand upper wing gap panel. Relieve main system pressure by cycling wing flaps until hydraulic gage in cockpit reads zero.

a. Disconnect and cap the four hydraulic lines at the valve.

b. Disconnect the electrical plug from the valve.

c. Remove the four bolts which secure the valve to the hydraulic panel. Remove valve.

4–1200. TESTING. The following test is made prior to installation of the selector valve. The electrical contact "A" on the receptacle energizes solenoid No. 1. When solenoid No. 1 is energized, cylinder port No. 1 is open to pressure and cylinder port No. 2 is open to return. When solenoid No. 2 is energized through contact "B," cylinder port No. 2 is open to pressure, and cylinder port No. 1 is open to return. When the solenoids are not energized, the valve returns to neutral.

a. With cylinder and return ports open, apply 2250 psi to pressure port for two minutes. Reduce pressure to zero psi and actuate valve. Increase pressure to 2250 psi for two minutes. There is to be no external leakage during test. Repeat test applying proof pressure to each cylinder port separately (plug pressure port during this portion of test).

b. With a low flow supplied to pressure port, there should be free flow from cylinder port number one with current applied at contact "A" and free flow from cylinder port two with current applied at contact "B."

c. Apply pressure of 100, 300, and 1500 psi to the pressure port for three minutes each. Cycle valve between pressure applications. Check leakage from cylinder and return ports after second minute of each pressure application. Leakage from any port is not to exceed one drop per minute. Repeat test, applying test pressures to each cylinder port separately (plug pressure port during this portion of test).

d. With a low flow applied to port one and current applied to contact "B," there shall be flow from return port. With a low flow applied to port two and current applied to contact "A," there shall be flow from the return port. When low flow is applied to port one, there will be a momentary discharge from port two, due to trapped pressure in pressure port. When low flow is applied to port two, the same momentary flow will occur at port one.

4–1201. INSTALLING. The installation of the selector valve is the reverse of the removing procedure given in paragraph 4–1199.

4–1201A. FILTERS.

4–1201B. DESCRIPTION. These units are manufactured by Purolator Products, Inc. of Newark, N. J. There are three filters, all of which are located on the hydraulic engine power panel on the right hand side of the engine. The purpose of these filters is to keep dirt from damaging the delicate mechanisms of the selector valve. The main pressure line filter, Purolator part No. 31585, which is screwed directly into the selector valve, is larger than the other two, and incorporates a replaceable type filter element and a relief valve, with which the other two filters are not provided. The relief valve by-passes hydraulic fluid should the filter become clogged. It opens if the differential pressure between the interior and exterior of the filter is from 24 to 31 psi. The other two filters are identical, their part number 32037. One is connected into the intercooler cylinder close line between the restrictor and relief valve. The other is connected into the open line and is screwed into the selector valve.

4—1201C. REMOVING. Relieve main system pressure by cycling wing flaps until hydraulic gage in cockpit reads zero.

a. Disconnect the two fittings at each end of the filter and remove filter.

4—1201D. TESTING. The following test is made prior to the installation of each filter.

a. Plug outlet port. Apply five psi for three minutes, and then 2250 psi for one minute at the inlet port. There should be no external leakage.

4—1201E. INSTALLING. The installation of the filters is the reverse of the removal procedure given in paragraph 4—1201C.

4—1202. RELIEF VALVE.

4—1203. DESCRIPTION. *(Refer to figure 4—116.)* This AN6200-4A part (VS-58279) may be purchased from Hydro-Aire, Beverly Hills, California. It is mounted on the aft portion of the hydraulic panel. The purpose of this relief valve is to allow the intercooler flap to blow open, should ram air pressures exceed safe structural loads. The relief valve is set to crack at 1150 psi. This valve has a four-port housing with one port capped and one line going to the retract side of the intercooler cylinder. The second line goes to the retract port of the selector valve and the third line connects directly to the main return line.

4—1204. REMOVING. Relieve the main system pressure by cycling the wing flaps until the hydraulic gage in the cockpit reads zero.

a. Remove and cap the three hydraulic lines at valve.

b. Remove the four bolts which secure the valve to the hydraulic panel. Remove valve.

4—1205. TESTING. The following test is made prior to the installation of the intercooler relief valve.

a. Plug all but one pressure port. Apply 3100 psi to the pressure port for two minutes. There shall be no external leakage.

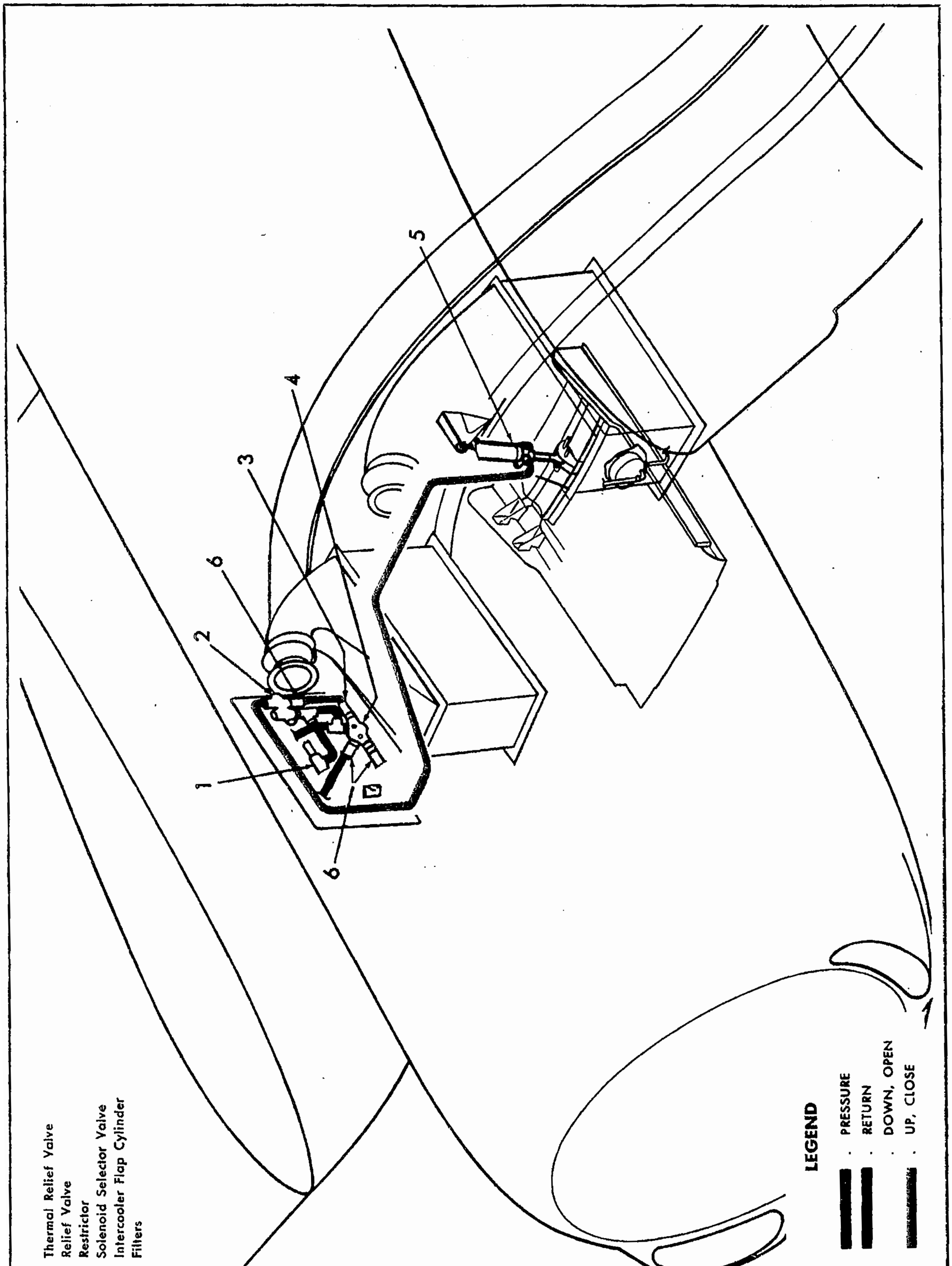


Figure 4-116. Hydraulic System—Intercooler Flap.

b. Apply slowly increasing pressure to one pressure port with opposite pressure port plugged. There shall be no leakage from return port below 1150 psi. Check leakage carefully by overflow method (filling port to be tested with hydraulic fluid and checking overflow) or a method of equivalent accuracy.

c. Increase flow to 1.2 gpm. Pressure should not exceed 1265 psi. (See Note.) Slowly decrease flow until a minimum pressure of 1035 psi has been reached. Hold this pressure constant for one minute. Valve must reseat at 1035 psi or above.

Note

Subtract whatever back pressure is incurred from use of the test return line for maximum relief pressure reading.

4—1206. INSTALLING. The installation of the relief valve is the reverse of the removal procedure given in paragraph 4—1204.

4—1207. INTERCOOLER FLAP ACTUATING CYLINDER.

4—1208. DESCRIPTION. *(Refer to figure 4—116.)* The intercooler flap cylinder is a Chance Vought part. Its drawing number is VS-48105. It is attached on the cylinder end to a bracket just forward of the main beam and on the piston rod end to the intercooler flap. Access to this unit is gained by removing the bottom engine access door. The purpose of this unit is to open and close the intercooler flap. The general design features of this cylinder may be found in the description of the typical cylinder in paragraph 4—917. The disassembly, repair, assembly, and test of this unit are covered by paragraphs 4—919 through 4—922.

4—1209. REMOVING. Relieve the main system pressure by cycling the wing flaps until the hydraulic gage in the cockpit reads zero. Access to the cylinder is gained through the intercooler flap.

a. Disconnect and cap the two hydraulic lines at the cylinder.

b. Remove the bolt which secures the end of the cylinder to the bracket on the main beam and withdraw the quick disconnect at the flap. Remove the cylinder.

4—1210. INSTALLING. The installation of the intercooler cylinder is the reverse of the removal procedure given in paragraph 4—1209.

Note

Prior to installation of this cylinder, the test given in paragraph 4—922 must be made.

4—1211. THERMAL RELIEF VALVE.

4—1212. DESCRIPTION. *(Refer to figure 4—116.)* This part is identical in every respect except for location to the wing flap thermal relief valve. This valve is installed near the middle of the hydraulic panel and is accessible for removal through the right hand upper wing gap cover. Refer to paragraphs 4—1082 through 4—1086 for information on this unit.

4—1213. RESTRICTOR.

4—1214. DESCRIPTION. *(Refer to figure 4—116.)* This valve is purchased from Adel Precision Products Corporation, Burbank, California. Their part number is A10003. This valve limits the speed at which the intercooler flap may open or close. It has a cast aluminum housing containing an adjusting screw which varies the amount of restriction. A locknut is provided to hold the adjusting screw in the desired position. This valve is located adjacent to the intercooler selector valve on the hydraulic panel and is accessible with the right hand upper wing gap panel removed.

4—1215. REMOVING. Relieve main system pressure until the hydraulic gage in the cockpit reads zero.

a. Remove and cap the hydraulic lines at the valve. Remove valve.

4—1216. TESTING. The following test is made prior to the installation of the valve.

a. Supply a flow to one port and check for free flow from other port. If adjustment screw is turned down completely, back off three or four turns.

b. Plug one port and apply 10 psi pressure at unplugged port for two minutes. Increase pressure to 2250 psi for one minute; there shall be no external leakage.

WARNING

Do not continue to back off adjustment screw if no flow is obtained, as personal injury may result.

4—1217. INSTALLING. Reverse the removal procedure given in paragraph 4—1215. Open the restrictor adjusting screw one turn; test door, and then further adjust the screw until the door opens in 10 to 15 seconds.

4—1218. TUBING CHART. Figure 4—117 should be used as a reference key in conjunction with the following table:

TUBING CHART—INTERCOOLER FLAP HYDRAULIC SYSTEM

(Refer to figure 4—117.)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-58278-1	1	1/4	.035	5 5/8	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN924-4D Nut AN804-4D Tee
AN6264-4-46 1/2	2	3/16 ID		46 1/2	Spec. AN-H-24	AN837-4D Elbow AN924-4D Nut AN6227-7 Packing
VS-58278-3	3	1/4	.035	4 7/16	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN6227-7 Packing AN837-4D Elbow AN924-4D Nut NAS43-DD8-18 Spacer
VS-58278-13	4	1/4	.035	5 13/16	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819 4Z Sleeve (2 req.) AN924-4D Nut AN6227 Gasket AN804 4D Tee
VS-58278-15	5	1/4	.035	5 3/16	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN6227-7 Packing AN815-4D Union NAS43-DD3-18 Spacer
VS-58278-11	6	1/4	.035	4 3/16	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN815-4D Union AN832-4D Union AN6227-7 Packing (3 req.) AN924-4D Nut VS-12805 Restrictor
VS-58278-7	7	1/4	.035	11 3/4	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN933-4D Elbow AN924-4D Nut AN6227-7 Gasket AN815-4D Union
AN6264-4-68	8	3/16 ID		68	Spec. AN-H-24	AN833-4D Elbow AN924 4D Nut AN6227-7 Packing

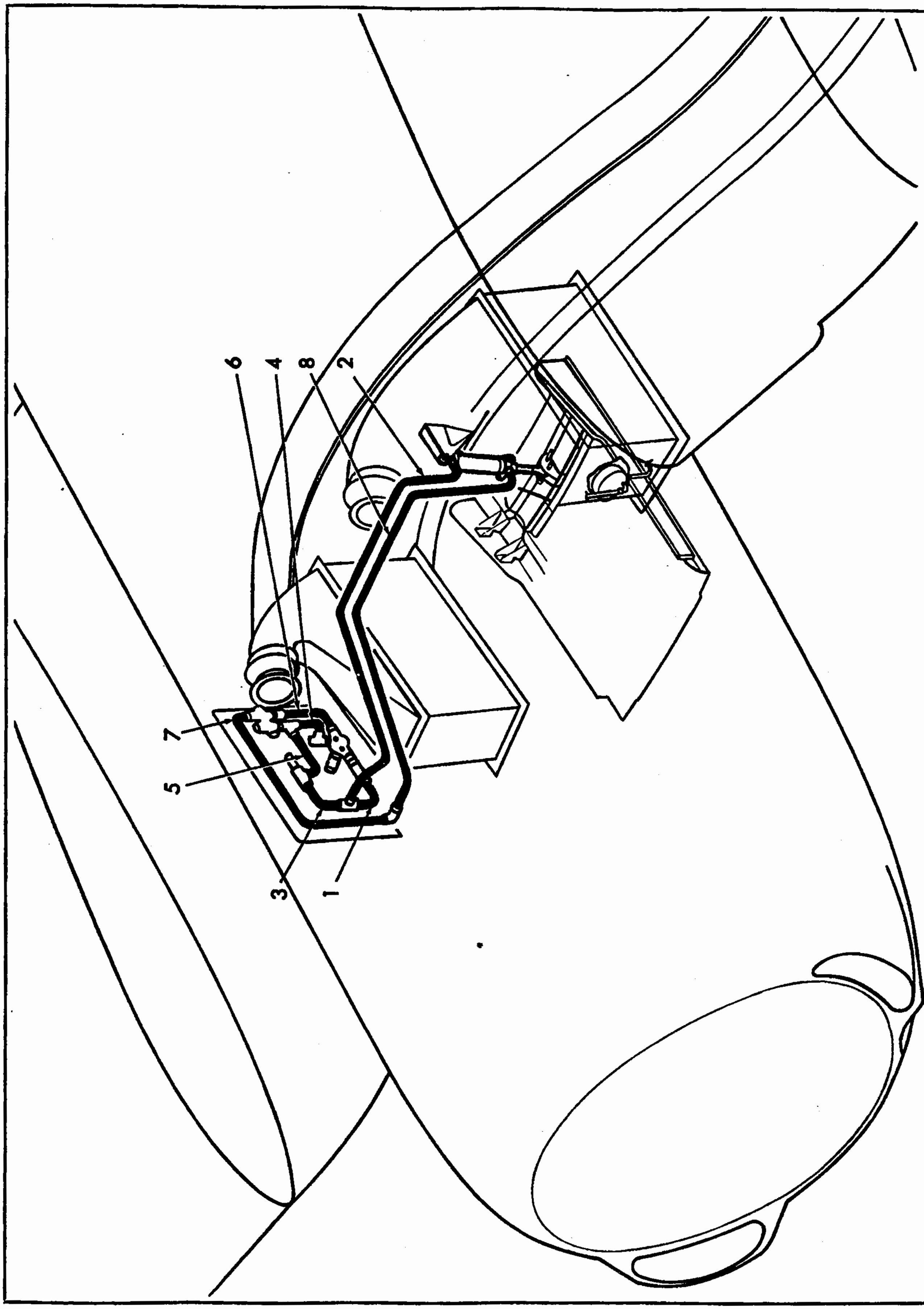


Figure 4—117. Hydraulic System—Intercooler Flap Tubing Diagram.

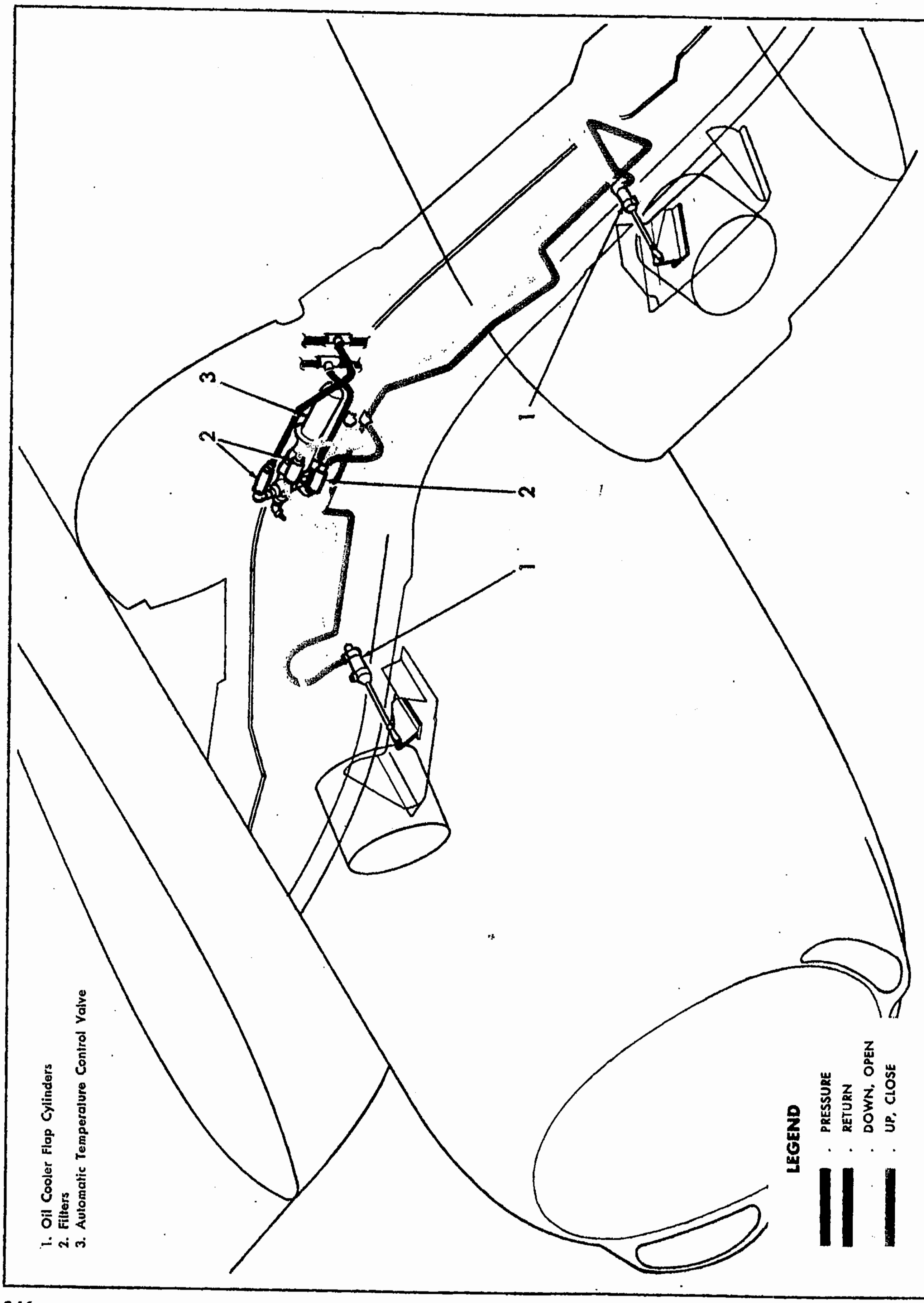


Figure 4-118. Hydraulic System—Oil Cooler Doors.

4—1219. HYDRAULIC SYSTEM — OIL COOLER DOORS.

4—1220. DESCRIPTION. *(Refer to figures 4—95 and 4—118.)* The units in this system are the automatic temperature control valve, the two oil cooler door cylinders, and three filters. The purpose of the system is to control oil temperature by opening or closing the oil cooler doors; see paragraph 4—700. The automatic temperature control valve has its thermal diaphragm element immersed in the hot oil return line from the oil cooler. Variations in oil temperature cause expansion or contraction of the diaphragm which, in turn, actuates the proper valve which supplies flow to either open or close the oil cooler flaps. The control for this system is a double pole, double throw switch located on the left hand control panel. In normal operation, the switch is kept in the automatic position. Should the automatic control system fail, this switch may be placed in the "OPEN" or "CLOSED" position to effect opening or closing of the doors. An indicator on the left hand control panel, electrically actuated by a transmitter located above the right hand oil cooler flap, indicates the position of the flap to the pilot. There are three micronic filters in the system; one in the pressure line to the valve and one in each of the cylinder lines. Their purpose is to minimize the possibility of dirt fouling the intricate mechanism of the automatic oil temperature control valve.

4—1221. OIL COOLER DOOR SELECTOR VALVE.

4—1222. DESCRIPTION. *(Refer to figure 4—118.)* The oil cooler door selector valve is manufactured by General Controls, Glendale, California. Their drawing number is 43R133, type tm 11.5. It is designed to control the fluid flow to the oil cooler door cylinders, thus operating the doors and controlling the volume of air passing through the oil coolers. This unit is mounted on a bracket on the front face of the firewall adjacent to the oil tank and just above the main beam. The four-way selector valve is directly operated by a temperature-reactant bulb assembly, the sensitive portion of which is immersed in the hot oil return line from the oil cooler. The control is set so that the oil cooler doors automatically begin to open at 75°C (167°F) and are fully open at 95°C (203°F).

4—1223. FUNCTION. The valve may also be operated by electromagnets which are energized by the "OPEN" and "CLOSED" position of the oil cooler door cockpit control switch; see paragraph 5—77 for electrical wiring diagram information. A rocker arm assembly within the valve housing is controlled by the movement of the temperature-controlled bellows and balanced by the reset arm which is connected to the oil cooler door. Figure 4—119A is a schematic representation of the operation of the selector valve when the oil cooler flap is closed and oil temperature is rising. The expanding bulb moves downward rotating the inner rocker arm about the stationary reset lever (1). The inner rocker exerts pressure on pin (3) forcing the outer rocker to rotate about fixed point (2) and compress spring (4). The rotation of the outer rocker moves the attached plungers which open the valves to allow hydraulic pressure to act on the extend port of the flap cylinder and to allow the return fluid to go back to the system. As the temperature becomes constant, the diaphragm ceases expansion and the reset lever, actuated by the motion of the flap, rotates the inner rocker upward. (See figure 4—119B.) This relieves some of the pressure on pin (3) allowing the spring (4) to return the outer rocker and the plungers to a horizontal neutral position. This cuts off the flow of fluid to and from the cylinder. The oil temperature drops (see figure 4—119C) and as the bulb contracts, it rotates the inner rocker arm upward about the fixed reset rod (1). Pin (3) is completely relieved of pressure and spring (4) expands, rotating the outer rocker so that the valves are set to the flap closed position. As the flap closes, the reset rod rotates the inner rocker downward (se figure 4—119D) so that the valve once again returns to the neutral position. When the switch in the cockpit is thrown to the "OPEN" position, one of the electromagnets is energized. The resultant plunger motion allows hydraulic pressure to reach the open override piston, which moves the outer rocker arm to the flap open position regardless of the temperature and reset conditions. However, the solenoid must remain energized to keep the door open; as soon as the cockpit switch is returned to "AUTOMATIC" position, the automatic control mechanism takes over. The "CLOSE" override operates in the same manner as the "OPEN" override, its override plunger being on the opposite end of the outer rocker. For further information on this unit, refer to Handbook of Instructions, Engine Coolant and Lubricating Oil Temperature Controls (AN 03-15-27).

Note

The override shall be used only during an emergency and shall be turned off immediately thereafter.

4—1224. REMOVING. The following procedure applies when removing the oil temperature regulator valve.

a. Remove the top accessory cowl panel.

b. Disconnect the electrical plug from the valve.

c. Disconnect the Teleflex control from the selector valve.

d. Drain the oil system; see paragraph 4—676.

e. Disconnect and cap the four hydraulic lines at the automatic control unit.

f. Remove the upper and lower clamps from the supporting bracket by loosening the bolt holding the two clamps together.

g. Remove the oil well and attached automatic control valve.

4—1225. TESTING.

4—1226. The following test is made prior to installing the automatic oil cooler control valve. With valve at

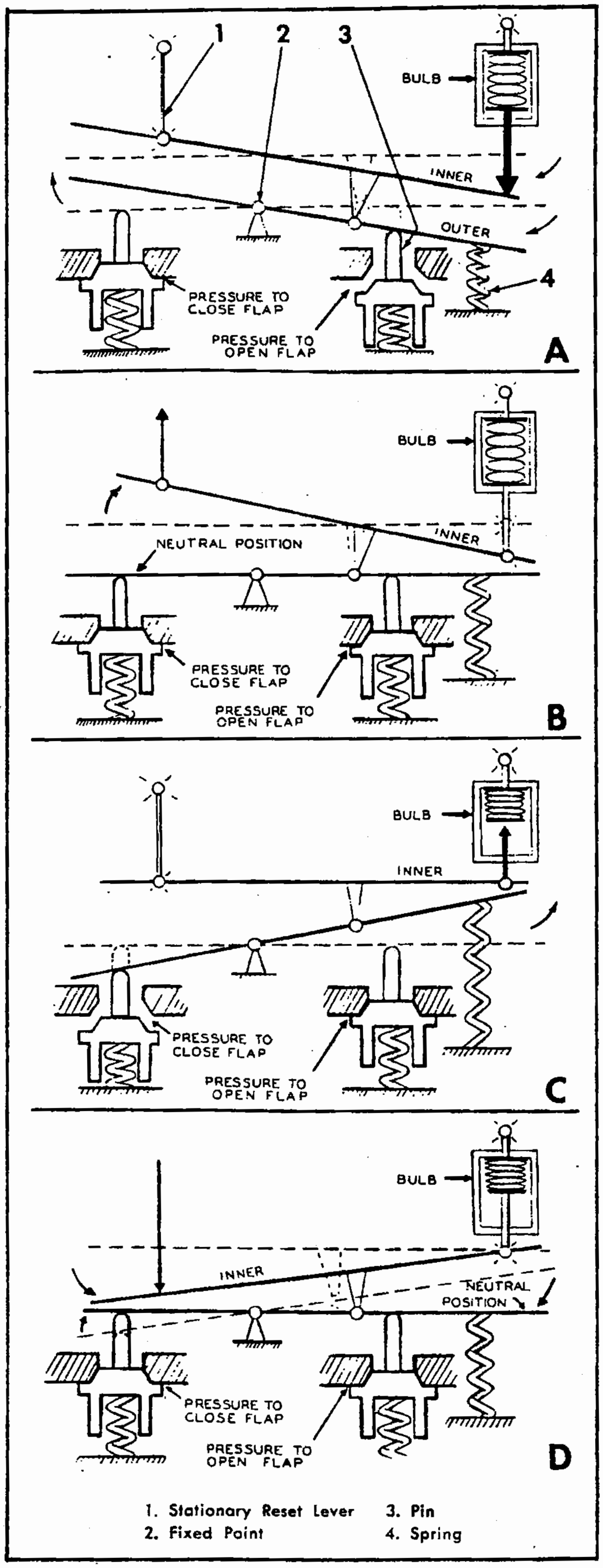


Figure 4–119. Operation of Oil Cooler Door Selector Valve.

room temperature, plug "flap open" port. Apply 5 psi to return port for ten minutes. No internal or external leakage shall occur.

4–1227. Perform the following bench test to check operation of the valve; see figure 4–120 for test set-up.

a. Immerse bulb assembly in oil up to flange.

b. Reset arm on valve must be set at ten degrees from full closed position for all tests except as noted.

c. Oil in bath must be constantly mixed during test.

d. Supply one gpm flow to pressure port. Cylinder must extend.

e. Move reset arm to "full closed" position. Cylinder must not retract.

f. Apply 1500 psi to pressure port for two minutes. Disconnect "open" and "return" lines. Internal leakage shall not exceed 15 drops per minute. Increase pressure to 2250 psi for two minutes. There is to be no external leakage.

g. Close override circuit to "door open." Cylinder must retract.

h. Open override circuit. Cylinder must extend. Repeat this test five times.

i. Raise temperature of oil bath slowly (no faster than 4°F per minute). Continually mix oil.

j. At 167°F (± 4°F), cylinder must retract.

k. At 172°F or over, close override circuit to "flap door closed." Cylinder must extend.

l. Open override circuit. Cylinder must retract. Repeat this test five times.

m. Apply 1500 psi for two minutes. Disconnect "close" and "return" lines. Internal leakage shall not exceed 15 drops per minute. Increase pressure to 2250 psi for two minutes. There is to be no external leakage.

4–1228. INSTALLING. The installation of this unit is the reverse of the removal procedure given in paragraph 4–1224.

CAUTION

In installing Teleflex controls the procedure given in paragraphs 4–602 through 4–604G must be followed exactly. Also see paragraph 6–6d.

4–1229. ADJUSTING. The control unit is designed to maintain the oil temperature between 75°C (167°F) and 95°C (203°F). Adjustment of this operating temperature through a range of plus or minus 5.5°C (10°F) is provided in the overtravel and calibration stem. Adjust as follows:

a. Remove the calibration inspection covers located just below the mounting flange.

b. Remove the safety wire from the adjusting discs just under the inspection cover.

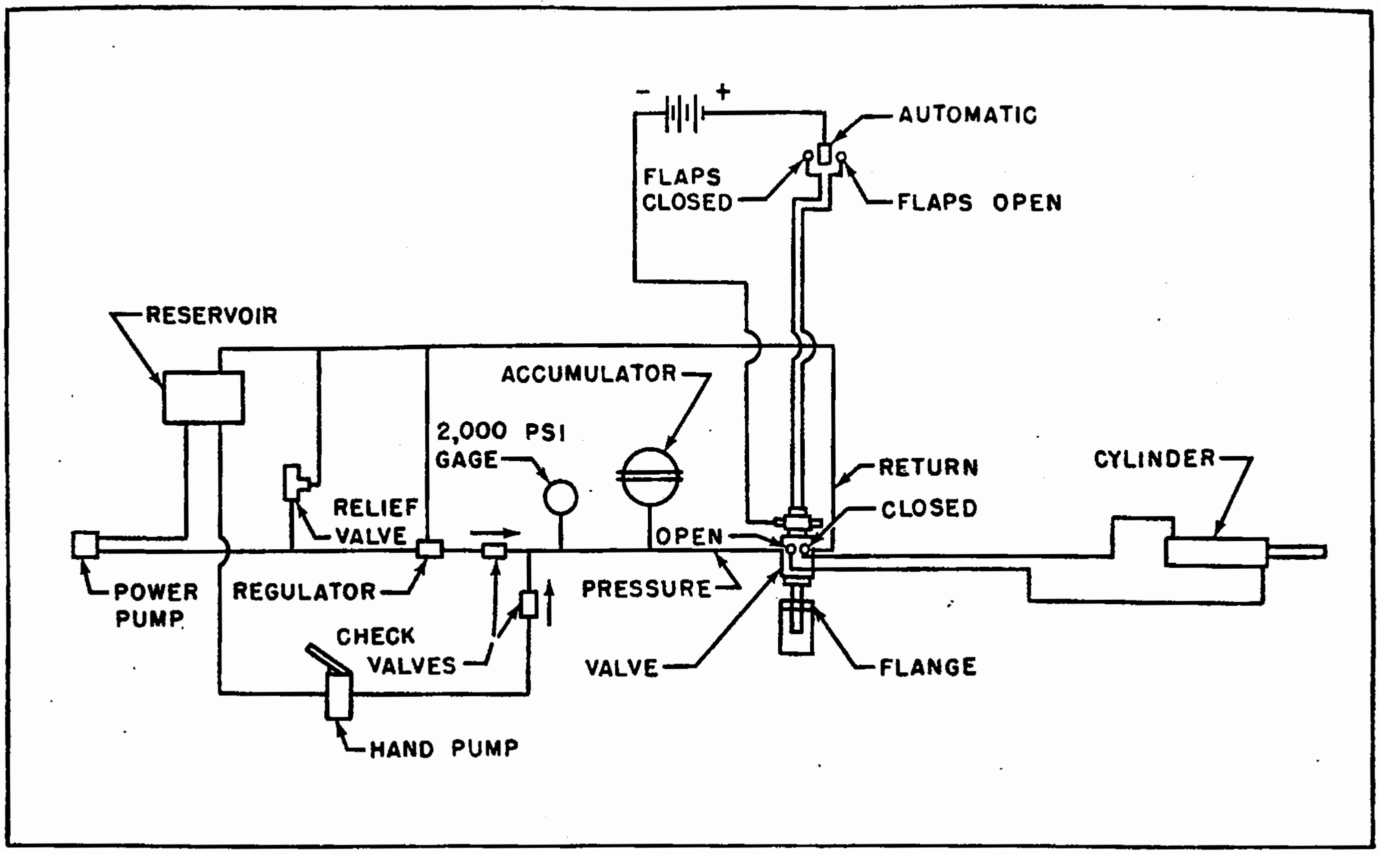


Figure 4—120. Oil Cooler Door Selector Valve Test Set-up.

c. Hold upper disc and rotate lower disc. Turn lower disc clockwise (when viewed from bottom) to increase, or counter clockwise to decrease temperature.

d. Re-safety the discs in their new position.

Note

It is suggested that operating temperature be made with unit mounted in airplane. Remove bottom engine accessory compartment cowl to gain access to unit. Operate engine to produce desired oil temperature, using cockpit oil temperature gage as a guide. By cutting out right hand oil cooler and using a cardboard cover in front of the left, the oil temperature desired can be easily reached.

4—1230. FILTERS.

4—1231. DESCRIPTION. (*Refer to fig. 4-118.*) The filters are manufactured by Purolator Products, Inc. of Newark, N. J. There are three of these units; one in the pressure line to the selector valve, and one in each of the cylinder lines. The main pressure line filter (Purolator Part No. 31585) is screwed directly into the selector valve. The other two filters (Purolator Part No. 32037) are located just forward of the main beam to the left of the airplane centerline in the oil cooler door cylinder lines. These filters are identical to those used in the intercooler flap system. For a description of these units, refer to paragraph 4—1201A.

4—1232. REMOVING. Relieve main system pressure by cycling wing flaps until hydraulic gage in cockpit reads zero.

a. Disconnect the two fittings at each end of the filter and remove filter.

4—1233. TESTING. The following test is made prior to the installation of each filter.

a. Plug outlet port. Apply five psi for three minutes, and then 2250 psi for one minute at the inlet port. There shall be no external leakage.

4—1234. INSTALLING. Installation of filters is reverse of removal procedure given in paragraph 4—1232.

4—1235. OIL COOLER DOOR CYLINDERS.

4—1236. DESCRIPTION. (*Refer to figure 4—118.*) These units are designed by Chance Vought Aircraft. Their drawing number is VS-58252. Each cylinder is installed with cylinder end attached to a bracket on main beam and piston rod end attached to oil cooler door. This unit consists of a cylinder with two threaded end caps locked with set screws, a piston and piston rod. The purpose of this unit is to open and close oil cooler doors when temperature control valve sends oil to either retract or extend ports of cylinder.

4—1237. REMOVING. Relieve the main system pressure by cycling the wing flaps until the hydraulic gage in the cockpit reads zero. These units are accessible when the oil cooler doors are open.

a. Remove and cap the two hydraulic lines at each cylinder.

b. Unfasten quick-disconnects which secure the rod ends to the brackets on the flaps.

c. Remove the bolts which secure the cylinders to the forward face of the main beam. Remove cylinders.

4—1238. DISASSEMBLY. The following procedure applies when disassembling the oil cooler flap cylinder.

a. Loosen both set screws in the end caps.

b. Unscrew the end caps and remove piston rod from end cap. All packings and gaskets are now accessible for replacement.

4—1239. LUBRICATING. On assembly, lubricate threads with anti-seize compound Spec. AN-G-6.

4—1240. REPAIRING. The repair of hydraulic cylinders is limited to the replacement of worn packings and gaskets. The replacement parts for these units are listed below.

CYLINDER	PACKING OR GASKET	NO. REQ.	LOCATION
Oil Cooler Door Actuating Cylinder			
	AN6227-17	1	Piston
	AN6426-17	2	Piston
	AN6227-23	2	Caps
	AN6227-7	1	Cap
	AN6246-7	1	Cap
	AN6232-C 3/16	1	Cap

4—1241. ASSEMBLING. Reverse the disassembly procedure given in paragraph 4—1238. Special attention is called to the fact that there are two leather back-up rings, one on either side of AN6227-17 packing.

4—1242. TESTING. Prior to installation of this cylinder, the test given in paragraph 4—922 must be made.

4—1243. INSTALLING. Reverse the removal procedure given in paragraph 4—1237.

4—1244. TUBING CHART. Use figure 4—121 as a reference key in conjunction with the following table.

TUBING CHART—OIL COOLER DOORS HYDRAULIC SYSTEM

(Refer to figure 4—121.)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-58278-19	1	1/4	.035	16 1/16	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN833-4D Elbow AN924-4D Nut AN6227-7 Gasket
VS-58278-21	2	1/4	.035	25 13/16	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) VS-48148 Filter Assy. AN927-4D Elbow AN832-4D Union AN924-4D Nut AN6227-7 Packing (3 req.)
VS-58278-23	3	1/4	.035	11 1/16	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.)
VS-58278-25	4	1/4	.035	10 7/8	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN927-4D Elbow AN832-4D Union AN924-4D Nut AN6227-7 Packing (3 req.) VS-48987 Filter Assy.
VS-58313-25	5	1/4	.035	30	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN827-4D Elbow AN824-4D Tee AN924-4D Nut
VS-58313-29	6	1/4	.035	31	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN924-4D Nut AN824-4D Tee AN837-4D Elbow

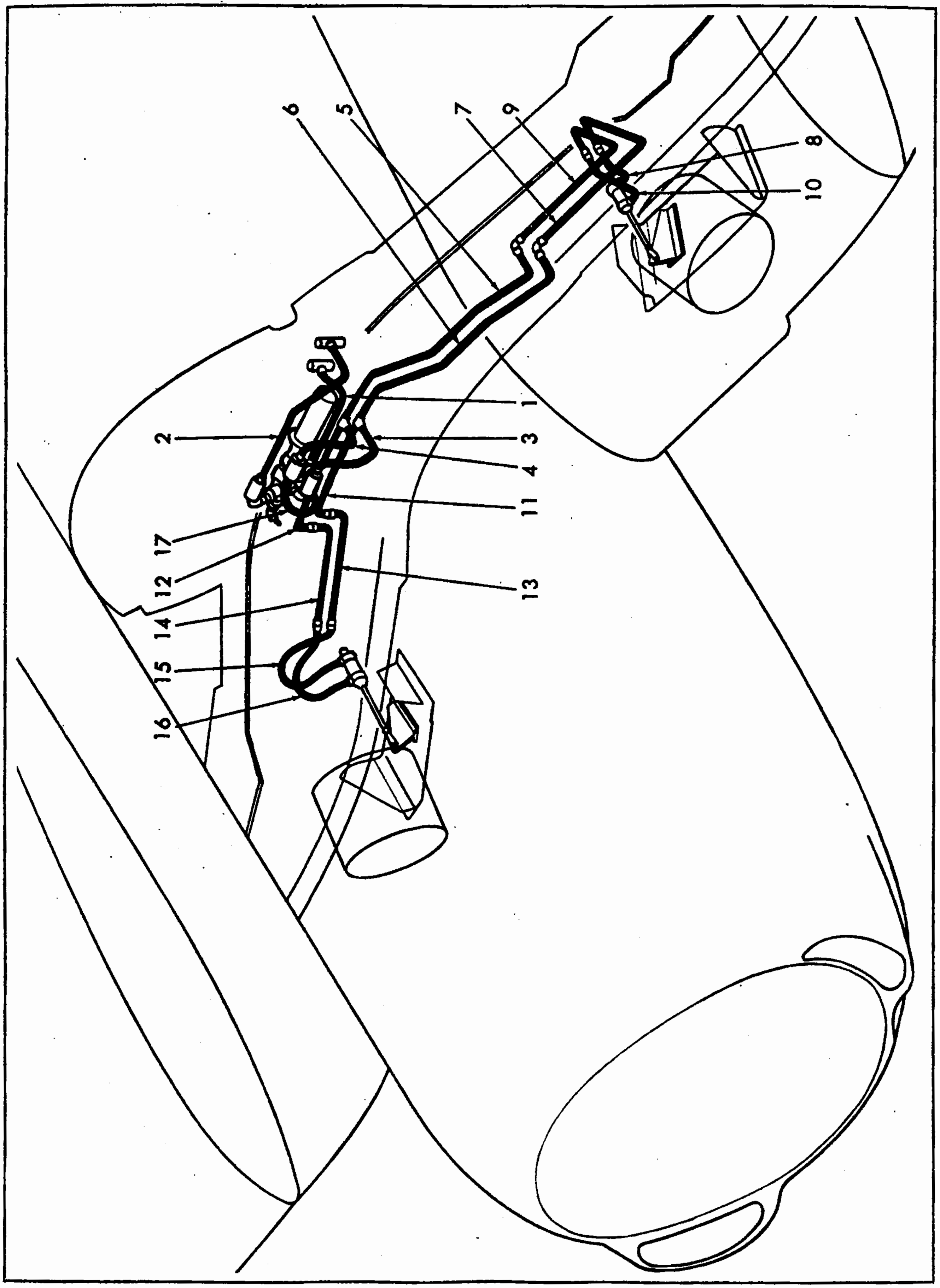


Figure 4—121. Hydraulic System—Oil Cooler Doors Tubing Diagram.

TUBING CHART—OIL COOLER DOORS HYDRAULIC SYSTEM (Continued)

(Refer to figure 4—121.)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-58313-31	7	¼	.035	12	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN924-4D Nut AN832-4D Union AN960-D716 Washer
AN6246-4-17	8					AN6227-7 Packing AN833-4D Elbow AN924-4D Nut
VS-58313-27	9	¼	.035	11	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN924-4D Nut AN832-4D Union AN960-D716 Washer
AN6246-4-18	10					AN6227-7 Packing AN815-4D Union
VS-58313-17	11	¼	.035	31	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN837-4D Elbow AN924-4D Nut
VS-58313-13	12	¼	.035	30	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN837-4D Elbow AN924-4D Nut
VS-58313-19	13	¼	.035	12	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN924-4D Nut AN832-4D Union AN960-D716 Washer
VS-58313-15	14	¼	.035	11	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN924-4D Nut AN932-4D Union AN960-D716 Washer
AN6224-4-17	15	3/16 ID		17	Spec. AN-H-24	AN815-4D Union (2 req.) AN6227-7 Packing AN833-4D Elbow AN924-4D Nut
AN6224-4-18	16	3/16 ID		18		AN815-4D Union (2 req.) AN6227-7 Packing
VS-58278-33	17	¼	.035	7 3/16		VS-48987 Filter Assy. AN815-4D Union AN6227-7 Packing AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.)

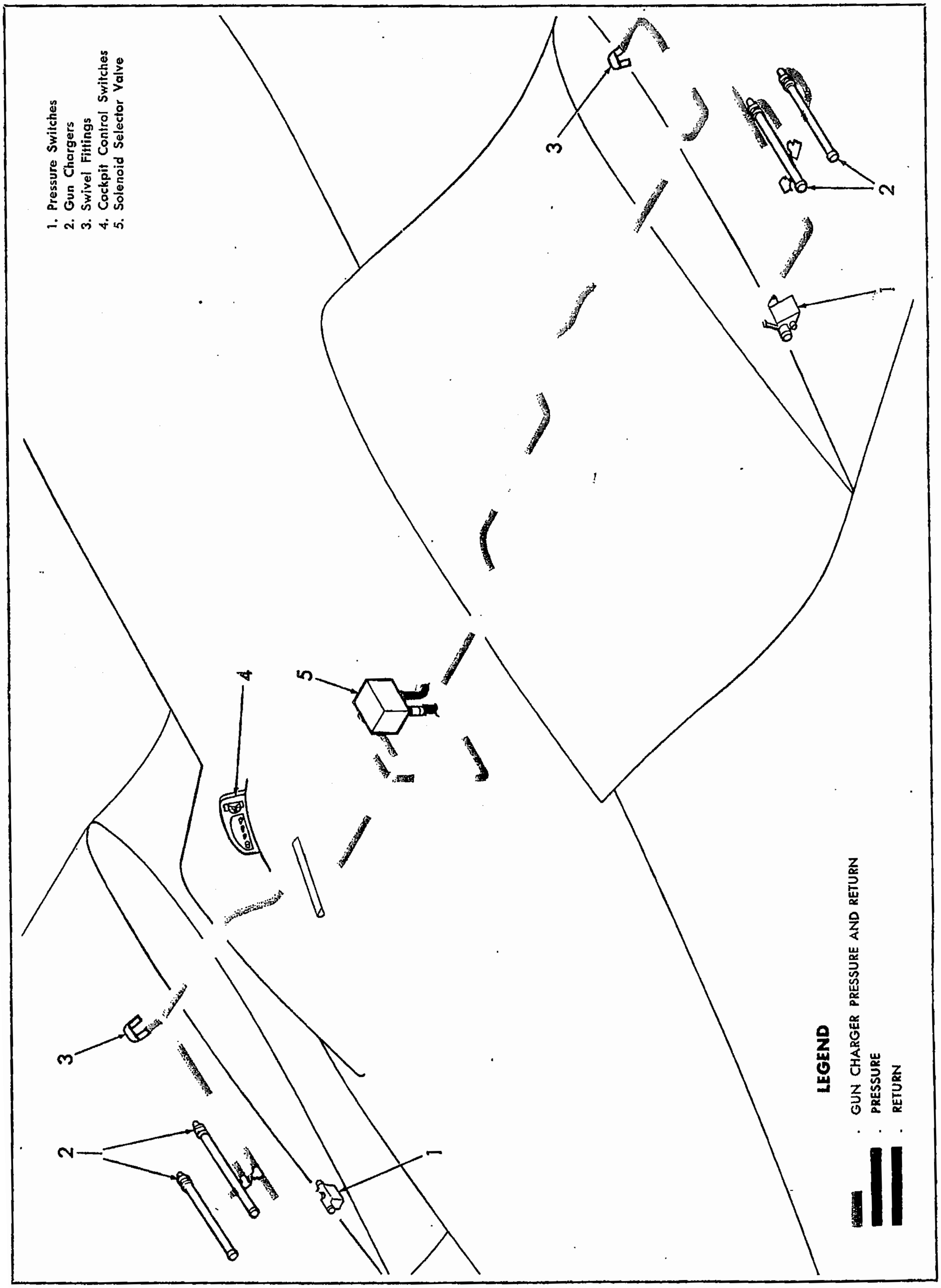


Figure 4–122. Hydraulic System—Gun Charging.

4—1245. HYDRAULIC SYSTEM — GUN CHARGING.

4—1246. DESCRIPTION. *(Refer to figures 4—95, 4—122 and 4—148A.)* The hydraulic gun chargers are used to charge the guns, hold the guns in a "safe" position, or eject a round which fails to fire. The flow of hydraulic fluid to the chargers is controlled, through a series of switches located on the left hand armament switch box in the cockpit, by a solenoid selector valve and pressure switches. When the "safe-ready" switch in the cockpit is thrown to the "READY" position and the "charge" button pressed, a solenoid is energized causing the pressure poppet on the selector valve to open, sending hydraulic fluid to the gun charger. The movement of the charger brings the bolt to the cocked position. As the charger completes its stroke, a relay and the pressure poppet solenoid which were energized by the "READY" switch position and by depressing the "charge" button, are de-energized, and the return port of the solenoid selector valve is opened, allowing the hydraulic fluid in the chargers to return to the system under pressure from the spring loaded charger piston which returns to the precharged position. This puts the guns in a charged state. If the "safe-ready" switch is in the "SAFE" position, hydraulic fluid is locked in the charger by the position of the poppets in the selector valve; this prevents the guns from firing. In the event that hydraulic leakage decreases the pressure of this locked fluid, a high pressure switch will open the selector valve pressure poppet, thus maintaining the guns in a "SAFE" position. When a round fails to fire, depressing the "charge" button momentarily with the "safe-ready" switch in the "READY" position will cycle the charger which, in turn, will eject the "dud" and allow a new round to enter the chamber. The hydraulic units which comprise the gun charging system are the solenoid selector valve, a pressure switch, the gun chargers, a check valve, and a thermal relief valve. Refer to paragraph 4—1768 for a mechanical interrelation of the charger and gun and to paragraphs 5—101 and 5—103 for electrical information.

4—1247. BENDIX SOLENOID SELECTOR VALVE.

4—1248. DESCRIPTION. *(Refer to figure 4—123* and *4—148A.)* This valve is manufactured by Bendix Products of South Bend, Indiana. Their drawing number is 83803. This valve controls the flow of hydraulic fluid both going to and returning from the chargers. It has two solenoid-operated pressure poppets which, when open, send pressure flow to the chargers and two solenoid-operated return poppets which allow return flow to go to the main system. The position of these solenoid-operated poppets is dependent on the position of the gunnery switches in the cockpit. Refer to paragraph 4—1246 for information on switch positions. This valve is located on the underside of the right hand forward section of the cockpit floor just aft of station 130.5. It is accessible through the lower cockpit access door.

4—1249. REMOVING. Access to the solenoid valve is gained through the lower cockpit access door.

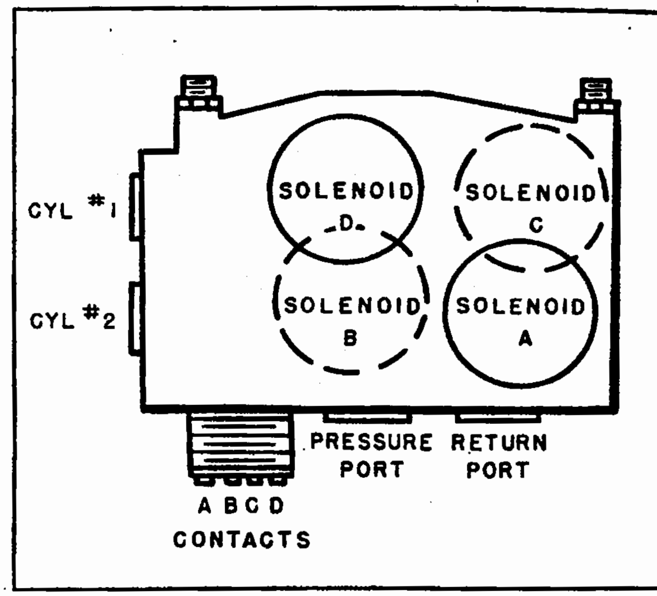


Figure 4—123. Gun Charging Solenoid Selector Valve.

a. Relieve main system pressure by operating wing flaps until hydraulic gage in cockpit reads zero.

b. Remove and cap the four hydraulic lines at the valve.

c. Remove the electrical plug from the socket.

d. Remove the four bolts which secure the valve to the bracket and remove the valve.

4—1250. TESTING. (See figure 4—123.) The following test is made prior to the installation of the gun charging solenoid valve.

a. With all ports open, apply 1500 psi to the pressure port for three minutes. Leakage from any port shall not exceed three drops per minute.

b. Increase pressure to 2250 psi for two minutes. Reduce pressure to zero psi. Actuate valve. Increase pressure to 2250 psi for two minutes. There is to be no external leakage during test.

c. Reduce pressure to 10 psi. Apply current to contact "D." There shall be free flow from cylinder port number one. Apply current to contact "B." There shall be free flow from cylinder port number two.

d. Plug pressure port and apply 10 psi to both cylinder ports simultaneously. Energize and de-energize contacts "A" and "C" three times. De-energize solenoid and increase pressure to 850 psi. Hold for three minutes. Leakage from return port is not to exceed three drops per minute after the first one-half minute.

e. Apply 10 psi to return port. Apply current to contact "C." There shall be free flow from cylinder port number one. Apply current to contact "A." There shall be free flow from cylinder port number two.

4—1251. INSTALLING. Reverse the removal procedure given in paragraph 4—1249.

4–1252. THERMAL RELIEF VALVE.

4–1253. DESCRIPTION. *(Refer to figure 4–122.)* This valve is located just aft of the bulkhead at station 130, below and to the left of the solenoid selector valve. It is accessible through the lower cockpit access door. The description, removing, testing, and installing paragraphs which pertain to the wing flap thermal relief valve (reference to paragraphs 4–1082 through 4–1086) will apply to this valve with the exception of location which is given above.

4–1254. CHECK VALVE.

4–1255. DESCRIPTION. *(Refer to figure 4–122.)* This valve is located just aft of bulkhead 130 in the main pressure line to the solenoid selector valve. It is accessible through the lower cockpit access door. This valve is identical to the valve used in the main pressure, supply, and return system. See paragraphs 4–953 through 4–957 for description, removing, testing and installing procedures. All the information in these paragraphs will apply to this valve except the location which is given above.

4–1256. PRESSURE SWITCHES.

4–1257. DESCRIPTION. *(Refer to figures 4–122 and 4–148A.)* These parts (MK 1 Mod. 1) are manufactured by the Bendix Products Division, South Bend, Indiana. Their drawing number is R94-BX-84012. These switches are composed of aluminum castings with one hydraulic port and contain two pressure operated electrical switches and a relay enclosed in the housing. Hydraulic pressure causes the high pressure switch to open at 1000 psi (plus or minus 25 psi) and the low pressure switch to open during pressure decrease at 17 to 20 psi. For information on the electrical circuit operation, see paragraph 5–101. These switches are located on both left and right hand sides of airplane in the outer wing panel at station seven, near the trailing edge. They are accessible through the rear gun bay door.

4–1258. REMOVING. Access to the pressure switches is gained by removing the rear gun bay doors on both left and right hand sides of the airplane.

a. Remove and cap the hydraulic line at the switch.

b. Remove the electrical plug from the switch.

c. Remove the two screws which secure the switch to the rib. Remove switch.

4–1259. TESTING. The following test is made prior to installing the gun charging pressure switches.

a. Apply 2250 psi to oil port for two minutes. Reduce pressure to zero psi. Actuate switch. Increase pressure to 2250 psi for two minutes. No external leakage is permitted during test.

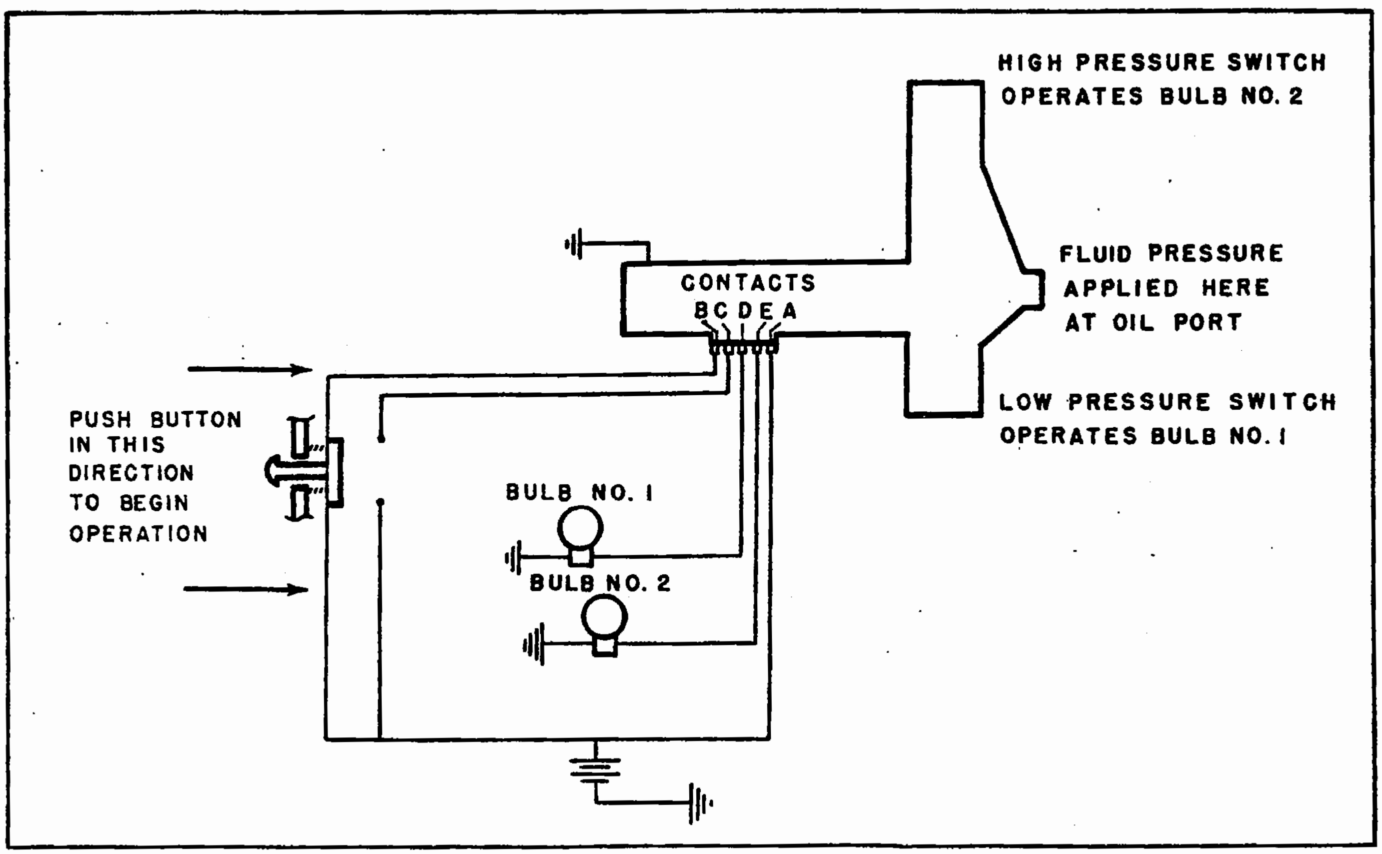


Figure 4–124. Gun Charging Pressure Switch Test Set-up.

b. Using set-up shown in figure 4–124, press button and apply slowly increasing pressure to oil port. When button is pressed, bulb number two must light. Release button when pressure reaches 50 psi. Bulb number two must remain lit. Continue to increase pressure. At 750 to 1025 psi (plus or minus 25 psi) bulb number two must go out and bulb number one must light. Reduce pressure slowly. Bulb number one must go out at 17 to 20 psi. Bulb number two must remain out. Repeat three times.

4–1260. INSTALLING. Reverse the removal procedure given in 4–1258.

4–1261. GUN CHARGING SWIVELS.

4–1262. DESCRIPTION. (*Refer to figure 4–122.*) The gun charging swivels are manufactured by Chicksan Tool Co., part number R68D2. The purpose of the gun charging swivels is to allow the wings to fold without damage to the rigid tubing in the system. Each gun charging swivel is made up of two interlocking elbows which are free to rotate about each other. The larger elbow is secured to the forward portion of the center section end rib and the other elbow rotates as the wing folds. These units are accessible when the wing is in the folded position.

4–1263. REMOVING. The gun charging swivels are accessible with the wings in a folded position.

a. Relieve main system pressure until hydraulic gage in cockpit reads zero.

b. Remove and cap the two hydraulic lines at the swivel.

c. Remove the two bolts which secure the swivel to the end rib. Remove the swivel.

4–1264. TESTING.

a. Apply 2250 psi pressure at one port and plug other port. Rotate elbow 180° in both directions. There must be no external leakage.

b. Apply five psi pressure on both ports for three minutes. Rotate elbow 180° in both directions. There must be no external leakage.

4–1265. INSTALLING. To install the gun charging swivel, reverse the procedure for removal given in paragraph 4–1263.

4–1266. GUN CHARGING CYLINDERS.

4–1267. DESCRIPTION. (*Refer to figure 4–122.*) The four Mk. 5 gun chargers in the system are Government Furnished parts (B.O. 630527). These one port cylinders contain a spring-loaded piston. The charger extends when hydraulic pressure is applied to the port and retracts due to the spring when the return port of the solenoid selector valve is open. The chargers are mounted on the upper aft section of each gun and are accessible through the rear gun bay door. For further information, refer to paragraph 4–1247.

4–1268. REMOVING. Relieve main system pressure until gage in cockpit reads zero. Remove the rear gun bay doors for access to the chargers.

a. Remove and cap the hydraulic line at the charger.

b. Pull rearward on the spring-loaded pin located on the aft side of the charger block.

c. Raise the spring-loaded latch which engages a projection on the forward end of the charging cylinder. Grasp the aft end of the cylinder and pull it out from the gun and to the rear. Remove the charger.

4–1269. TESTING. The following test is made prior to the installation of the gun charger.

a. Cycle cylinder ten times at 1500 psi.

b. On the last three cycles, check pressure required to start piston, and the pressure the piston develops just before it bottoms on the return stroke. The average pressure difference between the readings should not exceed 50 psi.

c. Apply five psi to the cylinder for two minutes and then 2250 psi to cylinder for two minutes. There must be no leakage at either pressure.

4–1270. INSTALLING. The installation of the gun charger is the reverse of the removal procedure given in paragraph 4–1268 with the following exceptions. When the hydraulic line is attached to the charger, cycle the system with the fitting loose enough to permit leakage. Continue cycling until all air bubbles are gone from leaking fluid. Tighten fittings.

4–1271. TUBING. Figure 4–125 must be used as a reference key in conjunction with the following table.

TUBING CHART — GUN CHARGING HYDRAULIC SYSTEM

(Refer to figure 4–125.)

PART NO.	REF. ON FIGURE	O D INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-58312-67	1	3/8	.035	12 1/8	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN833-6D Elbow AN924-6D Nut AN6227-9 Packing AN833-6D Elbow

TUBING CHART—GUN CHARGING HYDRAULIC SYSTEM (Continued)

(Refer to figure 4–125.)

PART NO.	REF. ON FIGURE	O D INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-58312-105	2	3/8	.035	2 1/2	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN919-12D Reducer
VS-58312-65	3	3/8	.035	18 7/8	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN833-6D Elbow AN924-6D Nut AN6227-9 Packing AN837-6D Elbow
VS-58312-89	4	3/8	.035	19 5/16	Spec. WW-T-787	AN818-6D Nut (2 req.) AN819-6Z Sleeve (2 req.) AN919-12D Reducer
AN6264-8D-21	5	13/32 ID		21	Spec. AN-H-24	AN837-8D Elbow AN960-D1216 Washer AN924-8D Nut
VS-48147-51	6	1/2	.042	37 1/16	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN832-8D Union AN924-8D Nut
VS-48147-49	7	1/2	.042	31 3/4	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN833-8D Elbow
VS-16101-1	8	1/2	.042	15 1/8	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN815-8D Union
VS-16101-65	9	1/2	.042	24 9/16	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.)
AN6264-8D-22	10	13/32 ID		22	Spec. AN-H-24	AN837-8D Elbow AN960-D1216 Washer AN924-8D Nut
VS-48147-11	11	1/2	.042	39 3/16	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN832-8D Union AN924-8D Nut
VS-48147-9	12	1/2	.042	31 5/8	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN833-8D Elbow
VS-16101-81	13	1/2	.042	15	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN815-8D Union
VS-16101-145	14	1/2	.042	24 3/8	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.)
VS-58309-1	15	1/2	.042	23 1/8	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN776-8D Elbow AN775-8D Bolt AN901-8A Gasket (2 req.) AN837-8D Elbow AN924-8D Nut

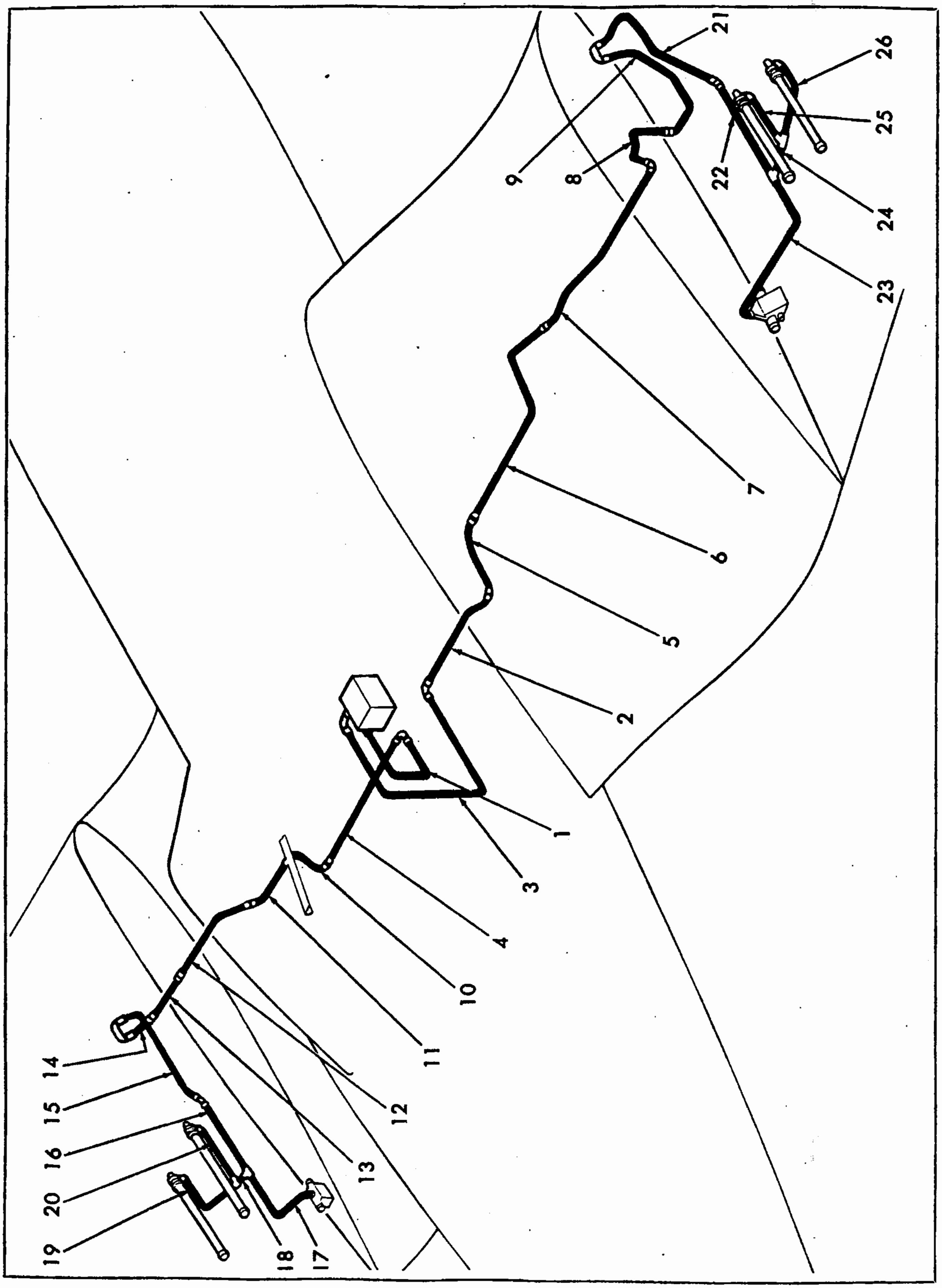
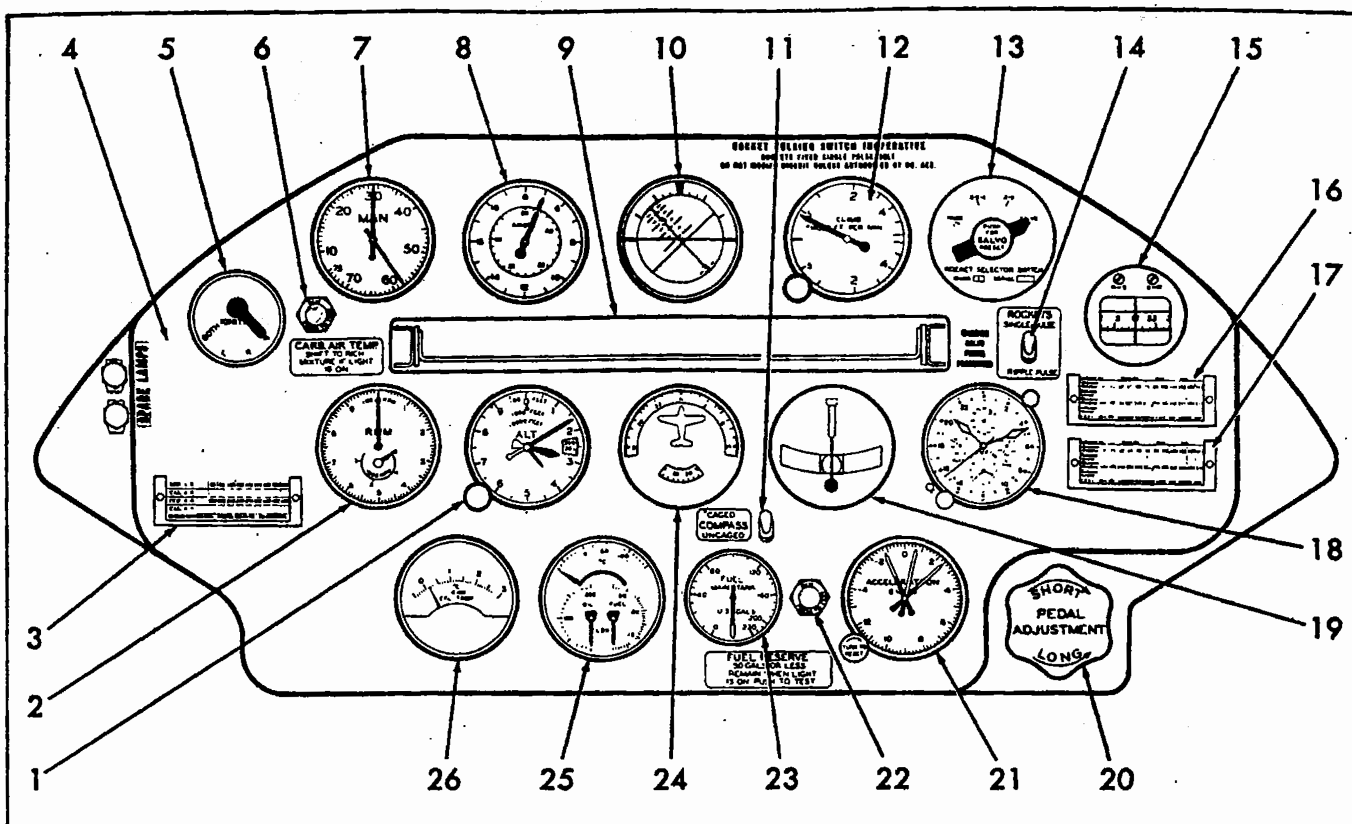


Figure 4–125. Hydraulic System—Gun Charging Tubing Diagram.

TUBING CHART — GUN CHARGING HYDRAULIC SYSTEM (Continued)

(Refer to figure 4—125.)

PART NO.	REF. ON FIGURE	OD INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-58309-11	16	½	.042	26½	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN926-8D Tee AN919-10D Reducer AN832-8D Union AN924-8D Nut AN815-8D Union AN6227-12 Packing (2 req.)
VS-58309-15	17	¼	.035	13½	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819 4D Sleeve (2 req.) AN833-4D Elbow AN924 4D Nut AN6227-7 Packing
VS-58309-13	18	½	.042	4¾	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN926-8D Tee AN815 8D Union (2 req.) AN6227-12 Packing (3 req.) AN832-8D Union AN924-8D Nut AN960-D-1216 Washer
AN6260-8D-22	19	13/32 ID		22	Spec. AN-H-6	AN815-8D Union AN6227-12 Packing
AN6260-8D-22	20	13/32 ID		22	Spec. AN-H-6	AN815-8D Union AN6227-12 Packing
VS-58309-23	21	½	.042		Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN776-8D Elbow AN775-8D Bolt AN901-8A Gasket (2 req.) AN837-8D Elbow AN924-8D Nut AN960-D1216 Washer AN901-8A Gasket
VS-58309-33	22	½	042		Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN926-8D Tee AN919-10D Reducer AN832-8D Union AN924-8D Nut AN815-8D Union AN6227-12 Packing (3 req.)
VS-58309-35	23	¼	.035		Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4D Sleeve (2 req.) AN833-4D Elbow AN924-4D Nut AN6227-7 Packing
VS-58309-13 °	24	½	.042	5.6	Spec. WW-T-787	AN818-8D Nut (2 req.) AN819-8D Sleeve (2 req.) AN926-8D Tee AN815-8D Union (2 req.) AN6227-12 Packing (3 req.) AN832-8D Union AN924-8D Nut AN960-D1216 Washer
AN6260-8D-22	25	13/32 ID		22	Spec. AN-H-6	AN815-8D Union AN6227-12 Packing
AN6260-8D-22	26	13/32 ID		22	Spec. AN-H-6	AN815-8D Union AN6227-12 Packing



1. Altimeter
2. Tachometer Indicator
3. Airspeed Indicator Card Holder
4. Cover
5. Ignition Switch
6. Carburetor Air Temperature Warning Light
7. Manifold Pressure Gage
8. Airspeed Indicator
9. Chart Board
10. Attitude Gyro Indicator
11. P-3 Compass Transmitter Caging Switch
12. Vertical Speed Indicator
13. Mk-1 Rocket Selector Switch
14. Ripple Pulse — Single Pulse Rocket Switch
15. Standby Compass
16. Standby Compass Card Holder
17. Remote Compass Card Holder
18. Elapsed Time Clock
19. Turn and Bank Indicator
20. Rudder Pedal Adjustment Knob
21. Accelerometer
22. Fuel Reserve Warning Light
23. Fuel Quantity Indicator
24. P-3 Compass Indicator
25. Engine Gage Unit (Fuel Pressure, Oil Pressure, Oil Temperature)
26. Engine Cylinder Temperature Indicator

Figure 4—126. Instrument Panel.

4—1272. INSTRUMENTS.

4—1273. DESCRIPTION. *(See figure 4—126.)* The instruments are mounted on an assembly consisting of two units; an aluminum alloy panel on which the instruments are flush-mounted and an aluminum alloy cover which fits over the instrument panel and houses the instrument lights. This cover is secured to the panel at seven points with screws. Protruding from the panel cover are the instrument caging and adjusting knobs. A chart board is secured to the chart board support assembly which is housed within a slot cut in the center of the instrument panel. The chart board is pushed in or pulled out as required; see paragraph 4—1568. The instruments are arranged on the panel in a "Universal" form, the engine group being on the left hand side so as to be more visible during carrier landings. The flight instruments are above and below the chart board, to the right of the engine instruments. The two warning lights on the main instrument panel are the fuel reserve warning light, located at lower right hand corner, which indicates that fifty gallons of fuel remain in the main fuel cell, and the carburetor air temperature warning light, on upper left hand corner, which indicates excessive carburetor air temperatures. Other indicators not on the main instrument panel are the landing gear and flap position indicator, hydraulic pressure gage, oil cooler door and intercooler flap position indicator, trim tab position indicator, and fuel transfer warning light, all of which are on the left hand control panel. The voltammeter is located on the right hand control shelf and is discussed in paragraphs 5—12 through 5—15.

4—1274. LIST OF INSTRUMENTS. The following list of instruments is arranged to conform with the sequence in which the instruments are covered in the text. Stock numbers for all Government Furnished instruments are listed.

ITEM	STOCK NO.	AN NO. OR MFRS. NAME AND NO.
Pitot Head	R88-T-2875	AN5813-1
Static Vent	R88-V-1200	NAF 600326
Airspeed Indicator	R88-I-350-25	BuAer 9155
Airspeed Correction Card	R88-C-151	BuAer 9444
Altimeter	R88-A-350-11	AN5760-L2A
Vertical Speed Indicator	R88-I-751-11	BuAer 843 SK
Suction Regulating Valve	R88-V-395	BuAer 811 SK
Turn and Bank Indicator	R88-I-3255-10	AN5820-1
Filter (for Turn and Bank Indicator)	R88-F-1001	
Accelerometer	R88-A-140-11	AN5745-L2A
P-3 Compass Inverter	R17-I-7463	
P-3 Junction Box	R88-B-862-50	
P-3 Compass Amplifier	R88-A-525	PR: 12074-1
P-3 Compass Transmitter	R88-T-1910	PR: 12008-1-A
P-3 Compass Transmitter Caging Switch	R17-S-28256-10	AN3021-2
P-3 Compass Indicator	R88-I-1681	PR: 1203-2D
Standby Compass	R88-C-777-10	AN5766-1
Compass Correction Card	R88-C-200	BuAer 9444
Attitude Gyro Indicator	R88-I-1305	BuAer 1017 SK
Attitude Gyro Inverter	R17-I-7461	
Engine Gage Unit	R88-G-1021-50	AN5773-2
"Oil-in" Temperature Bulb	R88-B-890	AN5525-1
Manifold Pressure Gage	R88-G-773-100	AN5770-1A
Fuel Quantity Indicator	R88-I-2008-300	LI: EA-100AN-48
Fuel Quantity Transmitter	R88-T-2677-600	LI: EA-67W-VS-43103
Engine Cylinder Temperature Indicator	R88-I-2664-10	AN5536-1A
Thermocouple Lead Assem.		VS-59933 (Mfg by Bristol Co., Waterbury, Conn.)
Tachometer Indicator	R88-I-2385-100	GE: 8DJ13AFF
Tachometer Generator	R88-G-1335	AN5531-1
Carburetor Air Temperature Warning Light		VS-44422-1 (Searle Aero Industries, Inc., No. VM400-2)
Temperature Switch		Fenwal No. 18301-3
Fuel Reserve Warning Light		VS-44422-1 (Searle Aero Industries, Inc., No. VM400-2)
Fuel Transfer Warning Light		VS-44422-1 (Searle Aero Industries, Inc., No. VM400-2)
Clock	R88-C-573-11	AN5741-L1
Hydraulic Pressure Gage	R88-G-620-10	AN5771-4B
Wheel and Flap Position Indicator	R88-I-1888	AN5780-3
Flap Position Transmitter	R88-T-2650	AN5785-1
Intercooler Flap and Oil Cooler Door Position Indicator		VS-59900 GE8DJ12
Intercooler Flap and Oil Cooler Door Position Transmitters	R88-T-2640	VS-59914 GE-8TJ9PAV
Trim Tab Position Indicator	R88-I-1884-400	VS-58056 (Weston Elec. Instr. Corp. Dwg. No. W-3100)

4–1275. LOCATION AND ACCESS. The instrument panel is mounted on shock mounts in the cockpit forward of the pilot. For location of individual instruments on panel, *see figure 4–126*. The instruments on the main panel are accessible by removing the front cover assembly which is secured to the main instrument panel by seven screws. Remove the two small access panels on each side of the fuselage just below windshield and work in the cockpit to gain access to rear of instruments.

4–1276. REMOVING. To remove any instrument located on the main instrument panel, proceed as follows:

Note

Before removing any instrument, note position of fittings, tee connections, or elbow so that they may be replaced at the proper angle.

a. Remove the instrument panel cover by removing the seven small screws. Disconnect electrical leads to cover.

b. Working from rear of instrument panel as described in paragraph 4–1275, remove leads or tubing from the instrument to be removed.

CAUTION

When disconnecting tubing at the instrument case, always grasp the case fitting with a wrench before applying torque to the tube fitting. Failure to do so may result in a cracked instrument case.

c. Remove the mounting screws which secure instrument to panel; remove instrument from behind panel.

CAUTION

Instruments should not be disassembled for repair except by specialists authorized to do so.

4–1277. INSTALLING. Reverse removal procedure given in paragraph 4–1276.

4–1278. INSTRUMENT PANEL.

4–1279. DESCRIPTION. *(See figure 4–126.)* The instrument panel consists of two units: the main panel, to which the instruments are secured and a cover made of aluminum alloy sheet into which the instrument lighting system is secured. There are seventeen small lamps to illuminate the instrument panel. These lights are controlled by the "INTERIOR LIGHTS" switch located on the right hand control shelf. Positions on the switch are "ALL INSTRUMENTS" which illuminates both the flight and engine instruments and "FLIGHT" which illuminates just the flight instruments. The main panel is secured at five points with bolts through rubber shock mounts. These are located as follows: one at each side of the panel secured by a bolt to a bracket which is riveted to the fuselage at station 149, one in the center of the panel secured to the underside of the cockpit cowling; the other two are secured to bulkhead 134 and are bolted to the ends of the chart board supports.

4–1280. REMOVING. The instrument panel is removed in the following manner:

a. Remove the two instrument panel access doors just below windshield.

b. Disconnect all tubing, electrical wiring, flexible hose and bonding wire at instruments.

Note

Label all instrument connections as they are removed to assure correct reinstallation. Cover ends of tubing and instruments to prevent entrance of foreign particles.

c. Remove the bolts at shock mounts on instrument panel and at shock mounts (station 134) of chart board support assembly.

d. Remove instrument panel, instruments, and chart board support as a complete unit by pulling aft. With instrument panel out of airplane, chart board support assembly is removed by removing four bolts from face of panel and support assembly.

4–1281. INSTALLING. Reverse removal procedure given in paragraph 4–1280.

4–1282. PITOT STATIC SYSTEM.

4–1283. DESCRIPTION. *(See figure 4–127.)* The airspeed system consists of a pitot head (AN5813-1), tubing for conveying ram air pressure to the airspeed indicator on the instrument panel, a static pressure vent (NAF 600326) at station 256, and tubing from the static vent on left hand side of fuselage to instrument panel. The static vent line connects to the airspeed indicator, altimeter and vertical speed indicator (climb indicator). The ram air pressure line from the pitot head connects to air speed indicator only.

4–1284. AIR PRESSURE TUBING.

4–1285. DESCRIPTION. *(See figure 4–127.)* The pitot air pressure is carried from the pitot head on the left hand outer panel to the rear of the airspeed indicator through aluminum tubing, color-coded by 1/2 inch bands of black approximately every 20 inches. The tubing runs inboard along the aft face of the main outer panel beam to the gun bay, thence forward of the main beam to the wing fold. Flexible hose is used at point of wing fold; flexible hose also continues on to the center section main beam. Tubing runs aft within center section to the forward face of the rear beam, and inboard through the wheel well into the fuselage and cockpit. Tee drains are provided in the system at three points. The first tubing drain (8) is located at approximately wing station 71 5/16 and is accessible through the tie-down door (9). A second tubing drain (11) is located at approximately station 25 and is accessible through the forward gun bay door (10). The third drain (14) is located in the center section and is accessible through the wheel well. The flexible hose at the wing fold may also be considered as a drain. Tubing from the static vent to instrument panel is covered in paragraphs 4–1296 through 4–1302.

4–1286. TROUBLE SHOOTING.

a. Check for leaks in system by testing as directed in paragraph 4–1289.

b. If system contains a leak, check each section of tubing for loose fittings. Check to see that tubing is not free to vibrate and chafe.

4–1287. REMOVING. *(See figure 4–127.)* Tubing may be removed by disconnecting each section at unions and loosening clamps that secure tubing to airplane.

a. Remove section of tubing adjacent to pitot tube through pitot access door.

b. Remove section of tubing between wing station 107 and 71 through tie-down access door.

c. Tubing between wing stations 71 and 25 may be removed through gun bay.

d. Remove tubing between stations 25 and 2 by removing access covers on outer panel wing butt.

e. Tubing in center section wing is removed through wheel well.

f. Sections of tubing running within fuselage may be reached through belly access door and from cockpit.

4–1288. INSTALLING. Reverse removal procedure given in paragraph 4–1287. Be sure to resecure each section of tubing so that it can not vibrate. Lubricate threads sparingly with petrolatum Spec. AN-P-51. Make each connection air-tight.

4–1289. TESTING. Two men may check pitot head and air pressure tubing by the following procedure.

a. Blow slowly into tip of pitot head until the airspeed indicator registers 200 knots.

b. Seal the pitot head with the tip of the tongue. The airspeed indicator reading should remain constant, after a slight initial drop when sealing the pitot head tip. Any change in the reading indicates leakage in the pitot tube, tubing or at the instruments.

c. If leakage is evident, disconnect pitot line at airspeed indicator and connect line to a new indicator.

d. Retest as in step b., and if leakage is still evident, the tubing should be tightened at each union and the system retested. Also check caps at tee drains for leakage.

e. Replace defective tubing and instrument if necessary. Tighten all unions and fittings.

f. If failure in the airspeed system cannot be traced to the aluminum tubing, or airspeed indicator, the pitot head should be removed and replaced by a new one.

4–1290. PITOT HEAD.

4–1291. DESCRIPTION. *(See figure 4–127.)* The pitot head, R88-T-2875 (AN5813-1) is a device for measuring impact air pressure as airplane passes through the air. The pitot head is mounted on a tube which protrudes from left outer wing panel leading edge. The impact air pressure is registered upon open tip of pitot head. The impact air pressure is transmitted through inner pitot tube and through aluminum tubing to airspeed indicator. Within the pitot head is a hermetically sealed heating element which provides strong internal application of heat to prevent formation of ice on or within tube. The switch to control the heating element is located on the right hand inclined panel, outboard of the oil dilution switch. For further information, see paragraph 5–133. A weather-proof cover should be used when the airplane is not in flight. The cover should always be removed slowly to prevent a high negative pressure which may harm the airspeed indicator.

4–1292. TROUBLE SHOOTING. After every flight, check pitot head for security of mounting and alignment.

a. Check for possible dents or nicks at pitot head tip.

b. Turn battery and pitot heater switches "ON" to check heating element in pitot head. Head should warm up in less than one minute.

c. Inspection of the pitot tube shall be made at frequent intervals as required by local operating conditions. It is preferable that this inspection be made prior to each flight. If it becomes necessary to clean the pitot tube, this shall be done with a cloth dampened with dry cleaning solvent, Stock No. R51-C-1326. If further cleaning is necessary a liquid polishing agent with a minimum of solids in solution may be used. Care should be taken to ensure that all holes are open and clean after the polishing operation.

4–1293. REMOVING. *(See figure 4–127.)* To remove pitot head, proceed as follows:

a. Remove hand hole cover (7) on under side of wing directly aft of pitot tube.

b. Disconnect tubing at aft end of support tube.

c. Remove the three screws which secure the pitot head to the support tube and carefully withdraw the head with the attached aluminum tubing.

d. Disconnect the heater plugs as the head is withdrawn from the support tube. Disconnect tubing from head when tube coupling is exposed.

e. No disassembly of the pitot head is permitted.

4–1294. INSTALLING. Reverse removal procedure given in paragraph 4–1293.

4–1295. TESTING. Test system as directed in paragraph 4–1289.

4–1296. STATIC VENT INSTALLATION.

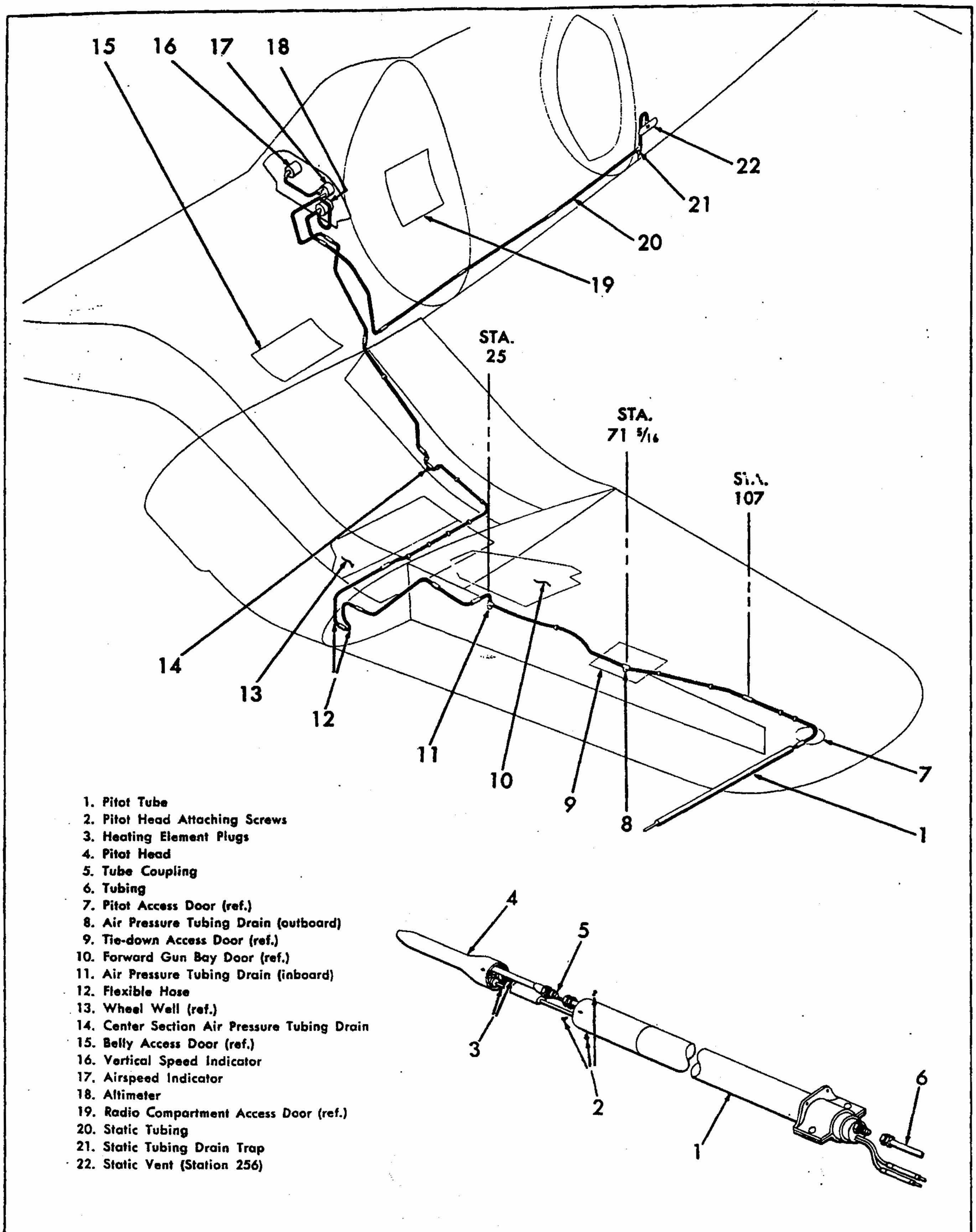
4–1297. DESCRIPTION. *(See figure 4–127.)* From the static air vent, R88-V-1200 (NAF 600326), on the left hand side of the fuselage, static air pressure is carried forward through aluminum tubing to the altimeter, airspeed indicator, and vertical speed indicator.

Note

The static vent is left unpainted, so that paint will not peel off and enter the static system.

The drain for the system is located at the lowest point below the vent installation.

4–1298. LOCATION AND ACCESS. The static air vent installation is located on the left hand side of the fuselage just aft of station 253 and is accessible through the radio compartment access door. The vent installation is riveted to the fuselage. Tubing runs forward to a point just aft of station 138.6. This section is accessible through the radio compartment and belly access doors. At station 138.6, the tubing bends at about a 90 degree



1. Pitot Tube
2. Pitot Head Attaching Screws
3. Heating Element Plugs
4. Pitot Head
5. Tube Coupling
6. Tubing
7. Pitot Access Door (ref.)
8. Air Pressure Tubing Drain (outboard)
9. Tie-down Access Door (ref.)
10. Forward Gun Bay Door (ref.)
11. Air Pressure Tubing Drain (inboard)
12. Flexible Hose
13. Wheel Well (ref.)
14. Center Section Air Pressure Tubing Drain
15. Belly Access Door (ref.)
16. Vertical Speed Indicator
17. Airspeed Indicator
18. Altimeter
19. Radio Compartment Access Door (ref.)
20. Static Tubing
21. Static Tubing Drain Trap
22. Static Vent (Station 256)

Figure 4—127. Pitot Static System.

angle and continues up to the instrument panel. The static line connects to the altimeter with a section of flexible hose. Static air pressure is tapped just aft of the altimeter to airspeed indicator, and from the airspeed indicator to the vertical speed indicator. The static pressure line is color-coded by bands of black and light green approximately every twenty inches.

4—1299. TROUBLE SHOOTING.

a. Check for leaks in unions and tee connections.

b. Check each section of tubing; see that it cannot vibrate, so as to crack or chafe.

c. Drain system by opening drain at station 253.

d. Inspection of the static vent shall be made at frequent intervals as required by local operating conditions. It is preferable that this inspection be made prior to each flight. If it becomes necessary to clean the static vent this shall be done with a cloth dampened with dry cleaning solvent, Stock No. R51-C-1326. If further cleaning is necessary a liquid polishing agent with a minimum of solids in solution may be used. Care shall be taken to ensure that all holes are open and clean after the polishing operation.

4—1300. REMOVING. *(See figure 4—127.)* Disconnect each section of tubing at unions. Sections aft of bulkhead 186 are accessible through radio compartment access door. Sections forward of bulkhead 186 are accessible through belly access door. The static vent is a fixed installation; rivets must be drilled out to remove it.

4—1301. INSTALLING. Reverse removal procedure given in paragraph 4—1300.

4—1302. TESTING.

a. Disconnect aluminum tubing at vent installation.

b. Attach a rubber hose to tubing and apply suction by mouth to create a negative pressure. When airspeed indicator registers 150 knots and altimeter shows a rise in reading, pinch rubber tubing to trap suction in static line. Indicator should hold this reading.

c. If readings drop, leaking in system is indicated.

d. Check for leakage at static line drain trap.

e. Localize leak in system and replace tubing or tighten fittings.

CAUTION

Before attempting to clean lines of static system, airspeed indicator, altimeter and climb indicator must be disconnected at their respective case fittings and disconnected lines moved out of line with fittings of instrument so as to prevent damage to instruments.

4—1303. AIRSPEED INDICATOR.

4—1304. DESCRIPTION. *(See figure 4—126.)* The airspeed indicator, R88-I-350-25, (BuAer 9155) is designed to indicate the speed of the airplane relative to the air through which it is flying. For navigational purposes at higher altitudes, indicated airspeed must be converted into true airspeed. The required correction may be approximated by adding 2% to the indicated airspeed for each thousand feet above sea level. An airspeed correction card (R88-C-151) is used in making the conversion. The indicator consists primarily of an airtight diaphragm assembly, and a linkage for multiplying its deflection. The linkage is composed of a rocking shaft assembly with a diaphragm lever and long lever, a restraining spring, a sector and a hand staff pinion. The entire mechanism is housed in an airtight case. The pitot tube is connected to interior of diaphragm, and static tube to case. As speed of airplane increases, increased pitot air pressure causes diaphragm to expand. The rocking shaft picks up the motion by means of its diaphragm lever, and in turn transmits this motion, through the long lever, to sector and finally to hand staff pinion which is fastened to pointer. The pointer indicates air speed in knots.

4—1305. LOCATION AND ACCESS. For location of and access to the airspeed indicator, refer to paragraph 4—1275.

4—1306. TROUBLE SHOOTING. Since all work on the instruments must be done by an instrument specialist with necessary repair and test equipment, only very minor repairs and checks can be made on the airplane.

a. If the instrument fails to respond or indicates incorrectly, leaks in the pressure line or obstructions in the pressure or static line may be the cause.

b. Test tubing for leaks as directed in paragraph 4—1289. If trouble is traced to the instrument, remove and replace with a new instrument.

4—1307. REMOVING. Follow procedure given in paragraph 4—1276.

4—1308. INSTALLING. Reverse removal procedure.

4—1309. ALTIMETER.

4—1310. DESCRIPTION. *(See figure 4—126.)* The sensitive altimeter R88-A-350-11 (AN5760-L2A) indicates the height of the airplane above sea level, assuming standard conditions of temperature and atmospheric pressure. There are three pointers for the instrument scale. The largest pointer completes one revolution for every one-thousand feet change of altitude, indicating hundreds of feet. The second pointer indicates in thousands of feet and makes one complete revolution in ten thousand feet. The third and smallest pointer indicates in units of ten thousand feet. In covering the complete range of 50,000 feet, the large pointer makes a total of fifty revolutions, the second pointer five revolutions, and the third pointer one-half revolution. Showing through a cutout in the face-plate is a small scale used for adjusting the altimeter to different barometric pressures. This is called the altimeter "barometric scale." It is adjusted by turning a small knob at the edge of the instrument case. The altimeter setting is the reading on the barometric scale of a master altimeter on the ground at any given airport when the pointers are set to indicate the actual altitude of that airport. If this value is set on the barometric scale of the airplane's altimeter, it automatically corrects the altitude indications. A temperature compensating unit within the instrument eliminates errors in the indication at all altitudes due to temperature variations of the indicator. The altimeter consists of a diaphragm assembly and mechanism for multiplying its deflection. The instrument case is airtight and its only outlet connects to the static pressure tubing. A change in altitude is accompanied by a change in air pressure which results in movement of the diaphragm. A link from the diaphragm transmits motion to the calibration arm, then to a sector which actuates a multiplying gear train connected to the pointer hand staff. A hairspring, secured to a member of the gear train, and to the mechanism body, removes the backlash from the mechanism. A reducing gear train operates two small pointers.

4—1311. LOCATION AND ACCESS. For location of and access to the altimeter, refer to paragraph 4—1275.

4—1312. TROUBLE SHOOTING. If the instrument pointers fail to respond to changes in barometric pressure, the cause might be an obstruction in the static tubing, or leak in the system. Test system as described in paragraph 4—1302. If correction cannot be made in this manner, remove and replace instrument.

4—1313. REMOVING. To remove the altimeter, follow the instrument removal procedure as described in paragraph 4—1276.

4—1314. INSTALLING. To install altimeter, reverse removal procedure.

4—1315. VERTICAL SPEED INDICATOR.

4—1316. DESCRIPTION. *(See figure 4—126.)* The vertical speed indicator R88-I-751-11 (843 SK) (sometimes called the rate of climb indicator) is used to indicate the rate of ascent or descent in feet per minute. The zero point on the indicator is horizontal to the left. The pointer moves clockwise when indicating descent. The dial is graduated into divisions of 100 feet per minute up to 1000 feet per minute, and divisions of 200 feet per minute from 1000 feet to 6000 feet. The vertical speed indicator incorporates two air-enclosing chambers. One is the pressure sensitive diaphragm. The atmospheric pressure from the static tube connection is introduced directly to the inside of this aneroid diaphragm and indirectly through a capillary tube to the remainder of the case. Changes of pressure due to changes of altitude are transmitted directly to the diaphragm and more slowly, through the capillary restriction, to the case. This sets up a temporary pressure differential which causes the diaphragm to expand or contract while the altitude is changing, thus activating a pointer on the face of the instrument. A few seconds after the airplane stops changing altitude, the pressure surrounding the diaphragm again equals the pressure in the diaphragm and the instrument registers "zero" vertical speed "level flight."

4—1317. LOCATION AND ACCESS. For location of and access to the vertical speed indicator, refer to paragraph 4—1275.

4—1318. TROUBLE SHOOTING. The vertical speed indicator should be set to zero prior to every flight using the control knob at lower corner of case. If it is not possible to do so, the instrument should be replaced.

4—1319. REMOVING. To remove rate of climb indicator, follow procedure for instrument removal given in paragraph 4—1276.

4—1320. INSTALLING. Reverse removal procedure.

4—1321. VACUUM SYSTEM.

4—1322. DESCRIPTION. *(See figure 4—128.)* Vacuum for the vacuum-driven turn and bank indicator is supplied by an engine drive vacuum pump, Navy Type B-2B, with a suction regulating valve (R88-V-395) installed in the suction line. The exhaust line from the vacuum pump passes through the oil separator which returns condensed oil to the engine. A line from the separator carries exhaust air pressure, free of oil, to the anti-blackout suit valve; see paragraphs 4—1350 through 4—1357. Tubing from vacuum pump to turn and bank indicator is color-coded white-light green; tubing for anti-blackout suit is coded light green-light blue.

4—1323. VACUUM PUMP.

4—1324. DESCRIPTION. *(See figure 4—128.)* The vacuum pump Navy Type B-2B is driven through an accessory drive from the engine. It is a rotary, four-vane, positive displacement type pump. The pump is lubricated by engine oil supplied under pressure through an internal oil channel in the pump mounting pad. The pump is coupled to the engine by means of a spring coupling with a safety shear section to protect the engine-driven gear and pump in case of seizure. When installed, this pump rotates in a clockwise direction when viewed looking forward.

4—1325. LOCATION AND ACCESS. *(See figure 4—128.)* The vacuum pump is located at the center of the aft face of the engine accessory drive case. It is accessible by working through the intercooler flap. Remove quick-disconnect pin at intercooler flap actuating cylinder and drop flap. The vacuum pump is mounted on a mounting plate with four studs.

4—1326. REMOVING. To remove vacuum pump, proceed as follows:

a. Working through engine intercooler flap, remove the two lines to the vacuum pump.

b. Remove four nuts at mounting flange. The pump is then free to be removed.

4—1327. INSTALLING.

CAUTION

Before installing, check to see that gasket between pump and engine mounting pad is seated so that its holes align with the oil feed holes in the mounting pad. Failure to observe this precaution will result in improper lubrication with resultant seizure of the pump.

a. Secure pump to engine mounting studs.

b. Make sure that vacuum line is connected to vacuum port and that exhaust line is connected to exhaust port of pump. *See figure 4—128.*

4—1328. TESTING.

a. A quick check of the operation of the vacuum pump may be made as follows. With the engine running, depress the top of the anti-blackout suit valve on the right hand control shelf. There should be a flow of air escaping from the quick-disconnect fitting. If no trace of air pressure is evident at fitting, the pump rotor may be sheared due to pump seizure.

b. If pump is operating and no vacuum is evident at the turn and bank indicator, check the suction valve located behind instrument panel by teeing a mercury manometer or suction gage into the line between valve and instrument. The gage should indicate 2.0 (plus or minus 0.2) inches of suction.

c. If the trouble is poor suction, it may be that the pump is improperly lubricated. Check oil discharge from separator by disconnecting line from separator to engine sump. The vacuum pump should discharge oil at the rate of 100 cc or about three ounces per hour maximum. If there is no drainage of oil from the separator, remove vacuum pump and check mounting; see that gasket between engine and vacuum pump is placed correctly so as to pass oil from engine to vacuum pump.

4—1329. OIL SEPARATOR.

4—1330. DESCRIPTION. *(See figure 4—128.)* The oil separator AN6121-2 is a small rectangular container with an inlet on the end and a baffle plate within. The baffle plate traps the oil in the incoming air from the vacuum pump and permits it to drain downward into a tube leading to the engine sump. An outlet at the top of the separator conducts the exhaust air to tubing leading to the anti-blackout suit valve in the cockpit. The separator is located on the left hand side of the engine accessory compartment.

4—1331. REMOVING.

a. Remove two small bolts which secure the separator to the engine mount.

b. Loosen clamps on hose connections at separator and remove hose; remove separator.

4—1332. REPAIRING. Where trouble in the anti-blackout suit system or vacuum system is traced to the oil separator, a new separator should be installed, as no repairing may be done on separator.

4—1333. INSTALLING. Reverse removal procedure given in paragraph 4—1331.

4—1334. TUBING.

4—1335. DESCRIPTION. *(See figure 4—128.)* Suction for the turn and bank indicator comes from the suction side of the vacuum pump through a section of flexible hose, through tubing secured by a clamp to the engine mount. Aluminum tubing runs aft to bulkhead 100. A second section of tubing runs between the fuel cell and skin on the left hand side of the airplane. A third piece of tubing continues up to the instrument panel. A fourth section runs behind instrument panel to the suction valve. Flexible hose is used from suction valve to instrument.

4—1336. REMOVING. To remove tubing, proceed as follows:

a. Working in engine accessory compartment, remove flexible hose from vacuum pump to first section of tubing by loosening clamps and removing.

b. Remove first section of tubing by loosening clamp at engine mount; disconnect fitting at bulkhead 100 (firewall) and remove.

c. Section of tubing within fuel cell compartment is not removable unless fuel cell is first removed. See paragraph 4—779 for removal of fuel cell.

d. Tubing from bulkhead 134 aft to union forward of instrument panel is removable by disconnecting it at the bulkhead and from forward side of instrument panel.

e. Remove last piece of tubing by disconnecting it at suction valve.

4—1337. INSTALLING. Reverse removal procedure given in paragraph 4—1336.

4—1338. SUCTION REGULATING VALVE.

4—1339. DESCRIPTION. *(See figure 4—128.)* The suction regulating valve, R88-V-395, is used to regulate the vacuum applied to the turn and bank indicator to 2.0 (plus or minus 0.2) inches of mercury, regardless of changes in altitude, air temperature and/or vacuum pump speed.

4—1340. LOCATION AND ACCESS. The suction regulating valve is located behind the instrument panel secured to a bracket on bulkhead 134. Access to the regulating valve is gained through the instrument panel access doors on each side of the airplane just below windshield.

4—1341. TROUBLE SHOOTING. After checking the vacuum pump (see paragraph 4—1328) and turn the bank indicator, check the suction valve behind the instrument panel as follows:

a. Tee a suction gage or manometer into the line between instrument and valve.

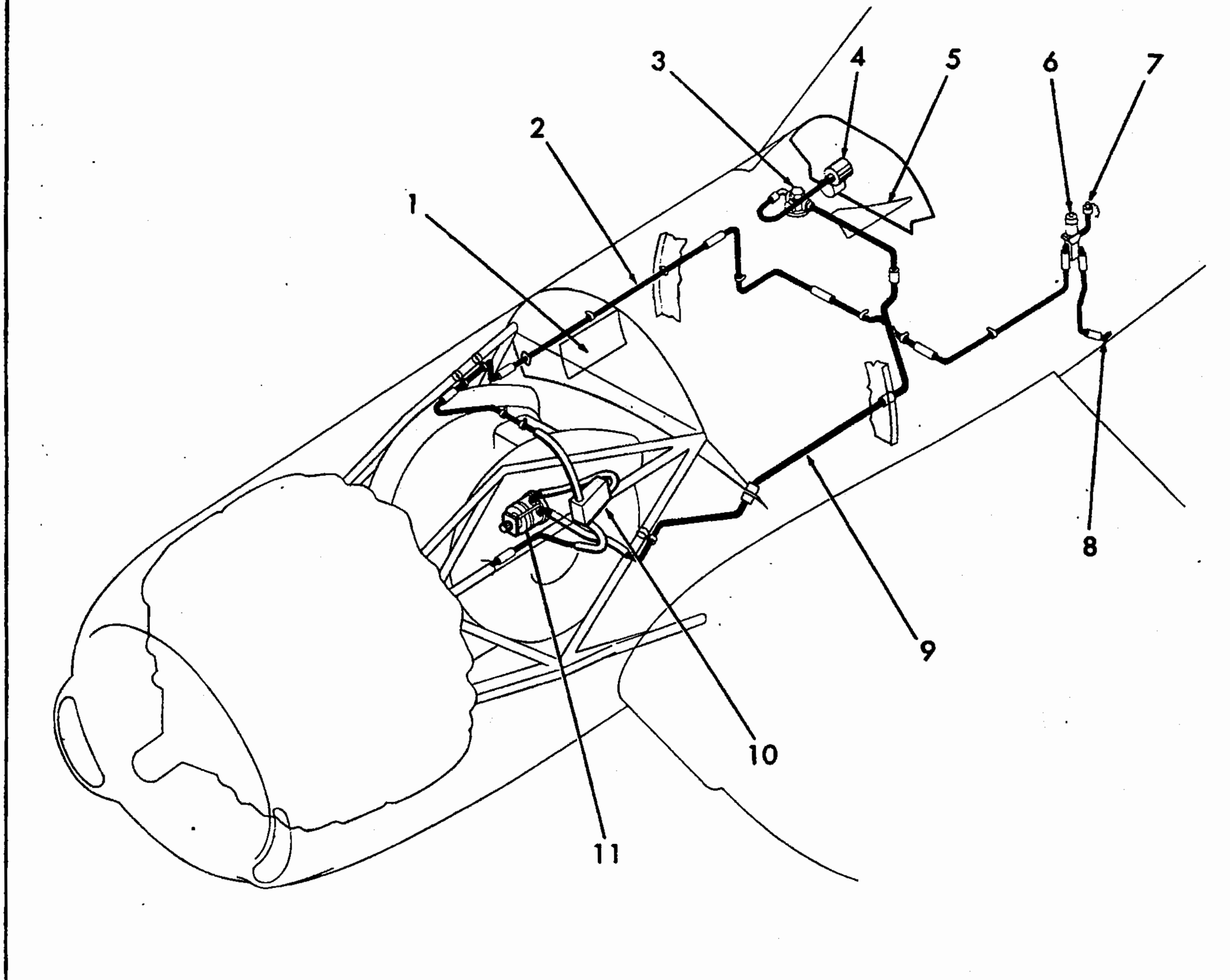
b. Loosen lock nut on top of valve and turn set screw for 2.0 inches of mercury of suction.

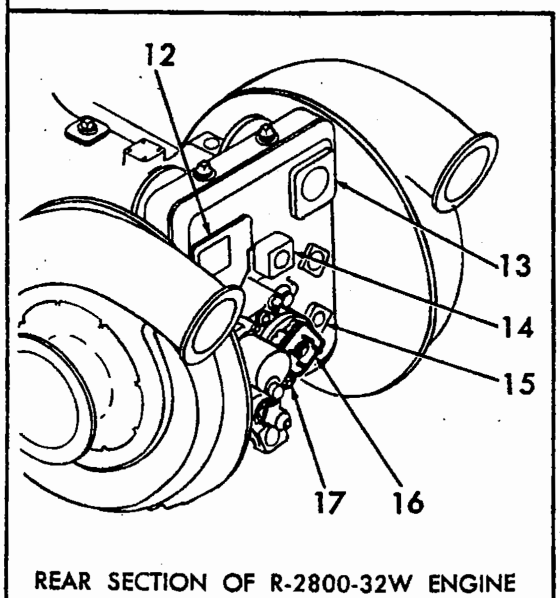
c. Reset lock nut and make line connection to instrument.

Note

The suction regulating valve should be cleaned at major repair periods but no oil or grease should be used on the valve at any time.

4—1342. REMOVING. To remove suction regulating valve, remove instrument panel access doors on each side of airplane just below windshield.





1. Fuel Cell Hanger Door (ref.)
2. Air Pressure Line to Anti-blackout Suit Valve
3. Suction Regulating Valve
4. Turn and Bank Indicator
5. Instrument Panel Access (ref.)
6. Anti-blackout Suit Valve
7. Anti-blackout Quick-disconnect Fitting
8. Overboard Discharge
9. Vacuum Line
10. Oil Separator
11. Vacuum Pump
12. Automatic Manifold Pressure Control Mounting Pad (ref.)
13. Hydraulic Pump Mounting Pad (ref.)
14. Tachometer Generator Mounting Pad (ref.)
15. Fuel Pump Mounting Pad (ref.)
16. Vacuum Pump Mounting Pad
17. Vacuum System Oil Return Inlet to Engine

Figure 4—128. Vacuum System.

a. Remove line from valve to turn and bank indicator.

b. Remove line from vacuum pump to regulating valve at valve.

c. Remove four screws holding valve to bracket.

4–1343. INSTALLING. Reverse removal procedure given in paragraph 4–1342.

4–1344. TURN AND BANK INDICATOR.

4–1345. DESCRIPTION. *(See figure 4–126.)* The turn and bank indicator R88-I-3255-10 (AN5820-2) is a combination of two flight instruments, the bank indicator and the turn indicator. The turn indicator unit is a gyroscopic device which indicates motion about the vertical axis of the airplane. It is composed of a suction-driven gyro rotor located in the rear section of the case on a restraining spring, and a dashpot for damping. The gyro rotor is carefully balanced and runs on specially designed precision ball bearings, to which oil is supplied from a reservoir within the gyro. The bank indicator unit is a simple pendulous device of the inclinometer type, consisting of a black glass ball which rolls against the damping action of a liquid in a curved glass tube.

4–1346. LOCATION AND ACCESS. For location of and access to the turn and bank indicator, refer to paragraph 4–1275.

4–1347. TROUBLE SHOOTING.

a. If pointer should fail to respond, the cause might be insufficient suction from pump.

b. Examine flexible hose for kinks or leaks.

c. Check operation of vacuum pump and suction valve; see paragraph 4–1328.

d. Check air inlet (filter) on instrument; clean screen.

4–1348. REMOVING. To remove turn and bank indicator, refer to paragraph 4–1276.

4–1349. INSTALLING. Reverse removal procedure.

4–1350. ANTI-BLACKOUT SYSTEM.

4–1351. DESCRIPTION. *(See figure 4–128.)* The anti-blackout suit system is installed for the purpose of inflating the pilot's "cover-all" type anti-blackout suit. Air pressure inflates the bladders in the suit around the calves, thighs and abdomen of the pilot. The expanding bladders pull the suit tightly around the veins, causing the circulation in the lower part of the body to slow down and keep the flow of blood from the head regular.

4–1352. TUBING.

4–1353. DESCRIPTION. *(See figure 4–128.)* A line from the exhaust side of the engine-driven vacuum pump runs to an oil-air separator in the engine accessory compartment. From the separator, a line runs to the right hand side of the engine mount, then aft through the firewall between the fuel cell and the skin on the right hand side, into the fuselage beneath the cockpit floor. It crosses the fuselage under the cockpit floor beneath the instrument panel, runs aft along the left hand side and up to the anti-blackout suit valve which is secured on the left hand control shelf. Anti-blackout suit tubing is color-coded by one-half inch bands of light green-light blue. The valve is an NAF 1233-1 type, and once set, its function is completely automatic. When the top of the valve is adjusted to the "LO" setting, the valve governs the supply of pressure to the suit at 1.0 psi per "g" starting at 1.75 "g." When adjusted to the "HI" setting, the valve governs air pressure at 1.4 psi per "g," starting at 1.75 "g." The output in either case remains constant in spite of the variations in input pressure. The valve is also equipped with a push button top for manual testing. This permits the pilot to pressurize the anti-blackout suit temporarily during flight or ground test. A ball plunger in the valve which, when depressed or elevated by the "g" force, opens or closes vents which lead air pressure to the suit or to the overboard discharge when the suit is not in use. The quick-disconnect fitting at the valve should be plugged with the cap which is chained to the fitting when the suit is not connected.

4–1354. TROUBLE SHOOTING. When the airplane is on the ground, with the engine running, the mechanic can check the air pressure through the system by pressing on top of valve and feeling the flow of air from the quick-disconnect fitting.

a. Check valve to see that air that comes through is free of oil.

b. Excessive traces of oil on the skin of the airplane from the overboard discharge located on the left hand side of airplane at the trailing edge of left inboard center section flap, should be investigated.

c. Check to see that separator is draining to engine sump; see paragraph 4–1329.

d. Clean anti-blackout suit lines by disconnecting them at valve and separator and blowing clear.

e. Check suits for leaks, tears, weakened fabric and signs of deterioration, caused by excessive oil leaking to suit.

4–1355. REMOVING VALVE AND QUICK-DISCONNECT. *(See figure 4–128.)*

a. To remove the valve, located on left hand control shelf, loosen clamps and hose connection at valve fittings.

b. Remove two bolts on bracket holding valve.

c. Remove four screws holding elbow tube assembly to valve; remove four screws from beneath shelf holding quick-disconnect fitting to shelf.

4–1356. REMOVING TUBING. *(See figure 4–128.)* The anti-blackout suit tubing is in six sections. From separator (10), tubing crosses to right hand side of airplane and is secured by a clamp. A second piece of tubing runs along engine mount to firewall and is secured to engine mount by a clamp. A third section runs between the fuel cell and skin and is secured to bulkhead 116 by a clamp. This section of tubing is sealed at bulkhead 130-1/2 with 3M-EC-504 Thiokol cement. A fourth section of tubing enters the cockpit, goes down through the floor, crossing to left hand side of fuselage after joining fifth section of tubing, and is secured by two clamps to floor channels. A sixth section runs down the left side to the valve (6). All tubing is removable.

a. Remove first and second sections of tubing by working from top of engine accessory compartment, with cowling removed.

b. The third section of tubing running between fuel cell and skin, is removed by removing right hand fuel cell hangar door (1). Remove clamp holding tubing. Remove plate on forward side of firewall by removing two screws. Break tubing connection at point where tubing enters cockpit and attach a string. Pull section of tubing between fuel cell and skin forward through firewall; untie string, leaving it within fuel cell compartment, to facilitate reinstallation of tubing.

Note

When section of tubing which runs between fuel cell and skin is removed as described above, the fumeproof seal is broken at point where tubing enters cockpit. When replacing tubing, reseal bulkhead 130-1/2 with 3M-EC-504 Thiokol cement from aft side, as forward side is inaccessible.

c. The fourth section of tubing is removed by working under instrument panel, removing rubber hose and one clamp near floor.

d. The fifth piece is removed by working from the belly access door and removing two clamps on floor channels.

e. Remove sixth and last section of tubing by removing one clamp from floor channel at station 160.

4—1357. INSTALLING. To install valve and tubing, reverse procedures directed in paragraphs 4—1355 and 4—1356.

4—1358. ACCELEROMETER.

4—1359. DESCRIPTION. *(See figure 4—126.)* The accelerometer, R88-A-140-11, (AN5745-L2A), is a self-contained instrument used by pilots to check the forces imposed on the aircraft structure when permissible maneuvers such as climb, dive or turn are executed. A solid metal block or mass is the activating element of the mechanism. When such maneuvers are performed, three indicating hands respond to the acceleration imposed on the mass. The main pointer shows at all times the accelerations imposed on the aircraft, whereas the the plus hand indicates only maximum positive accelerations and the minus hand indicates maximum negative accelerations. These two hands hold their maximum position until reset by the knob. The instrument enables the pilot to make a visual check of the number of "g's" attained, so that maximum permissible air speeds and accelerations will not be unknowingly exceeded when using an anti-blackout suit, resulting in failure of the airplane.

4—1360. LOCATION AND ACCESS. For location of and access to the accelerometer, refer to paragraph 4—1275.

4—1361. TROUBLE SHOOTING. No servicing or inspection is possible on the airplane other than a superficial examination for loose or broken cover glass and loose pointers. The indicator should be removed and replaced with a new instrument if it is defective.

4—1362. REMOVING. To remove accelerometer, follow procedure given in paragraph 4—1276. Since there is no tubing connected to back of instrument, simply remove screws holding instrument to panel.

4—1363. INSTALLING. Reverse removal procedure.

4—1364. COMPASSES.

4—1365. DESCRIPTION. Two kinds of compasses are installed on the airplane. One is a remote indicating compass, consisting of a gyro flux gate transmitter, an amplifier, an inverter, and an indicator. The other is a standby compass which is a self-contained instrument for use in case of failure of either the remote indicating units or of the electrical system in the airplane.

4—1366. REMOTE INDICATING GYRO FLUX COMPASS SYSTEM.

4—1367. DESCRIPTION. The gyro flux gate compass is a remote-indicating, gyro stabilized, earth-inductor compass. It is designed to supply an accurate and continuous directional reading which is not affected by turns, banks, climbs, or dives. By locating the compass element in a transmitting unit which can be mounted at a distance from magnetic and electrical interference, the effect of these disturbances is minimized. The system consists of a remote compass transmitter, located at fuselage station 260, an amplifier on frames 199 and 211½ providing voltage and power amplification for the signals, and an inverter, installed on left hand frames 160 and 165½, for changing the direct electrical current to alternating current for the operation of the system. The transmission of the magnetic indications in the compass to the indicator on the instrument panel in the cockpit is entirely electrical. Wiring information will be found in paragraph 5—97. A switch installed to the right of the indicator is provided for caging the gyro in the transmitter to prevent damages when the power is off or when the airplane engages in maneuvers exceeding the design limitations of the remote indicating compass.

4—1368. FUNCTION. The P-3 gyro flux gate compass system receives power as soon as the battery switch on the right vertical panel under the voltammeter is turned on and the inverter provides the required operational ac current. After power is turned on, the gyro in the transmitter will run-up. A period of five minutes must be allowed before the gyro reaches its normal operating speed of approximately 20,000 rpm. After the gyro run-up, the gyro must be erected by putting the system through a complete caging and uncaging cycle by manually operating the toggle switch on the instrument panel. The gyro should also be erected after any maneuvers departing from level flight by more than 70 degrees in pitch and 100 degrees in bank. This procedure is necessary because the headings indicated by the indicator are accurate only when the sensitive compass element stabilizing gyro in the transmitter is in a vertical position with respect to the earth. A change in heading of the airplane produces a signal to the autosyn in the indicator. The follow-up autosyn, which is under excitation by a 26 volt, 400 cycle, single-phase current, provided by the transformer in the junction box, has a rotor; this rotor is in a null position when not excited, that is, with its poles at a right angle to the stator. As long as the autosyn rotor is in a null position, no signal from the flux gate is induced in the rotor by the stator field, but if the stator field shifts, because of a change in heading of the airplane, the rotor will no longer be in a null position, and the electrical impulse from the flux gate is duplicated by the rotor windings, thus affecting the reading of the indicator showing a change in direction of the airplane. The compass element transmitter cable carries current as follows: *(see figure 5—23)* the three-phase, 26 volt power to the gyro, the excitation voltage to the flux gate, and the returning flux gate signal together with the dc and ac circuits interconnecting the caging switch, the caging motor in the transmitter, and the caging relays in the junction box. The indicator electrical cable carries current as follows: the flux gate signal to the autosyn (routed through the amplifier for strength), the resultant autosyn rotor signal, and the fixed and variable phase of the induction motor.

4—1369. TROUBLE SHOOTING. When electrical trouble is encountered, a great deal of time may be saved by first checking amplifier vacuum tubes and electrical connections. Always examine plugs inside for failure at soldered connections. For wiring diagram information, see paragraph 5—97.

Trouble	Probable Cause	Suggested Remedy
No power.	*a.* Direct current failure.	*a.* Check connections at battery switch. Check direct current voltage at amplifier end of cable. Check cable for continuity and shorts.
	b. Internal failure of amplifier.	*b.* Replace amplifier; see paragraph 4—1380.
Gyro in transmitter does not run.	*a.* Internal failure in transmitter.	*a.* Replace transmitter and check compensation of system; see paragraph 4—1399.
	b. Alternating current power inverter failure.	*b.* Check alternating current voltage and frequency. Replace defective inverter; see paragraph 4—1370.
Indicator dial does not move when airplane is swung.	*a.* Failure of one or more tubes in amplifier.	*a.* Check tubes and replace with new ones, if defective.
	b. Failure in indicator cable or plugs.	*b.* Inspect soldered connections in plugs; check voltage at indicator end of cable.
	c. Internal failure in indicator.	*c.* Check for mechanical freedom by turning knurled shaft at rear. If defective, replace indicator with a new one and recompensate; see paragraph 4—1394 and paragraph 4—1399.
Indicator shows excessive deviations on compass swing.	*a.* Stray electrical pick-ups through unshielded signal leads or ungrounded shielding.	*a.* Check all signal leads for shielding and grounding.
Indicator dial rotates slowly and continuously.	*a.* Failure of tube in amplifier.	*a.* Check tube and replace with new one, if defective.

Trouble	Probable Cause	Suggested Remedy
	b. No flux gate excitation or signals.	*b.* Check voltage at transmitter end of cable.
	c. No follow-up autosyn signal.	*c.* Check continuity between amplifier receptacles and in cables from indicator to amplifier.
Indicator dial oscillates on all headings.	*a.* Sensitivity control set too high.	*a.* Set knob on lower number. Use highest number possible without oscillation; see paragraph 4—1381.
Indicator dial is on wrong heading and swings with pitch and roll of airplane.	*a.* Gyro transmitter is not running and is uncaged.	*a.* Check voltage at transmitter end of cable. Check cable for continuity and shorts. Inspect soldered connections in plugs.
Indicator dial swings about 40 times per minute.	*a.* Ball in erection mechanism on transmitter gyro is magnetized.	*a.* Replace transmitter and check compensation of system; see paragraph 4—1399.
Indicator hand swings slightly with pitch and roll of ship in straight flight.	*a.* Magnetized object near transmitter.	*a.* Make sure there are no magnetic parts near the transmitter installation. Make sure there are no untwisted dc leads near transmitter.
Caging system does not operate.	*a.* Internal failure in caging relays.	*a.* Check voltage at caging relay terminals, and make resistance check at caging relay terminals with all plugs to power box disconnected.

4—1370. P-3 COMPASS INVERTER.

4—1371. DESCRIPTION. *(See figure 5—23.)* The inverter operates on direct current input voltage of 24 volts and delivers alternating current power at 400 cycles. The R17-I-7463 inverter consists of two units, a motor and a generator in a single frame. The motor is designed to run at approximately 6000 rpm. The alternating current power generated, is used to operate remote indicating compass units. The operation of the inverter is entirely automatic upon closing the battery switch.

4—1372. LOCATION AND ACCESS. The P-3 compass inverter is located in the lower left hand cockpit section between frames 160 and 165½ to which it is attached through supporting brackets. Access to the inverter is gained through the lower cockpit access door.

4—1373. REMOVING. To remove the inverter, observe the following procedure:

a. With battery switch in the "OFF" position, disconnect the electrical plug from the inverter.

b. Remove the four bolts attaching the inverter to the supporting brackets.

c. Lift and remove the inverter.

4—1374. INSTALLING. To install the inverter, reverse the removing procedure given in paragraph 4—1373.

4—1375. P-3 COMPASS POWER JUNCTION BOX.

4—1376. DESCRIPTION. *(See figure 5—23.)* The R88-B-862-50 power junction box contains a three-phase transformer to step down 115 volts, 400 cycle power supply to 26 volts for operation of the gyro and the caging motor in the gyro flux gate transmitter. In addition, the transformer provides 26-volt, 400 cycle, single-phase excitation for operation of the magnesyn in the compass indicator. The junction box also contains the caging relays.

4—1377. LOCATION AND ACCESS. The junction box is attached to the under surface of the upper radio shelf, to the right of the radio units. Access is gained through radio compartment access door.

4—1378. REMOVING. With battery switch "OFF," remove the junction box by observing the following procedure:

a. Disconnect the electrical cables at their respective connector receptacles.

b. Remove junction box cover to gain access to the four mounting bolts within the box.

c. Detach mounting bolts and remove junction box.

4—1379. INSTALLING. To install the junction box, reverse the removing procedure.

4—1380. P-3 COMPASS AMPLIFIER.

4—1381. DESCRIPTION. *(See figure 5—23.)* The R88-A-525 single channel amplifier is the power distributing center for the system. It also provides voltage and power amplification for the signals from the compass transmitter to the indicator. The amplifier is a five tube unit with an adjustment for sensitivity. The sensitivity control knob is located on the amplifier chassis near the rectifier tube. Adjustment of the sensitivity control knob increases or decreases the sensitivity of the compass system. This adjustment is necessary because the horizontal component of the earth's field varies with latitude. In general, the control should be kept as high as possible. The sensitivity control knob should be increased if compass operation appears sluggish. If oscillation occurs, the sensitivity control knob should be backed off one division. The amplifier assembly is protected by a metal cover which is secured to the chassis. Louvers are provided in the cover to permit an adequate amount of air to enter the unit for cooling purposes during operation.

4—1382. LOCATION AND ACCESS. The amplifier is located on the lower radio shelf to the right of the radio units. It is accessible through the radio compartment access door.

4—1383. REMOVING.

a. Be sure battery switch is "OFF."

b. Disconnect electrical cables to amplifier.

c. Remove the four attaching bolts and lift the amplifier off the shelf.

4—1384. INSTALLING. To install the P-3 compass amplifier, reverse the removing procedure.

4—1385. P-3 COMPASS TRANSMITTER.

4—1386. DESCRIPTION. *(See figure 5—23.)* The remote compass transmitter, R88-T-1910, consists of a gyro mounted in gimbals, a vertical seeking gyro or erection mechanism, the compass or flux gate element, and a caging mechanism.

4—1387. The gyro, a three-phase induction motor, consists chiefly of a rotor and a stator within a housing. Above the housing, an erection ball runs in a circular grooved cut in the top of the gyro frame cup. The gyro turns about a stator which is shielded from the flux gate or compass element mounted directly beneath the stator assembly. Two adjusting screws, located at either side of the gyro housing, are used to balance the gyro assembly. Power is supplied to the stator windings through the hairsprings on the gimbal bearings.

4—1388. The vertical seeking gyro provides the only means of holding the flux gate or compass element in a horizontal position with respect to the earth, not only in straight flight but also during maneuvers. The gyro is made to seek the vertical with reference to the earth by means of the rolling ball in the circular groove on top of the gyro cup. Also, with the airplane in flight along the curvature of the earth, the gyro's spin axis must be shifted one degree for every 60 miles of travel to keep the flux gate horizontal with respect to the earth's surface. The rolling ball which is the erection or vertical seeking mechanism performs this function.

4—1389. The flux gate, or the sensitive element in the compass, is rigidly mounted beneath the gyro housing and is thus stabilized in a horizontal plane. The flux gate consists of three cores, each of which is mounted in an induction coil incorporating a primary and secondary winding. The assembly takes the shape of a triangle with the apex used for take-off leads for the transmission of the flux gate signal to the indicator. When the flux gate primary windings are under excitation of single-phase cycle power supply furnished by the amplifier, the triangular-shaped core becomes saturated and demagnetized with each fall and rise of the alternating current. No inductive effects are, however, produced in the secondary windings. When the alternating current passes through zero, the cores become temporarily demagnetized permitting the flux lines of the earth's magnetic field to flow through the demagnetized cores. Each time time the exciting current rises, the earth's flux lines cannot pass the cores. By being alternately excluded from the cores and then allowed to pass through it, the direct current flux of the earth's magnetic field is made to have an alternating current effect by cutting the secondary windings on the cores and inducing in them an electrical impulse or signal. The flux gate cores are mounted in the form of a triangle, and the strength of the signal voltage developed across each secondary winding is dependent upon the angle at which the cores on which it is wound is positioned with respect to the earth's magnetic field. Only one possible combination of voltages, therefore, exists for any given compass heading. Three leads are connected to the flux gate secondary windings, one at each apex of the triangle, to permit the signal voltages induced by the earth's magnetic field to be taken off. The three leads from the flux gate secondary windings are connected, in parallel, to the stator of the follow-up autosyn in the direction indicator.

4—1390. CAGING TRANSMITTER GYRO. The caging transmitter gyro mechanism is mounted on the stationary frame of the transmitter housing aft of the gyro assembly. It consists of a two phase caging motor, a reduction gear train, and a shaft bearing three cams. The pitch-caging cam provides the movement necessary to cage the gyro in a vertical plane with the airplane in pitch. The bank-caging cam moves the bank-caging lever. This lever is mounted on the gimbal ring. The lever turns the gimbal ring and thus brings the ring to the horizontal. With the gimbal in the horizontal position, the gyro is locked at the vertical, both in bank and pitch. A third cam, operates a switch which is closed when the mechanism is in the caged position and open when the mechanism is uncaged. The switch controls one of the caging relays through which the caging motor is actuated. With the pitch-caging and bank-caging rollers away from the cams, the gyro housing and the gimbal ring are released and the gyro is uncaged. The operation of the caging mechanism of the remote compass transmitter is interlocked with the operation of the caging switch of the vertical gyro control. The vertical gyro is caged manually. The caging mechanism of the transmitter is operated electrically and is automatic. The AN3021-2 caging switch, is a one hole mounting single pole toggle type switch installed on the instrument panel to the right of the P-3 compass indicator. The operation of the switch will cage and uncage or erect the gyro in the remote compass transmitter.

4—1391. LOCATION AND ACCESS. The remote compass transmitter, located to the left of the centerline is bolted to channels which are riveted to the upper frames of the turtle-deck assembly, at stations 260 and 267. Access to the transmitter is obtained through the radio compartment access door.

4—1392. REMOVING. With the battery switch in the "OFF" position, proceed to remove the compass transmitter in the following manner:

a. Disconnect the electrical lead from the transmitter.

b. Remove the three nuts attaching the transmitter to its supporting channels.

c. Lift and remove the transmitter.

4—1393. INSTALLING. To install transmitter, reverse removal procedure given in paragraph 4—1392.

4—1394. P-3 COMPASS INDICATOR.

4—1395. DESCRIPTION. *(See figures 4—126 and 5—23.)* The R88-I-1681 compass indicator consists of the following parts: a coupling autosyn, a two phase induction motor which turns the rotor of the autosyn through a gear train, a transmitting magnesyn, a transmitting autosyn, a compensating mechanism, and a dial graduated from 0 to 360 degrees. The compensating mechanism, which contains no magnets, is entirely mechanical in operation and deviations and corrections are made by 12 adjusting screws arranged around the mounting flange of the instrument, three to each side of the flange. An uncorrected dial on the body of the instrument, just aft of the mounting flange, serves as an indicator of the compass deviation during ground swinging of the compass; see paragraph 4—1399. An adjusting knob at the rear lower left corner of the indicator is used to change uncorrected dial readings. The instrument is housed in a 3⅛ x 9½ inch metal case.

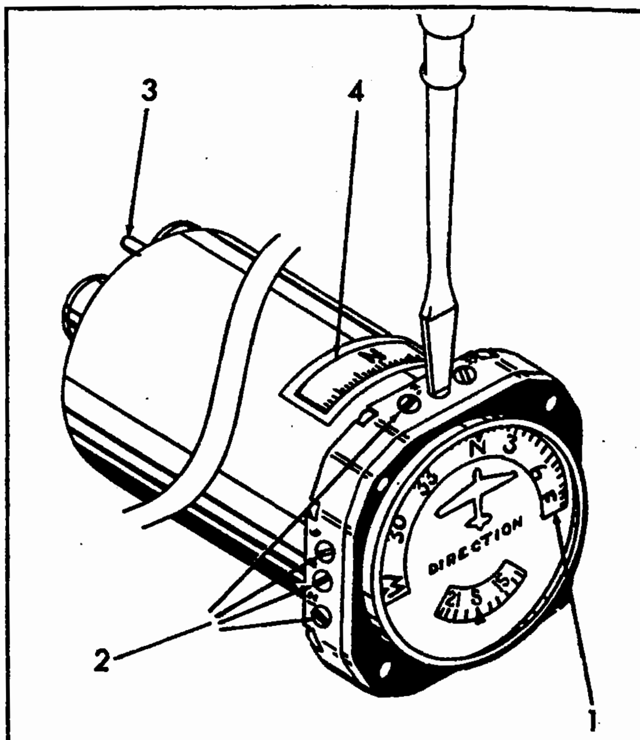
4—1396. LOCATION AND ACCESS. The P-3 compass indicator and caging switch are located on the main instrument panel. See paragraph 4—1275.

4—1397. REMOVING. Follow procedure given in paragraph 4—1276.

4—1398. INSTALLING. Reverse removal procedure.

4—1399. COMPENSATION OF P-3 COMPASS SYSTEM.

4—1400. DESCRIPTION. *(See figure 4—129.)* In the P-3 compass system, all constant errors are corrected at



1. Corrected Dial
2. Adjusting Screws (12)
3. Adjusting Knob
4. Uncorrected Dial

Figure 4—129. P-3 Compass Indicator Adjusting Screws.

the indicator on the instrument panel during the ground swinging procedure. The compensating mechanism is entirely mechanical in operation, and deviation corrections are made by turning twelve adjusting screws arranged around the mounting flange, three to each side. Access to the adjusting screws is gained by removing the indicator; see paragraph 4—1276. The other ends of these screws are attached to a flat, circular metal cam, over which a cam follower wheel rides. Turning the compensating adjusting screws to the right or left changes the contour of the metal cam, thus causing the cam follower to rise or fall as it passes over that section. The cam follower is attached to a correction mechanism which introduces a spread between the reading of the uncorrected dial and the corrected dial. The corrected dial can thus be made to lead or lag the uncorrected dial at those points where compensating adjustments have been made. In making adjustments, the following precautions should be carefully observed:

a. Turn only the screw nearest the heading indicated by the uncorrected dial.

b. Adjust all screws in consecutive order; do not skip back and forth.

c. Do not attempt to take out more than five degrees of deviation at the first adjustment of any screw. If deviation at any point exceeds five degrees, return to that point after other screws have been adjusted and take out the balance.

Note

An error requiring excessive adjustment between neighboring screws should be investigated as it may indicate the presence of magnetic objects near the gyro flux gate transmitter, such as steel tools or mounting bolts or, it may indicate an error in compiling data.

4—1401. GROUND SWINGING.

4—1402. DESCRIPTION. The P-3 gyro flux gate compass in this airplane is to be swung on the ground.

Note

The standby compass may be swung simultaneously with the P-3 compass.

In ground swinging, a properly equipped compass rose will facilitate procedure. Make sure that any auxiliary power supply, tractor, automobile, or tail hoist, near airplane, will be far enough removed from location of compass transmitter at all points in the swing so that it will not cause magnetic interference. Before starting compass swing, make following preparations:

a. Check alignment of gyro flux gate transmitter. The "FORE" and "AFT" marks on transmitter case must line up with center-line of airplane.

b. Turn battery switch "ON", and allow the P-3 compass system to operate for 30 minutes. If the gyro is caged at the start of this run, uncage it after 10 minutes and run it for the next 20 minutes uncaged. If uncaged at the start of this run, cage the gyro after 10 minutes; then immediately uncage it and run the next 20 minutes uncaged.

c. Remove the four mounting screws from the compass. In order to remove the plug from the rear of the instrument, it will be necessary to remove the four mounting screws from both the engine gage unit and the fuel quantity indicator (references (21) and (19) on figure 4—126) which are mounted immediately below the compass. It is then possible to tilt the compass until it can be pulled down below the instrument board and the plug removed. The instrument can then be removed through the space in the rear of the instrument panel.

d. Place indicator in front of panel and hold it in a horizontal position corresponding to the flight position of the airplane. In this position the indicator uncorrected dial can be read.

4—1403. COMPASS SWINGING PROCEDURE.

a. Starting at a point corresponding to location of any one of 12 adjusting screws (N, 30, 60, E, etc.) set airplane on 12 accurate magnetic headings, 30 degrees apart. At each point, make a record of heading shown on uncorrected dial as compared to accurate magnetic heading *(see figure 4—130)* and also enter deviation (correction required) with its correct algebraic sign. If accurate magnetic heading of airplane is more than that indicated by uncorrected dial, deviation (correction required) is (+) plus; and if accurate magnetic heading is less than that indicated by uncorrected dial, deviation (correction required) is (—) minus.

b. Prepare a graph similar to the one in figure 4—130, and enter it on deviation (correction required) found at each of accurate magnetic headings used in swing of airplane on compass rose. Then draw a smooth curve as close to deviation point as possible. By interpolation, read from curve deviation (correction required) at each of exact 30 degree headings at which an adjusting screw is located (N, 30, 60, E, etc.) and list these figures in a separate column shown in figure 4—130.

c. Disconnect the electrical cables from the compass indicator, after first shutting off the power.

d. Select the adjustment point (N, 30, 60, E, etc.) having the least deviation. Then press knurled knob at the rear of the instrument and turn it until the uncorrected dial is on this adjustment point.

e. Find correct magnetic heading for this adjustment point by taking uncorrected dial heading and adding to it or subtracting from it amount of deviation; then turn nearest adjusting screw until corrected dial reads accurate magnetic heading; *see figure 4—129.*

f. Repeat procedure at each of other adjustment points until all screws have been adjusted; then go around compass rose again and check each heading. If any slight differences are found, refine adjustment at those points which still require it, until each is accurate.

g. Reinstall the compass indicator in the instrument panel by reversing the removing procedure given in paragraph 4—1277.

4—1404. PREFLIGHT CHECK.

4—1405. PROCEDURE.

a. With engine running and power on, wait five minutes for gyro to reach operating speed, then erect gyro; see paragraph 4—1390.

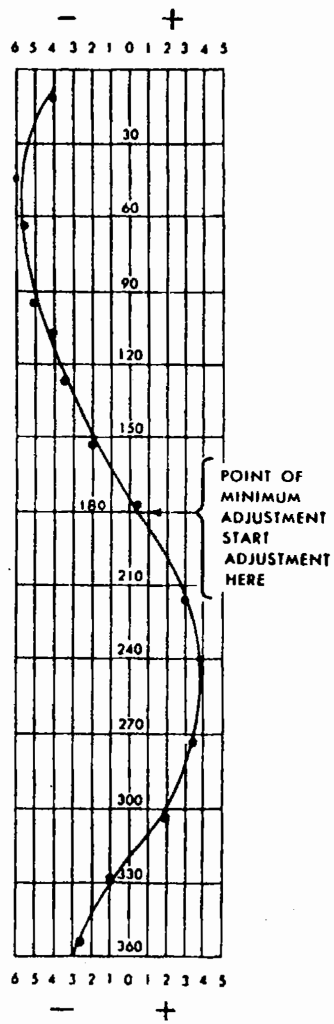
b. With airplane in the three-point position, allow an additional 15 minutes for the gyro to erect itself to a vertical position with respect to the earth.

c. Taxi the airplane in a zigzag fashion and see if compass indicator follows correctly each change in direction. If it does not, find the cause of the trouble; see paragraph 4—1369.

4—1406. STANDBY COMPASS.

4—1407. DESCRIPTION. *(See figure 4—126.)* The R88-C-777-10 standby compass, a self-contained instrument for use in case of failure of remote compass units or of electrical system of airplane, indicates direction in which airplane is flying with respect to magnetic north pole. Its card is graduated in degrees of a circle. The cardinal headings are shown in enlarged letters: N for north at zero degrees, E for east at 90 degrees, S for south at 180 degrees, W for west at 270 degrees. The reading of card is made against a fixed lubber line which is vertical white line visible on front of instrument.

ACCURATE MAGNETIC HEADING (Obtained in Ship-Swinging)	UNCORRECTED DIAL HEADING CORRESPONDING TO ACCURATE MAGNETIC HEADING	DEVIATION CORRECTION REQUIRED AT UNCORRECTED DIAL HEADING
9	13	−4
39	45	−6
56½	62	−5½
90	95	−5
109	113	−4
124½	128	−3½
149	151	−2
176½	176	+½
220	217	+3
244	240	+4
275½	272	+3½
306	304	+2
328	329	−1
351½	354	−2½



12 ADJUSTMENT POINTS ON UNCORRECTED DIAL (Set uncorrected dial at these points by means of manual drive knob)	COMPASS CORRECTION NECESSARY AT 12 ADJUSTMENT POINTS OF UNCORRECTED DIAL (Obtained from curve)	CORRECTED COMPASS HEADING (Set corrected dial at these points by means of adjusting screws)
30	−5½	24½
60	−5½	54½
E	−5	85
120	−3½	116½
150	−2	148
S	+½	180½
210	+3	213
240	+4	244
W	+3½	273½
300	+2	302
330	−1	329
360	−3	357

ALL VALUES IN DEGREES

Figure 4—130. P-3 Compass Ground Swinging Deviation Chart.

4—1408. LOCATION AND ACCESS. For location and access to the standby compass, refer to paragraph 4—1275.

4—1409. REMOVING. Follow procedure given in paragraph 4—1276.

4—1410. INSTALLING. Reverse removal procedure.

4—1411. SWINGING AND COMPENSATION OF STANDBY COMPASS.

4—1412. DESCRIPTION. The standby compass may be swung simultaneously with the remote compass in the airplane. With the airplane on the compass rose, observe the following procedure:

a. Slide the shutter on the front of the compass to the left to make the compensating screws accessible.

b. With a non-magnetic screwdriver, turn the compensating screws until the spot on the screw head is aligned with the spot on the lens ring. This reduces to zero the effect of the compensator magnets on the main compass magnets.

c. Obtain a compass correction card No. R88-C-200.

d. Place the airplane on a south magnetic heading. Note the compass reading and determine the compass deviation on the south heading.

e. Place the airplane on a west magnetic heading. Note the compass reading and determine the compass deviation on the west heading.

f. Place the airplane in a north magnetic heading. Note the compass reading and determine the compass deviation on the north heading and compute the coefficient "C." The coefficient "C" is the deviation on north minus, algebraically, the deviation on south, divided by 2; that is:

$$C = \frac{\text{dev. on N-dev. on S.}}{2}$$

With the airplane still on the north heading, the north-south compensator is adjusted to cause the compass reading to change by an amount equal in magnitude and in algebraic sign to the coefficient "C." The adjustment is made by turning the north-south compensator screw.

g. Place the airplane on an east magnetic heading. Note the compass reading and determine the compass deviation on the east heading and compute the coefficient "B." The coefficient "B" is the deviation on east minus, algebraically, the deviation on west divided by 2; that is:

$$B = \frac{\text{dev. on E} - \text{dev. on W.}}{2}$$

With the airplane still on the east heading, adjust the east-west compensator so as to cause the compass reading to change by an amount equal in magnitude and in algebraic sign to the coefficient "B." Adjust the compensator by turning the east-west screw. While the airplane is still on the east heading, the coefficient "A" is computed. This is equal to the algebraic sum of the compass deviations on the four cardinal headings, divided by 4; that is:

$$A = \frac{\text{dev. on N} + \text{dev. on E} + \text{dev. on S} + \text{dev. on W.}}{4}$$

If the coefficient "A" exceeds two degrees, the compass is compensated by turning its face relative to the plane of the instrument panel by means of washers or spacers placed between the instrument panel and the attaching flange of the compass.

h. All the readings are then recorded on the compass correction card No. R88-C-200.

i. After compensation, the airplane is swung for residual deviations on eight symmetrical headings and the compass reading recorded on the compass correction card. The correction card is placed in the compass correction card holder on the instrument panel cover near the compasses. The reverse side of the card gives brief but complete directions for performing the compensation.

4—1413. ATTITUDE GYRO INDICATOR.

4—1414. DESCRIPTION. The R88-I-1305 attitude gyro indicator provides the pilot with a continuous indication of the attitude of the airplane in pitch and bank. The unit has no angular limitations, permitting a full 360 degree indication about the roll and pitch axes of the airplane. The attitude gyro indicator consists of a stabilized sphere housing. In level flight, the pilot views the "equator" line on the sphere. This line coincides with the "horizon" bar, which can be adjusted to zero pitch or the "equator" line by means of the knob in the lower left corner of the face of the instrument. The pitch graduations on the gyro housing range from zero degrees (equator line) to 90 degrees (either pole). The upper or dive indicating half of the sphere has graduations at 10° 15°, etc., continuing to 60° in increments of five degrees and to 70° with an increment of 10 degrees. The 90° dive is indicated by a circle with a heavy dot in the center. The upper or climb indicating half of the sphere has graduations at 30° and 60° only. The 90° climb is indicated when the horizon bar rests at the center of the large circle at the lower pole of the sphere. Bank graduations of the unit appear on the upper half of the dial and range from a heavy zero graduation (at the top center) to 90 degrees, both clockwise and counterclockwise. Graduations are placed at 0° to 60° in increments of 10 degrees, and from 60° to 90° with a 30 degree increment. The attitude gyro is always on when the engine is operating. Closing the battery switch, prior to starting the engine, will start the attitude gyro. The ac current for the operation of the instrument is furnished by the inverter; see paragraph 4—1419. For electrical wiring information see paragraph 5—99.

4—1415. LOCATION AND ACCESS. For location of and access to the attitude gyro, refer to paragraph 4—1275.

4—1416. TROUBLE SHOOTING.

Trouble	Probable Cause	Suggested Remedy
Excessive drift in either direction.	*a.* Excessive vibration.	*a.* Tighten loose mounting screws.
	b. Connections pulling on instrument.	*b.* Provide sufficient slack in electrical lead.
Dial spins continuously.	*a.* Defective rotor.	*a.* Replace instrument.
Instrument lacks sensitivity.	*a.* Insufficient electrical current.	*a.* Repair or tighten broken or loose electrical leads. Check inverter for satisfactory operation.

4—1417. REMOVING. Follow procedure given in paragraph 4—1276.

4—1418. INSTALLING. Reverse removal procedure.

4—1419. ATTITUDE GYRO INVERTER.

4—1420. DESCRIPTION. The R17-I-7461 inverter is a small, motor-like mechanism, furnishing 400 cycle, alternating current required for the operation of the attitude gyro. An attached filter minimizes radio frequency caused by feedback into the battery circuit. The operation of the inverter is entirely automatic upon closing the battery switch.

4—1421. LOCATION AND ACCESS. The attitude gyro inverter is located beneath the cockpit floor on the same support that holds the remote compass inverter. It is attached by four bolts to the side of the support in line with frame 160. Access to the inverter is obtained through the lower cockpit access door.

4—1422. REMOVING.

a. Make sure the battery switch is in the "OFF" position .

b. Disconnect electrical cable at the inverter.

c. Detach the four bolts and remove the inverter.

4—1423. INSTALLING. Reverse removal procedure given in paragraph 4—1422.

4—1424. ENGINE INSTRUMENTS.

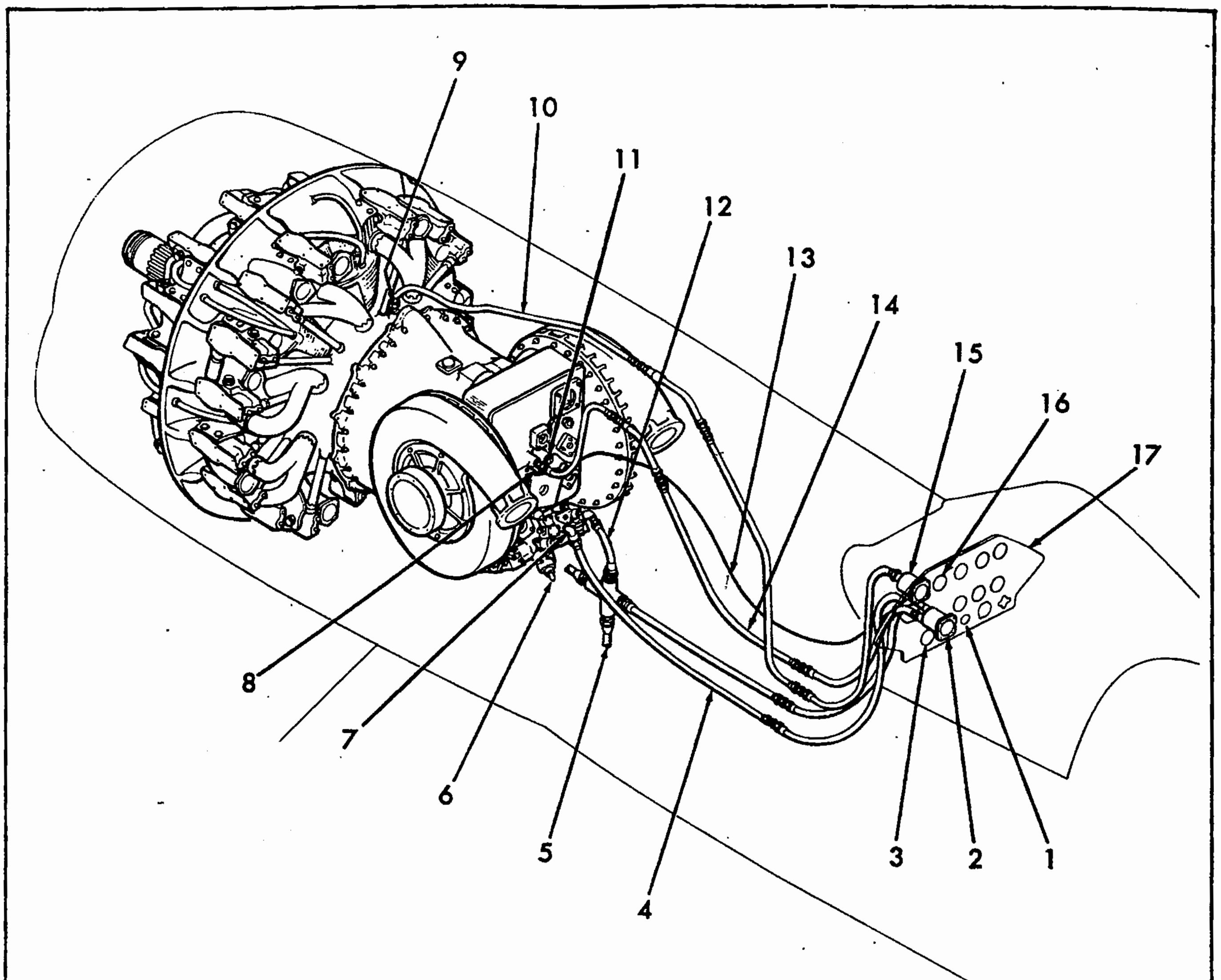
4—1425. ENGINE GAGE UNIT.

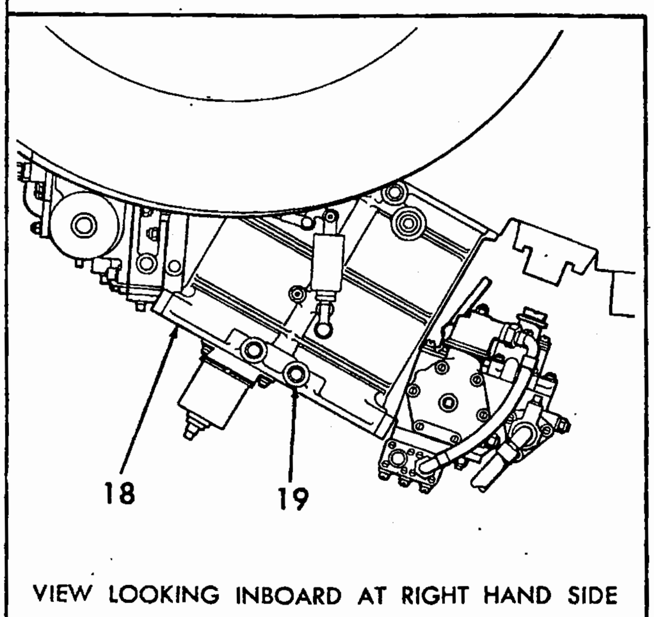
4—1426. DESCRIPTION. *(See figure 4—131.)* The engine gage unit (R88-G-1021-50) is actually three separate instruments housed in a single case. The gage unit consists of an electrical thermometer for the oil temperature, and two Bourdon type pressure gages which indicate oil pressure and fuel vented pressure at the carburetor. The oil temperature gage is a ratiometric type galvanometer connected in a modified Wheatstone bridge circuit with an external thermocouple as one of the bridge resistances. The other resistances in the circuit are housed within the gage unit. The thermocouple is housed in a plug which is inserted in the engine at the oil inlet connection of the engine. A rise in the temperature of the oil in contact with the thermometer bulb causes a corresponding change in temperature of the resistance winding in the bulb. A rise in temperature results in an increase in the resistance of the winding, and a drop in temperature results in a decrease in the resistance of the winding. The ratiometric galvanometer contains two coils connected so that their flux acts in opposition. A small constant current flows through one coil, providing the control for the galvanometer. The deflection of the pointer is proportional to the current flowing through the second coil. A small hairspring throws the pointer off-scale to the left when the galvanometer is not energized. When the oil temperature changes, the resistance of the thermocouple varies, redistributing currents in the bridge, and causing a change in the current flowing through the galvanometer. The amount of current which flows through the galvanometer is directly proportional to the temperature and the pointer scale is calibrated directly in degrees centigrade. The temperature range of the gage is from minus 50° to plus 150°, Centigrade. See paragraph 5—89 for electrical wiring diagram information.

4—1427. The fuel pressure gage indicates the pressure at which fuel is pumped into the carburetor, relative to the carburetor air pressure. The fuel pressure gage has two Bourdon tubes which are connected through a linkage to the fuel pressure pointer. One of the Bourdon tubes is actuated by the fuel pressure; the other by the carburetor static pressure. Deflections of the tubes due to the pressures applied to them act against each other through the linkage so that the gage gives the relative fuel pressure. Thus, if the fuel pressure at the carburetor is 28 psi above atmospheric pressure and the carburetor static pressure is 3 psi above atmospheric pressure, then the fuel pressure gage will indicate a pressure of 25 psi. The gage scale runs from zero to 35 psi, calibrated in increments of one psi.

4—1428. The oil pressure gage has a single Bourdon tube arrangement operating through a linkage to actuate the oil pressure pointer. The scale range is from zero to 200 psi, calibrated in 10 psi increments.

4—1429. LOCATION AND ACCESS. *(See figure 4—131.)* The engine gage unit is located on the main instrument panel, between the engine cylinder tempera-





1. Fuel Quantity Indicator (ref.)
2. Engine Gage Unit
3. Engine Cylinder Temperature Indicator (ref.)
4. Fuel Pressure Line
5. To Water Pump (ref.)
6. To Engine-driven Fuel Pump (ref.)
7. Fuel Pressure Connection on Carburetor
8. Oil Pressure Gage Connection on Engine
9. Manifold Pressure Gage Connection on Engine
10. Manifold Pressure Gage Line
11. Oil Temperature Gage Connection on Engine
12. Fuel Vent Line (connection on right hand side of carburetor)
13. Oil Temperature Gage Electrical Cable
14. Oil Pressure Line
15. Manifold Pressure Gage
16. Airspeed Indicator (ref.)
17. Instrument Panel (ref.)
18. Carburetor
19. Fuel Vent Line Connection to Carburetor

Figure 4—131. Engine Gage Unit and Manifold Pressure Gage Installations.

ture indicator and the fuel quantity indicator, and is accessible when working in the cockpit. The oil temperature electrical lead is connected to the temperature bulb (R88-B-890) located on the rear engine cover, beneath the tachometer generator mounting pad. Access to the oil temperature bulb is gained through the engine intercooler flap and forward panel. From the engine connection, the lead enters the engine section junction box on the right hand upper engine mount member, passes to the firewall junction box on the main beam to the right of the airplane's centerline, and from there passes to the main junction box underneath the cockpit floor and then to the engine gage unit. Access to the fuel and oil pressure and fuel vent connections on the engine is gained through the intercooler flap and forward panel. Access to the pressure gage connections on the engine gage unit is gained through the cockpit. The fuel vent connection on the engine is located on the right hand side of the carburetor just above the carburetor air box and the fuel pressure connection on the engine is located about three inches below the fuel inlet connection.

4—1430. TROUBLE SHOOTING.

a. Check the oil temperature gage by observing that the pointer is off-scale to the left when the instrument circuit-breaker is out, and that the pointer does not pull hard to the left or right or waver after the instrument circuit-breaker is in.

b. The oil pressure gage should read approximately zero, with engine inoperative, but a small error is not serious unless the "zero" gage reading is observed to "creep" more than five psi per weekly check. If the allowable creep is exceeded, the gage must be replaced.

c. The fuel pressure gage should read zero when both the fuel and vent pressure lines have been disconnected from the instrument. This should be done at the thirty hour check. Care must be taken to avoid interchanging the fuel and vent connections.

d. During engine warm-up, check the engine gage unit to be sure readings are consistant with engine conditions.

e. Check for intermittent operation of oil temperature indicator or excessive oscillation of any pointer.

f. Check gage unit for loosened mounting screws and loose or cracked cover glass.

g. Check electrical connections at both gage unit and bulb to be sure that coupling nuts are tight. Check conditions of visible wiring.

h. Check resistance bulb for leakage around gasket.

i. Check oil and fuel lines for leakage.

OIL TEMPERATURE INDICATOR

Trouble	Probable Cause	Suggested Remedy
Pointer fails to register.	*a.* Defective battery switch.	*a.* Replace switch.
	b. Broken battery lead, broken ground jumper or grounded lead.	*b.* Repair or replace ground jumper or lead.
	c. Ground in bulb lead.	*c.* Repair or replace lead.
	d. Defective bulb.	*d.* Replace bulb.
	e. Defective indicator.	*e.* Replace gage unit.
Pointer goes off high end of scale.	*a.* Broken or grounded lead.	*a.* Repair or replace lead.
	b. Defective bulb.	*b.* Replace bulb.
	c. Defective indicator.	*c.* Replace gage unit.
Indicator operates intermittently.	*a.* Defective battery switch.	*a.* Replace switch.
	b. Loose or broken battery lead or ground jumper.	*b.* Repair, replace, or tighten lead or jumper.
	c. Defective bulb.	*c.* Replace bulb.
	d. Defective indicator.	*d.* Replace gage unit.
Excessive pointer oscillation.	*a.* Loose or broken lead or jumper.	*a.* Repair, replace, or tighten jumper.
	b. Defective bulb.	*b.* Replace bulb.
	c. Defective indicator.	*c.* Replace gage unit.
Obviously incorrect temperature reading.	*a.* Defective bulb.	*a.* Replace bulb.
	b. Defective indicator.	*b.* Replace gage unit.
Pointer fails to go off-scale with current off.	*a.* Defective indicator.	*a.* Replace gage unit.

OIL AND FUEL PRESSURE GAGES

Trouble	Probable Cause	Suggested Remedy
Pointer does not register.	*a.* Leak in pressure line.	*a.* Repair or replace tubing or nipple.
	b. Stoppage in pressure line.	*b.* Clean tubing and nipples.
	c. Defective gage.	*c.* Replace gage unit.
Pointer fails to return to zero.	*a.* Stoppage in pressure line.	*a.* Clean tubing and nipples.
	b. Defective gage.	*b.* Replace gage unit.
Obviously incorrect pressure reading.	*a.* Leak in pressure line.	*a.* Repair or replace tubing or nipples.
	b. Defective gage.	*b.* Replace gage unit.
Excessive pointer oscillation.	*a.* Loose mounting.	*a.* Tighten mounting screws.
	b. Defective gage.	*b.* Replace gage unit.
Fuel enters case.	*a.* Leak in Bourdon tube.	*a.* Replace instrument.

4—1431. REMOVING. *(See figure 4—131.)* To remove tubing connecting the engine gage unit with the accessories to which the tubing is attached, proceed as follows:

a. Disconnect hose connections from the fuel pressure, oil pressure, and fuel vent lines from the engine gage unit on the instrument panel.

b. Disconnect hose and aluminum alloy tubing from union forward of instrument at fuselage station 138.6.

c. Disconnect unions, clips, and tubing from bulkhead at fuselage station 130.5.

d. Disconnect unions, clips, and tubing in wing fillet bulkhead located on the right hand side of the airplane at approximately fuselage station 102.5.

e. Disconnect the tubing, unions, and clips on right hand side of the airplane at fuselage station 91.75 and disconnect line from the "oil-in" temperature bulb located on the engine in the center of the rear cover below the tachometer generator mounting pad.

f. Disconnect the oil pressure line from the engine connection which is located beneath the oil thermometer connection.

g. Disconnect the fuel pressure gage connections located just below the fuel inlet connection located on the aft right hand side of the carburetor.

h. Disconnect electrical lead from oil temperature bulb located under the tachometer mounting pad.

i. Disconnect electrical lead from engine gage unit which leads from main junction box.

j. Remove engine gage unit from the instrument panel, working in the cockpit.

4—1432. INSTALLING. To install the engine gage unit, reverse the removal procedure. See paragraph 4—1431.

Note

When installing the gage be careful not to interchange the fuel pressure and the vent pressure lines.

4—1433. MANIFOLD PRESSURE GAGE.

4—1434. DESCRIPTION. *(See figure 4—131.)* The manifold pressure gage, AN5770-1A (R88-G-773-100) indicates the absolute pressure at the intake manifold of the engine. A warning mark affixed to the cover glass indicates the maximum permissible manifold pressure at which the engine may be operated unless combat power is being used. The gage contains an aneroid diaphragm and a linkage for transmitting the motion of the diaphragm to the pointer. The linkage is completely external to the pressure chamber, and thus is not exposed to the corrosive vapors of the manifold. The pressure existing in the manifold enters the sealed chamber through a damping tube, which is a short length of capillary tubing at the rear of the case. This damping tube, acting as a safety valve, prevents damage to the instrument which would be occasioned by engine backfire. The sudden surge of pressure caused by backfire is considerably reduced by the restricted capillary tubing.

4—1435. LOCATION AND ACCESS. The manifold pressure gage is located in the upper left hand corner of the instrument panel to the left of the airspeed indicator and above and to the right of the ignition switch. Access to the gage is obtained through the cockpit and through the left hand instrument access panel in the cowl. Access to the manifold pressure gage connection on the engine is through the accessory section engine cowling. The gage connection is located on the engine main stage blower aft of No. 18 engine cylinder intake pipe. The flexible hose and rigid tubing connecting the gage to the engine are accessible through the engine accessory cowling, instrument access doors and cockpit.

4—1436. TROUBLE SHOOTING.

a. Check the reading of the manifold pressure gage against the reading of the station barometer or the barometric pressure as determined by setting the altimeter to read the known elevation. If the manifold gage error is greater than 0.5 inch Hg, replace the instrument.

b. Check the installation for security.

c. Check gage for leakage by disconnecting the manifold pressure line at the engine and apply suction with the mouth. When the pressure reaches about 15 inches Hg, seal off the line with the tongue while an assistant notes the reading on the gage. If the pointer does not remain stationary, there is a leak in the line or the instrument case. If the pointer does not move, the line is obstructed. In either event, remedy the defect before making the final connection. All connections should be air tight.

Note

At first evidence of excessive pressure fluctuation or other symptoms of malfunction, the gage should be removed and tested.

4—1437. REMOVING.

a. Working in the cockpit, disconnect the hose connection from the manifold pressure gage and remove gage.

b. At fuselage station 138.6 disconnect union and rigid tubing which runs forward to right hand side of the airplane at station 130.5.

c. Disconnect tubing and unions on rigid tubing going forward to the bulkhead in the wing fillet at fuselage station 102.5.

d. Disconnect rigid tubing and nipple at power plant station 91.75.

e. Disconnect flexible hose connection from nipple secured on upper right hand engine mount member.

f. Disconnect nipple and rigid tubing going forward to engine connection aft of No. 18 engine cylinder intake pipe, on left hand side.

4—1438. INSTALLING. To install manifold pressure gage and tubing, reverse the removal procedure.

4—1439. FUEL QUANTITY INDICATING SYSTEM.

4—1440. DESCRIPTION. The quantity of fuel in the main fuel cell is indicated to the pilot by a remote indicating system. It consists of a Liquidometer type indicator located on the instrument panel *(see figure 4—126)* which is connected electrically to a float type transmitter in the fuel cell. A low level warning switch is incorporated in the transmitter which illuminates a warning light on the instrument panel when the quantity of fuel in the main cell drops to 50 U. S. gallons; see paragraph 4—1483.

4—1441. FUEL QUANTITY INDICATOR.

4—1442. DESCRIPTION. The fuel quantity indicator (R88-I-2008-300) is located on the main instrument panel; *(see figure 4—126).* It is a single pointer, 300 degree scale instrument, calibrated at intervals of 10 U. S. gallons from O for empty to 230 for full. (Tank actually holds 234 U. S. gallons.) This instrument is connected by three wires to a variable resistance in the fuel quantity transmitter. The indicator has a ratio type mechanism consisting of a rotor which moves in a magnetic field produced by three stationary coils. The rotor carries the pointer and is balanced to return the pointer to a vertical position between the empty and full marks when the indicator circuit is open or short-circuited. Variable resistance in the transmitter controls the current flowing through the stationary coils in the indicator. Movement of a contact shoe over the resistance strip in the transmitter (see paragraph 4—1447) causes a change in the indicator coil flux, which in turn, causes the rotor and pointer assembly to assume a position corresponding to that of the transmitter contact shoe.

4—1443. LOCATION AND ACCESS. For location of and access to the fuel quantity indicator, refer to paragraph 4—1275.

4—1444. REMOVING. To remove the fuel quantity indicator, observe the procedure given in paragraph 4—1276.

4—1445. INSTALLING. To install the fuel quantity indicator, reverse the removal procedure.

4—1446. ADJUSTING. If the fuel quantity indicator reads incorrectly, observe the adjusting procedure given in paragraph 4—809.

4—1447. FUEL QUANTITY TRANSMITTER.

4—1448. DESCRIPTION. The fuel quantity transmitter (R88-T-2677-600) is a long cylindrical tube of aluminum alloy mounted vertically in the main fuel cell and extending the depth of the tank. The bottom of the tube rests on the floor of the fuel cell in a cup which is supported by studs. The top of the tube extends out of the top of the fuel cell and is accessible through the liquidometer access door just forward of the windshield. The tube guides an aluminum float which is keyed to a vertical shaft extending the length of the tube. A spiral slot in the tube constrains the float so that it must rotate slowly as it rises or falls. The rotation of the float is transmitted by the vertical shaft to a contact shoe (sliding arm or rheostat wiper) which slides over a resistance strip in the housing at the top of the tube. Changes in resistance cause changes in the current flowing through the fuel quantity indicator and the pointer rotates accordingly; see paragraph 4—1441. The fuel reserve warning light is actuated by a microswitch within the transmitter; see paragraph 4—183. The transmitter is easily removed, installed and adjusted by observing the procedures in paragraphs 4—804 through 4—809; information on the electrical circuit is covered in paragraph 5—83.

4—1449. ENGINE CYLINDER TEMPERATURE INDICATING SYSTEM.

4—1450. DESCRIPTION. Engine cylinder temperatures are measured by thermocouples installed in engine cylinder numbers two and four and are indicated on the engine cylinder temperature indicator in degrees centigrade. The voltage generated at the thermocouples is amplified and registers on the indicator which is located on the instrument panel to the left of the engine gage unit. In addition, during normal operation, with the propeller governing above or below 2300 rpm and the cowl flap switch on "AUTOMATIC," engine cylinder head temperatures (through the thermocouples) will cause the mechanism of a controller box to energize the cowl flap motor, opening or closing the flaps according to predetermined engine cylinder head temperatures. The controller box amplifies the voltage generated by the thermocouples and remotely controls the cowl flap position by energizing the cowl flap motor. When the propeller is governing engine speeds at 2300 rpm and below, through relays in the main junction box, one circuit of the system is energized and the controller box setting causes the cowl flap actuating motor to open the cowl flaps when engine cylinder head temperatures reach 232 degrees Centigrade and above. When the propeller is governing at 2300 rpm and above, another circuit is energized through the relay and the controller box again energizes the cowl flap motor when engine temperatures reach 248 degrees Centigrade and above. These settings of the controller box are made at the factory. The adjusting knobs on the controller box are lockwired to prevent inadvertent movement. For wiring information, see paragraph 5—79. Refer to paragraph 4—440 for further information on cowl flap controls.

4—1451. TROUBLE SHOOTING.

a. Check system for security.

b. Check the indicator by disconnecting one of the thermocouple leads and comparing the indicator temperature reading with that of a reliable thermometer which has been in the cockpit a sufficient time to indicate cockpit temperature. If indicator temperature is off more than three degrees, break the wax seal on the adjusting screw and rotate the pointer until the indicator reading corresponds to the correct cockpit temperature. Reseal with wax.

c. If the indicator does not operate with a rise in engine temperature, check all external connections. An alternate thermocouple may be connected and heated with a soldering iron to determine whether the indicator is at fault.

CAUTION

Do not change the lengths of the thermocouple leads as doing so will upset the indicator calibration. Resoldering the terminals at the instrument is permitted.

d. Check adjusting knobs on controller box for safety wiring.

e. Check that all electrical plugs in system are secure.

4—1452. ENGINE CYLINDER TEMPERATURE INDICATOR.

4—1453. DESCRIPTION. The engine cylinder temperature indicator (R88-I-2664-10) is basically a D'Arsonval type galvanometer, having a permanent magnet and a moving coil. The moving coil carries the pointer and control is effected by two phospher bronze hairsprings and a compensator for minor temperature variations, which also serves to carry the moving coil The movement is mounted on a phenolic base and housed in a shielded iron case to minimize the effect of stray magnetic currents. The indicator is connected to the two triple thermocouples by a lead assembly (R88-L-910), consisting of two parts joined by a connector assembly (R88-6-1310). The lead assembly is composed of two wires coded black and yellow. The first section leads from the indicator to the connector assembly at power station 82 and contains a variable resistor (R88-R-383-50). The second section leads from the connector assembly to the engine section junction box, located outboard of the generator on the right hand side of the engine. From the engine section junction box the two wires pass through a conduit to the cowl flap controller box, located on the left hand side of the engine. The two triple thermocouples lead from the controller box to engine cylinders number two and four.

4—1454. LOCATION AND ACCESS. The engine cylinder temperature indicator is located in the lower row of instruments on the instrument panel to the left of the engine gage unit; *(see figure 4—126.)* Access to the instrument is through the cockpit. For access to the remainder of the system, remove the engine cowling and upper engine accessory cowl panel.

4—1455. REMOVING. To remove the engine cylinder temperature indicator and its leads observe the following procedure:

a. Remove the four screws that mount the indicator to the instrument panel.

b. Disconnect the two lead terminals from the rear of the indicator, and remove the indicator from the airplane.

c. Disconnect the two sections of the lead at the thermocouple disconnect at power plant station 82, and remove the first section with its attached resistor.

d. Disconnect the other end of the second section at the engine section junction box and remove it from the airplane.

4—1456. INSTALLING. To install engine cylinder temperature indicator, reverse removal procedure.

4—1457. THERMOCOUPLES.

4—1458. DESCRIPTION. Two triple thermocouples actuate the engine cylinder temperature indicator, one attached to number two engine cylinder, the other to number four engine cylinder. Each thermocouple contains six elements, three of iron and three of constantan. They are connected to the cowl flap controller box on the left hand side of the engine at one end, and to adapters in the rear of engine cylinders number two and four at the other end. The thermocouple leads are secured to the engine adapters by a bayonet type locking plug.

4—1459. LOCATION AND ACCESS. Access to the thermocouple connections on the engine is through the upper engine cowl panels, and the left hand upper wing gap cover and top accessory compartment panel.

4—1460. REMOVING.

a. Disconnect thermocouples at numbers two and four engine cylinders by releasing the bayonet type lock.

b. Release clips securing thermocouple leads to structure.

c. Disconnect thermocouple leads at the controller box on the left hand side of the engine.

4—1461. INSTALLING. Reverse removal procedure.

4—1462. TACHOMETER INSTALLATION.

4—1463. DESCRIPTION. The tachometer installation is designed to indicate true engine speed by means of a small generator on the engine which supplies energy to a motor driving a magnetic tachometer element in the cockpit indicator. The generator, driven at one-half crankshaft speed, converts mechanical energy into electrical energy in the form of three-phase alternating current of varying frequency, which drives the rotor of the synchronous-motor portion of the indicator at the same speed as the generator rotor. The generator output reaches the indicator via the engine section junction box at Station 100 and the main junction box at Station 149. Plugs are located at the generator, firewall junction box, main junction box, and tachometer indicator. Refer to paragraph 5—85 for additional information on the electrical installation of the tachometer.

4—1464. TROUBLE SHOOTING.

Trouble	Probable Cause	Suggested Remedy
Unit does not function properly. (Zero reading of tachometer is not within plus or minus 20 rpm at preflight inspection.)	*a.* Electrical system is not functioning correctly.	*a.* Check wiring. Refer to paragraph 5—85.
	b. Mounting is insecure.	*b.* Check security of screws.
	c. Tachometer generator or indicator is not operating correctly.	*c.* Install new instruments, one at a time, and check to determine which unit is not functioning properly.

4—1465. TACHOMETER INDICATOR.

4—1466. DESCRIPTION. The tachometer indicator is designated as R88-I-2385-100. To the rotor of the synchronous motor is attached a magnetic-drag assembly, which consists of a number of magnets that are separated by a narrow air gap. A disc of conducting material of low temperature coefficient is located in the gap. The pointer, the control spring, and the drag disc are fastened on the same shaft. The torque, proportional to the engine speed, produced in the drag disc by the rotating magnets, drives the pointer around the scale. The pointer comes to rest when the torque, exerted by the disc, equals that of the control spring, and thus indicates the rpm of the engine. Equal gradations from zero to 4500 rpm in one complete revolution are marked off in green phosphorescent paint on the dial.

4—1467. LOCATION AND ACCESS. *(Refer to figure 4—126.)* The tachometer indicator is located on the left hand side of the main instrument panel. Access to the aft side of the tachometer indicator is obtained through the left hand instrument panel access door located in the windshield cowl. Access to the attaching screws may be obtained by removing the instrument cover.

4—1468. REMOVING. Refer to paragraph 4—1276 for removal of the tachometer indicator from the main instrument panel.

4—1469. INSTALLING. Reverse removal procedure.

4—1470. TACHOMETER GENERATOR.

4—1471. DESCRIPTION. The tachometer generator, R88-G-1355 (AN5531-1) operates through an engine drive rotating at one-half crankshaft speed. A right angle electrical outlet connection transmits three-phase electrical power to the stator of the synchronous motor of the indicator. The frequency of the power is directly proportional to the airplane engine speed.

4—1472. LOCATION AND ACCESS. The tachometer generator is mounted on a square engine pad on the rear face of the engine accessory drive housing, slightly up and to the right of the center of the face. Access to the rear face of the engine accessory drive housing is obtained through the intercooler flap.

4—1473. REMOVING.

a. Disconnect the electrical cable from the plug on the tachometer generator.

b. Remove the four bolts which attach the tachomter generator flange to the engine housing.

Note

If the tachometer generator is to remain detached for any considerable length of time, the engine mounting pad should be covered with tape or other suitable seal to prevent the entrance of dirt.

4—1474. INSTALLING. Install the tachometer generator by reversing the removal procedure.

4—1475. WARNING LIGHTS.

4—1476. CARBURETOR AIR TEMPERATURE WARNING SYSTEM.

4—1477. DESCRIPTION. *(See figure 4—126.)* The carburetor air temperature warning light is mounted on the instrument panel to provide a visible indication to the pilot when the average carburetor air temperature exceeds the maximum allowable limit of 43°C (110°F).

Note

> Although the switch is set to close at 51°C (124°F) the average carburetor air temperature throughout the carburetor air entrance area is 43°C (110°F).

Wiring from the temperature-actuated switch mounted to the carburetor air box reaches the instrument panel warning light via the engine section junction box, the firewall junction box at station 100, and the main junction box at station 149. The temperature switch is manufactured by Fenwal Incorporated, Ashland, Massachusetts, their part number 18301-3, with the addition of lock washers. The switch consists of a brass tube in which are mounted two long leaf springs. The springs are rigidly fastened to the capped ends of the tube. Normally, the springs are slightly compressed, resulting in their bowing outward and separating the two insulated contact points which are mounted at their midpoints. As the carburetor air temperature rises, the switch housing expands. This action draws the springs together, closing the contacts and energizing the warning light on the instrument panel. An adjusting screw in the head of the switch housing permits precise setting of the contact spacing so that the switch will close at the desired temperature. Refer to paragraph 5–87 for additional electrical information.

4–1478. LOCATION AND ACCESS. The carburetor air temperature warning light is located on the left hand side of the main instrument panel just to the right of the ignition switch. Access to the light may be gained by removing the instrument panel cover. Access to the wiring on the aft side of the instrument panel may be gained by opening the left hand instrument panel access door located in the left hand windshield cowling. The carburetor air temperature switch is located in the carburetor air box. Access may be gained by opening the intercooler flap.

4–1479. TROUBLE SHOOTING.

Trouble	Probable Cause	Suggested Remedy
Carburetor warning light fails to light under conditions such as engine backfire or during starting operations.	*a.* Bulb burned out.	*a.* Replace bulb.
	b. Electrical connection loose or improperly wired.	*b.* Check wiring. Refer to paragraph 5–87.
	c. Switch operating incorrectly.	*c.* Check operation of switch by unscrewing, grounding the case, and applying heat with a large soldering iron. The switch should be set to close at 51°C (124°F). To adjust, insert the switch in an oil bath, loosen the locknut and adjust the screw until the contacts just close at the required temperature of 51°C (124°F) plus or minus 1°C (2°F).
Carburetor warning light always on, even with engine off and outside air temperature lower than setting of switch.	*a.* Temperature bulb installed with excessive torque; excessive torque lowers setting on bulb.	*a.* Install new bulb or loosen bulb. Reset and reinstall with less torque.

4–1480. REMOVING.

a. Disconnect the electrical plug and unscrew the carburetor air temperature switch assembly to remove it from the carburetor air box.

b. Remove the carburetor air temperature warning light from the main instrument panel by disconnecting wires and unscrewing bulb from the mounting hole; see paragraph 4–1486.

4–1481. INSTALLING. Install the carburetor air temperature indicator light and carburetor air temperature switch by reversing removal procedure. Allowable torque on installation is 100 (–0 +20) pound inches.

4–1482. TESTING. With battery switch "ON," test the warning light, by pushing in the extending movable fixture on the front of the light. When pushed in, the light makes contact with test circuit which supplies the electrical current for the test procedure. If the bulb does not light, it must be replaced.

4—1483. FUEL RESERVE WARNING LIGHT.

4—1484. DESCRIPTION. When the quantity of fuel in the main tank drops to 50 U. S. gallons, a low level warning switch in the transmitter illuminates a warning light on the instrument panel *(see figure 4—126)*. The transmitter switch consists of a microswitch and a contacting shoe which is rotated by the shaft within the transmitter (see paragraphs 4—1439 and 4—804). When the float turns the shaft to the fuel warning level, the contact assembly and light segment contact and close the warning light circuit. In addition to the transmitter-warning light circuit, there is a separate warning light test circuit which closes and illuminates the warning light when the light is depressed by hand. See paragraph 5—83 for electrical information.

4—1485. LOCATION AND ACCESS. The fuel reserve warning light is located on the main instrument panel; see paragraph 4—1275.

4—1486. To remove the fuel reserve warning light assembly, observe the following procedure:

a. Turn battery switch "OFF."

b. Unscrew the red lens cover and remove from front of instrument panel.

c. Unscrew and remove light bulb from front of instrument panel.

d. Remove the instrument panel cover; see paragraph 4—1276.

e. Remove the two locknuts and washers, one located in front of the warning light receptacle and the other located to the rear of the receptacle.

f. Break the weld spots on the warning light terminals and remove wires.

g. Remove the warning light receptacle by pulling it from the front of the instrument panel.

4—1487. INSTALLING. To install the fuel reserve warning light assembly, reverse the removal procedure in paragraph 4—1486.

4—1488. TESTING. To test the fuel reserve warning light, observe the following procedure:

a. Turn the battery switch "ON.'

b. Depress the warning light by hand. The light should illuminate. If the light does not go on and yet is not burned out, the test circuit is open or short-circuited.

c. Test the light to make certain that it illuminates when the fuel quantity drops to 50 U. S. Gallons; see paragraph 4—810.

4—1489. FUEL TRANSFER WARNING LIGHT.

4—1490. DESCRIPTION. The fuel transfer warning light, manufactured by Searle Aero Industries, Inc., of Orange, California, (their part number VM400-2) lights to notify the pilot that the fuel transfer system has emptied the external auxiliary fuel tank from which fuel is being pumped into the main cell. When the auxiliary tank is emptied there is not enough pressure in the fuel transfer line to open the transfer pressure switch circuit. Therefore, the switch closes, causing the red warning light to go on indicating that no fuel is being passed to the main cell. For further details covering the fuel transfer system and its components, see paragraphs 4—758, and 4—870 through 4—903. For information concerning the electrical installation of the system, see paragraph 5—71.

4—1491. LOCATION AND ACCESS. The fuel transfer warning light is located on the left hand control panel, forward of the fuel transfer switch. The remainder of the system which consists of the fuel transfer pressure switch located on the bulkhead at fuselage station 134 below the windshield, the fuel transfer pump and two solenoid shut-off valves secured to brackets under the cockpit floor at fuselage station 171, and the circuit-breakers located on the right hand console, are all accessible through the cockpit and through the belly access door.

4—1492. REMOVING.

a. Turn battery switch "OFF."

b. Remove access panel on side of left hand control panel.

c. Remove adjusting knob, lockwire and hex nut securing warning light to top of control panel.

d. Remove locknut and washer from underside of warning light and control panel.

e. Break electrical connections to warning light, after noting location of circuit connections.

f. Remove warning light.

g. Disconnect plug at warning light switch.

4—1493. INSTALLING. Installation of the fuel transfer warning light is the reverse of the procedure covered in removal.

4—1494. TESTING. To test the warning light, press lamp downward. When pushed in, the light makes contact with the test circuit which supplies current for test.

4—1495. MISCELLANEOUS INSTRUMENTS.

4—1496. CLOCK.

4—1497. DESCRIPTION. The clock, a R88-C-573-11 (AN5741-L-1) instrument, incorporates in one spring-actuated instrument, an eight day clock with a center sweep second hand, a 24 hour dial, a civil date indicator and an elapsed time indicator for both minutes and hours. The elapsed time unit and the stop watch unit may be operated singly or simultaneously as desired without interfering with the operation of the clock as a timepiece.

4—1498. OPERATING INSTRUCTIONS. To wind and set the clock, observe the following procedure:

a. Wind the clock by turning the lower left hand knob in a clockwise direction.

CAUTION

Damage to the mechanism of the clock will result if the knob is forced to turn counterclockwise. The clock should be fully wound at approximately the same time every seventh day. Wind steadily and not too rapidly. The conclusion should be approached carefully to avoid injury to the spring or winding mechanism.

b. Set the clock by pulling the lower left hand knob outward to the stop (without turning). In doing this the setting mechanism is engaged, and the hands may be set backward or forward by turning the knob in either direction. The hour and minute hands operate continuously except when the knob is pulled out into the setting position. The civil date is set by pressing the red button, located next to the lower left hand knob, the required number of times to bring the pointer up to date. The pointer advances one day for each depression of the button.

CAUTION

Do not set the civil date pointer while the clock indicates between 2230 and 2430 hours, or damage to the mechanism will result.

c. The sweep second hand may be run continuously as an ordinary second hand or it may be used as a stop watch. When used as a stop watch, the number of revolutions of the second hand are indicated by a small minute hand on the upper small dial of the clock. The sweep second hand is started, stopped, and returned to zero by successive depressions on the upper right hand knob.

d. The elapsed time unit, located at the lower center of the main clock dial, consists of a minute and hour hand on a 12 hour dial. The hands are started, stopped and returned to 12 by successive depressions of the lower left hand knob on the clock case.

e. The "chronograph" system for measuring and recording short intervals of elapsed time is controlled with a single push button on the upper right hand edge of the clock dial. If the clock runs consistently fast or slow, it may be regulated by removing the plug in the rear of the case and moving the lever toward "S" if the clock is running fast and toward "F" is the clock is running slow.

4—1499. LOCATION AND ACCESS. For location and access, refer to paragraph 4—1275 and to figure 4—126.

4—1500. REMOVING. For removing, refer to paragraph 4—1276.

4—1501. INSTALLING. Reverse removal procedure.

4—1502. HYDRAULIC PRESSURE GAGE.

4—1503. DESCRIPTION. The hydraulic pressure gage is a Bourdon tube pressure measuring instrument designated as R88-G-620-10 (AN5771-4B). For complete information on this instrument refer to paragraphs 4—963 through 4—967.

4—1504. WHEEL AND FLAP POSITION INDICATING SYSTEM.

4—1505. WHEEL AND FLAP POSITION INDICATOR.

4—1506. DESCRIPTION. The R88-I-1888 (AN5780-3) wheel and flap position indicator is used to give remote indication of the position of the landing gear and landing flaps. The instrument consists of four elements: three to show wheel position, and one to show flap position. The landing gear and flap position indicator incorporates three riders on the dial. One is located at the bottom center of the dial for tail wheel position indication. Two riders, one to the right and one to the left, indicate the position of the main landing gear. At the top of the dial is a simulated flap with a range of from zero to fifty degrees to indicate the landing flaps position. The indicator is electrically actuated; see paragraph 5—93.

4—1507. LOCATION AND ACCESS. The landing gear and flap position indicator is located on the left hand inclined panel and is accessible by working from within the cockpit. The flap position transmitter is located on the left hand side of the fuselage between stations 143-149 and is accessible through the belly access door.

4—1508. REMOVING. To remove the indicator, unscrew the electrical receptacle from behind indicator and remove three screws which secure the indicator to the inclined panel. Remove indicator.

4—1509. INSTALLING. Reverse removal procedure.

4—1510. MICROSWITCHES.

4—1511. DESCRIPTION. The tail wheel rider on the indicator is actuated by the closing of either an "up" or "down" microswitch located in the tail gear wheel well. The "up" position microswitch is secured to the support fitting at bulkhead 288. The "down" position microswitch is secured to the tail wheel scissors at the center folding point. The main landing gear riders are actuated by closing microswitches which are located on the landing gear and within the wheel well. The "up" position switches are located on a bracket which is secured to the inboard side of the main wing beam within the wheel well. The "down" position switches are located on the main shock strut and are actuated by the downlock hook.

4—1512. ADJUSTING MICROSWITCHES.

a. The setscrew on the lever assembly in the wheel well (inboard side) should be set so as to close the microswitches when the landing gear is in the "up" position. If adjustment has to be made, loosen lock nut and turn setscrew in or out as required. Reset lock nut when proper adjustment is made.

b. To make adjustment to the "down" position microswitch, loosen the two bolts which secure the microswitch to the mounting bracket on the shock strut and move the microswitch forward or aft in the elongated holes of the bracket. With switch set so as to indicate down and locked position, retighten the two bolts which secure the microswitch to the bracket.

c. The tail wheel microswitches are adjusted as follows: The "up" position microswitch which is located at the support fitting on bulkhead 288 is adjusted by loosening the lock nuts on the setscrew and screwing the screw in or out as required to close the microswitch with the tail wheel in the up and locked position. The "down" position adjustment is made by loosening the two bolts which secure the microswitch to the bracket on the tail wheel scissors and moving the microswitch forward or aft as required so that the indicator shows gear locked down, when the tail wheel is down and locked. With microswitch properly adjusted, retighten the two bolts which secure the switch to the mounting bracket.

4—1513. FLAP POSITION TRANSMITTER.

4—1514. DESCRIPTION. The transmitter R88-T-2650 (AN5785-1) consists of a variable resistor with a floating arm which moves by a system of linkage with the movement of the flaps. The variable resistor is wired directly to landing gear and flap position indicator and transmits the flap positions to the indicator. For electrical information see paragraph 5—93.

4—1515. LOCATION AND ACCESS. The transmitter is located on the bottom of the fuselage on the left hand side between stations 143 and 149. It is accessible through the belly access door.

4—1516. REMOVING. To remove the transmitter:

a. Disconnect the electrical receptacle at the transmitter and remove the four screws which secure the transmitter to the mounting bracket.

b. Loosen the small bolt which secures the clamp to the transmitter shaft and remove the transmitter.

4—1517. INSTALLING.

a. Install transmitter on bracket; secure it with the four screws.

b. Make the electrical connection.

c. Replace linkage arm on the transmitter shaft but do not tighten clamp.

d. With the battery switch turned on or with external power turned on, check flap indicator on left hand inclined panel. See that it indicates flaps up with flaps in up position. If flap position is not correctly indicated, turn the transmitter shaft with a screwdriver until indicator registers up position with flaps in up position.

e. Tighten clamp at shaft and lower flaps and check indicator for down position.

4—1518. ADJUSTING. If proper adjustment of flap and indicator cannot be obtained by the procedure given in 4—1517, further adjustment can be made as follows:

a. Remove the bolt from one end of the link assembly turnbuckle at the transmitter.

b. With flaps in up position and indicator showing up position, loosen lock nut on turnbuckle and lengthen or shorten turnbuckle until bolt may be replaced without forcing.

c. Retighten locknut at turnbuckle and operate flaps; check indicator for correct reading.

d. Any trouble which is traced to either the indicator or the transmitter is corrected by removing and replacing indicator or transmitter, as no repairing of this equipment is permitted.

4—1519. INTERCOOLER AND OIL COOLER DOOR POSITION INDICATING SYSTEM.

4—1520. INTERCOOLER FLAP AND OIL COOLER DOOR POSITION INDICATOR.

4—1521. DESCRIPTION. The indicator used to show the position of the oil cooler doors and intercooler flap, consists of two indicating elements with concentric shafts and pointers. Each pointer is operated by a separate transmitter. This indicator combines two full size large scale instruments in one, which enables the pilot to determine at a single glance two functions. This indicator is manufactured by General Electric Company, their part number GE8DJ12. For electrical information refer to paragraph 5—91.

4—1522. LOCATION AND ACCESS. The intercooler and oil cooler door indicator is located on the left hand console aft of the hydraulic pressure gage. It is accessible by working from within the cockpit.

4—1523. REMOVING. To remove the oil cooler door and intercooler flap position indicator:

a. Remove the four Phillips screws which secure the indicator to the console.

b. Remove the electrical lead from the indicator by unscrewing the receptacle.

c. Remove indicator.

4—1524. INSTALLING. To install indicator, reverse removal procedure.

4—1525. INTERCOOLER FLAP AND OIL COOLER DOOR POSITION TRANSMITTERS.

4—1526. DESCRIPTION. The intercooler flap and oil cooler door position transmitters are manufactured by General Electric Co., their part number GE8TJ9PAV. For description of the intercooler and oil cooler door transmitters, refer to paragraph 4—1513 as these transmitters are the same as the wing flap transmitter.

4—1527. LOCATION AND ACCESS. The intercooler flap transmitter is located on a bucket which is secured to the actuating cylinder of the intercooler flap. It is accessible by disconnecting the intercooler flap at the actuating cylinder and working through flap opening. The oil cooler door position transmitter is located in the center section, right hand side, secured to the partition of the oil cooler exit duct. It is accessible by disconnecting the oil cooler door at the quick-disconnect fitting and working through door opening.

4—1528. REMOVING. Remove the intercooler flap transmitter as follows:

a. Disconnect the intercooler flap and drop open. Disconnect the electrical lead to the transmitter, remove the four screws which secure the transmitter to its mounting bracket. Loosen clamp which secures lever to transmitter shaft and remove the transmitter.

b. The oil cooler door transmitter in the right hand center section is removed by disconnecting the quick-disconnect to the actuating cylinder which will allow the door to open. Remove the electrical connection at the transmitter. Remove the four screws which secure the transmitter to its mounting bracket. Loosen the clamp which secures the lever to the transmitter shaft. Remove transmitter.

4—1529. INSTALLING. Reverse removal procedure. In installing the transmitter, do not tighten the clamp which secures the transmitter shaft and lever until adjustment has been made.

4—1530. ADJUSTING INTERCOOLER FLAP TRANSMITTER. The intercooler flap transmitter is adjusted to the indicator in the following manner:

a. With battery switch "ON," open the intercooler flap from the cockpit and observe indicator setting when flap is fully open. The indicator should register "OPEN." If not, loosen the bolt which secures the clamp to the transmitter shaft and turn transmitter shaft with a small screwdriver until indicator registers "OPEN." Retighten the bolt which secures the clamp to the transmitter shaft and check operation.

b. If proper setting cannot be made by this slight adjustment at the transmitter, disconnect the turnbuckle by removing one bolt. Loosen lock nut and increase or decrease the turnbuckle length as required. Retighten lock nut, replace bolt and test intercooler flap for proper indication at indicator.

4—1531. ADJUSTING OIL COOLER DOOR TRANSMITTER. Adjustment of the oil cooler door transmitter is made at the turnbuckle. This is done by disconnecting the door at the quick-disconnect fitting. Remove the lower bolt which secures the turnbuckle to the door and increase or decrease its length as required. Replace bolt which secures turnbuckle to the door and operate door manually by pushing closed each time a change of adjustment is made and checking the indicator for proper indication.

4—1532. TRIM TAB POSITION INDICATING SYSTEM.

4—1533. DESCRIPTION. The system consists of three actuators, one each for the aileron, elevator and rudder tabs. Each actuator performs all the mechanical work involved in moving the tabs. The actuators are electric motor-driven screw jacks. Coupled to and part of the actuator is a position indicating transmitter consisting of a potentiometer (variable resistor) which acts in the circuit to indicate the position of the tabs on the indicator which is on the left hand console. The indicator is manufactured by the Weston Electrical Instrument Corp. of Newark, N. J.; their part number W-3100. For electrical information, refer to paragraph 5—95.

4—1534. LOCATION AND ACCESS. The aileron tab actuator is located between wing stations 100 and 106. The actuator is accessible through the tie-down access door on the under side of the wing. The elevator tab actuator is located in the tail of the airplane at station 342 and is accessible through the access doors on both sides of the tail at the base of the fin and through the tail wheel doors. The rudder tab actuator is located at station 310 and is accessible through the two access doors at the base of the fin and through the tail gear access door.

4—1535. REMOVING. For removal of the actuators, refer to the following paragraphs: aileron, 4—139; elevator, 4—160; rudder, 4—188.

4—1536. INSTALLING. Reverse removal procedure.

4—1537. ADJUSTING. With the actuator installed, set actuator at neutral position. This may be done by checking indicator in cockpit with power on and by checking proper length of screwjack at neutral position.

a. With actuator in neutral position, make linkage connection to the tab. Tab should be in neutral position with actuator in neutral. If not make necessary adjustment at the adjustable actuator rod so as to have tab in neutral.

b. Check tabs for full travel in both directions using protractor or contour boards.

4—1538. FUSELAGE EQUIPMENT.

4—1539. PILOT'S SEAT.

4—1540. DESCRIPTION. The pilot's seat assembly consists of an adjustable bucket seat and back constructed in one piece, with a removable sheet metal bucket assembly furnished as loose equipment to provide the needed height usually taken by the pararaft. For ferrying, the pilot sits on seat pad, parachute and ferrying bucket; in service he sits on seat pad, pararaft and parachute. The ferrying bucket is placed in the bottom of the seat and trapped by the seat. The seat is equipped with arm rests which can be raised out of the way when not in use. The seat is mounted to a set of steel tracks which are bolted to bulkhead 186. Steel trunnions, secured to the seat, travel in the tracks and secure the seat fore and aft. The tracks are tilted in such a way as to provide vertical adjustment of seven inches, concurrently with horizontal adjustment of one inch. A lock pin, controlled through a Teleflex cable by a knob on the right hand control shelf, secures the seat vertically. Secured to the underside of seat bucket is a sheet metal pan. This pan houses the oxygen mask hose when mask is not in use.

4—1541. FUNCTION. A control knob, located on the right hand control shelf, actuates the lock pin through a Teleflex cable which is enclosed in an aluminum conduit. The conduit runs from the control knob under the edge of the right hand control shelf aft to bulkhead 186, down and then across the bulkhead and up to the lock pin. As long as the knob is held down, the seat locking pin is released, and the pilot can adjust the seat downward by remaining seated and upward by raising slightly. His weight overcomes the action of the tension springs and pushes the seat down. When he lifts his weight, the springs pull up and the seat travels up in the tracks. The seat control knob is spring loaded to remain in an up and locked position.

4—1542. TROUBLE SHOOTING.

a. If seat fails to adjust properly, check to see that the lock pin moves from the locked position when control knob is pushed down, and that control returns to proper position when control knob is released. Trouble may be caused by broken or weak spring at lock pin.

b. Check to see that adjustment stop bolts under each side of seat are adjusted so as to have seat lock in lowest possible position.

c. See that trunnions are sliding smoothly in tracks and that they are lubricated; see paragraph 4—1546.

4—1543. REMOVING SEAT. The seat may be removed from the airplane in the following manner:

a. Loosen clamp and remove oxygen hose connections to seat pan.

b. Bring seat to highest position to slacken seat adjusting springs; unhook springs from attachments at bulkhead 186.

c. Remove lock bolts from top of tracks.

d. Disengage seat locking pin by pressing down on control knob on right hand shelf.

e. Slide seat up and out of airplane. Seat weighs about twenty pounds.

f. With seat removed from cockpit, oxygen hose pan may be removed from bottom of seat by removing thirteen small bolts which secure pan to base of seat.

4—1544. REMOVING ARM RESTS. The two arm rests are removable by simply unhooking the springs under each arm rest and removing the Phillips head screw at point of hinge. The arm rest pads are removable by removing four small screws under each arm rest.

4—1545. REMOVING CONTROL KNOB LINKAGE. With seat removed, proceed as follows to remove linkage:

a. Remove bolt attaching lock pin to bellcrank.

b. Remove bolt attaching bellcrank to support assembly.

c. Disconnect seat lock pin return spring from spacer.

d. Remove two U-shaped lock pins from each end of conduit.

e. Loosen two jam nuts, one beneath the control shelf and other beneath spacer on bulkhead 186.

f. Remove Teleflex cable by lifting control knob to which Teleflex cable is attached.

4—1546. LUBRICATING.

a. Lubricate control linkage lightly with general purpose oil, Spec. AN-O-6.

b. Grease track trunnion of seat with lubricating graphite, Spec. AN-G-6.

4—1547. INSTALLING CONTROL KNOB LINKAGE. To install control handle, reverse procedure given in paragraph 4—1545.

CAUTION

In installing Teleflex controls the procedure given in paragraphs 4—602 through 4—604G must be followed exactly.

4—1548. INSTALLING SEAT. With seat control handle and linkage installed and properly adjusted, install seat as follows:

a. Hook tension springs into bottom trunnion fittings on seat.

Note

Hold springs up and taut so that they remain hooked to bottom of seat until they are secured to bulkhead 186.

b. Retract seat locking pin by pressing down knob on right hand shelf.

c. Start seat guide trunnions in tracks and allow seat to lock in highest position.

d. Replace lock bolts at top of tracks.

CAUTION

Make certain seat locking pin is "home" before attempting to hook springs to bulkhead.

e. Hook springs to bulkhead 186.

f. Check seat for full travel. Make adjustments at stop bolts on either side of seat, so that seat will lock in lowest position.

4—1549. INSTALLING FERRYING BUCKET. Place bucket on seat. Bucket is not secured except by the fact that the pilot sits on it and a lap belt secures him to seat.

4—1550. HEADREST.

4—1551. DESCRIPTION. The pilot's headrest is a flat piece of latex sponge neoprene known as Formex, 2 3/8 inches thick, and 8 x 10 inches in size. This is secured to a plate of alclad and the sponge latex is covered with black artificial leather. The complete headrest assembly is then secured to bulkhead 186 armor plate with three bolts. The headrest is brought out from the bulkhead by three spacers, one-half inch thick. The purpose of this additional thickness is to bring the pilot's head into a more satisfactory position during catapulting operations.

4—1552. REMOVING. Working from radio compartment, remove three bolts from bulkhead 186 to headrest.

4—1553. INSTALLING. Reverse procedure directed for removing.

4—1554. SHOULDER HARNESS, INERTIA REEL AND SAFETY BELT.

4—1555. DESCRIPTION. The pilot's seat is equipped with a lap belt and shoulder harness, NAF1201-4. The lap belt is bolted to the sides of the seat with two bolts, the bolt heads on the outside and the nuts protected by a fairing within the seat. The belt is fastened on the pilot's lap with a quick-release safety buckle. Both left and right shoulder straps fit into this buckle, and both the lap belt and shoulder straps are released when the safety buckle is opened. Both the lap and shoulder straps may be adjusted by the individual pilot. The shoulder straps extend from the lap buckle over the shoulders, through a strap support bar which is secured to bulkhead 186 above the seat. The straps extend down behind the seat where they are attached through a fitting to a cable-wound inertia reel incorporating the "Stay-lock" feature. The inertia reel is controlled by a handle on the left hand control shelf. Press down and forward to "LOCKED" position and down and aft to "UNLOCKED" position. This allows the pilot to lock the shoulder straps in any desired position (in 1/2 inch increments, with a maximum cable extension of 18 inches) or to release them and move forward in the cockpit. With the control handle in the "UNLOCKED" position, spring tension on the reel keeps the cable wound up, holding the straps snugly against the pilot. The control handle is connected to a cable which travels around a pulley, through a fairlead to a bellcrank which is connected to a spring at the reel. The reel will lock automatically upon application of longitudinal decelerations in excess of 2.5 "gs." Since the reel is suspended by two light springs in a floating position within the housing, inertia automatically overcomes the strength of the springs and forces the floating reel against the housing teeth, locking it and preventing any further extension of the shoulder straps in the event of a sudden maneuver or crash landing. By moving control handle to "LOCKED" position, ratchet teeth on reel mesh with teeth on reel housing, locking reel in place and preventing the shoulder straps from extending further.

4—1556. REMOVING LAP BELT. Remove the two bolts which hold the ends of the belt to each side of the seat.

4—1557. REMOVING SHOULDER HARNESS. To remove shoulder harness, simply unscrew inertia reel cable from harness fitting behind seat.

4—1558. REMOVING INERTIA REEL. Remove seat as directed in paragraph 4—1543 and open bushing by removing two screws from top of seat support assembly. Remove four bolts holding reel to support and unhook spring lock assembly.

4—1559. INSTALLING. To install reel, shoulder harness and lap belt, reverse procedures given in paragraphs 4—1556 through 4—1558.

4—1560. PILOT'S CATAPULT HANDGRIP.

4—1561. DESCRIPTION. *(Refer to figure 3—12.)* The pilots catapult handgrip is located in the sheathing between stations 154 1/2 and 160 on the left hand side of the cockpit, near the engine control unit. By lifting a small flap, the pilot can extend a steel tube assembly which will give him a stationary handgrip, enabling him to hold the throttle steady in take-off position.

4—1562. REMOVING. Unhook spring from eyebolt and arm. Remove two bolts holding assembly to bracket.

4—1563. INSTALLING. Prior to installing, grease hinge lightly with Spec. AN-G-10 grease. Install by reversing removal procedure.

4—1564. RELIEF TUBE.

4—1565. DESCRIPTION. The relief tube installation consists of a horn and rubber tube, which leads to an opening in the bottom of the fuselage to the right of centerline of the airplane. The opening in the fuselage skin is shielded by a small plastic fairing. A cup assembly which is clamped to the control stick holds the horn when not in use. The tube passes through a hole in the boot at the base of the stick. An elastic cord is taped to the tube and to the frame at station 160 in the bottom of the fuselage. This cord holds the horn securely in the cup, taking up the slack in the hose which allows it to be pulled to the extended position for use.

4—1566. REMOVING.

a. Working from belly access door, loosen clamp holding hose to fairing in bottom of fuselage.

b. Loosen nut holding elastic cord, and disconnect.

c. Pull entire assembly up through hole in boot at base of control stick.

4—1567. INSTALLING. Reverse removal procedure.

Note

Avoid crimping of line and make sure that overboard vent is not plugged.

4—1568. CHART PLOTTING BOARD.

4—1569. DESCRIPTION. The chartboard is a Government Furnished, R88-13-645, Mk 6A board which is locked into a sheet metal tray, by four spring steel clips. The tray and board then slide on tracks into a slot in the instrument panel. When the board is in place within the instrument panel, a spring is compressed. This spring ejects the board aproximately one inch when the lock is removed. The board can be tilted downward slightly toward the pilot for ease in reading and use.

4—1570. REMOVING.

a. To remove chartboard, simply lift from tray.

b. Chartboard support and instrument panel are removed as a unit. Refer to paragraph 4—1280.

4—1571. MAP CASE.

4—1572. DESCRIPTION. *(See figure 3—11.)* A map case made of aluminum sheet is secured to the forward side of bulkhead 186, at the aft end of the right hand control shelf, by two bolts. A spring on the hinge cover holds the cover closed. The face of the map case has a half circular cutout to facilitate easy handling of maps.

4—1573. REMOVING. Map case cannot be removed unless right hand control shelf is removed. See paragraph 4—222.

4—1574. ASH TRAY AND CIGARETTE LIGHTER.

4—1575. DESCRIPTION. *(See figure 3—12.)* The ash tray is located on the left hand side of the cockpit within the sheathing. For use, the ash tray swings around a pivot pin into the cockpit. The cigarette lighter is the conventional "push-in" type. Refer to paragraph 5—137 for wiring diagram information.

4—1576. REMOVING ASH TRAY. Simply pull out inner half of assembly, clean and snap back into place.

4—1577. CHECK-OFF LISTS.

4—1578. DESCRIPTION. *(See figures 3—11 and 3—12.)* Two check-off lists, "TAKE-OFF" and "LANDING," are provided on the inclined portion of both right and left control panels. These lists are made of lucite with the lettering filled in with white paint. Check-off lists are illuminated from beneath by two bulbs. Turning interior light selector switch to "ALL INTERIOR LIGHTS" position illuminates both check-off lists.

4—1579. REAR VIEW MIRRORS.

4—1580. DESCRIPTION. These mirrors are attached to the aft face of the forward framework of the sliding section cockpit enclosure. One is located on the arch at the centerline of the airplane, and the other two on either side of the centerline. The mirrors have a demagnification factor of 2-1/2:1 to provide a greater field of view. The center mirror is attached to a bracket on the arch by means of a single bolt. Adjustments are made by loosening the bolt, twisting the mirror and retightening the bolt. Each side mirror is secured by means of two bolts attaching the mirror to two angles which are riveted to the frames. The side mirrors are adjusted by loosening the two bolts, moving the mirrors to the desired position and retightening bolts.

4—1581. PILOT'S LOCKER.

4—1582. DESCRIPTION. *(See figure 3—11.)* A small metal box which is a part of the right hand control panel is located inboard of the wing folding control. This box is provided for stowage of pilot's personal gear.

4—1583. BAGGAGE COMPARTMENT.

4—1584. DESCRIPTION. The baggage compartment is a gray canvas zipper bag of 100 pounds capacity which is secured to a plywood floor in the aft section of the radio compartment. Only non-metallic gear is to be stowed there, as the remote indicating compass transmitter might otherwise be affected. The straps which are attached to the bag must be used to secure gear in the bag, and the zipper safety-wired. Access to the baggage compartment is obtained through the radio compartment access door on the right side of airplane.

4—1585. REMOVING. To remove canvas bag, remove top row of bolts and remove bag and plywood floor as a unit.

4—1586. INSTALLING. Reverse removal procedure.

4—1587. TOW TARGET INSTALLATION.

4—1588. DESCRIPTION. The tow target installation is furnished as loose equipment and may be installed in the field. The tow target mechanism consists of a release installation and a control installation. The release assembly housing is secured to the forward face of bulkhead 218 by two bolts, and to the fuselage skin on the airplane centerline. A fitting assembly is attached to the bottom of the fuselage (outside) sandwiching the skin between itself and the housing. A spring within the housing extends a plunger beyond the fuselage skin, where it engages a latch on the fitting. The target cable is held by this plunger pin. When the plunger is retracted, the target cable is released. The cable installation consists of one cable in two parts connected by a turnbuckle for adjustment. This cable runs from the release housing through a pulley at station 199.5. The turnbuckle is located between the first pulley and bulkhead 186. The cable then passes through a rubber boot on bulkhead 186 and continues through an aluminum alloy tube and a second pulley to a bellcrank at station 165.5. Another cable continues from the bellcrank to the control handle located on the forward side of left hand shelf. *(See figure 3—12.)*

4—1589. INSTALLING.

a. Remove radio compartment floor by removing necessary screws.

b. Working in radio compartment, secure release assembly housing to station 218 with four bolts and four nuts, through holes in housing and through skin to fitting on outside of airplane.

c. Bolt short section of cable containing turnbuckle fitting to housing.

d. Thread the other section of cable containing the turnbuckle fitting through rubber boot on bulkhead 186 and through the aluminum alloy tube between bulkhead 186 and station 177.5 Secure the rubber boot and the aluminum alloy tube support assembly to bulkhead 186. Secure the other end of the tube to station 177.5.

e. Secure cable to short end of bellcrank, and bellcrank to bracket which is riveted to airplane at approximately station 165.5.

f. Attach third piece of cable to long arm of bellcrank, and bolt other end of cable to control handle by working through belly access door and in cockpit.

g. Adjust turnbuckle so that plunger in housing assembly is retracted when control is in unlocked position and free to lock when control is in locked position.

4—1590. PORTABLE EQUIPMENT RECEPTACLE.

4—1591. DESCRIPTION. *(See figure 3—11.)* The pilot's flying suit plug-in is located on the right hand control shelf forward of the pilot's locker. To use, unscrew cap over receptacle and insert flying suit plug. Refer to paragraph 5—129 for wiring diagram information.

4—1592. HEATING AND VENTILATING SYSTEM.

4—1593. DESCRIPTION. *(See figure 4—132.)* The heating and ventilating system consists of the following: Janitrol heater with an hourly output of 50,000 Btu, a solenoid at the fuel selector valve which stops flow of fuel to heater when heater output exceeds 350°F, a pressure switch which completes the electrical circuit permitting heater to function at 120 knots IAS and above, a pilot-controlled master heater switch and a heater selector (distributor) valve which directs flow of heated air through multiflex tubing to windshield diffuser and ventilator, and an ignition unit located on the underside of the radio compartment shelf, which supplies high voltage to the spark plug on the heater.

4—1594. FUNCTION. *(See figure 4—132.)* With the master heater switch (located on the panel (1) above right hand control shelf) turned "ON" and at airspeeds over 120 knots, the air pressure switch (12) closes, energizing the cockpit heater relay in the main junction box. This, in turn, energizes the heater fuel shutoff solenoid (10) located on the fuel selector valve. The heater fuel cycling solenoid (15) on the heater is also energized, allowing fuel to flow to the heater combustion chamber (6). The heater ignition box (3) produces the necessary high voltage for the heater spark plug (17). Refer to paragraph 5—131 for further electrical information on the heater. Combustion air taken from the main ram air intake line, and metered fuel from the fuel regulator, flow to the combustion chamber of the heater. The auxiliary (booster) fuel pump switch must be turned to "LOW" to supply fuel to the heater. The main flow of ram air is heated as it passes over the combustion chamber jacket within the walls of the heater. Heated air is then routed through multiflex tubing to the distributor valve (4), which is secured to the left hand forward side of bulkhead 186. The distributor valve is controlled through a Teleflex cable from the heater control panel (1). The heated air may be routed to the windshield diffuser (2), to the ventilator (11) in the cockpit floor just forward of the control stick, to both the windshield and ventilator at the same time, or the flow of air may be shut off completely. The ventilator is equipped with two, foot-operated controls. The left foot control directs the angle at which the heated air enters the cockpit or shuts off flow of air completely. The right foot control restricts the amount of air entering the cockpit through the ventilator. If the master heater switch is left "ON" and the flow of ram air is prevented from flowing through the system, by turning off air at distributor valve, the heater is prevented from over-heating by two thermal switches located on the aft end of the heater. One (22) shuts off the fuel cycling solenoid on the heater when temperature exceeds 250°F. Should the heater continue to function because of some defect in the circuit, a second thermal switch (14) shuts off the heater fuel shutoff solenoid (10) on fuel selector valve at 350°F, shutting off flow of fuel to the heater completely. Note that the ventilating system may be used to direct fresh unheated air into cockpit with the heater inoperative.

4—1594A. TROUBLE SHOOTING. To insure that the cockpit heater is functioning properly and to check the cockpit heater fuel line for leaks, observe the following procedure:

a. Disconnect the electrical plug at the heater air pressure switch mounted on the aft side of the main beam in the left hand wheel well. Short the disconnected plug momentarily.

b. With mixture control in "IDLE CUT-OFF," battery switch "ON." turn auxiliary (booster) fuel pump switch to "LOW" and turn master heater switch "ON."

c. With heater on and auxiliary (booster) fuel pump operating, check heater fuel line for leaks. Also check action by feel and sound of solenoid valves and ignition system.

d. Upon satisfactory completion of preceding steps, reconnect electrical plug in air pressure switch. Turn heater on again after electrical plug is installed in pressure switch. There should be no action of the heater.

e. Turn "OFF" all switches used in making this check before leaving cockpit.

4—1595. HEATER AND ACCESSORIES.

4—1596. DESCRIPTION. *(See figure 4—132.)* This heater is cylindrical in form, seven inches in diameter and approximately 18 inches long. The heater is manufactured by the Surface Combustion Corporation, their model number ABS-50D-P41D-B. Combustion takes place inside a cylindrical combustion chamber (6) which is encircled by a double walled radiator, both of which are made of a heat-resisting alloy steel and welded gas-tight. At the forward end are the combustion chamber fuel and air inlets, (21) and (18) respectively, and the overboard exhaust (7). At the aft end, are four cross-over passages from the combustion chamber to the radiator which connect to the overboard exhaust. Fitted over the inlet end of the combustion chamber is a removable head which carries a spray nozzle and spark plug. The spark plug is also manufactured by the Surface Combustion Corporation, their part number 54A35. Surrounding the combination chamber and radiator assembly, is a stainless steel jacket with a self-sealing joint which forms the heater housing. It is held at a uniform distance from the radiator by spacers welded to the radiator and held in place by three jacket clamps and the piping of the combustion air inlet and exhaust. Controls for the heater are mounted on this housing and include the Model 450 fuel filter (20), air-loaded fuel pressure regulator (19) and heater fuel cycling solenoid (15). Fuel for the heater is taken from the fuel selector valve located on the left hand side beneath the cockpit floor. A fuel shutoff solenoid (10) is secured to the valve. This solenoid stops flow of fuel to the heater when the heater exceeds a temperature of 350°F. Exhaust gases from the heater go overboard through a hole in the skin (7) beneath heater. In the event of failure of the heater ignition system, the fuel drain (5), located just beneath the heater, will permit drainage of fuel which may accumulate in the combustion chamber of the heater.

Note

The two thermal switches (14), (22) located on the aft end of heater are there as safety features. If, for any reason, their proper function is doubted, remove and replace with new switches.

4—1597. LOCATION AND ACCESS. The heater is located just aft of bulkhead 186 on the left hand side of the fuselage. It is accessible through the radio compartment access door. The heater is secured by a collar attaching it to the fitting which is part of bulkhead 186, and also by a support arrangement which is secured to station 205.5.

4—1598. REMOVING. To remove heater, proceed as follows:

a. Disconnect coupling from heater to exhaust outlet by loosening bolt on coupling and sliding coupling.

b. Disconnect heater from adapter assembly at bulkhead 186 by lifting link clamp coupling, and sliding to one side.

c. Disconnect strap assembly at station 205.5 by removing bolt.

d. Disconnect fuel inlet line at point where fuel line connects to heater, near heater fuel filter.

e. Disconnect overboard fuel outlet beneath heater by loosening clamp.

f. Disconnect thermal switches at heater.

g. Disconnect air intake tube at heater by loosening clamps.

h. Disconnect hot air outlet tube by loosening clamp at aft end of heater.

i. Disconnect all electrical leads at heater.

4—1599. INSTALLING.

a. Set heater in cradle.

b. Secure heater to adapter assembly.

c. Continue installing by reversing steps given in paragraph 4—1598.

4—1600. AIR PRESSURE SWITCH.

4—1601. DESCRIPTION. *(See figure 4—132.)* The air pressure switch is a diaphragm and microswitch enclosed in a case. It is designed to close the circuit at a predetermined pressure of six inches (plus or minus one inch) water by the action of air pressure on a diaphragm. This action closes the microswitch and the heater circuit is completed. When air pressure on the diaphragm is relieved, the switch opens and the circuit is broken. See paragraph 5—131 for electrical information. The switch is manufactured by the Aerotec Company of White Plains, N. Y., their part number No. P-501.

4—1602. LOCATION AND ACCESS. The pressure switch is located on the aft left hand side of the main beam behind the air intake scoop. It is accessible through the left hand landing gear wheel well, by opening zipper on inboard side.

4—1603. REMOVING. The pressure switch may be removed by disconnecting pressure tubing at switch, disconnecting electrical leads at switch and removing three bolts which hold switch to stiffeners on main beam.

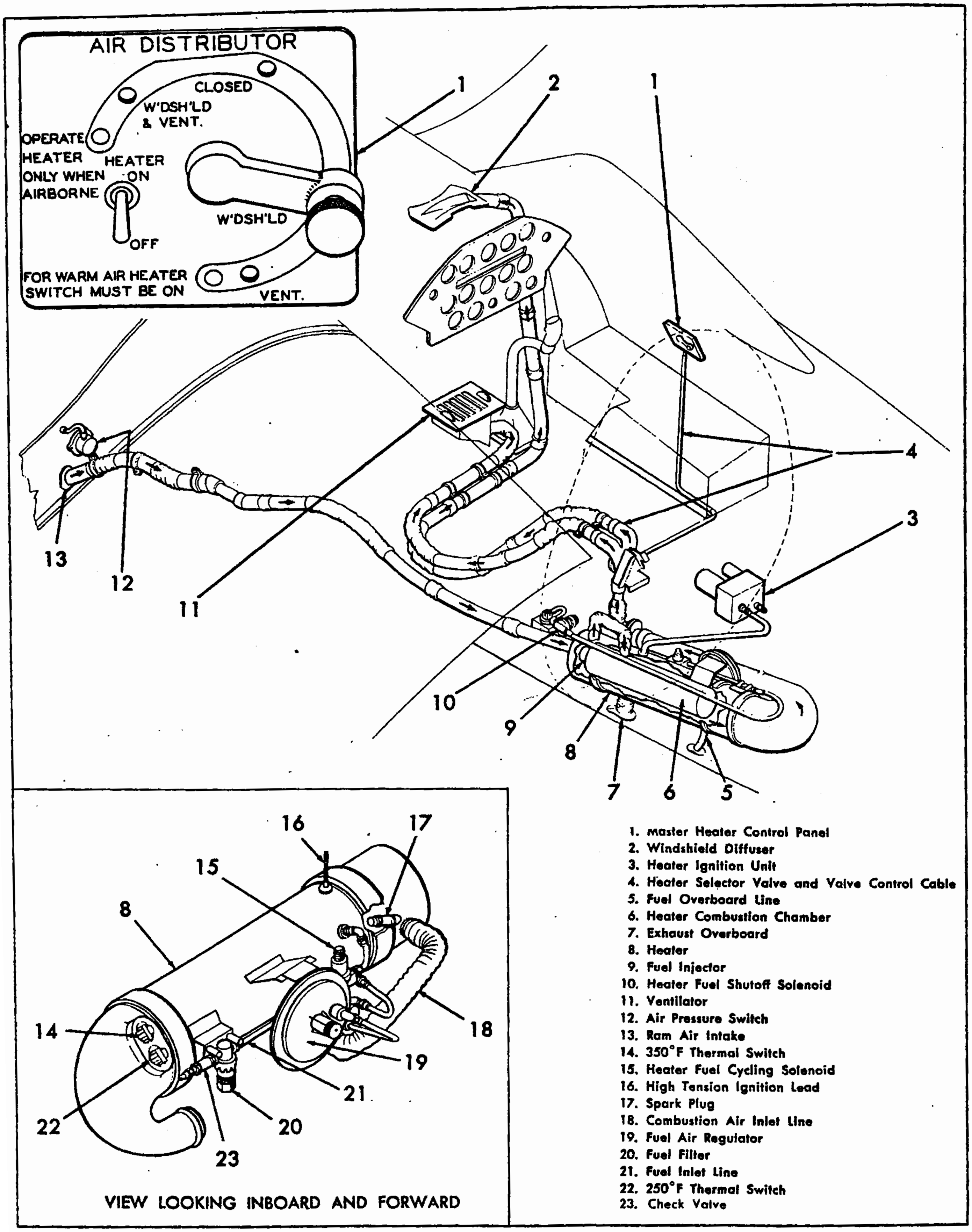
4—1604. INSTALLING. Reverse procedure given in paragraph 4—1603.

4—1605. HEATER FUEL SHUTOFF SOLENOID.

4—1606. DESCRIPTION. *(See figure 4—132.)* The fuel solenoid valve consists of a valve body, gasket, armature, guide pin, spring and coil. When an electrical current is transmitted to the valve, it energizes the coil, lifting the guide pin from the valve body, allowing fuel to pass on to the heater. When the circuit is broken (when the heater exceeds 350°F.) the valve pin returns by spring pressure to the valve seat, shunting off flow of fuel to heater. This solenoid is mounted to the fuel selector valve beneath the cockpit floor. The solenoids used on the heater and at the selector valve (station 177.5) are manufactured by Minneapolis Honeywell Company, their aircraft valve type G104A2CA3. This valve is listed by Surface Combustion Company as their part number 40A31.

4—1607. REMOVING.

a. Break fuel line to heater solenoid at main fuel cell inlet elbow on selector valve; cap line.



1. Master Heater Control Panel
2. Windshield Diffuser
3. Heater Ignition Unit
4. Heater Selector Valve and Valve Control Cable
5. Fuel Overboard Line
6. Heater Combustion Chamber
7. Exhaust Overboard
8. Heater
9. Fuel Injector
10. Heater Fuel Shutoff Solenoid
11. Ventilator
12. Air Pressure Switch
13. Ram Air Intake
14. 350°F Thermal Switch
15. Heater Fuel Cycling Solenoid
16. High Tension Ignition Lead
17. Spark Plug
18. Combustion Air Inlet Line
19. Fuel Air Regulator
20. Fuel Filter
21. Fuel Inlet Line
22. 250°F Thermal Switch
23. Check Valve

Figure 4—132. Heating and Ventilating System.

b. Break fuel line from solenoid to heater.

c. Disconnect electrical wiring to solenoid.

d. Remove clamp securing solenoid valve to selector valve.

4—1608. INSTALLING. Reverse procedure given in paragraph 4—1607.

Note

Before installing, connect solenoid to 28 volt dc power source with an ammeter in the line, having a range of 0-1 amperes. Turn power on and off several times to check valve operation. The valve should draw 0.25 amperes. A clicking sound will be heard when the valve opens.

4—1609. HEATER FUEL CYCLING SOLENOID.

4—1610. DESCRIPTION. *(See figure 4—132.)* The heater fuel cycling solenoid is identical with the solenoid described in paragraph 4—1605. It is connected to and is part of the heater assembly. The current to the solenoid flows through the 250°F thermal switch. When the heater reaches 250°F, the thermal switch opens the circuit, closing the solenoid, shutting off flow of fuel to the heater. When heater temperature drops to below 250°F the electrical circuit is closed again and the solenoid is energized, opening flow of fuel to heater.

4—1611. REMOVING.

Note

Make a reference drawing and note the angle and position of all controls and their relationship to each other and to the heater, so that on assembly they can be put back in exactly the same relative position.

a. Disconnect tubing on outlet side of solenoid.

b. Disconnect both lines to fuel-air regulator (19).

c. Disconnect four bolts holding fuel-air regulator assembly to brackets on heater.

d. Remove two bolts holding fuel filter (20) to bracket.

e. Disconnect fuel line inlet to filter.

f. Remove heater shutoff solenoid (10).

4—1612. INSTALLING.

Note

Prior to installing solenoid, observe test procedure given in paragraph 4—1608 to determine that it is functioning.

a. Make reference to drawing made before removing. Reinstall all parts as a unit.

b. Be sure to mount solenoid as indicated by arrow on bottom of valve body.

c. Make all tubing connections loose until all have been started, then proceed to tighten.

4—1613. HEATER IGNITION UNIT.

4—1614. DESCRIPTION. *(See figure 4—132.)* This unit is a Janitrol Aircraft heater ignition unit (type 1D) consisting of a spark coil and vibrator. The spark coil produces a voltage of 32,000 volts for the spark plug. The unit is located just aft of bulkhead 186 on the right hand side of the airplane, secured to the underside of the radio compartment shelf by four bolts. It is accessible through the radio compartment access door. The wiring diagram of the cockpit heater, figure 5—40, should be referred to for further information.

4—1615. REMOVING. To remove ignition coil, disconnect all leads at ignition unit. Remove four bolts holding unit to underside of shelf.

4—1616. INSTALLING. Secure unit to underside of shelf just aft of bulkhead 186 on right hand side with four bolts. Make all electrical connections. When making lead connection to spark plug and top of coil, apply small amount of Dow Corning Dialectric Compound No. 4 to eliminate moisture at connecting points.

4—1617. HEATER SELECTOR VALVE AND VALVE CONTROL.

4—1618. DESCRIPTION. *(See figure 4—132.)* The heater selector valve (4) is secured to a bracket by three bolts. The bracket is secured to the forward left hand side of bulkhead 186. The valve is "Y"-shaped and directs heated air from the heater to either ventilator or to the windshield or both. The valve is controlled by a Teleflex cable within a conduit which runs from the valve to the heater control panel (1) on the right hand side of the cockpit above the control shelf.

4—1619. FUNCTION. The control panel, located on the right hand side of the cockpit above the control shelf, contains the master heater switch and a crank with four positions: "WINDSHIELD," "VENTILATOR," "CLOSED," and "WINDSHIELD-VENTILATOR." The crank, when removed from one position to another, moves the ports in the "Y" valve to different positions, through Teleflex cable.

4—1620. REMOVING TELEFLEX CONNECTION. Remove tubing at valve inlet and at two outlets.

a. Remove "U"-shaped pin from short section of conduit which extends beyond valve. Remove conduit.

b Place crank on control panel in "WINDSHIELD" position. This will cause Teleflex cable to extend about three inches at bottom of valve.

c. Unscrew Teleflex cable by turning clockwise until cable is free of control panel gear box.

d. Pull cable down and out of conduit. Disconnect conduit at two connections. Remove clamps holding conduit to underside of right hand control shelf.

4—1621. REMOVING VALVE. With Teleflex cable free, and multiflex hose disconnected from the three valve ports, remove the three bolts holding valve to bracket on bulkhead 186.

4—1622. INSTALLING VALVE. Reverse procedure given in paragraph 4—1621.

4—1623. INSTALLING TELEFLEX.

a. With "Y" valve installed, set crank at control panel to "WINDSHIELD-VENTILATOR" position.

b. Grease the Teleflex cable slightly and insert cable at "Y" valve, push cable through conduit until cable hits control panel gear box.

c. Note aligning marks on "Y" valve housing and shaft. See that they line up; if not back off cable until they do.

d. With marks on housing and shaft lined up, insert a wooden plug 4 inches long and 1⅛ inches in diameter into inlet port to hold this position.

e. Screw Teleflex cable into control box counterclockwise until small welded pin on the Teleflex cable almost hits end of conduit at the "Y" valve.

f. Set jam nut and insert "U"-shaped pin into holes in jam nut.

g. Check heating and ventilating system by inserting an air hose in the inlet port and checking flow of air to the floor ventilator and windshield diffuser. Check all positions on the heater control panel.

CAUTION

In installing Teleflex controls the procedure given in paragraphs 4—602 through 4—604G must be followed exactly. See also paragraph 6—69.

4—1624. WINDSHIELD DIFFUSER.

4—1625. DESCRIPTION. *(See figure 4—132.)* The diffuser is located at the base of the windshield bulletproof glass. It is secured by bolts to top of cowl and is connected to the heater by multiflex tubing. Heated air from the heater exits at base of windshield and aids in defogging. The windshield diffuser is a fixed installation.

4—1626. COCKPIT VENTILATOR.

4—1627. DESCRIPTION. *(See figure 4—132.)* The ventilator is located on the floor of the cockpit forward of the control stick. It is secured to the floor by four bolts. There are two foot controls on the ventilator, one on the left hand side and one on the right. The one on the left controls the angle at which air enters cockpit. It also stops flow of air from entering cockpit. The right foot control restricts the amount of air entering cockpit. There is a small spring-loaded door on the right hand side of the ventilator below the floor of the cockpit which exhausts air when the left foot control is shut off.

5—1628. REMOVING. To remove ventilator, remove four bolts which secure ventilator to cockpit floor. Remove multiflex tubing by loosening clamp.

4—1629. INSTALLING. Reverse removal procedure.

4–1630. OXYGEN SYSTEM.

4–1631. DESCRIPTION. *(See figure 4–134.)* The oxygen system consists of an oxygen cylinder, a cylinder recharging installation, a diluter-demand regulator, oxygen flow indicator, a pressure gage, and appropriate tubing interconnecting the oxygen equipment. Oxygen from the high pressure oxygen cylinder, located under the right hand control panel, is carried to the pilot in flight by mask and tube assemblies attached to the diluter-demand oxygen regulator. The diluter-demand regulator is installed in the cockpit on the left hand control panel. The diluter-demand oxygen regulator automatically supplies an adequate air-oxygen mixture in a ratio depending upon altitude. Copper tubing connects the outlet on the oxygen cylinder to the recharging installation. From the recharging installation, a copper tube extends to the channel piece under the cockpit floor and along frame 160; it continues up, with a slight bend, to the left hand control panel in the cockpit. The tube is attached to the inlet fitting on the diluter-demand oxygen regulator. A 24 SO aluminum alloy tube connects the outlet of the demand regulator to a flexible hose which is clamped to an elbow fitting welded to the bottom pan of the pilot's seat. A standard breathing tube, provided with a quick-disconnect female coupling, is clamped to the same elbow fitting on the outlet side. The pan is designed to hold the breathing tube when not in use. A receptacle in the forward end of the pan permits the pilot to reach the quick-disconnect end of the breathing tube to which the tube end of the mask may be quickly and easily coupled. All oxygen tube ends are color-coded with one-half inch bands of light green.

4–1632. DILUTER-DEMAND OXYGEN REGULATOR.

4–1633. DESCRIPTION. *(See figure 4–133.)* The diluter-demand oxygen regulator, located on the forward end of the left hand control panel, is a Pioneer No. 2858-A1 high pressure type regulator. The emergency valve, the air valve, and the diaphragm are the principal parts of the oxygen regulator. The regulator incorporates neither a pressure gage nor a flow indicator; these instruments are auxiliary equipment in the demand system and are mounted separately from the regulator. The diluter-demand regulator is a suction-operated valve which releases oxygen upon inhalation. It mixes varying quantities of air and oxygen, the ratio depending upon the altitude. Above 30,000 feet, pure oxygen is released. The emergency valve knob, attached to the regulator, protrudes through the horizontal face of the left hand control panel and controls the emergency flow of oxygen through the regulator. Above the horizontal face of the left hand control panel and attached to the regulator, is the oxygen air valve lever, which can be turned to the "ON" or "OFF" position. From the side of the regulator, tubes extend to the oxygen flow indicator and pressure gage which are mounted separately from the regulator with adapter plates on an inclined bracket. This bracket is attached to bulkhead 186 and to the left hand

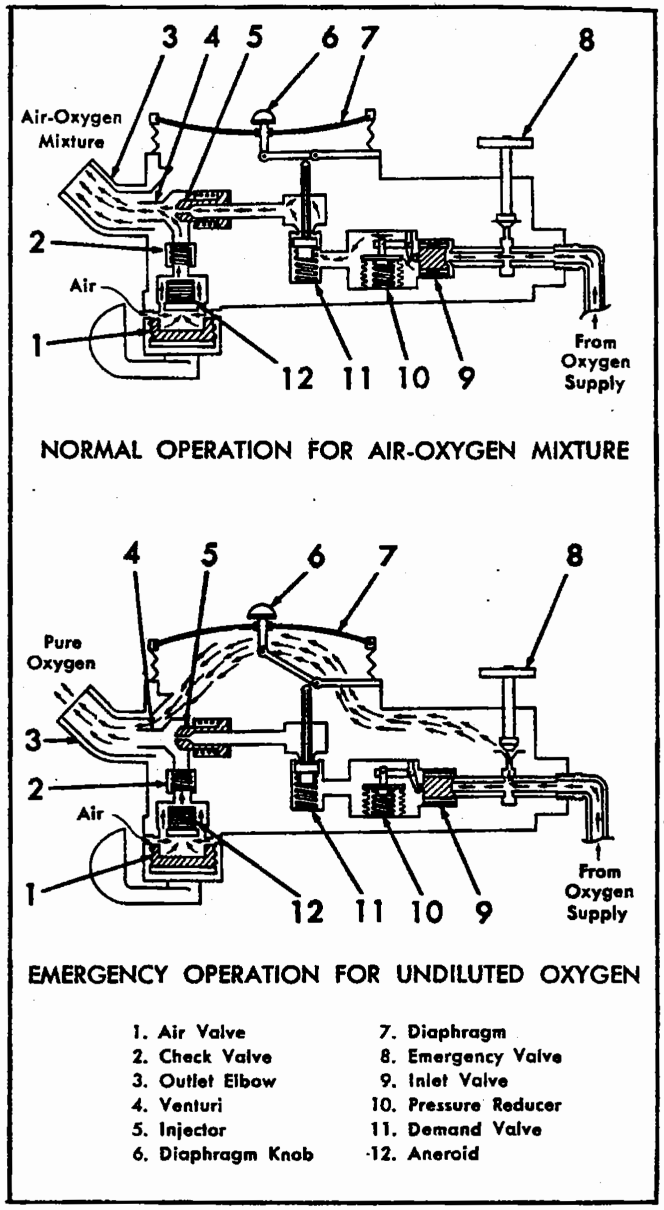


Figure 4–133. Oxygen Regulator—Schematic.

control panel. The oxygen flow indicator gives visual indication of the positive flow of oxygen through the regulator, and the pressure gage indicates the oxygen pressure in the cylinder, in psi.

4–1634. FUNCTION. *(See figure 4–133.)* The diluter-demand oxygen regulator automatically supplies an adequate air-oxygen mixture (or oxygen only) in a ratio depending upon altitude whenever the oxygen cylinder valve is open. For normal, automatic operation, the emergency valve (8) is turned "OFF" and the air valve (1) is turned "ON." Inhalation causes the diaphragm (7) to deflate. The down motion of the diaphragm, conveyed by a lever, opens the demand valve (11). Oxygen from the supply cylinder flows through the inlet valve (9) to the pressure reducer (10), where the pressure is decreased to operating value. From the pressure reducer, it flows through the demand valve and past the injector (5) into the venturi (4), where the oxygen mixes with air that enters through the air valve. The air-oxygen mixture then travels via the outlet elbow (3) to the mask. Exhalation expands the diaphragm. This causes closure of the demand valve, thus stopping the flow of oxygen. Simultaneously, the check valve (2) seals the air inlet, preventing loss of the mixture. At lower altitudes, the aneroid (12) is contracted, permitting entry of air in relatively great volume. As the airplane climbs, the aneroid expands, progressively decreasing the air supply until, at about 30,000 feet, air is excluded entirely; then, undiluted oxygen only flows through the regulator. At any altitude, a continuous stream of pure oxygen can be obtained by turning on the emergency valve, causing the oxygen to by-pass the regulator mechanism and flow directly to the mask. Used this way, oxygen only is fed to the lungs by the regulator. When desired, the demand valve can be held open by depressing the diaphragm knob (6). This is done to check the working of the regulator or to obtain a larger flow than is provided through regular operation. Used this way, air-oxygen mixture (or oxygen only, above 30,000 feet) is supplied to the lungs in an uninterrupted flow.

4—1635. LOCATION AND ACCESS. The diluter-demand oxygen regulator and connecting tubes, are accessible from the cockpit through the removable side panel of the left hand control shelf.

4—1636. REMOVING. The following procedure should be observed when removing a defective regulator:

a. Close the oxygen cylinder valve tight.

b. Remove the access panel screws on the side of the left hand control shelf.

c. Break the tube connections to the regulator.

d. Remove the four screws which hold the regulator to the control panel.

e. Support the regulator and carefully remove it through the opening at the side of the control panel.

4—1637. INSTALLING. Before attempting to install the diluter-demand regulator, be sure the tubing and connecting points on the regulator are clean, dry and free from foreign material.

CAUTION

Never use grease or oil on oxygen tubing fittings or connections. Keep hands and tools clean.

a. To install, reverse the removing procedure given in paragraph 4—1636.

4—1638. RECHARGING INSTALLATION.

4—1639. DESCRIPTION. *(See figure 4—134.)* The recharging installation consists of a high pressure AN 6015 style B check valve with a filler fitting cap assembly. The check valve is designed to permit the flow of oxygen only in the direction of the cylinder during the recharging operation. The recharging installation is installed in the line between the oxygen cylinder and the oxygen regulator. A block supporting the recharging installation is bolted to a channel under the cockpit floor at station 160.

4—1640. LOCATION AND ACCESS. The recharging installation is located underneath the cockpit floor aft and to the right of the pilot's control stick. It is accessible through the lower cockpit access door.

4—1641. REMOVING. A defective recharging installation check valve and filler fitting may be removed in the following manner:

a. The valve on the oxygen cylinder must be in the closed position.

b. Disconnect tubing at recharging installation and unscrew filler cap.

c. Unfasten clamps and remove recharging unit from supporting block.

4—1642. INSTALLING. Before any attempts are made to install the recharging installation, be sure that the openings in a unit are clean and dry.

CAUTION

Never use grease or oil on oxygen tubing fittings or connections. Keep hands and tools clean.

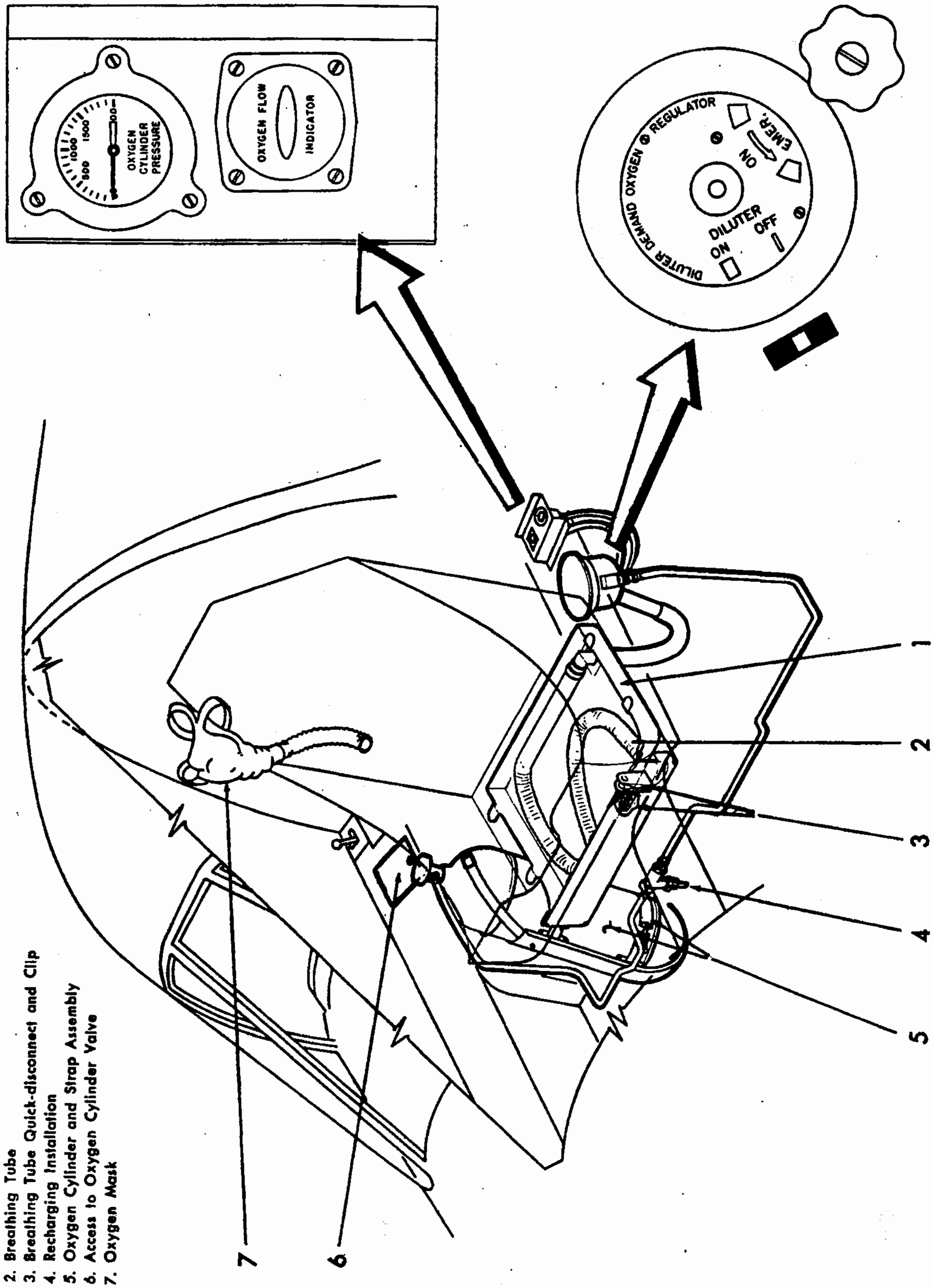
a. Install by reversing the removal procedure given in paragraph 4—1641.

4—1643. OXYGEN CYLINDER.

4—1644. DESCRIPTION. *(See figure 4—134.)* The oxygen cylinder NAF 1135-514 is a wire wound non-shatterable metal design. It has a 514 cubic inch capacity and it is charged with grade A oxygen, Spec. AN-O-1, to 1800 psi. at 21.1°C (70°F). The oxygen cylinder, equipped with an outlet connection and air-oxygen valve (AN 6040-2), is held in an almost upright position by three strap assemblies which are attached along the sides and on top of the support holding the cylinder. The support is attached to a pan and bracket assembly which is riveted to the fuselage frames and "Z" sections at stations 165 1/2, 171 and 177 1/2. The oxygen valve on the cylinder is accessible to the pilot through a small door. identified by a decalcomania "OXYGEN BOTTLE INSIDE—LIFT PANEL FOR CONTROL" on the right hand control panel.

4—1645. LOCATION AND ACCESS. The oxygen cylinder is on the right hand side of the cockpit compartment under the control panel. Access to the oxygen cylinder is obtained through the lower cockpit access door.

4—1646. REMOVING. To replace a partly filled or defective cylinder, note the following removal procedure:



1. Pilot's Seat Pan
2. Breathing Tube
3. Breathing Tube Quick-disconnect and Clip
4. Recharging Installation
5. Oxygen Cylinder and Strap Assembly
6. Access to Oxygen Cylinder Valve
7. Oxygen Mask

Figure 4–134. Oxygen System.

a. Make sure that the oxygen cylinder valve is closed tight.

b. Disconnect the tube from the outlet connection on the oxygen cylinder.

c. Unfasten and remove the wing nuts and open the cylinder supporting straps.

d. Lift the cylinder from its seat and remove from the support.

4–1647. INSTALLING. Before installing the oxygen cylinder, make sure that the release valve is closed tight, and that the outlet connection is clean, dry, and free from foreign material.

a. Open the cockpit access door at bottom of the fuselage.

b. Through the access door, hold the cylinder against the support and slowly allow it to settle into its seat.

c. Tighten the straps around the cylinder.

d. Connect the copper tube to the outlet connection on the cylinder.

4–1648. FILLING—OXYGEN CYLINDER INSTALLED.

4–1649. PROCEDURE. In filling the oxygen system, use only grade A oxygen, Spec. AN-O-1. The oxygen cylinder is conveniently filled by observing the following procedure:

a. Loosen the filler cap on the recharging installation, accessible through lower cockpit access door.

b. Make sure the line from the charging apparatus is clean and dry.

c. Connect charging line securely to the filler fitting.

d. Turn the oxygen valve on the oxygen cylinder to the open position and charge the oxygen cylinder to an oxygen pressure of 1800 psi, as read on pressure gage installed on filling apparatus.

e. When the cylinder is completely filled, turn the cylinder release valve to the closed position.

f. Remove the charging line and replace the filler cap on the recharging installation.

g. Test the valve on the cylinder by opening the valve slightly and then turning to the closed position.

4–1650. OXYGEN MASK.

4–1651. DESCRIPTION. *(See figure 4–134.)* The oxygen mask used is a demand type mask. The demand mask consists of a rubber face piece with a flutter valve mounted in it and a connecting corrugated rubber tube equipped with a rapid connecting fitting, which connects to the regulator outlet tube. Straps are provided for holding the mask to the head harness. The nose section is designed to hold a microphone. All mixtures which the pilot breathes must come from the diluter-demand regulator. The demand mask must, therefore, fit tightly to the face to insure the proper supply of oxygen at extreme altitudes. A leak-proof fit is essential. The mask, when not used, may be stowed in pilot's locker in the airplane.

4–1652. TESTING OXYGEN SYSTEM

4–1653. GENERAL. Examine the entire oxygen system to insure that it is correctly installed and that the oxygen cylinder, regulator, flow indicator and pressure gage are properly interconnected. Make sure that the oxygen supply is sufficient to conduct the test, (the normal oxygen content of the cylinder is 1800 psi). Then proceed to test the operation of the pressure gage and the oxygen-demand regulator as outlined in the following paragraphs.

CAUTION

Prior to testing units of the oxygen system, test all tubing, fittings and connections for leakage by coating with a soap-water solution and watching for bubbles, with pressure in the system; ALWAYS CHECK TUBING FOR LEAKAGE BEFORE ASSUMING THAT A UNIT IS DEFECTIVE.

4–1654. PRESSURE GAGE. Proceed as follows to test the pressure gage:

a. Turn the cylinder valve to the open position.

b. Note the reading on the pressure gage.

c. Close the cylinder valve.

d. After a five minute interval, note the pressure reading again. If there is no noticeable pressure decrease, the pressure gage is functioning satisfactorily. When leakage is present as indicated by a decrease in the pressure gage reading, the pressure gage must be replaced.

4–1655. REGULATOR DEMAND VALVE. In testing the regulator demand valve which controls the regulator diaphragm, the following procedure should be carefully observed:

a. Turn oxygen valve on the cylinder to open position.

b. Turn the regulator air-valve lever to the "ON" position.

c. See that the emergency valve knob is turned off.

d. Hold the regulator diaphragm fully depressed with the hand and feel for oxygen flow at end of breathing tube. If a flow of oxygen is not noticeable, the regulator is defective and should be replaced.

e. Release diaphragm. If oxygen flow does not immediately cease, the demand valve in the regulator is probably sticking and the regulator should be replaced.

4–1656. REGULATOR DIAPHRAGM. To test the diaphragm for leakage:

a. Turn the oxygen valve on the cylinder to closed position.

b. See that emergency valve knob is turned "OFF."

c. Empty oxygen distribution line by depressing the regulator diaphragm.

d. Set air valve lever to the "ON" position.

e. Grasp breathing tube, fully stretching a tube section between the hands. While tube is extended, and diaphragm depressed, cover the open end of disconnect of the tube with the thumb and then release the tension on the breathing tube.

f. Observe the regulator diaphragm as it expands to normal position. If the diaphragm returns to normal position in less than five seconds, examine breathing tube and its connections with the regulator for leakage.

g. Remedy any evident leakage in breathing tube and connections.

h. Retest, observing steps 4—1656a through 4—1656f. If leakage persists, the regulator must be replaced.

4—1657. REGULATOR EMERGENCY VALVE. The recommended procedure to test the regulator emergency valve is as follows:

a. Turn cylinder valve to open position.

b. Turn emergency valve knob to "ON" position.

c. Set the air valve lever to the "OFF" (or 100% oxygen) position.

d. Feel for oxygen flow at the end of the breathing tube. If a flow of oxygen is not noted, the emergency valve is defective and the regulator must be replaced.

4—1658. OXYGEN FLOW INDICATOR DIAPHRAGM. The following procedure should be observed when testing the flow indicator for leakage:

a. Turn the oxygen valve on the cylinder to open position.

b. Set the regulator air valve lever to the "ON" position.

c. See that the emergency valve knob is turned "OFF."

d. Manually depress the regulator diaphragm.

e. Apply soap solution, made from water and mild soap, to the base of the flow indicator case.

f. Replace the oxygen flow indicator if formation of soap bubbles reveals leakage in the flow indicator diaphragm. The normal venting of air with each blinking cycle of the flow indicator must not be mistaken for leakage.

g. On completion of tests, wipe off all soap solution.

4—1659. INTERNAL REGULATOR LEAKAGE. Pressure leakage within the regulator is tested as follows:

a. Turn the oxygen cylinder valve to the open position.

b. Set the air lever on the regulator to the "ON" position.

c. See that the emergency valve knob is turned "OFF."

d. Apply a film of soap solution to the open end of the breathing tube. (Do not permit the soap solution to enter the breathing tube or the regulator.)

e. Hold the tube steady. The formation of one-quarter inch bubble within ten seconds indicates internal leakage within the regulator.

f. Repeat the test three or four times, to make sure that the excessive formation of soap bubbles is not the result of differences in temperature between the interior and exterior sections of the regulator.

g. Replace defective regulator.

4—1659A. All diluter demand regulators which (a) fail to satisfactorily meet the "Installation Test," (b) have been in service ninety days subsequent to previous shop test, (c) are installed in airplanes undergoing major overhaul, shall be removed from the aircraft and shop-tested to determine each regulator's suitability for continued usage.

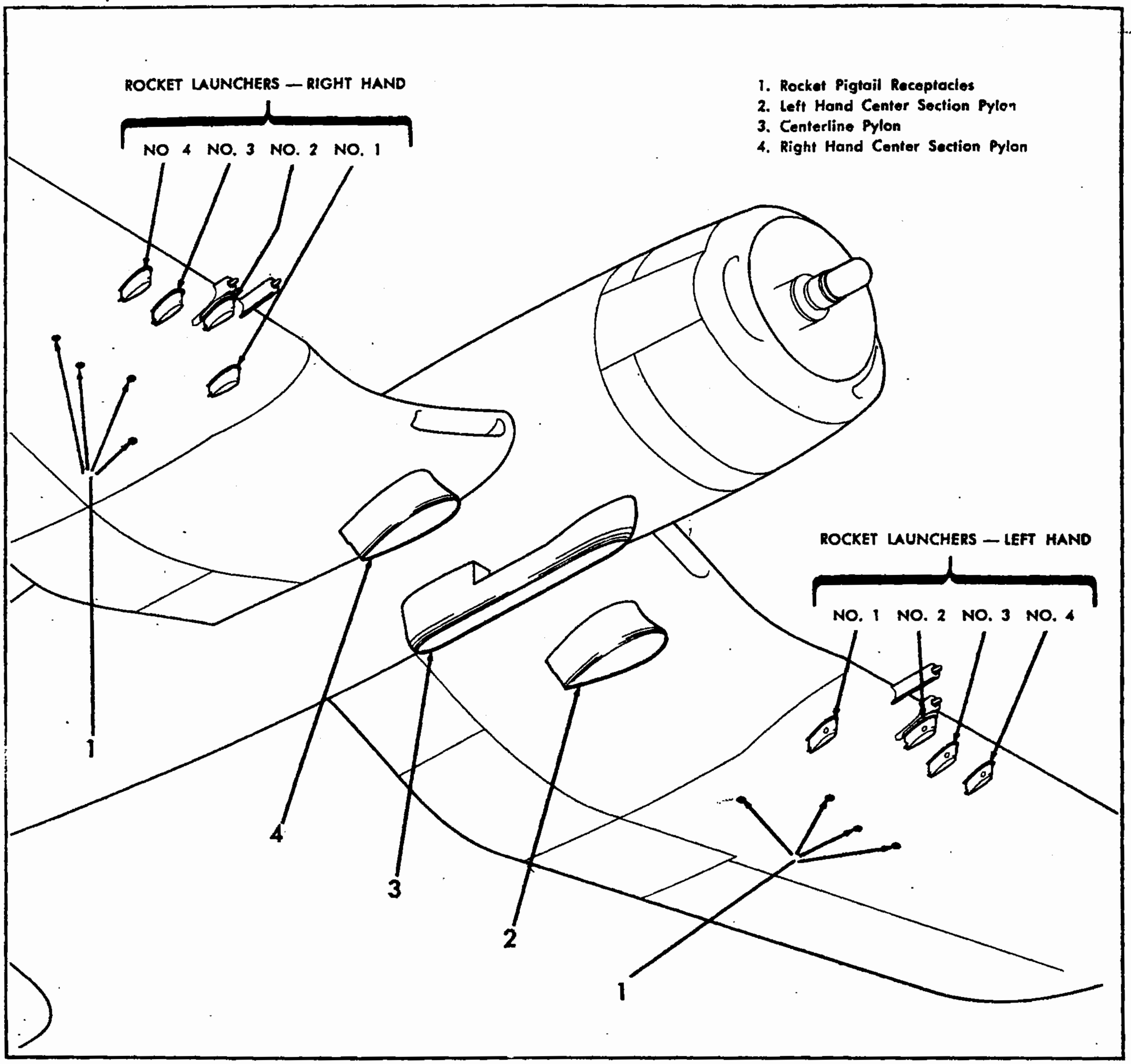


Figure 4—135. Bomb and Rocket Installation.

4—1660. BOMBING AND ROCKET SYSTEMS.

4—1661. DESCRIPTION. *(See figure 4—135.)* Three bomb pylons, located on the lower surface of the wing center section and on the fuselage centerline are designed to carry bombs, 11.75″ rockets or external auxiliary fuel tanks. In addition, eight rocket launchers provide for carrying four 5.0″ rockets under each outer wing panel. The bomb and rocket systems are controlled electrically by two buttons on the pilot's control stick, two rocket switches on the instrument panel, and five bomb and two rocket switches contained in the armament switch box on the right hand side of the cockpit cowling. The entire rocket and bombing system is inoperative when the master armament switch is "OFF" or when the arresting hook handle is down. The bombs may be salvoed or released individually, in an "armed" or "safe" condition. The rockets may be launched in singles or in pairs. Also included is an emergency release handle located on the left hand control shelf which releases the bombs when the electrical release system fails. The bomb pylons and rocket launchers are secured to the airplane in the simplest manner possible and are easily removed.

4—1662. TROUBLE SHOOTING. If any part of the bombing and rocket system fails to operate, the electrical circuits should be checked. See electrical system paragraphs 5—111, 5—115, and 5—117. If the trouble is caused by the bomb racks or launchers, these units should be repaired by qualified ordnance personnel. Test

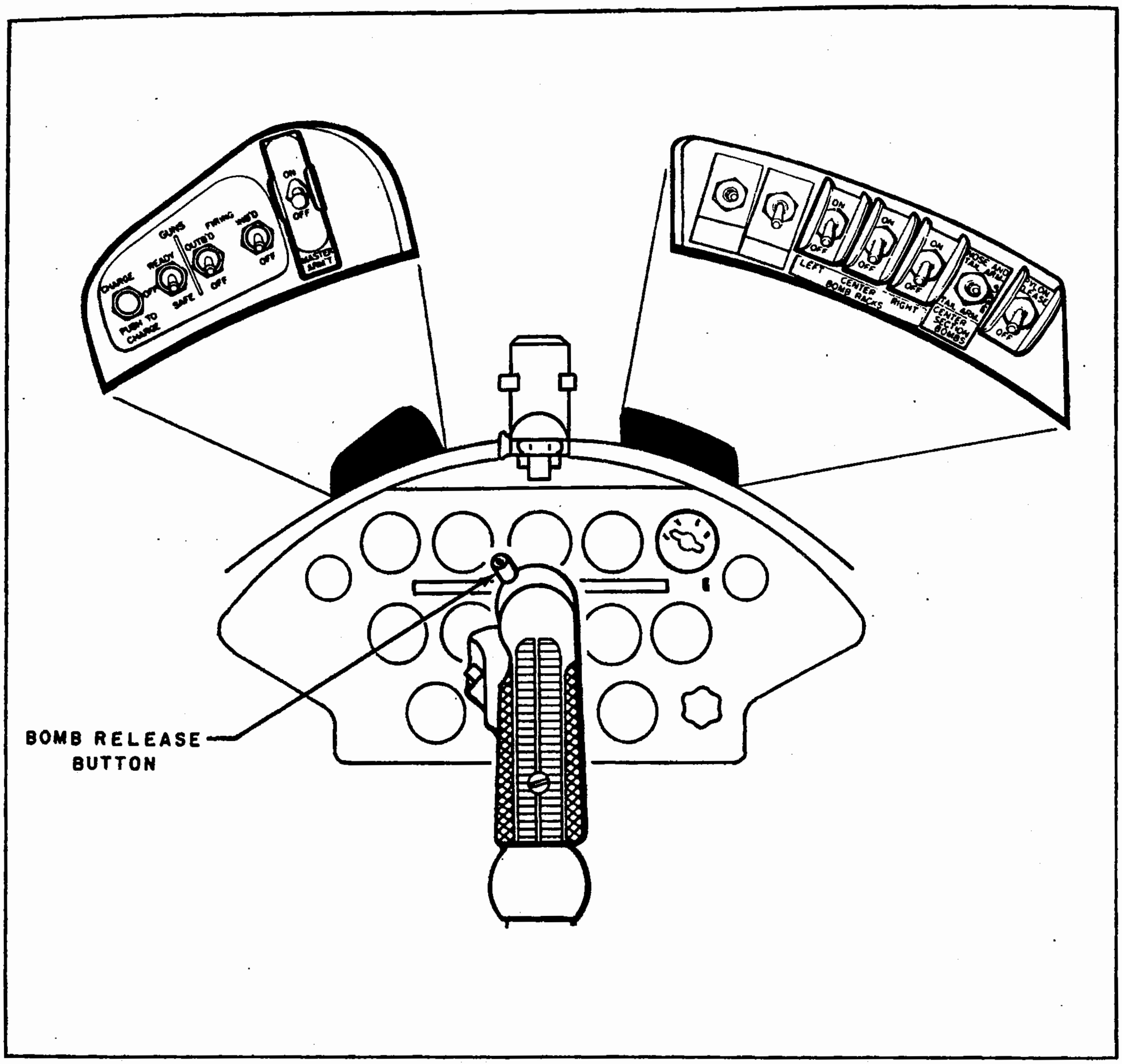


Figure 4—136. Bombing System Switches.

procedures to determine whether the bombing and rocket systems are functioning properly may be found in paragraph 4—1716.

4—1663. BOMBING SYSTEM.

4—1664. DESCRIPTION. *(See figure 4—135.)* The bombing system consists essentially of the centerline pylon secured to the underside of the fuselage, and the left hand and right hand center section pylons secured to the lower surfaces of the wing center sections. Each of the pylons incorporates a Mk 51, Mod. 12 bomb rack which is electrically operated. Mechanical release triggers in the bomb rack, connected to cables leading to the cockpit control handle, permit emergency release of the bombs when the electric release system is inoperative; see paragraph 4—1688. An armament switch box *(see figure 4—136)* located on the right hand side of the cockpit cowling, contains seven switches, five of which are the bomb switches; the left bomb selector switch, center bomb selector switch, right bomb selector switch, the bomb arming switch, and the pylon release switch. Except for the pylon release switch, these switches are operated in conjunction with the bomb release button located on the pilot's control stick. The master armament switch located in the gunnery switch box, must be turned to the "ON" position, before operation of the bomb switches is effective. Each bomb rack is provided with a separate release circuit which energizes the bomb rack release solenoid; see paragraph 4—1667. Each release circuit is controlled by a separate selector switch and the bomb release button. When all three selector switches are thrown to their respective "ON" positions and the release button is depressed, the bombs will be released in salvo. The bombs may be released individually by placing only one selector switch at a time in the "ON" position. Each bomb rack is also provided with two bomb arming circuits which individually energize the bomb rack nose and tail arming solenoids; see paragraph 4—1667. The bomb arming circuits are controlled by the three-position arming switch located in the armament switch box. When this switch is thrown to "NOSE AND TAIL ARMING", both the nose and tail fuses on all of the bombs will be armed when the bombs are released. In the "TAIL ARMING" position, only the tail fuses will be armed. When the arming switch is thrown to "SAFE," both the nose and tail fuses will remain unarmed. Note that the pylon release switch is inoperative, since means for jettisoning the pylons are not provided in this airplane. To arm and release the bombs, the bomb switches *(see figure 4—136)* should be operated as follows:

Note

It is assumed that electrical power is available.

a. Place the master armament switch in the "ON" position.

b. Throw the bomb arming switch to "NOSE AND TAIL ARMING." This switch may be placed in the "TAIL ARMING" position if it is desired to arm only the tail fuses of the bombs. If it is necessary to drop the bombs in a "safe" condition, throw the switch to "SAFE."

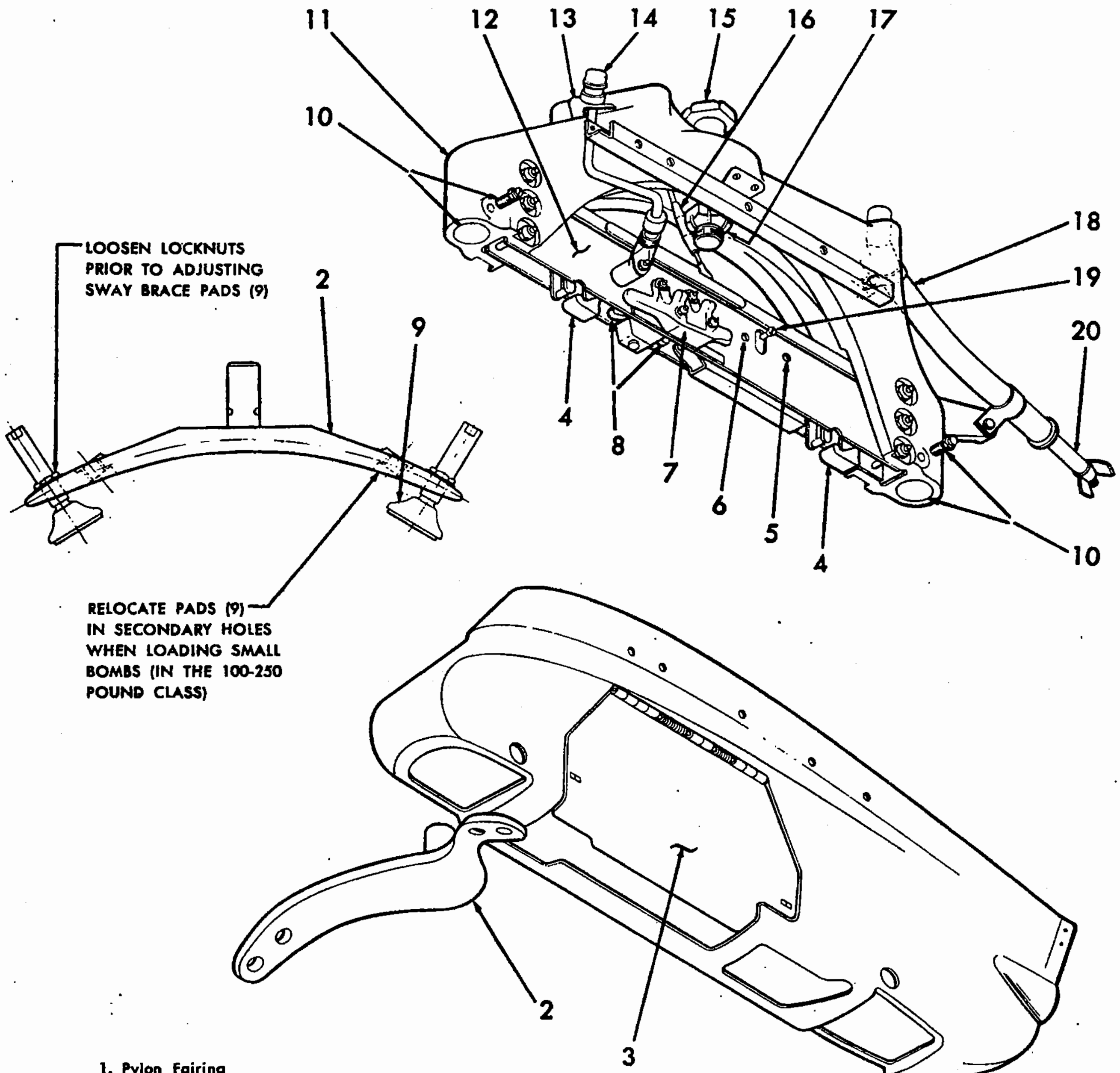
c. Place all three bomb selector switches in the "ON" position to salvo the bombs. To release the bombs individually, turn on only one selector switch at a time.

d. Depress the bomb release button located on the pilot's control stick. If the release circuit is inoperative, push emergency bomb release handle forward in the three slots as desired. This handle is located on the left hand control shelf; see paragraph 4—1688.

4—1665. CENTER SECTION PYLONS.

4—1666. DESCRIPTION. *(See figure 4—137.)* The two center section pylons provide for carrying bombs, external auxiliary fuel tanks, or 11.75" rockets beneath the center sections. Each pylon is designed to carry a maximum load of one 1600 pound bomb. Each pylon is located on the lower surface of the wing center section, inboard of the wheel well, and directly behind the oil cooler door. The pylon assembly consists primarily of a casting which supports the Mk 51, Mod. 12 bomb rack. Each end of the bomb rack is bolted to the casting. The entire pylon assembly is secured to the wing center section by a one inch bolt and retaining nut. The bolt passes through a special fitting in the wing and is accommodated by a hole in the pylon. Two studs projecting from the top of the casting fit into receptacles in the wing, thereby preventing lateral movement of the pylon after installation. Two coat-hanger type sway braces are mounted on the forward and aft ends of the pylon. The sway brace shanks are inserted into receptacles in the casting and held in place by set screws. The position of the braces may be reversed when necessary. Adjustable sway brace pads prevent lateral play of the bomb, and secondary holes in the sway braces permit relocation of the pads to accommodate small bombs in the 100 to 250 pound class. The pylon is provided with an electrical lead which is "plugged" into the bomb rack receptacle to permit electric arming and release of the bombs. The pylon assembly also incorporates a mechanical bomb release linkage which consists of a bellcrank, connected to a turnbuckle which is attached to the bomb rack manual release trigger. This linkage is actuated by another bellcrank and plunger assembly located in the inner compartment of the wing center section; see paragraph 4—1688. A fuel line for the external auxiliary fuel tank is secured to the aft end of each pylon by two clamps. A special plug must be inserted in the bottom opening of the fuel line when the external tank is not installed. The left hand pylon is provided with a pressurizing line which maintains pressure in the left external tank at high altitudes. For information on the external auxiliary fuel tanks installation, see paragraphs 4—850 and 4—866. The entire pylon assembly, with the exception of the sway braces, is covered by a boot type fairing which is secured to the pylon by eight screws. The fairing assembly incorporates a spring-loaded hinged access door which is held closed by two snap fasteners. The sway braces must be removed prior to installation or removal of the fairing.

4—1667. *(See figure 4—137.)* The Mk 51, Mod. 12 bomb rack is employed to perform the two operations of releasing and arming the bombs. It is designed so that the bombs may be released electrically or manually. Arming is accomplished electrically only, and if desired, the bombs may be dropped in a safe (unarmed) condition. The bomb rack release assembly consists essentially of a solenoid, a release lever which seats a release pawl, and two bomb suspension hooks incorporating a connecting link which is actuated by movement of the release pawl. In electrical release, the release solenoid is energized and retracts the release lever. This frees the release pawl, allowing it to swing downward. As the release pawl rotates, the connecting link slides forward causing the bomb suspension hooks to open. In manual release, the emergency bomb release cable system actuates the manual release trigger. Movement of the trigger retracts the release lever, thereby, causing the suspension hooks to open. When the pull on the release cable is relaxed, a spring returns the trigger to its original position. To latch the bomb rack (close the hooks), it is necessary to press upward on the release pawl latching pin. This pin projects from the outboard side of the bomb rack. A small hole located just aft of the latching pin permits insertion of a lock and relatch pin. When this pin is installed, downward movement of the release pawl is restricted and the bombs cannot be released accidentally.



1. Pylon Fairing
2. Sway Braces
3. Pylon Access Door
4. Bomb Suspension Hooks
5. Lock and Relatch Pin Hole
6. Anti-release Safety Pin Hole
7. Portable Hoist Bracket
8. Nose and Tail Arming Wire Retainers
9. Sway Brace Pads
10. Sway Brace Receptacles and Set Screws
11. Pylon Support Casting
12. Mk 51, Mod. 12 Bomb Rack
13. Electric Lead Slide Bracket
14. Quick-disconnect Plug — Bomb Rack Electric Lead
15. One-inch Pylon Bolt
16. Manual Release Control Cable Turnbuckle
17. Pylon Retaining Nut (tighten to 100-120 foot pounds)
18. External Tank Fuel Line
19. Latching Pin (push up to close hooks)
20. Special Plug VS-59213 (insert plug in fuel line when external tank is not installed)

Figure 4—137. Center Section Wing Pylon.

This pin should be installed prior to ground checking the release mechanism with the bomb racks loaded, or to prevent accidental release of the bombs while work is being done on the airplane. A safety pin hole is provided in the rack for insertion of a number five taper pin which also prevents accidental release of the bombs.

WARNING

> Warning flags should be attached to the handle of the lock and relatch pin and to the safety pin, so as to be easily seen from below the rack and bomb. The pins must be removed from the rack prior to each bombing flight in order to permit release of the bombs. Make certain that the bomb rack is completely latched before removing the pins.

The bomb rack arming assembly is semi-selective in that it permits simultaneous arming of the nose and tail fuses or arming of the tail fuse alone. It also permits a safe (unarmed) release of the bomb. The bombs are armed to explode on contact when the spinners revolve off the nose and tail fuses. Two arming wires prevent the spinners from revolving until the bomb is released. One end of the arming wire is inserted into a hole in the spinner while the other end (looped end) is secured by either the nose or tail arming wire retainer (hook). The retainers are controlled by separate arming solenoids which, if energized, lock the retainers in the closed position and prohibit the arming wires from pulling free of the bomb rack when the bomb is released. As the bomb falls, the spinners pull away from the arming wires and revolve off the fuses. When it is desirable that the bomb explode after penetration, only the tail arming solenoid is energized. The tail arming wire is locked while the nose arming retainer is free to open against a two pound spring tension. When the bomb is released, the tail spinner pulls away from the arming wire and revolves off the tail fuse to arm the bomb. The nose fuse is prevented from arming by the nose arming wire which slips from the bomb rack retainer and remains in the spinner. The bomb is released in a safe (unarmed) condition when both arming wires are permitted to slip from the bomb rack retainers and remain in the fuse spinners. Further information on bomb arming can be found in Ordnance Pamphlet 1375. A hoisting hook bracket is mounted on the outboard side of the bomb rack. This bracket is suitable for single hoisting loads up to 2240 pounds and will accommodate either a Mk 7 or Mk 8 portable bomb hoist.

4—1668. LOCATION AND ACCESS. *(See figure 4—137.)* All parts in the pylon assembly are readily accessible for removal, installation and servicing. Access to the manual latching pin, mechanical release linkage, bomb hoisting bracket, and other parts of the bomb rack may be gained through the pylon access door hinged to the outboard side of the pylon fairing. Installation and removal of the sway braces is facilitated by special holes in the forward and aft ends of the fairing which provide access to the sway brace set screws. A zipper opening in the wheel well curtain permits installation or removal of the one inch pylon bolt.

4—1669. REMOVING. *(See figure 4—137.)* To remove a center section pylon, proceed as follows:

a. Remove the two sway braces by loosening the locknut and then the set screw which secures each of the sway braces to the pylon support casting. The set screw should be loosened with an Allen wrench.

b. Remove the pylon fairing by taking out the eight screws which secure the fairing to the pylon.

c. Break the safety wire and loosen the bolt which secures the electric lead disconnect bracket to the pylon casting. Slide the bracket down to clear the electric lead disconnect. Break the safety wire and pull the electric lead disconnect from the wing receptacle.

d. Detach the fuel line and two clamps from the pylon by removing the bolt and fibre locknut which secures each of the fuel line clamps to the pylon.

Note

> The left hand pylon also incorporates the external auxiliary fuel tank pressurizing line which may be detached by removing the two clamps which secure it to the pylon.

e. Support the pylon and remove the one inch bolt retaining nut after taking out the cotter key. Remove the pylon from the wing.

f. Remove the one inch pylon bolt from the wing by reaching through the zipper opening in the wheel well curtain and grasping the head of the bolt.

4—1670. DISASSEMBLY. To disassemble the pylon after it has been removed from the airplane, observe the following procedure:

a. Remove the electric lead disconnect bracket by removing the bolt which secures the bracket to the pylon casting.

b. Remove the bomb rack electric lead by pulling the lead plug out of the bomb rack receptacle after first breaking the safety wire and unscrewing the plug cap.

c. Remove the manual bomb release linkage (bellcrank and turnbuckle) by breaking the safety wire and unscrewing the bolt which secures the bellcrank to the pylon casting. Disconnect the turnbuckle from the bomb rack release trigger cable by taking out the cotter key and removing the pin which attaches the turnbuckle to the cable bushing.

d. Remove the bomb rack from the pylon casting by removing the three fibre locknuts and bolts which secure each end of the bomb rack to the pylon casting. If steps b. and c. of the disassembly procedure have not been observed, it will be necessary to disconnect the manual release turnbuckle from the release trigger cable, and remove the electric lead plug from the bomb rack receptacle prior to taking out the bolts which secure the bomb rack to the pylon.

e. Remove the rear stud, locknut, and washer from the pylon by loosening the locknut and unscrewing the stud.

f. Remove the three anchor nut plate brackets located on the inboard side of the pylon by removing the two flush screws which secure each of the brackets to the pylon casting. Remove the anchor nut plate channel and center bracket located on the outboard side of the pylon by breaking the safety wire and removing the two fillister head screws which secure each end of the channel to the pylon casting. Also remove the two flush screws which secure the center bracket to the pylon casting.

4—1671. CLEANING AND LUBRICATING. To clean or remove corrosion from the bomb racks, observe the procedures given in Ordnance Pamphlet 1375. The major components of the Mk 51, Mod. 12 bomb rack are made of corrosion resistant materials, or are suitably plated to resist corrosion. Use of tectyl, lacquer and other preservatives has been discontinued. The bomb rack solenoid plunger pins and surfaces of the suspension hooks should be lubricated with grease, Navy Spec. O.S. 1350 whenever the bomb rack is disassembled; see Ordnance Pamphlet 1375. No further lubrication of the rack is required. The two studs projecting from the top of the pylon casting and the stud receptacles in the wing should be coated with Paralketone preservative, Spec. AN-C-52, prior to mounting the pylon to the wing. Paralketone should also be applied to the manual release trigger turnbuckle and to the inside of the sway brace receptacles.

4—1672. REPAIRING. Repairs to the bomb racks should be made in accordance with procedures recommended by the Bureau of Ordnance. If cracks or other structural damage of the pylon casting is apparent, the casting should be removed and replaced with a new one. Pylon fairing access doors which do not latch properly should be removed and replaced. Bump out all dents in the pylon fairing.

4—1673. ADJUSTING. *(See figure 4—137.)* It is necessary to make three adjustments on the center section pylon after the pylon has been mounted to the wing. To make the adjustments, observe the following procedures:

a. The retaining nut on the one inch pylon bolt should be tightened to 100 to 120 pound-feet. To tighten the retaining nut to the correct torque and at the same time provide clearance for the cotter key, it is necessary to place three washers under the head of the bolt and usually two washers under the retaining nut. Manufacturing tolerances necessitate determining by trial and error just how many washers must be placed under the retaining nut.

b. Adjust the rear stud on the pylon casting to insure a four-point contact of the pylon with the bottom surface of the wing center section. This is done by loosening the locknut and screwing the stud out of the pylon until it bottoms in the center section receptacle. The other bearing surfaces (three) must be in contact with the wing before this adjustment is made.

c. Adjust the manual release trigger turnbuckle until the bellcrank just contacts the release plunger which extends out of the bottom surface of the wing center section. The release plunger should extend out 1/8 inch (plus or minus 1/16 inch) from the bottom surface of the wing center section, and must be properly adjusted prior to adjustment of the pylon turnbuckle and bellcrank linkage. Safety wire the turnbuckle after the adjustment is completed.

4—1674. ASSEMBLING. To assemble a center section pylon, reverse the disassembly procedure given in paragraph 4—1670.

Note

In assembling the pylon, note that neoprene tape (protective and waterproof tape) should be placed between all surfaces of the bomb rack and pylon which are in contact with each other (ends of bomb rack). Neoprene tape should also be placed between the pylon and the electrical disconnect bracket, the three anchor nut plate brackets, the anchor nut plate channel, and on all bearing surfaces of the pylon, with the exception of the rear stud. In general neoprene tape should be placed between all dissimilar metal surfaces which are in contact with each other.

4—1675. TESTING. The bomb rack is tested for proper operational limits by means of an inspection jig as described in Ordnance Pamphlet 1375. The bomb rack may be tested for proper operation after it has been installed on the pylon by observing the general test procedure given in paragraph 4—1717. The entire center section pylon assembly should be tested for proper electrical bonding as required in Spec. AN-B-10a whenever a center section pylon is mounted to the wing. Make certain that the external auxiliary fuel tank line and bomb rack are properly bonded to the pylon, and that the pylon is properly bonded to the wing.

4—1676. INSTALLING. *(See figure 4—137.)* To install a center section pylon on the wing, observe the following procedure:

a. Prepare the pylon for installation by applying Paralketone preservative, Spec. AN-C-52, to the two pylon studs and to the stud receptacles in the bottom surface of the center section; see paragraph 4—1671. The adjustable rear stud should be screwed (not tightly) as far as it will go into the pylon. The stud locknut should be loose to permit adjustment of the stud after the pylon has been bolted to the center section; see paragraph 4—1673b. Cover three bearing surfaces of pylon with neoprene tape; see "Note" in paragraph 4—1674.

b. Reach through the wheel well curtain zipper access opening and insert the one inch pylon bolt through the hole in the center section fitting. Three washers are required under the head of the bolt.

c. Lift the pylon in place under the center section so that the bolt is accommodated by the hole in the pylon casting, and the two pylon studs properly fit into the center section stud receptacles.

d. Apply two washers and the retaining nut to the end of the bolt. Tighten the retaining nut to from 100 to 120 pound-feet; see paragraph 4—167a.

e. Screw the adjustable rear stud out of the pylon until it bottoms in the receptacle; see paragraph 4—1673b. After the adjustment is completed, tighten the rear stud locknut.

f. Attach the fuel line and two fuel line clamps to the pylon by means of the bolt and fibre locknut which secure each of the clamps to the pylon casting. Before tightening the fibre locknuts, push the fuel line up until it bottoms in the wing fuel inlet fitting.

Note

If an external auxiliary fuel tank is not to be installed, insert Special Plug (VS-59213) in the bottom opening of the fuel line. Secure the plug in place by tightening and safety-wiring the wing nut.

g. Plug the electrical disconnect into the wing receptacle. Safety-wire the disconnect plug to the screw installed in the wing next to the receptacle. Slide the disconnect bracket up so that it engages and supports the disconnect plug. Tighten and safety-wire the bracket bolt.

h. Adjust the manual release trigger turnbuckle until the bellcrank just contacts the release plunger; see paragraph 4—1673c. After the adjustment is completed, the turnbuckle should be safety-wired and coated with Paralketone Spec. AN-C-52.

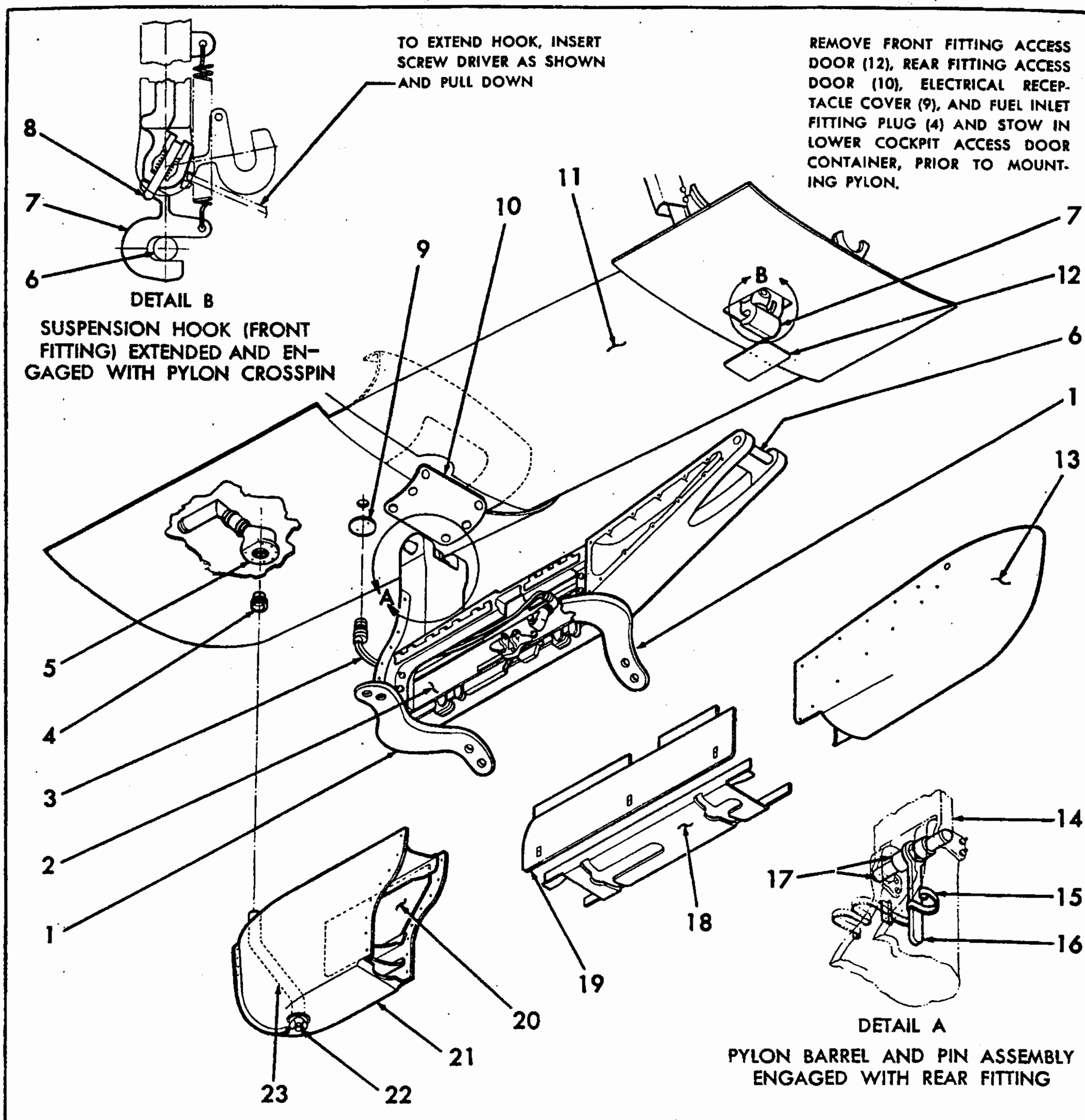
i. Install the pylon fairing and secure it to the pylon with eight screws.

j. Install the two sway braces in the sway brace receptacles and tighten the set screws and locknuts. The inner surfaces of the sway brace receptacles should be coated with Paralketone, Spec. AN-C-52, prior to installation of the sway braces.

4—1677. CENTERLINE PYLON.

4—1678. DESCRIPTION. *(See figure 4—138.)* The centerline pylon, located on the underside of the fuselage between the two center section pylons, provides for carrying a bomb, external auxiliary fuel tank, or 11.75" rocket. It is designed to support a maximum load of one 2,000 pound bomb. The pylon consists primarily of a casting which supports a Mk. 51, Mod. 12 bomb rack. Each end of the bomb rack is bolted to the casting. For information on the bomb rack, see paragraph 4—1667. The pylon is mounted at two points. The front end of the pylon is secured to a fitting which is bolted to the engine mount, just forward of the intercooler flap, while the rear end is secured to a fitting which is bolted to the main beam and located immediately aft of the intercooler flap. The front fitting incorporates a hook assembly which is retracted into the fuselage by a spring when the pylon is not installed. Prior to mounting the pylon, the hooks are pulled down by hand and automatically locked in the extended position by a spring-loaded plunger. The hooks secure the forward end of the pylon by engaging a cross pin located on the front end of the pylon casting. An arm, which extends up from the aft end of the pylon and is integral with the casting, incorporates a barrel and pin assembly (similar to a turnbuckle). The aft end of the pylon is secured to the fuselage centerline when the barrel pins are extended and engage two holes in the fuselage rear fitting (trunnion). The pins are extended to engage the holes or retracted to clear them by turning the barrel with a special wrench which is permanently secured to the barrel and pin assembly *(see detail in figure 4—138.)* The coat-hanger type sway braces are mounted just forward and aft of the bomb rack. The sway brace shanks are inserted into recesses in the pylon support casting and held in place by set screws. The position of the braces may be reversed when necessary. Adjustable sway brace pads prevent lateral play of the bomb, and secondary holes on the sway braces permit relocation of the pads to accommodate small bombs in the 100 to 250 pound class. The pylon is provided with an electrical lead which is "plugged" into the bomb rack receptacle to permit electric arming and release of the bombs. The pylon assembly also incorporates a mechanical bomb release linkage which consists of a bellcrank and an adjustable cable attached to the bomb rack manual release trigger. This linkage is adjusted in conjunction with the manual release system Teleflex cable which is connected to one end of the pylon bellcrank by means of a quick-disconnect fitting; see paragraph 4—1699. A fuel line for the external auxiliary fuel tank is secured to the pylon aft fairing by two brackets welded to the fuel line which are bolted to supports located on the inside of the fairing. The upper bracket on the fuel line is slotted to permit alignment of the fuel line with the opening in the fuel inlet fitting located in the fuselage. A special plug (VS-48818) must be inserted in the bottom opening of the fuel line when the external fuel tank is not installed. When the plug is not in use, it may be stowed in a hole in the lower horizontal rib of the pylon aft fairing. For information on the external auxiliary fuel tank installation, see paragraph 4—867. The entire pylon assembly, with the exception of the sway braces is covered by three fairing assemblies which incorporate two access doors. The access doors facilitate installation, removal, and servicing of the pylon.

4—1679. LOCATION AND ACCESS. *(See figure 4—138.)* All parts of the pylon are readily accessible for removal, installation and servicing. The pylon aft fairing access door provides access to the pylon barrel and pin assembly, special wrench, electric lead fuselage receptacle, manual release trigger bellcrank, Teleflex quick-disconnect fitting, and the external tank fuel line. Access to the bomb rack may be gained through the pylon intermediate fairing access door. Openings to the two pylon fuselage fittings and the electric lead receptacle are covered by access doors when the pylon is not in-



1. Sway Brace
2. Bomb Rack
3. Bomb Rack Electric Lead
4. Fuel Inlet Fitting Plug (VS-46609)
5. Fuel Inlet Fitting
6. Crosspin (Pylon Forward Suspension Point)
7. Front Fitting Assembly (Suspension Hook)
8. Spring-loaded Plunger (to unlock and retract hook, depress plunger)
9. Electrical Receptacle Cover
10. Rear Fitting Access Door
11. Intercooler Flap (ref.)
12. Front Fitting Access Door
13. Pylon Forward Fairing
14. Rear Fitting — Trunnion
15. Special Wrench Lock
16. Special Wrench VS-57966 (permanently installed in barrel and pin assembly)
17. Barrel and Pin Assembly (Pylon Rear Suspension Point)
18. Pan Assembly (Intermediate Fairing)
19. Access Door (Intermediate Fairing)
20. Aft Fairing Access Door
21. Pylon Aft Fairing
22. Special Plug VS-48818 (install plug and safety wire when external tank is not installed)
23. External Tank Fuel Line

Figure 4—138. Centerline Pylon.

stalled. Prior to mounting the pylon, these doors must be removed and stowed in a container located on the lower cockpit access door. The special plug (VS-46609) must also be removed from the fuel inlet fitting in the fuselage and placed in this container.

4—1680. REMOVING. *(See figure 4—138.)* To remove the centerline pylon, observe the following procedure:

a. Close the intercooler flap; see paragraph 4—486.

b. Unfasten and open pylon aft fairing access door.

c. Reach through access door and disconnect electric lead plug from fuselage receptacle.

d. Detach Teleflex cable from the manual release trigger bellcrank at the quick-disconnect fitting.

e. Unfasten and rotate the wrench lock away from the special wrench which is permanently attached to the pylon barrel and pin assembly.

f. Using the special wrench, rotate the barrel clockwise (as seen from the right hand side) to disengage the barrel pins from the holes in the rear fitting (trunnion) in the fuselage. It will be necessary to rotate the wrench in short rearward strokes, and re-position it on the barrel between each stroke. Make certain that the pylon is properly supported to prevent it from dropping when the pylon barrel and pin assembly becomes completely disengaged from the rear fitting.

g. When the pylon barrel and pin assembly is disengaged from the rear fitting, carefully lower the aft end of the pylon and at the same time move it aft to disengage the cross pin on the forward end of the pylon from the front fitting hooks. Remove the pylon from the airplane.

h. If the centerline pylon is being removed for an extended period of time, the front fitting hooks should be retracted, Special Plug (VS-46609) should be installed in the fuel inlet fitting, and access covers should be placed over the fuselage openings to the bomb rack electrical receptacle, front pylon fitting, and rear pylon fitting. The special plug and access covers are stowed in the container located on the lower cockpit access door.

Note

The front fitting hook assembly is retracted by depressing the spring-loaded plunger which locks the hooks in the extended position.

4—1681. DISASSEMBLY. To disassemble the pylon after it has been removed from the airplane, observe the following procedure:

a. Remove the two sway braces by loosening the locknut and then the set screw which secures each of the sway braces to the pylon support casting. The set screw should be loosened with an Allen wrench.

b. Remove the pylon aft fairing, forward fairing, bomb rack access door and pan (or intermediate fairing) by removing the screws which secure them to the pylon support casting.

c. Remove the external tank fuel line from the pylon aft fairing by removing the cotter key, bolt, retaining nut, and spacer which secure each of the two fuel line brackets to the supports located in the fairing.

d. Remove the electric lead from the bomb rack by unscrewing the electric plug cap and pulling the electric lead plug from the bomb rack receptacle.

e. Remove the manual release trigger bellcrank and cable assembly by removing the cotter key, bolt, retaining nut, and washer which secure the bellcrank to the pylon bracket; also remove the cotter key, pin and washer which secure the bellcrank cable to the manual release trigger bushing.

f. Remove bomb rack from pylon support casting by removing the three bolts, retaining nuts, and washers which secure each end of the bomb rack to the pylon.

4—1682. CLEANING AND LUBRICATING. To clean or remove corrosion from the bomb rack, observe the procedures given in Ordnance Pamphlet 1375; see paragraph 4—1671 for added information.

4—1683. REPAIRING. Repairs to the bomb rack should be made in accordance with procedures recommended by the Bureau of Ordnance; see paragraph 4—1672 for added information.

4—1684. ADJUSTING. The manual release trigger bellcrank and cable assembly must be adjusted in conjunction with the emergency bomb release system; see paragraph 4—1699.

4—1685. ASSEMBLING. To assemble the centerline pylon, reverse the disassembly procedure given in paragraph 4—1681.

Note

In assembling the pylon, note that neoprene tape (protective and waterproof tape) should be placed between all surfaces of the bomb rack and pylon which are in contact with each other (ends of the bomb rack).

4—1686. TESTING. The bomb rack may be tested for proper operation after it has been installed in the aircraft by observing the general test procedure given in paragraph 4—1717; also refer to paragraph 4—1675.

4—1687. INSTALLING. *(See figure 4—138.)* To install a centerline pylon on the fuselage, reverse the removal procedure given in paragraph 4—1680.

Note

Due to manufacturing tolerances, the external auxiliary tank fuel line may not align properly with the fuel inlet fitting in the wing when the pylon is installed. For this reason, the support in the aft pylon fairing which secures the upper fuel line bracket is slotted and facilitates alignment by permitting the fuel line to be moved fore and aft when the bracket bolt is loosened. It is advisable to loosen the bolt prior to mounting the pylon so that the fuel line can be aligned with the fuel inlet fitting when the pylon is installed. The bracket bolt should be tightened after the pylon has been secured to the wing.

4—1688. EMERGENCY BOMB AND EXTERNAL FUEL TANK MANUAL RELEASE SYSTEM.

4—1689. DESCRIPTION. *(See figure 4—139.)* The emergency bomb and external fuel tank manual release system is designed to permit individual emergency release of a bomb or external fuel tank from any one of the three pylons. This system does not provide for manual arming of the bombs, and if the electric arming circuit is inoperative, the bombs will be dropped in a "safe" condition. The emergency release system consists primarily of a three-position control unit which may be positioned to individually operate any one of three Teleflex cables which control separate bellcranks connected to the manual release triggers in the three pylon bomb racks. The control unit is located on the left hand control shelf and consists of a pivot handle, accommodated by a tri-slotted bracket, which individually actuates three cable arm assemblies bolted to the underside of the control unit. The ends of the three Teleflex cables are secured to separate telescopic units which attach to the control unit arms. The two Teleflex cables leading from the control unit to the center section pylons are contained in rigid conduits which guide the cables to the left hand and right hand inner compartments of the wing center section. At this point, each of the Teleflex cables attaches to another telescopic unit which in turn is connected to an ordinary aircraft cable which, guided by two fairlead pulleys, leads to a bellcrank located in each of the inner compartments in the wing center section. The aircraft cable is attached to the spring-loaded bellcrank arm which tends to resist the pull of the cable and maintains tension throughout the cable system. Each of the two bellcranks incorporates a plunger which extends through an opening in the wing and contacts another bellcrank bolted to each of the center section pylons. The pylon bellcranks are connected by means of turnbuckles to the bomb rack manual release trigger assemblies; see paragraph 4—1667. The emergency release cable for the centerline pylon bomb rack is a single Teleflex cable which is secured to the control unit center arm by means of a telescopic unit identical to those which secure the two center section Teleflex cables. The centerline cable is contained in a rigid conduit which guides the cable from the control unit to a fairlead pulley located below the main beam. The conduit ends at this point while the exposed cable passes over the fairlead pulley and continues down through an opening in the fuselage to attach directly to the bellcrank bolted to the centerline pylon; see paragraph 4—1678. The Teleflex cable is attached to the pylon bellcrank by means of a quick-disconnect fitting, and the bellcrank in turn connects to the bomb rack release trigger. All of the Teleflex cables are secured to their respective end fittings (telescopic units, quick-disconnect fitting) by means of spiral locks which screw on the helix wire which encircles the outer diameter of the cable. The spiral locks permit minor adjustments of the entire release system. The cable end fittings incorporate two inspection holes ("go" and "no go") large enough to permit insertion of a wire to determine whether or not the cable end is locked far enough into the end fitting. Passage of a wire through the "no go" inspection hole should be blocked by the end of the cable, otherwise the cable is not inserted far enough into the fitting. Any adjustment of the cable is permissible between the "no go" inspection hole, which should be blocked, and the "go" inspection hole which should be clear. Additional adjustments can be made on the release linkage incorporated in the center section pylons; see paragraph 4—1673c. Further information on Teleflex cable installations may be found in paragraph 4—602.

4—1690. LOCATION AND ACCESS. All parts of the emergency bomb release system are readily accessible for installation, removal, and servicing. Access to the underside of the cockpit control unit and cable telescopic units may be gained through the aft cover on the vertical face of the left hand control shelf. The Teleflex conduit may be reached through the lower cockpit access door. Access to the fairlead pulleys and center section bellcranks is provided through the openings in the wheel well curtains. The centerline pylon Teleflex cable quick-disconnect can be reached through the centerline pylon aft fairing access door.

4—1691. TROUBLE SHOOTING. The troubles, probable causes and remedies listed below are intended as an aid in determining probable mechanical malfunctions of the emergency bomb release system. See paragraph 4—602 for further information on Teleflex cable installations.

Trouble	Probable Cause	Suggested Remedy
Stiff operation of control handle.	*a.* Damaged conduit.	*a.* Replace conduit.
	b. Insufficient lubrication.	*b.* Lubricate cable and moving parts.
	c. Dirt accumulated in conduit and on cable.	*c.* Remove dirt with cleaning solvent.
	d. Fouled cable.	*d.* Check system to see that all cables are free.
	e. Binding plunger due to bent bellcrank or insufficient lubrication of the plunger.	*e.* Straighten bellcrank arm and lubricate plunger.

Trouble	Probable Cause	Suggested Remedy
Stiff operation of control handle. (con't.)	*f.* Telescopic unit slider tubes bent.	*f.* Replace telescopic unit.
Loose operation of control handle.	*a.* Loose conduit connections.	*a.* Butt the ends of conduit clamp connectors. Tighten clamps and install locking pins.
	b. Loose cable connections in telescopic units or missing spring lock.	*b.* Install spring and tighten end fittings of telescopic units.
	c. Weak or missing bellcrank springs.	*c.* Replace springs.

4—1692. REMOVING EMERGENCY BOMB RELEASE CONTROL UNIT ASSEMBLY. *(See figure 4—139.)* Observe the following procedure:

a. Remove the aft cover located on the vertical face of the left hand control shelf by removing screws.

b. Detach the three telescopic units from control unit arm assemblies by removing the cotter key, bolt, retaining nut and washers which secure each telescopic fork end fitting to the control unit arm.

c. Remove the screws which secure the control unit to the left hand control shelf.

d. Lift the control unit from the shelf and remove it from the airplane.

4—1693. REMOVING CENTER SECTION PYLON EMERGENCY BOMB RELEASE CABLES. *(See figure 4—139.)* The center section pylon emergency bomb release cables may be removed with or without the control unit installed by observing the following procedure:

a. Remove the aft cover located on the vertical face of the left hand control shelf.

b. Unscrew the outer sliding tube of each of the telescopic units from the fork end fitting which secures the telescopic unit to the control unit arm. It is necessary to bend the tab washer on the telescopic unit before unscrewing the sliding tube.

c. Remove the spring lock from the end of each of the two Teleflex cables.

d. Unfasten the zipper openings and reach through each of the wheel well curtains. Detach the aircraft cable terminal fitting from the telescopic unit fork end fitting by removing the cotter key, bolt, retaining nut, and washers.

e. Unscrew the outer sliding tube of each of the telescopic units from the fork end fitting. Note that these telescopic units are located in the wing center section and are accessible through the wheel well curtains.

f. Grasp the exposed end of each of the Teleflex cables and pull the cable from the conduit through the wheel well curtain.

Note

To avoid misplacing any Teleflex parts, reinstall the spring locks which were removed from the ends of the cables connected to the control unit. Replace the fork end fittings on the telescopic units located in the wing center section.

g. Reach through each of the wheel well curtains and remove the two fairlead pulleys provided for each of the aircraft cables which were previously detached from the Teleflex telescopic units.

h. Reach through each of the wheel well curtains and detach the aircraft cable from the bellcrank by removing the bolt, retaining nut, and washers which secure the cable terminal to the bellcrank arm.

i. Pull the aircraft cables out through the wheel well opening and remove them from the airplane.

4—1694. REMOVING CENTERLINE PYLON EMERGENCY BOMB RELEASE CABLE. *(See figure 4—139.)* The centerline pylon emergency bomb release cable may be removed with or without the control unit installed by observing the following procedure:

a. Remove the aft cover located on the vertical face of the left hand control shelf.

b. Unscrew the outer sliding tube of the center telescopic unit from the fork end fitting which secures the telescopic unit to the control unit arm. It is necessary to bend the tab washer on the telescopic unit before unscrewing the sliding tube.

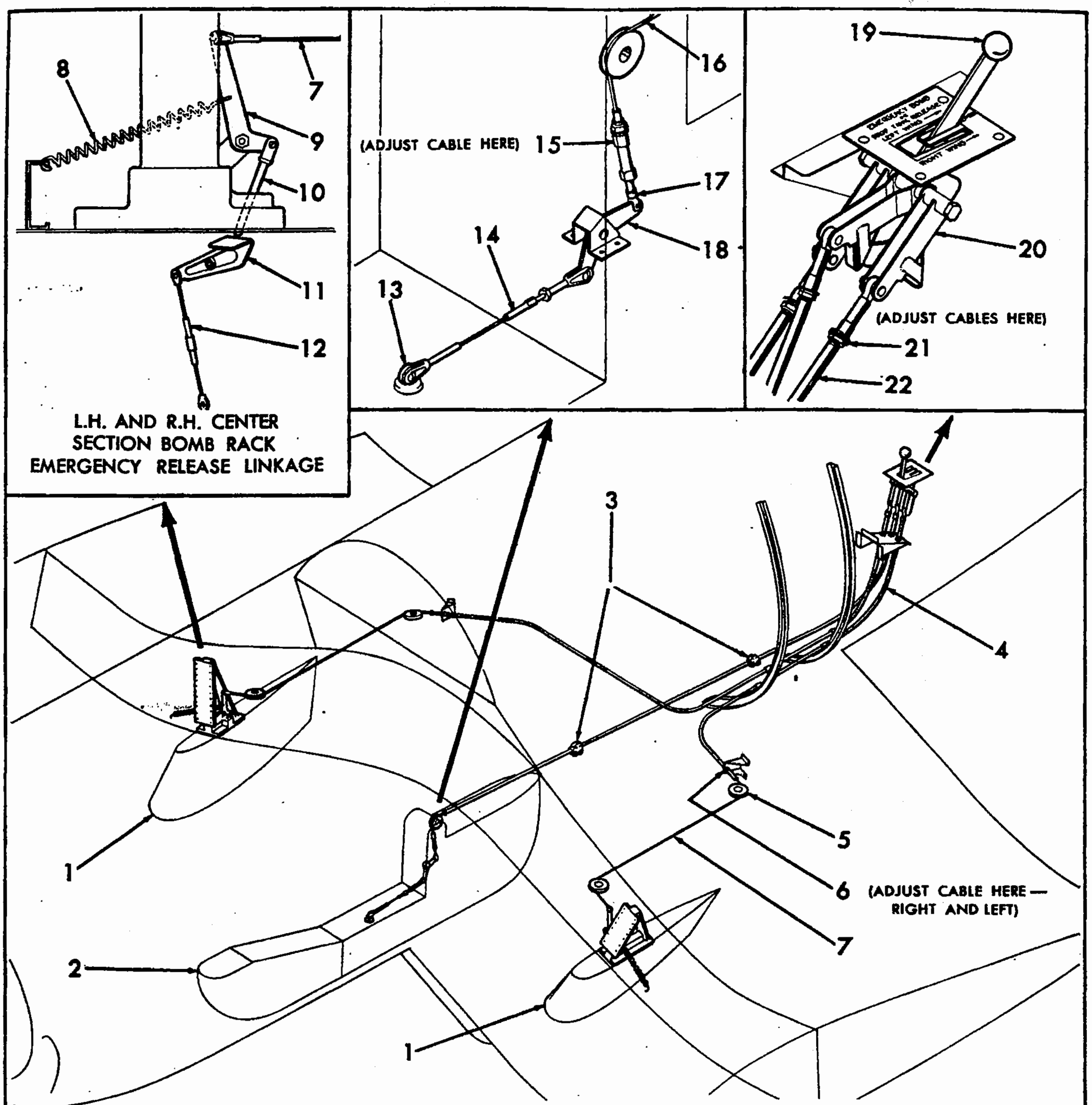
c. Remove the spring lock from the exposed end of the Teleflex cable.

d. Open the centerline pylon aft fairing access door to gain access to the Teleflex quick-disconnect.

e. Detach the Teleflex cable from the pylon bellcrank by unfastening the quick-disconnect fitting.

f. Grasp the quick-disconnect end of the cable and pull the cable out through the centerline pylon aft fairing access door.

g. Remove the quick-disconnect fitting from the cable by bending the tab washer and unscrewing the quick-



1. Center Section Wing Pylons (ref.)
2. Centerline Pylon (ref.)
3. Conduit Clamp Connectors
4. Teleflex Conduit
5. Fairlead Pulleys (four)
6. Telescopic Unit with End Fitting (adjust)
7. Cable
8. Bellcrank Spring
9. Center Section Bellcrank
10. Plunger (adjust cables so that plunger extends $1/8'' \pm 1/16''$ from bottom surface of wing)
11. Bellcrank (bolted to pylon)
12. Turnbuckle (adjust turnbuckle so that pylon bellcrank just contacts plunger)
13. Manual Release Trigger Bushing
14. Turnbuckle and Cable Assembly
15. Special End Fitting (adjust)
16. Teleflex Cable
17. Quick-disconnect
18. Centerline Pylon Bellcrank
19. Emergency Bomb Release Handle
20. Control Unit Arms
21. End Fittings (adjust)
22. Telescopic Units

Figure 4—139. Emergency Bomb and External Fuel Tank Manual Release System.

disconnect off of the special end fitting. The special end may be removed from the cable after the lock spring has been removed.

Note

After removal of the cable, reinstall the spring locks to avoid misplacing them.

4–1695. REMOVING TELEFLEX CONDUIT AND TELESCOPIC UNITS. *(See figure 4–139.)* To remove the Teleflex conduit and telescopic units after the cables have been removed, observe the following procedure:

a. Remove the three telescopic units from the brackets located below the cockpit control unit. To detach each of the telescopic units, observe the following procedure. *1.* Remove the locking pin from the entry nipple which secures the conduit to the telescopic unit. *2.* Unscrew the entry nipple. *3.* Unscrew the lock washer which secures the telescopic swivel coupling to the mounting bracket. *4.* Pull the telescopic unit out of the bracket. *5.* Replace the lock washer and entry nipple to avoid misplacement.

Note

A telescopic unit may be removed without removing the cable from the conduit by removing the cable lock prior to following the above procedure.

b. Remove the two telescopic units mounted to brackets located in the left hand and right hand inner compartments of the wing center section. The brackets are accessible through openings in the sides of the fuselage which permit passage of the Teleflex cable and conduit into the wing center section. It will be necessary to work through the lower cockpit access door to remove these telescopic units. The locking pin, entry nipple and lockwasher securing each telescopic unit are readily acessible through the opening in the fuselage. To remove the telescopic units, follow the procedure given in step a.

c. Remove the two conduits which guide the Teleflex cables to the left and right hand inner compartments of the swing center section. To remove the conduit, it will be necessary to detach two supporting clips which secure the left hand conduit to the fuselage, and detach three supporting clips which secure the right hand conduit to the fuselage. Each clip is held to the fuselage by one screw. The conduit is accessible through the lower cockpit access door.

d. Remove the conduit which contains the centerline pylon Teleflex cable. This conduit travels from the control unit and passes through the rear beam to the fairlead pulley located just below the main beam. The conduit is made up in three sections which are joined together by two conduit clamp connectors. Remove the clamp connectors by removing the locking pins and loosening the clamp screws. Detach the supporting clips which secure the conduit to the fuselage. Remove the locking pin and unscrew the entry nipple which secures the conduit to the bracket located behind the fairlead pulley under the main beam. Remove the conduit from the airplane.

4–1696. CLEANING AND LUBRICATING. Proper operation of the Teleflex installation depends on cleanliness of both the conduit and the cable. To assure a clear line of conduit, it is advisable to pull through a length of clean cable. This will remove any dirt, filings, or cuttings that may be in the line. Make certain that the cable is clean prior to installing it in the conduit. If necessary, it should be washed with a suitable grease solvent to remove any foreign matter that may have accumulated on the exposed cable. The cable should be lubricated with Spec. AN-G-25 low temperature lubricant as it is run into the conduit. The telescopic units, control handle and bellcrank pivot points should also be lubricated with Spec. AN-G-25 low temperature lubricant.

4–1697. REPAIRING. All damaged cable, conduit, telescopic units and fairlead pulleys must be removed and replaced. Replace weak or missing springs located in the control unit and on the bellcranks. Remove and replace all damaged bellcranks. If a bellcrank arm is slightly bent, causing binding of the plunger in the wing opening, straighten the bellcrank.

4–1698. INSTALLING. *(See figure 4–139.)* To install the emergency bomb release system conduit, cable, telescopic units and control unit, reverse the removal procedures given in paragraph 4–1693 through 4–1695. Install all conduit and telescopic units prior to installing cables. The Teleflex cables are rigid enough to be easily passed through the conduits. Installation of the cable will be facilitated if all cable is started into the conduit from the cockpit.

CAUTION

In installing Teleflex controls the procedure given in paragraphs 4–602 through 4–604G must be followed exactly. See also paragraph 6–6V.

4–1699. ADJUSTING. See paragraph 4–602 for further information on Teleflex cables. Minor adjustments of the emergency bomb release system are made at the telescopic end fittings *(see figure 4–139.)* The end fitting is secured to the cable by means of the spiral cable lock which threads over the cable in the same manner as a threaded nut engages a bolt. Adjustment is obtained by turning the cable lock along the cable to the desired position before the cable is locked into the end fitting. The cable lock may be adjusted so that the cable end is positioned at any point along the distance between the two inspection holes; see paragraph 4–1667. To correctly adjust a center section pylon emergency release cable, observe the following procedure:

a. Secure the cockpit emergency bomb release handle in the extreme aft position.

b. Unscrew the cable end fittings from the telescopic units located at each end of the Teleflex cable. One of the telescopic units is located below the control unit and the other is located in the inner compartment of the wing center section and is accessible through the wheel well curtain.

c. Adjust the cable locks threaded to each end of the

Teleflex cable so that when the entire cable system is properly connected with the control handle in the extreme aft position, the bellcrank plunger will extend out 1/8 inch (plus or minus 1/16 inch) from the bottom surface of the wing. To extend the plunger, thread the cable locks further onto the cable at both ends, not to the extent, however, that the "go" inspection hole will be blocked when cable is inserted into the end fittings. To retract the plunger, reverse the above procedure making certain that in so doing the "no go" inspection hole will still remain blocked when the cable is inserted into the end fittings.

d. It may be necessary to adjust one cable lock less than the other, depending on how the cable is positioned in relation to the end fitting inspection holes.

e. If it is impossible to extend the bellcrank plunger sufficiently, it is an indication that the cable is too long. In this case, it is permissible to shorten the cable, cutting one end a fraction at a time, and checking between each cutting to determine if the cable is the correct length to permit the plunger to extend sufficiently from the bottom surface of the wing. Teleflex cable may be cut either with a cold chisel or wire cutters. After it is cut, the ends should be chamfered smooth with a file or a grinding wheel. All filing or grinding must be done only in the direction of the winding of the helix on the cable. A Teleflex cable which is too short will force the bellcrank plunger to extend too far out of the bottom surface of the wing. Short cables must be removed and replaced.

f. After the Teleflex cable has been adjusted so that the bellcrank plunger extends 1/8 inch (plus or minus 1/16 inch) from the bottom surface of the wing, the bellcrank-turnbuckle linkage bolted the center section pylon must be adjusted so that the pylon bellcrank just contacts the plunger; see paragraph 4—1673c. Operate the cockpit control handle to make certain that the center section pylon bomb rack hooks open.

4—1700. *(See figure 4—139.)* To correctly adjust the centerline pylon emergency release cable, observe the following procedure:

a. Remove the centerline pylon aft fairing; see paragraph 4—1680 b. through d. and 4—1681b.

b. Secure the cockpit emergency bomb release handle in the extreme aft position.

c. Unscrew the cable end fittings from each end of the Teleflex cable. One of the fittings secures the telescopic unit to the control unit arm, the other fitting is integral with the quick-disconnect which connects to the centerline pylon bellcrank.

d. Adjust the cable locks threaded to each end of the Teleflex cable so that when the entire cable system is properly connected with the control handle in the extreme aft position (neutral), the cable tension will be only enough to eliminate play in the bellcrank.

WARNING

The cable tension should not be great enough to unseat the release trigger cable bushing located on the top of the bomb rack. Failure to comply with this warning may result in involuntary release of the bombs.

e. To increase tension on the cable, thread the cable locks further onto the cable at both ends, not to the extent, however, that the "go" inspection hole will be blocked when the cable is inserted into the end fittings. To slacken the cable, reverse the above procedure, making certain that in so doing, the "no go" inspection hole will still remain blocked when the cable is inserted into the end fittings.

f. It may be necessary to adjust one cable lock less than another, depending on how the cable is positioned in relation to the end fitting inspection holes.

g. If it is impossible to take the slack out of the Teleflex cable, it is an indication that the cable is too long. In this case, it is permissible to shorten the cable; see paragraph 4—1699e.

4—1701. TESTING. Operate the cockpit control handle to make certain that the bomb rack hooks open; see paragraph 4—1717.

4—1702. LOADING BOMBS ON CENTERLINE AND CENTER SECTION PYLONS. *(See figure 4—140.)* The procedure for loading bombs on the centerline and center section pylons is identical. The position of the sway braces depends on the size of the bombs. Note that the sway braces can be positioned so that the sway brace pads extend either forward or aft. When loading small bombs, the sway brace pads may be relocated so that they are closer together.

4—1703. PROCEDURE. *(See figure 4—140.)* To load a bomb on either a centerline or center section pylon, observe the following procedure:

a. Roll the assembled bomb on a dolly under the pylon. Bomb suspension lugs should be directly under the hooks of the bomb rack.

b. Turn "OFF" the master armament switch and all bomb selector switches.

c. Hang the arming wire loops in the bomb rack arming wire retainers and thread the wires through the bomb suspension lugs.

d. Place the correct hoisting band or sling around the bomb and lock it in place. When lifting a 2000 pound bomb, use the Mk. 10 hoisting band. A Mk. 21 or Mk. 26 sling should be used on smaller bombs.

e. Hook the Mk. 7 portable hoist to the bomb rack hoist bracket and attach the portable hoist cable to the bomb hoisting sling.

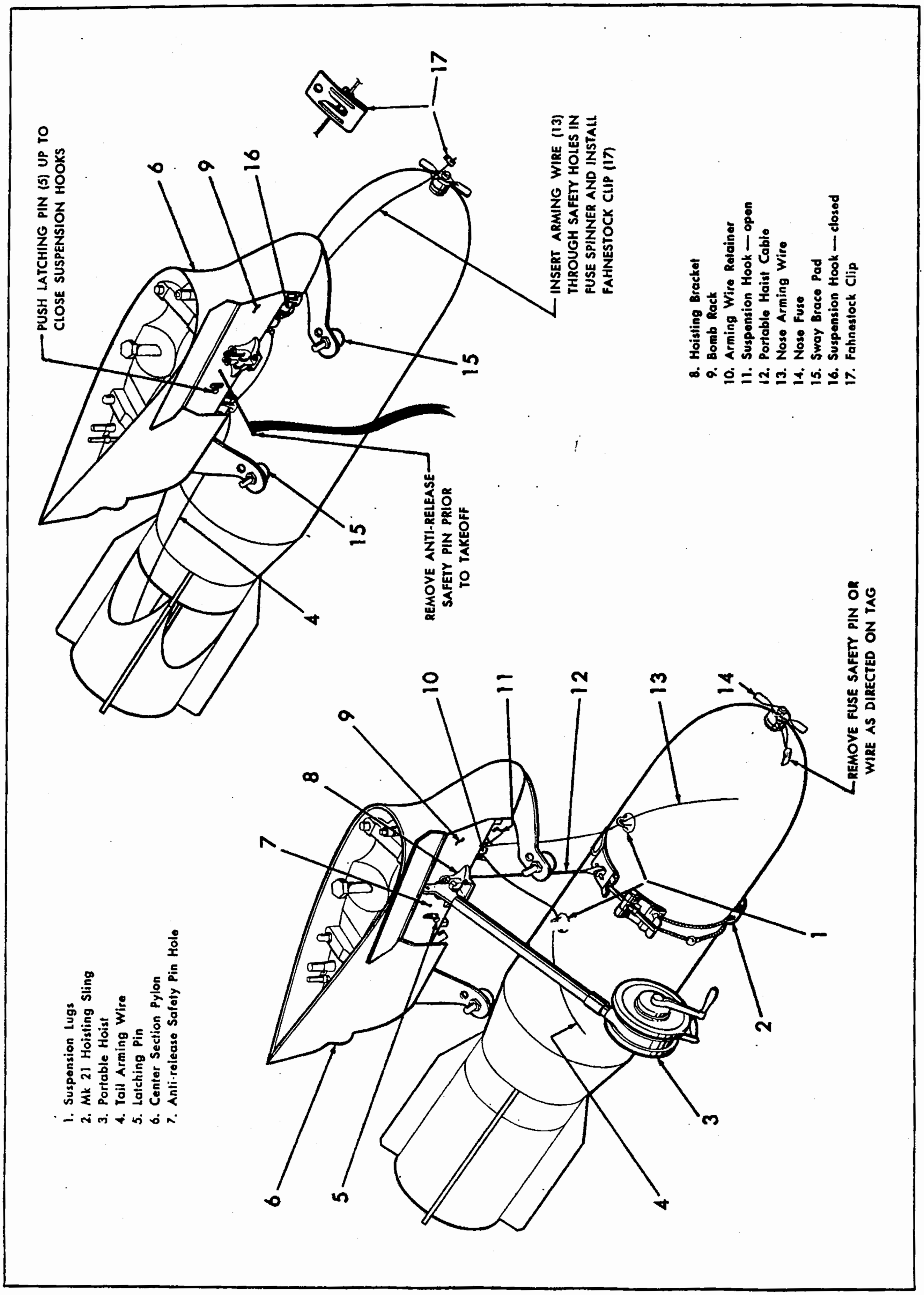


Figure 4—140. Bomb Hoisting.

f. By means of the portable hoist, raise the bomb until the suspension lugs are aligned with the bomb rack hooks. Engage the bomb rack hooks with the bomb suspension lugs by pushing up the bomb rack latching pin. This secures the bomb to the rack.

g. Insert a number five taper pin into the safety pin hole provided in the bomb rack. This prevents accidental release of the bomb.

h. Remove the portable hoist and hoisting sling.

i. Tighten the sway brace pads sufficiently to secure the bomb against lateral play. Do not overtighten the sway braces, as this will overload the rack.

j. Insert the ends of the arming wires in the holes provided in the nose and tail fuse spinner assemblies. Install a Fahnestock clip on the end of each wire. On some types of fuses, it is necessary to remove a cotter key or safety wire from the fuse before inserting the arming wire. On other types of fuses, the cotter key or safety wire must be left on the fuse until after the arming wire is in place *(see figure 4—140)*.

k. Remove the bomb rack safety pin and fuse safety wires prior to take-off.

WARNING

All armament switches must be left in the "OFF" position while the airplane is on the ground and loaded with bombs or rockets.

4—1704. LOADING 11.75" ROCKETS ON CENTERLINE AND CENTER SECTION PYLONS. The procedure for loading 11.75" rockets on the centerline and center section pylons is identical.

4—1705. PROCEDURE. *(See figure 4—140.)* To load an 11.75" rocket on either a centerline or center section pylon, observe the following procedure:

a. Roll the assembled rocket on a dolly under the pylon.

b. Turn "OFF" the master armament switch and all selector switches.

c. Position the sway braces so that the rear sway brace pads are extending aft, and the front sway brace pads are extending forward.

d. Hang an arming wire in the bomb rack nose arming wire retainer if the rocket is equipped with a nose fuse and thread the wire through the suspension lug.

e. Hook the portable hoist to the bomb rack hoist bracket.

f. Attach the Mk 7 portable hoist cable to the rocket hoisting band by means of a 3/8 inch bolt provided with the band.

g. By means of the portable hoist, raise the rocket until the suspension lugs are aligned with the bomb rack hooks. Engage the bomb rack hooks with the rocket suspension lugs by pushing up the bomb rack latching pin. This secures the rocket to the rack.

h. Insert a number five taper pin into the safety pin hole provided in the bomb rack. This prevents accidental release of the rocket.

i. Remove the portable hoist.

j. Tighten the sway brace pads sufficiently to secure the rocket against lateral play. Do not overtighten the sway braces, as this will overload the rack.

k. Insert the end of the arming wire in the hole provided in the nose fuse spinner assembly. Install a Fahnestock clip on the end of the wire. On some types of fuses, it is necesary to remove a cotter key or safety wire from the fuse before inserting the arming wire. On other types of fuses, the cotter key or safety wire must be left on the fuse until after the arming wire is in place.

l. Insert the loop end of the rocket magneto cable into the tail arming wire retainer.

m. Remove the bomb rack safety pin, fuse safety wire and rocket magneto safety wire prior to take-off.

WARNING

All armament switches must be left in the "OFF" position while the airplane is on the ground and loaded with bombs or rockets.

4—1706. ROCKET SYSTEM.

4—1707. DESCRIPTION. *(See figure 4—135.)* Four Mk 9 Mod. 3 rocket launchers, designed to carry either 3.5" or 5" rockets, are located on the lower surface of each outer panel. The launchers on each outer panel are numbered inboard to outboard, one through four. The following switches control the rocket arming and launching system (See figure 4—141):

a. The Master Armament switch, located on the left cockpit cowling, is an "ON"-"OFF" switch, used to energize all armament circuits.

b. The Mk 1 station selector switch, located on the right side of the instrument panel, is a four-position switch with the stations: "PAIRS," "2-2-4," "2-6," and "SALVO." The Mk 1 station selector switch pointer moves or steps automatically to the next clockwise station each time the rocket firing button is depressed and released. The pointer may be moved counterclockwise by turning it, and clockwise only by depressing the "SALVO PRESET" button. When set at "PAIRS," the Mk 1 station selector switch will energize the No. 1 launcher circuit. As the pointer steps to each successive clockwise station, each successive outboard pair of rocket launcher circuits is energized in addition to those previously energized. This latter provision reduces the possibility of not completing the desired launching of a rocket. Although the launching of more than two rockets at one time may be accomplished by presetting the pointer to a position other than "PAIRS," the firing of more than one rocket from each outer panel at one time

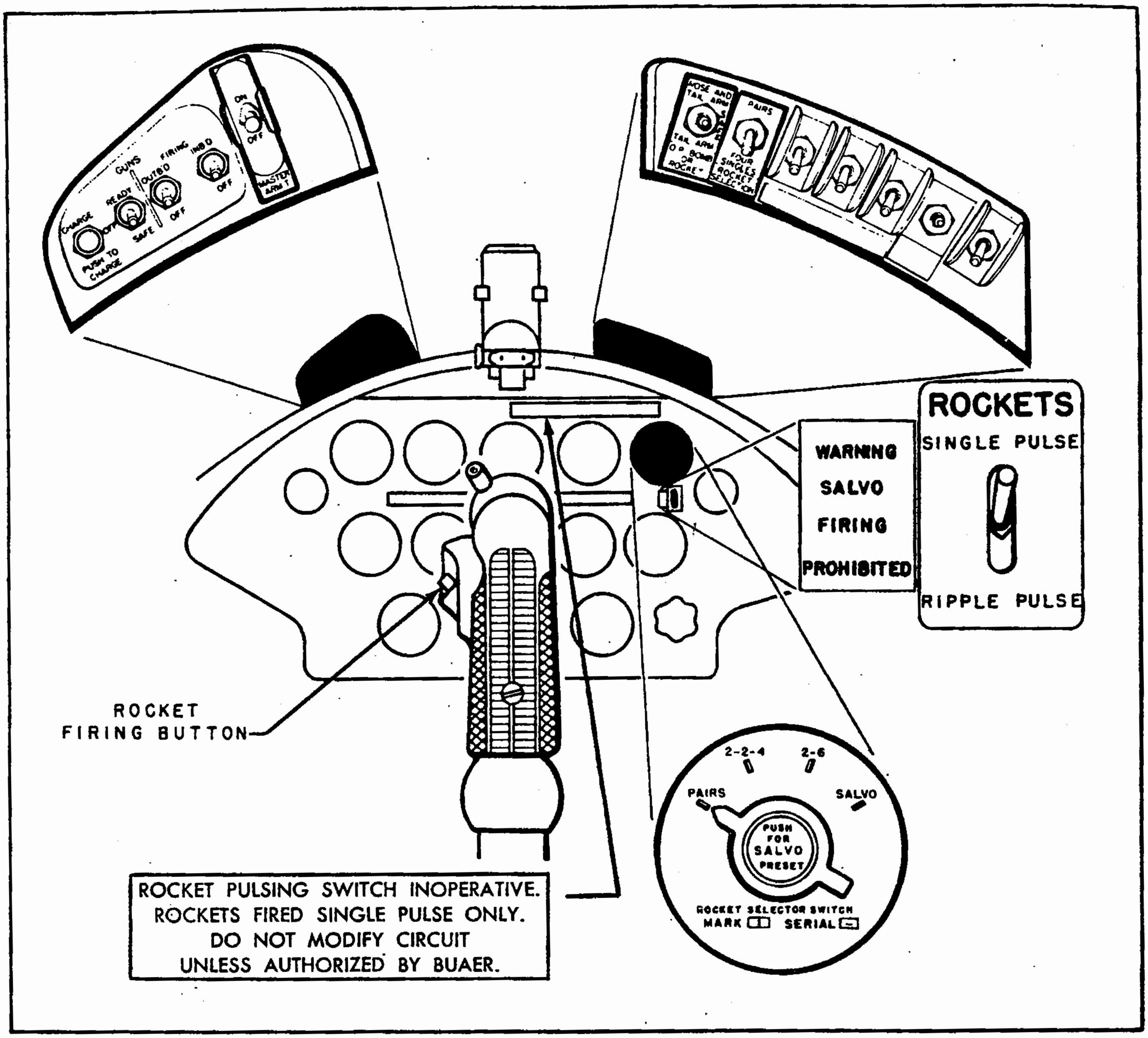


Figure 4—141. Rocket System Switches.

is NOT permitted. The pointer must always be started from the "PAIRS" position.

c. A rocket selection switch, located on the right cockpit cowling, permits the firing of rockets singly or in pairs. The switch has two positions, "PAIRS" and "FOUR SINGLES." When placed in the "FOUR SINGLES" position, the switch opens four firing circuits permitting only No. 1 left, No. 2 right, No. 3 left, and No. 4 right rockets to be launched. To launch singly the remaining four rockets, rocket selection switch must be placed in "PAIRS" position and the Mk. 1 station selector switch pointer returned to "PAIRS" position.

d. A ripple pulse-single pulse switch, located on the right side of the instrument panel, permits the launching of rockets at rapid, automatically-controlled intervals, or at pilot-controlled intervals. When the switch is in the "SINGLE PULSE" position, the rocket firing button must be depressed for each pair of rockets (or single rocket) launched. When the switch is in the "RIPPLE PULSE" position (while the rocket firing button is held depressed) a ripple pulse relay in the main junction box is energized which intermittently opens and closes the launching circuits, making it possible for the Mk. 1 station selector switch to step from one station to the next in rapid succession.

Note

Ripple pulse switch is inoperative pending completion of firing tests.

e. A rocket launching or firing button is located on the pilot's control stick.

f. The outer panel bomb or rocket arming switch, located on the right cockpit cowl, is a three-position switch: "NOSE AND TAIL ARM," "TAIL ARM," and "SAFE" (neutral position). The Mk 9, Mod. 2 rocket launchers incorporate only nose-arming solenoids; see paragraph 4—1709. There is no tail-arming solenoid in the launchers, since the tail fuses are automatically armed when the rockets are fired. The "SAFE" and "TAIL ARM" positions are provided in case Mk 55, Mod. O bomb racks are substituted for Mk 9, Mod. 2 rocket launchers. It may be noted, therefore, that rockets can never be launched in a completely unarmed condition. For further electrical information, refer to paragraph 5—115 through 5—118.

4—1708. OPERATION. Present restrictions on this airplane permit the launching of rockets singly or in pairs in the following manner.

a. Throw the master armament switch "ON."

b. If nose-arming is desired, place the outer panel bomb or rocket arming switch in the "NOSE AND TAIL ARM" position.

c. Set the Mk 1 station selector switch to "PAIRS."

WARNING

Always set Mk 1 station selector switch to "PAIRS." Partial salvo may inflict severe damage on the wings flaps and ailerons.

d. To fire eight rockets singly at pilot-controlled intervals after observing steps a., b., and c. above: *1.* Throw rocket selection switch to "FOUR SINGLES." *2.* Place ripple pulse-single pulse switch in "SINGLE PULSE" position. *3.* Depress and release rocket firing button four times. This will cause No. 1 left, No. 2 right, No. 3 left, and No. 4 right rockets to be fired and will cause the Mk 1 station selector switch to step clockwise to "SALVO." *4.* Return Mk 1 station selector switch to "PAIRS." *5.* Place rocket selection switch at "PAIRS." *6.* Depressing and releasing the rocket firing button will cause the remaining four rockets to be released in the following order: No. 1 right, No. 2 left, No. 3 right, No. 4 left.

e. To fire eight rockets singly in rapid succession after observing steps a., b., and c. above: *1.* Throw rocket selection switch to "FOUR SINGLES." *2.* Place ripple pulse-single pulse switch in "RIPPLE PULSE" position. *3.* Hold rocket firing button depressed. Four rockets will be launched in rapid succession, as follows: No. 1 left, No. 2 right, No. 3 left, and No. 4 right. The Mk 1 station selector switch will step rapidly clockwise to "SALVO." *4.* Return Mk 1 station selector switch to "PAIRS." *5.* Place rocket selection switch at "PAIRS." *6.* Hold rocket firing button depressed, causing the remaining four rockets to be launched rapidly in the following order: No. 1 right, No. 2 left, No. 3 right, and No. 4 left.

f. To fire eight rockets in pairs at pilot-controlled intervals (after observing steps a., b., and c. above): *1.* Throw rocket selection switch to "PAIRS." *2.* Place ripple pulse-single pulse switch at "SINGLE PULSE." *3.* Depress and release the rocket firing button four times. This will cause the rockets to be launched in pairs, commencing with the rockets on No. 1 right and left launchers.

g. To fire eight rockets in pairs in rapid succession after observing steps, a., b., and c. above: *1.* Throw rocket selection switch to "PAIRS." *2.* Place ripple pulse-single pulse switch at "RIPPLE PULSE." *3.* Hold the rocket firing button depressed. The eight rockets will be launched in pairs in rapid succession, commencing with the rockets on No. 1 right and left launchers.

4—1709. ROCKET LAUNCHERS. *(See figure 4—142.)* Provisions for mounting the four Mk 9, Mod. 2 rocket launchers are incorporated in the lower surface of each outer panel. If desired, Mk 55, Mod. O bomb racks can be substituted for the launchers. The launchers are numbered one, two, three and four starting from inboard. Each launcher is secured to the wing by means of a single hanger bolt which screws into a wing fitting. Correct fore and aft alignment of the launcher and electrical connections is provided by an aligning tube incorporating an electrical connector, which fits into a wing receptacle. A T-slot (slideway) on the bottom of the launcher accommodates the mounting lugs on the rocket. The front end of the T-slot is open to permit entrance of the lugs. After the lugs are inserted into the front end of the T-slot, the rocket is pushed aft until a latch engages the rear lug and locks the rocket in place. The latch may be manually released by a lever which extends from the aft end of the launcher. During rocket firing the latch is unlocked by a solenoid which is actuated when the rocket firing button on the control stick is depressed. After the latch is unlocked, the rocket must still overcome a latch spring to leave the launcher. Each launcher is designed to support either a 3.5″ or 5″ rocket; however, a Mk 6 launcher, modified in acordance with Aircraft Armament Bulletin No. 66, can be mounted on the Mk 9, Mod. 2 launcher. This makes it possible to fire 2.25″ sub-caliber rockets. Each rocket is provided with a "pig tail" (electrical lead) which leads from the rocket and ends in a telephone jack type plug which is inserted into a special wing receptacle located aft of the launcher. When the rocket firing button on the control stick is depressed, current passes through the "pig tail" to a squib which explodes and starts the initial burning of the powder in the rocket motor. The "pig tail" is blown off by the rocket discharge as the rocket leaves the launcher. The T-slot latch which detains the rocket in the launcher is unlocked by the latch solenoid which is energized simultaneously with the rocket firing circuit. The rocket motor, however, has to build up a certain amount of pressure before it can overcome the latch spring and leave the launcher. As a safety feature, a shear pin is incorporated in the latch assembly. Should the latch fail to release, the pin will

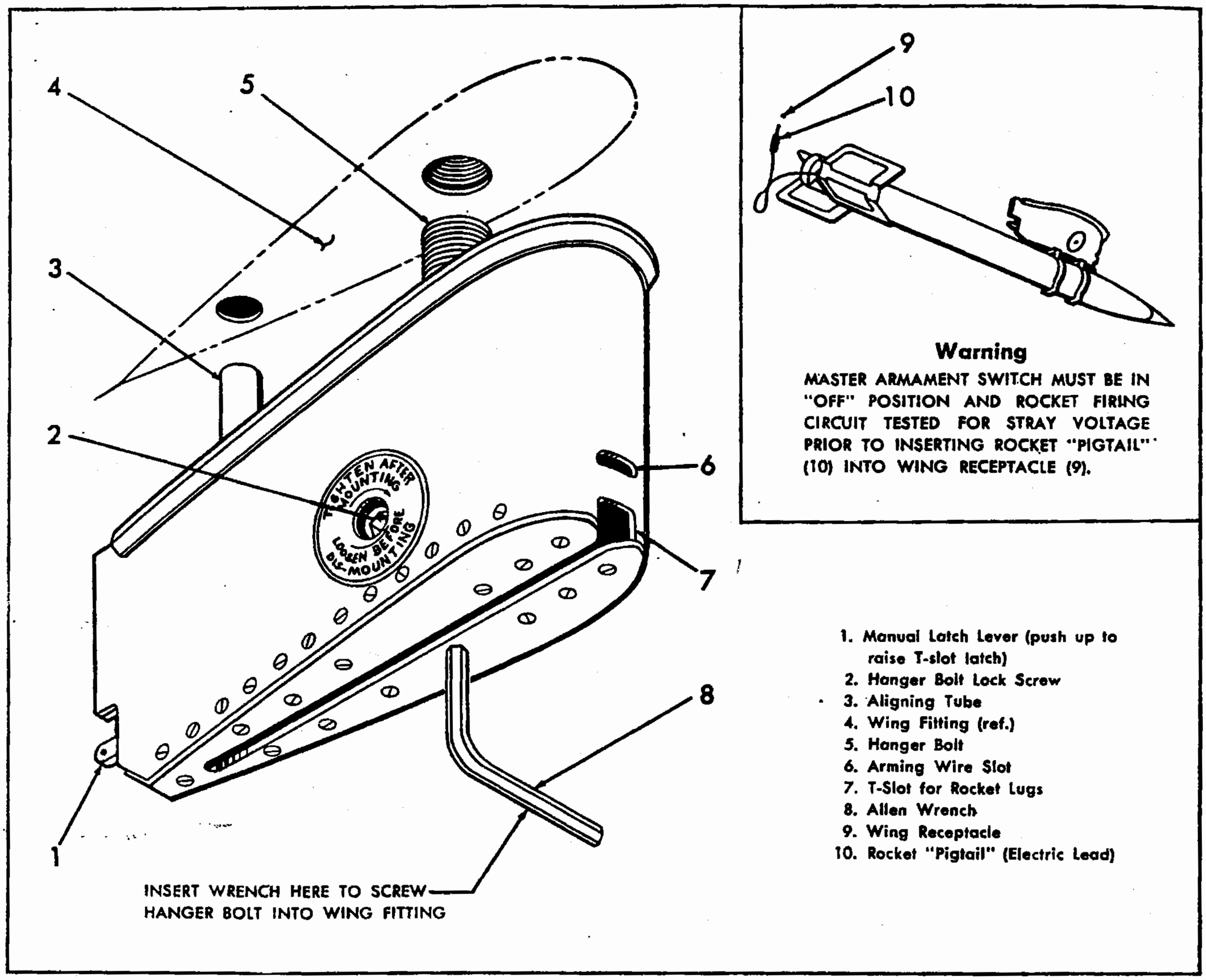


Figure 4—142. Rocket Launcher.

shear at a force of approximately 2,000 pounds. The design of certain rocket heads permits either instantaneous or delayed detonation, depending on whether the nose fuse of the rocket is armed or not. A rocket arming solenoid incorporated in the front end of the launcher permits insertion of the loop end of a standard arming wire. The arming wire extends from the solenoid to the rocket nose fuse. When the arming solenoid is energized by the rocket arming switch, the solenoid plunger extends and locks the arming wire to the launcher. When the rocket is fired from the launcher, the arming wire is pulled from the rocket fuse permitting it to become armed. The principle of rocket arming is similar to bomb arming; see paragraph 4—1667. The only difference is that under no conditions can the rocket be fired in a "safe" condition due to the fact that the inside of the rocket contains a base fuse which arms automatically and will cause delayed detonation of the rocket.

4—1710. REMOVING. *(See figure 4—142.)* To remove a rocket launcher observe the following procedure.

a. Loosen the hanger bolt locking screw located on the side of the launcher, with an Allen wrench.

b. Loosen the hanger bolt Allen plug located between the T-slot (slideway) on the bottom of the launcher. As this plug is rotated, hanger bolt unscrews from wing fitting, permitting the launcher to break away from the wing.

4—1711. CLEANING AND LUBRICATING. Keep the rocket launcher clean at all times. Remove any dirt by wiping with a cloth moistened with Navy approved cleaning fluid. Kerosene, Spec. FED-VV-K-211 or solvent, Spec. FED-P-S-661 are satisfactory cleaning fluids. The launcher is lubricated at the factory and requires no further lubrication. If any metal parts develop a tendency to corrode because of the action of sea water or from other causes, keep them covered with a film of protective lubricant. Grease conforming to Spec. AN-G-3 is satisfactory for this use.

4—1712. REPAIRING. Damaged or inoperative rocket launchers should be removed for repair and replaced. Only qualified ordnance personnel should attempt to repair a rocket launcher. To repair the rocket launcher, refer to the Aircraft Rocket Launcher Mk 9, Mod. 2 Handbook of Operation, Service and Overhaul Instructions (AN-11-75 BB-1).

4—1713. TESTING. The rocket launcher and rocket firing circuit may be ground tested for operation by observing the procedure given in paragraph 4—1718.

4—1714. INSTALLING. To install a rocket launcher, reverse the removal procedure given in paragraph 4—1710.

4—1715. LOADING ROCKET ON MK 9, MOD. 2 LAUNCHER. *(See figure 4—142.)* A 5″ or 3.5″ rocket may be loaded on a Mk 9, Mod. 2 launcher by observing the following procedure:

a. Turn the master armament switch "OFF" to avoid accidental discharge of the rockets. The master armament switch must be left in the "OFF" position until the aircraft is in the air.

b. Lift rocket up with mounting lugs on top (one man required).

c. Enter rear mounting lug of the rocket into launcher T-slot (slideway).

d. Push rocket all the way aft, until the T-slot latch snaps down ahead of the rear lug on the rocket. Check to make certain the rocket is locked in position by pressing the latch lever down with the fingers.

e. Where a rocket with a nose fuse is used, attach a standard bomb arming wire between the rocket nose fuse and rocket arming solenoid in the front of the launcher. The loop end of the arming wire should be secured by the solenoid plunger.

f. Insert telephone jack type plug at end of rocket "pig tail" (electric lead) into wing receptacle located behind launcher.

WARNING

Make certain that the master armament switch is turned to the "OFF" position and that the rocket firing circuit has been tested for stray voltage prior to inserting rocket "pig tails" into wing receptacles; see paragraph 4—1718. Failure to comply with this warning may result in an accidental rocket blast which would cause serious, if not fatal, injury to the ordnance man.

4—1716. BOMB AND ROCKET SYSTEM TESTING.

4—1717. PROCEDURE FOR TESTING BOMBING SYSTEM. *(See figures 4—136, 4—137, and 4—138.)* The bombing system may be ground-tested for proper operation by observing the following procedure:

a. Suspend a weight from each of the bomb rack release hooks in each pylon. Close the hooks by pushing up the bomb rack latching pins.

b. Insert the loop ends of standard arming wires into both the nose and tail arming wire retainers in each bomb rack.

c. With the battery switch "OFF," attach an external source of electrical power and turn the master armament switch to the "ON" position.

d. Place the bomb arming switch in the "NOSE AND TAIL ARM" position. All of the arming wires should be locked in the arming wire retainers.

e. Throw the bomb arming switch to the "TAIL ARM" position. The tail arming wires should remain locked in the tail arming wire retainers. The nose arming wires should release from the bomb racks when pulled by hand.

f. Place the bomb arming switch in the "SAFE" (center) position. Both the nose and tail arming wires should release from the bomb racks when pulled by hand.

g. Place the three bomb selector switches in their respective "ON" positions. Depress the bomb release button on the control stick. The bomb rack hooks in all the pylons should open simultaneously and evenly release the weights that were placed on the hooks.

h. Relatch the bomb rack hooks in all three pylons. Turn "ON" one bomb selector switch at a time and depress the bomb release button. Make certain that the hooks open only in the bomb rack which is controlled by the corresponding selector switch.

i. Relatch the bomb rack and insert a number five taper pin into the safety pin hole provided in the bomb rack. With the correct selector switch in the "ON" position, depress the bomb release button. The safety pin should prevent the hooks from opening. Remove the safety pin and insert a lock and relatch pin in the hole provided behind the bomb rack latching pin. Repeat the same procedure. The lock and relatch pin should also prevent the bomb rack hooks from opening.

j. Remove the lock and relatch pin and turn off all bombing switches. Operate the emergency bomb release handle located on the left hand control shelf, to make certain that it opens the bomb rack hooks in each of the three pylons.

4—1718. PROCEDURE FOR TESTING ROCKET SYSTEM. *(See figures 4—141 and 4—142.)* The rocket system may be ground tested for proper operation and for stray voltage by observing the following procedure:

a. Insert a rocket circuit test plug into each of the rocket firing receptacles located on the lower surfaces of the outer panels.

b. Insert the loop ends of arming wires into the rocket launcher nose arming wire retainers.

c. With the battery switch "OFF," attach an external source of electrical power and turn the master armament switch to the "ON" position.

d. Throw the rocket arming switch to the "NOSE AND TAIL ARM" position. The nose arming wire attached to each launcher should be locked by the nose arming solenoid. When the rocket arming switch is at any other position, the arming wires should release from the launchers when pulled by hand.

e. The Mk. 1 station selector switch determines which firing circuits will be closed when the rocket firing button is depressed. Each time the firing button is depressed and released, the switch should step (move) clockwise to the next station until it reaches the fourth and last one. Each station on the selector switch closes a different number of firing circuits. When the firing circuit to a rocket launcher is closed, the test plug installed in the receptacle behind the launcher will light. The launchers on each outer panel are numbered one, two, three and four starting from the inboard. By observing which test plugs light it can be determined whether or not the Mk. 1 selector switch is closing the correct firing circuits at each station. Set the Mk. 1 station selector switch so that it will start from the "PAIRS" position. Throw the rocket selection switch to the "PAIRS" position. Place the single pulse-ripple pulse switch in the "SINGLE PULSE" position. Depress and release the rocket firing button four times, making certain that the Mk. 1 selector switch steps to each of the four stations. The four stations on the selector switch should close the firing circuits to pairs of launchers in the following order:

When the firing button is depressed and the Mk. 1 station selector switch is pointing to:	The firing circuit test plugs should light behind:
"PAIRS" (First Station)	No. 1 launchers (inboard, left and right wings); total two.
"2-2-4" (Second Station)	No. 1 and No. 2 launchers (left and right); total four.
"2-6" (Third Station)	No. 1, No. 2, and No. 3 launchers (left and right); total six.
"SALVO" (Fourth Station)	All launchers (left and right); total eight.

Note

Not only are two additional firing circuits closed at each successive station, but all firing circuits closed at preceding stations and from which rockets would have already been fired, are also closed.

f. Throw the rocket selection switch to "FOUR SINGLES." Reset the Mk. 1 station selector switch so that it will start again from the "PAIRS" position. Again depress and release the rocket firing button four times. The four stations of the Mk. 1 selector switch should close the firing circuits to single rockets in the following order:

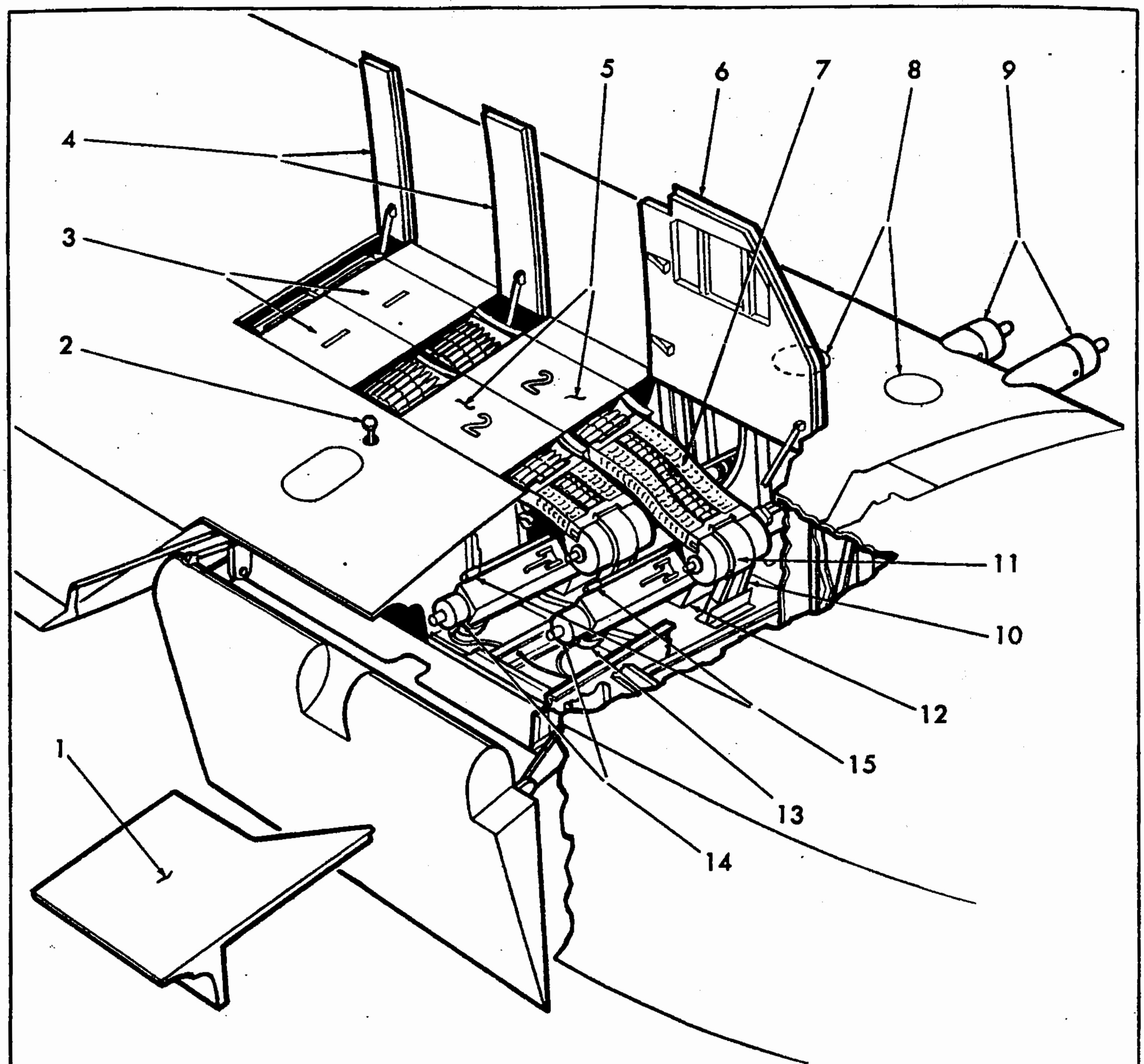
When the firing button is depressed and the Mk. 1 station selector switch is pointing to:	The firing circuit test plugs should light behind:
"PAIRS" (First Station)	No. 1 launcher (left wing only).
"2-2-4" (Second Station)	No. 1 (left), and No. 2 launcher (right).
"2-6" (Third Station)	No. 1 (left), No. 2 (right), No. 3 launcher (left).
"SALVO" (Fourth Station)	No. 1 (left), No. 2 (right), No. 3 (left), and No. 4 launcher (right).

g. Throw the single pulse-ripple pulse switch to the "RIPPLE PULSE" position. Place the rocket selection switch in the "PAIRS" position. Again reset the Mk. 1 station selector switch so that it will start from the "PAIRS" position. Depress and hold down the rocket firing button. The firing circuits will be automatically opened and closed by the ripple pulse relay and the Mk. 1 selector switch should step in rapid succession from one station to the next while the firing button remains depressed. The test plugs should light in the same sequence as described in step e., at automatically controlled intervals.

h. Place the rocket selection switch in the "FOUR SINGLES" position and repeat the procedure in step g. The test plugs should light in the same sequence as described in step f., at automatically controlled intervals.

i. Turn off all switches and remove the test plugs from the rocket receptacles.

j. With all switches "OFF", test rocket firing circuits for stray voltage. Plug a rocket circuit test plug into each rocket firing receptacle in turn. If the bulb fails to glow when plugged into the receptacle but lights when plugged into the battery circuit of a test kit, the rocket firing circuit is free of dangerous stray voltage. If the light glows when inserted into the receptacle, stray voltage is present and the trouble must be remedied before rocket loading is permissible. If the test plug is faulty (fails to light when inserted into test kit) the entire stray voltage test must be repeated with a new test plug.



1. Rear Gun Bay Door
2. Flap Disconnect Warning Pin
3. L. H. Outboard Ammunition Boxes
4. Ammunition Box Retaining Doors
5. L. H. Inboard Ammunition Boxes
6. Front Gun Bay Door
7. Feed Chute
8. Gas Cylinder Access Doors
9. Front Mount Fairing Caps
10. Link Ejection Chute
11. Feed Mechanism
12. Case Ejection Chute
13. Electric Trigger Solenoid
14. 20MM Guns
15. Gun Chargers

Figure 4—143. Gun Installation.

4—1719. GUNNERY SYSTEM.

4—1720. DESCRIPTION. *(See figure 4—143.)* The gunnery system consists primarily of four M3 (T-31) 20-mm guns (1-G-5599-150) which are hydraulically charged and electrically operated The guns are supplied a maximum of 924 rounds when eight ammunition boxes installed in the wings are fully loaded and linked to additional belts installed in the feed chutes. The feed chutes guide the ammunition belts from the boxes to the feed mechanisms. Ejection chutes in the wing direct the expended belt links and cartridge cases into the air-stream. The hydraulic cylinder attached to the side of each gun, charges the gun (cocks for firing) when the charging button on the gunnery switch box is pushed in. After the initial hydraulic charge, the gun mechanism is electrically operated by the electric trigger solenoid which is bolted to the sear cover plate at the aft end of the gun. Electric current for actuating the solenoid is supplied by depressing the trigger on the pilot's control stick. A gun camera is mounted in the leading edge of the right outer panel. Heating elements attached to the camera and the guns, automatically turn on when the air temperature in the right wing drops below 21.1°C (70°F). The gunnery system also includes a Mk 6 fire control installation consisting primarily of a lead-computing Mk. 8 sight unit. The sight is centrally located on the cockpit cowling and is controlled by a switch panel located on the left hand control shelf. The guns, gunsight and camera mounts may be adjusted when boresight corrections are required. The entire system is readily accessible for installation, removal, and servicing.

4—1721. GUNNERY SYSTEM SWITCHES.

4—1722. DESCRIPTION. *(See figures 4—136 and 4—148A.)* A gunnery switch box located on the left hand side of the cockpit cowling contains five switches; the master armament switch, the inboard and outboard gun firing switches, the gun "safe-ready" switch, and the charging push button switch. A gun trigger switch is located on the front of the pilot's control stick. A separate switch panel is provided for the gunsight; see paragraph 4—1798. The master armament switch must be placed in the "ON" position before gun firing or gunsight operation is possible. The guns can be charged, however, with the master armament switch in the "OFF" position. It is necessary to have the "safe-ready" switch in the "READY" position to charge or fire the guns. The gunsight is the only unit which can be operated when the "safe-ready" switch is in the "OFF" or "SAFE" position. The guns are safetied when the breechblocks are locked in the aft position by the gun charger. Throwing the gun "safe-ready" switch from the "SAFE" to "READY" position, causes the charger to return to its normal position. This is the equivalent of charging the guns and the charging push button need not be depressed. The standard procedure for charging the guns (with breechblocks forward) is to place the "safe-ready" switch in the "READY" position and momentarily depress the charging button. The gun firing switches permit simultaneous firing of all guns or firing of only the inboard or outboard guns. Two limit switches are automatically actuated by the arresting hook control handle. With the arresting hook control in the "DOWN" position, one limit switch makes the master armament circuit inoperative, and the other makes the gun charging circuits inoperative. To charge and fire the guns, the switches should be operated as follows:

Note

It is assumed that all gunnery switches are "OFF" and the breechblocks forward, that the hydraulic system is pressurized and that electrical power is available.

a. To charge the guns, throw the "safe-ready" switch from the "OFF" to "READY" position. Depress the charger button. The guns are now charged. It is unnecessary to turn "ON" the master armament switch for this operation alone.

b. To fire the guns, they must first be charged and the "safe-ready" switch left in the "READY" position. Place the master armament switch in the "ON" position. Throw the two gun firing switches to their respective "INBOARD" and "OUTBOARD" positions. Depress the trigger switch on the control stick.

c. After firing, the guns must be safetied. Place all gunnery switches in the "OFF" position except the "safe-ready" switch which should be placed in the "SAFE" position.

4—1723. TROUBLE SHOOTING. If any part of the gunnery system fails to operate, the electric and hydraulic systems should be checked. See electric system paragraphs 5—101 through 5—110 and hydraulic system paragraphs 4—1245 through 4—1270. Malfunctions in the guns should be remedied by qualified ordnance personnel. Test procedures to determine whether the gunnery system is functioning properly will be found in paragraph 4—1838.

4—1724. 20-MM AUTOMATIC GUNS.

4—1725. DESCRIPTION. *(See figure 4—143.)* Four air-cooled M3 (T-31) 20-mm automatic guns (1-G-5599-150) are located in the outer wing panels. Operated on the gas and blow-back principle, each gun has a firing rate of approximately 720 rounds per minute and a muzzle velocity of 2780 feet per second. Each gun weighs approximately 100 pounds and is supported by means of a front and rear mount assembly. Eccentrics in the front mount are designed to permit boresight adjustments. A front mounting clamp anchors the non-recoiling parts of the gun, i.e., the adapter assembly, the recoil spring housing, and the magazine slide assembly. The rear mount supports the aft end of the gun and provides a pivot point to permit a limited horizontal and vertical adjustment of the gun at the front mount. A rear mount slideway accommodates the receiver guides (flanges) and permits fore and aft movement of the gun during recoil and counter-recoil.

4—1726. The gun tube (barrel) is threaded at both ends, with the breech end screwed into the receiver. Threads on the muzzle end will accommodate a T-20 flash hider. Recoil springs around the tube cushion the shock of recoil and return the gun to battery. The receiver houses the principle parts of the gun and two guideways on the upper surface accommodate a magazine slide. This slide remains stationary while the gun recoils and counter-recoils, and provides a mount for the feed mechanism. An ejector attached to the bottom of the magazine slide deflects empty cartridge cases through an opening in the receiver body. The receiver houses the breechblock assembly which consists essentially of a bolt, inertia blocks, breechblock slides and a breechblock lock. The lock holds the breechblock in battery (forward) while a round is being fired. When a round is fired, two push rods projecting through the front of the receiver, force the breechblock slides aft to unlock the breechblock and retract the firing pin. The push rods are actuated by a sleeve extension, integral with a gas cylinder piston. A portion of the propellent gases bled from a gas port in the tube forces the piston and sleeve back against the pushrods. After the breechblock is unlocked, it is forced to the rear by direct blow-back action, and an extractor secured to the front underside of the bolt removes the empty cartridge case. Recoil shock is cushioned by a rear buffer assembly which stops the breechblock and starts it forward again. The breechblock is held in the rearward position (cocked for firing) by a sear. When the sear is pulled down by a solenoid plunger (electric trigger), the breechblock is released and forced forward by a driving spring.

4—1727. CYCLE OF OPERATION. When the gun charger button is pushed in with the "safe-ready" switch in "READY" position, the breechblock is drawn to the rear by the charger piston. The breechblock lock is engaged by the sear. The gun charger piston then returns to its normal forward position. Depressing the trigger on the control stick, (see paragraph 4—1722b) causes the solenoid plunger to pull the sear down, releasing the breechblock and allowing it to be forced forward by the driving spring. During the forward travel of the breechblock, the face of the bolt contacts the rim of the cartridge positioned in the mouth of the feed mechanism and carries it into the chamber. The momentum of the slides causes them to continue to move forward after the bolt stops, and the slides force the breechblock lock into its locked position. The firing pin continues forward under the action of the driving spring, strikes the cartridge primer and fires the round. The projectile starts out of the tube propelled by expanding gases, and as it moves forward it passes a gas port where a portion of the gases enter and exert pressure on the gas cylinder piston. The piston sleeve moves rearward and engages the pushrods, which in turn force the breechlock slides aft. The movement of the slides unlocks the breechblock and retracts the firing pin. The breechblock is then forced back by direct blow-back action, and the extractor removes the empty cartridge case from the chamber. The ejector then deflects the cartridge case through the opening in the bottom of the receiver. When the breechblock has traveled sufficiently to the rear, a new round is forced downward into the mouth of the feed by a spring. As the breechblock nears the end of its rearward travel, it strikes the rear buffer and compresses the buffer springs, which absorb the remaining force of recoil and bring the breechblock to a stop. The expansion of the rear buffer springs and the driving-spring, compressed during recoil, force the breechblock forward again, thus starting a new cycle.

4—1728. LOCATION AND ACCESS. Access to the guns is gained through the front and rear gun bay doors located on the upper surface of each outer panel. The forward door is hinged to the wing and may be opened to a vertical position. The door is held open by a support strut. The rear gun bay door can be completely removed from the wing when access to the aft end of the guns is required. Two gas cylinder access doors located on the upper leading edge of each outer panel, facilitate servicing of the gas cylinder vent plugs while the guns are installed in the wing.

4—1729. REMOVING GUNS. To remove the guns, observe the following procedure:

a. Drop the outer panel flap; see paragraph 4—37.

b. Unlatch and open front gun bay door.

c. Unlatch and remove rear gun bay door.

WARNING

Before proceeding further, attach an external source of electric power (with the battery switch "OFF"). Turn "ON" the auxiliary hydraulic pump switch. Throw the gun "safe-ready" switch in cockpit to the "SAFE" position. Turn "OFF" pump switch. Make certain that no live rounds are in chambers or feedways by looking through case ejection chutes.

d. Detach link ejection chutes from feed mechanism by depressing the bayonet latches.

e. Detach inboard ends of feed chutes from feed mechanisms by depressing the bayonet latches. Disengage outboard ends of the chutes by squeezing the ammunition rollers together allowing end holes of feed chutes to clear roller pins.

f. Remove the feed mechanism by first pulling the feed operating lever out to disengage it from the bracket located on the outboard side of the receiver body. Raise the magazine slide lever and lift the rear of the feed mechanism. Pull the feed magazine aft to free it from the hooked projections on the magazine slide and remove. The flexible link ejection chutes, detached in step d., may now be removed from the rigid wing chutes.

CAUTION

Check for last round in feed mechanism. If round has not previously been removed by ordnance personnel, release it by lifting cartridge control pawl and remove from feeder mouth.

g. Allow breechblocks to go into battery (forward) position after checking THOROUGHLY to make certain that no live rounds are in chambers. With source of external electric power connected and battery switch "OFF", turn "ON" master armament switch and gun firing switches. Throw "safe-ready" switch to "READY" and depress trigger switch; then place "safe-ready" switch in the "OFF" position.

WARNING

Whenever it is necessary to put breechblocks in the battery (forward) position while the feed mechanism is attached, make certain that both the chamber and the feed mechanism are not loaded.

h. Disconnect the gun heater electrical leads by unscrewing plug caps and pulling plugs from receptacles installed on rib 10 13/16.

CAUTION

Each heater lead must be unsnapped from the two clips that hold it to the rib before gun can be taken from wing.

i. Break the safety wire and disconnect the gun trigger solenoid leads by unscrewing the plug caps and pulling the plugs from the receptacle on the solenoids.

j. Remove the hydraulic gun charger from the gun by pulling rearward on the spring-loaded pin located on the aft side of the charger block. This releases the plate attached to the block and permits it to pivot down. Raise the spring-loaded latch which engages a projection on the forward end of the charging cylinder. Grasp the aft end of the cylinder and pull it out from the gun and to the rear. Place the charging cylinder in the stowage clips provided in the wing.

Note

It is not necessary to disconnect any hydraulic lines when removing the charger from the gun as directed above.

k. Remove front mount fairing cap by removing two screws.

l. Remove front mounting clamp by pulling out on spring-loaded pin and then splitting clamp.

m. Slide gun to the rear through wing beam cutouts and remove from airplane.

4–1730. REMOVING ADAPTER ASSEMBLY. The adapter assembly may be removed from the gun after the gun has been removed from the airplane (see paragraph 4–1729), by observing the following procedure:

a. Detach the gun heater electric lead clip *(see figure 4–148)* by removing the screw which secures the clip to the inboard adapter arm assembly.

b. Remove the two fibre locknuts and washers which secure the adapter tube to the forward end of the arm assemblies.

c. Slide the adapter tube off the gun barrel.

d. Remove the bracket which anchors the two adapter arms on the studs projecting from the recoil spring housing. The bracket passes under the recoil spring housing and may be removed by breaking the safety wire and removing the two bolts which secure it to the adapter arms.

e. Remove the outboard arm from the gun by disengaging it from the stud projecting from the recoil spring housing.

f. Remove the cotter key, lock washer and bolt which secures the inboard arm (arm with turnbuckle) to the magazine slide.

g. Remove the inboard arm from the gun by disengaging it from the stud projecting from the recoil spring housing.

4–1731. INSTALLING ADAPTER ASSEMBLY. To install the adapter assembly, reverse the removal procedure given in paragraph 4–1730. The two fibre locknuts which secure the adapter tube to the arm assemblies must be tightened to 25 pound-feet. The scribe marks on the magazine slide must align with those on the receiver body. To realign scribe marks, adjust turnbuckle on adapter arm after first loosening turnbuckle locknuts.

4–1732. CLEANING AND LUBRICATING. Use oil, Spec. O.S. 1361 for guns under all service conditions, regardless of the temperatures to be encountered. To remove the oil and clean, use dry cleaning solvent.

a. BEFORE FIRING. Run several clean patches through the bore and chamber to remove all dirt and oil. Thoroughly clean all metal parts and lightly oil. Wipe outer surfaces of gun with oiled cloth.

CAUTION

Do not oil the bore and chamber before firing because dangerous pressures may develop.

b. AFTER FIRING. Immediately after firing, run wet patches impregnated with RIXS-205 rifle bore cleaner through the bore. If bore cleaner is not available, use warm soapy water or warm water alone. After this, run a cleaning brush through the bore several times. Remove the brush and run patches, wet with water through the bore. Follow this with dry patches until the bore is absolutely clean and dry; then apply a light coat of oil, Spec. O.S. 1361. Clean the breechblock and receiver with dry cleaning solvent, wipe dry and oil lightly with cloth. Unscrew the gas cylinder vent plug and clean. Remove carbon with wire brush. Clear the vent plug passage with a No. "51" drill. Apply a very thin coat of oil and replace plug. The barrel sweats after firing; therefore, it is necessary to wipe it dry and lightly re-oil once a day for three days after firing.

c. REAR MOUNT LUBRICATION. Apply low

temperature lubricant, Spec. AN-G-25 to all surfaces of rear mount trunnion that are in contact with removable slideway and to all surfaces of slideway that are in contact with receiver guides (flanges).

4—1733. ADJUSTING. To make gun boresighting adjustments, observe procedure in paragraph 4—1827.

4—1734. INSTALLING GUNS. Observe the following procedure:

a. Prepare the guns for installation by having them completely cleaned, checked, and adjusted by qualified ordnance personnel.

b. Drop flexible link ejection chutes into rigid wing chutes.

c. Slide gun through wing beam cutouts, making certain that receiver guides (flanges) engage rear mount slideway. Push gun all the way forward.

Note

Difficulty may be encountered when inserting muzzle end (front end) of gun through front mount opening. Guide gun through front mount opening with a brass bar inserted into muzzle end. To prevent the slideway from canting when installing gun, insert screwdriver point between slideway and trunnion and align slideway with receiver guides (flanges).

d. Install front mounting clamp on forward end of gun. Make certain that spring-loaded pin does not bind and that it locks the clamp properly. If the front mounting clamp will not fit because the gun is not far enough forward, hammer on rear buffer with fibre mallet to force gun forward.

e. Install the hydraulic gun charger by reversing the removal procedure; see paragraph 4—1729j.

f. Connect the electric trigger lead and safety wire.

g. Connect the gun heater electric leads and snap them into the clips provided on ribs 10 13/16 and 20.

h. Install feed mechanism by reversing the removal procedure; see paragraph 4—1729f. Make certain that the operating lever is engaged with the bracket on the receiver.

i. Attach flexible link ejection chutes to the feed mechanisms. If the flexible chute binds in the rigid wing chute opening due to misalignment, adjust the whole gun and adapter assembly fore or aft by turning the outer front mount eccentric.

j. Install feed chutes by reversing removal procedure given in paragraph 4—1729e.

k. Install front mount fairing cap with the two screws.

l. Install and latch rear gun bay door.

m. Close and fasten the forward gun bay door.

n. Raise and secure outer panel flap; see paragraph 4—37.

4—1735. TESTING. The guns may be ground tested for proper operation by observing the testing procedure in paragraph 4—1838.

4—1736. FEED MECHANISM.

4—1737. DESCRIPTION. *(See figures 4—144 and 4—145.)* Ammunition is fed to each gun by the AN-M2 feed mechanism which is mounted on the magazine slide. The forward end of the feed mechanism is held rigidly in position by two hook-shaped projections and the aft end is secured by the magazine slide lever latch. The feed mechanisms (IF-122-300) on the right wing guns are not interchangeable with those (IF-122-275) on the left wing guns. In operation, however, all four are identical in that they bring belted ammunition into the gun, separate the rounds from the links, and feed the rounds, one at a time, into the breech of the gun. The feed mechanism remains stationary and is operated by the fore and aft movement of the operating lever during recoil and counter-recoil of the gun. The feed mechanism drive system will regain full drive spring torque after a dud has been encountered and removed from the gun by recharging.

4—1738. The feed mechanism consists essentially of a starwheel assembly, a clutch drive, an operating lever, stripper cams, a cartridge control pawl and a cartridge holding dog. The starwheel assembly is rotated by a drive-spring, which is contained in and anchored to, the starwheel housing. A drive-shaft, which passes through the center axis of the housing, winds the spring. Initial tension for the drive-spring is supplied by turning the manual drive nut three-quarters of a turn in the direction of feed while the starwheel assembly remains stationary. Damage to the feed mechanism will not result from excessive winding because torque stabilizer action prevents the spring from overwinding. After the initial spring winding, the drive-spring retains its tension by means of the fore and aft motion of the operating lever during recoil and counter-recoil. The operating lever is engaged and actuated by a drive bracket attached to the receiver. The motion of the operating lever is transmitted to the clutch drive group which permits the drive shaft to turn in the same direction during both fore and aft movement of the operating lever. The tension on the drive-spring may be released by depressing and then turning the drive-spring release shaft hexagon which extends out of the aft face of the feed mechanism. After insertion of the ammunition belt into the feed mechanism, the starwheels engage the first round. During the turning of the drive shaft, the starwheels direct the rounds past the stripper cams. A sidewise force, exerted on the links by the stripper cams, causes the links to be stripped from the rounds and forced into the link chute. Freed from the links, the rounds are carried on by the starwheel until they are in line with the feed mouth. At this point they are guided into the mouth by the front and rear cartridge guides and held in position in the bottom of the mouth by the force of the starwheels on the round following. The round is then carried into the chamber and the bolt, in its forward travel, contacts the lower portion of the cartridge base. Just before the incoming rounds enter the feed mouth, they contact the cartridge control pawl, raising it slightly. This action lifts the cartridge holding dog, allowing the rounds to enter the mouth. As the last round passes under the control pawl and enters the feed mouth, the control pawl springs downward and the holding dog prevents this round from dropping all the way down. The last round is held so that it clears the starwheels and is out of contact with the bolt. If it were not held in such a manner, this round, without a following round to hold it in position, would drop into the path of the bolt and cause the gun to jam. The last round is removed after the feed mechanism is taken off the gun.

4—1739. LOADING AND UNLOADING THE FEED MECHANISM.

WARNING

The breechblock must be forward when loading the feed mechanism.

a. LOADING. *(See figure 4—144.)* A belt of ammunition is inserted into the feed mechanism, empty single link loop first, with open end of loop toward the starwheels. As soon as the first round of the belt has engaged the teeth of the starwheels, the ammunition can be drawn into the feed; by turning the manual drive nut on the front face of the feed mechanism. The starwheel drive-spring is wound by continuing to turn the manual drive nut three quarters of a turn after the ammunition has been forced to the bottom of the feed mouth. The drive spring is wound clockwise (as viewed from the rear of the gun) for left hand feed mechanisms and counterclockwise for right hand feed mechanisms.

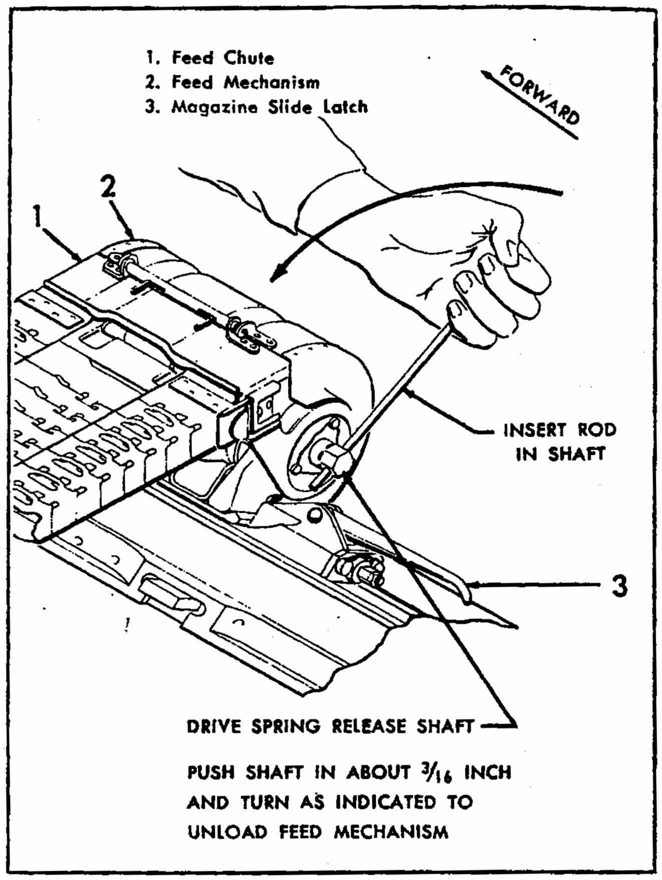


Figure 4—145. Unloading Feed Mechanism.

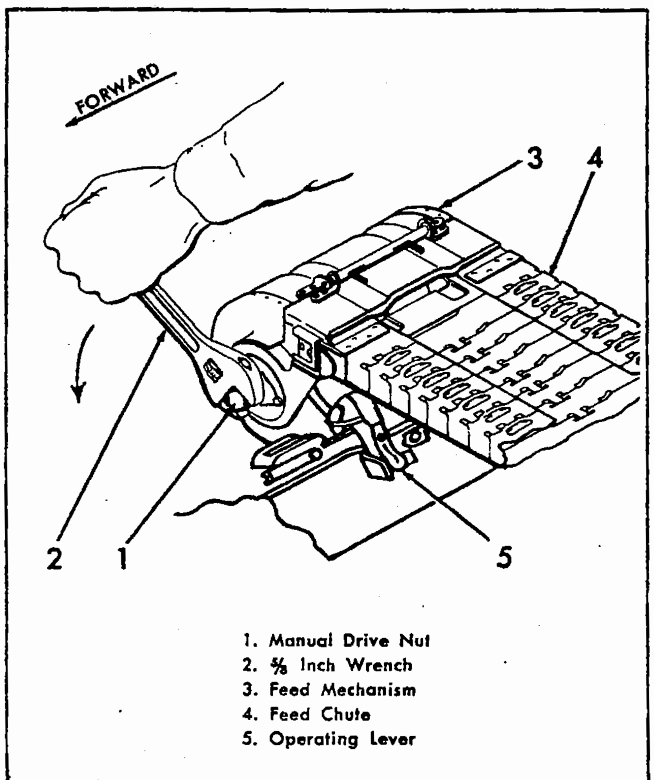


Figure 4—144. Loading Feed Mechanism.

b. UNLOADING. *(See figure 4—145.)* When the ammunition has been completely expended, the starwheel housing assembly will spin and automatically unwind the drive-spring. When it is necessary to unload a belt of ammunition from the feed, the drive-spring must be unwound manually. This is done by pushing in the drive-spring release nut on the aft end of feed mechanism, and turning it in the opposite direction to that of winding. About three quarters of a turn will completely unwind the drive-spring. With the spring unwound, the belt can be pulled from the feed mechanism as the release nut is further rotated in the unwinding direction.

4—1740. REMOVING. Note that the feed mechanism is removed prior to gun removal. To remove the feed mechanism, observe the procedure given in paragraph 4—1729f.

4—1741. LUBRICATING. Whenever the gun has been used, the exposed surfaces of the feed mechanism should be wiped with a lightly oiled cloth; (use oil, Spec. O.S. 1361). Grease (Army Spec. O.D. No. O) is used for lubricating clutches, end bearings, link studs, and other bearing surfaces whenever the feed mechanism is dis-

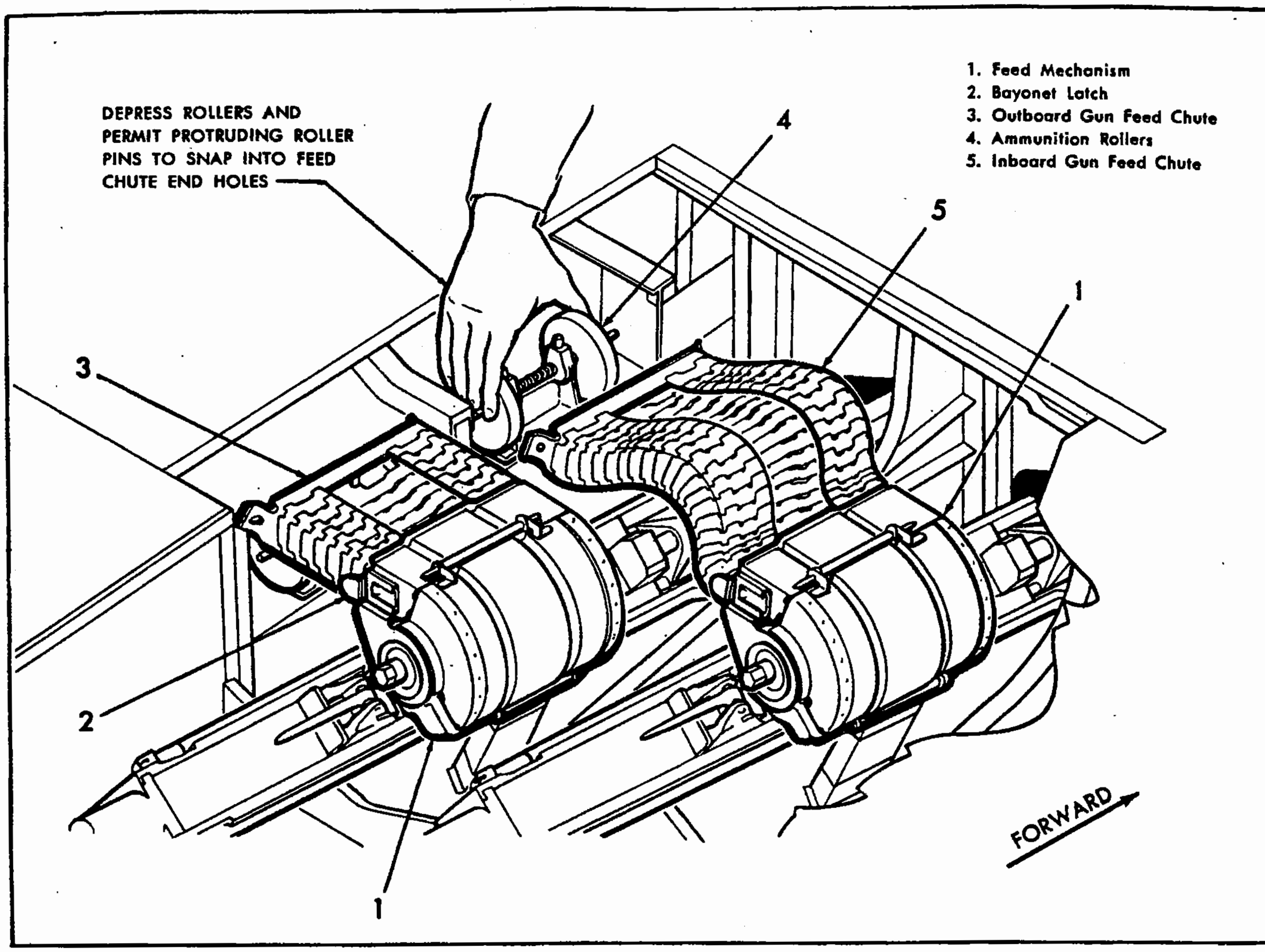


Figure 4—146. Feed Chutes.

assembled. Therefore under normal conditions, daily lubrication of these parts is unnecessary.

CAUTION

Do not dip the complete feed mechanism in any cleaning fluid or lubricating oil, as the star wheel is lubricated during manufacture and no provision is made for cleaning and re-lubrication after the assembly is riveted together.

4—1742. TESTING. After every firing mission, the following check should be made after the feed mechanism is removed from the gun:

a. Actuate clutch linkage by hand (operating lever) to assure that clutches and linkage operate properly, and turn starwheel during both fore and aft motion of the operating lever.

b. Determine that cartridge guides, control pawl and holding dog operate freely.

4—1743. INSTALLING. To install the feed mechanism, reverse the removing procedure given in paragraph 4—1729f. Make certain that the breechblock is in the battery position (forward) and that the operating lever is engaged with the bracket on the receiver.

4—1744. FEED CHUTES.

4—1745. DESCRIPTION. *(See figure 4—146).* Four flexible feed chutes are provided to guide the cartridge belts from the ammunition boxes inboard to the gun feed mechanisms. They are accessible through the forward gun bay doors. The front feed chutes guide the rounds from the forward ammunition boxes to the inboard guns while the rear chutes guide the rounds from the aft boxes to the outboard guns. The box ends (outboard ends) of the chutes are secured to the ammunition belt rollers by means of protruding pins on the rollers which snap into the end holes on the chutes. The inboard ends of the chutes incorporate bayonet latches which are inserted into the side receptacles of the feed mechanism.

4—1746. REMOVING. The feed chutes are taken out prior to removal of the guns. To remove the feed chutes, observe the procedure given in paragraph 4—1729e.

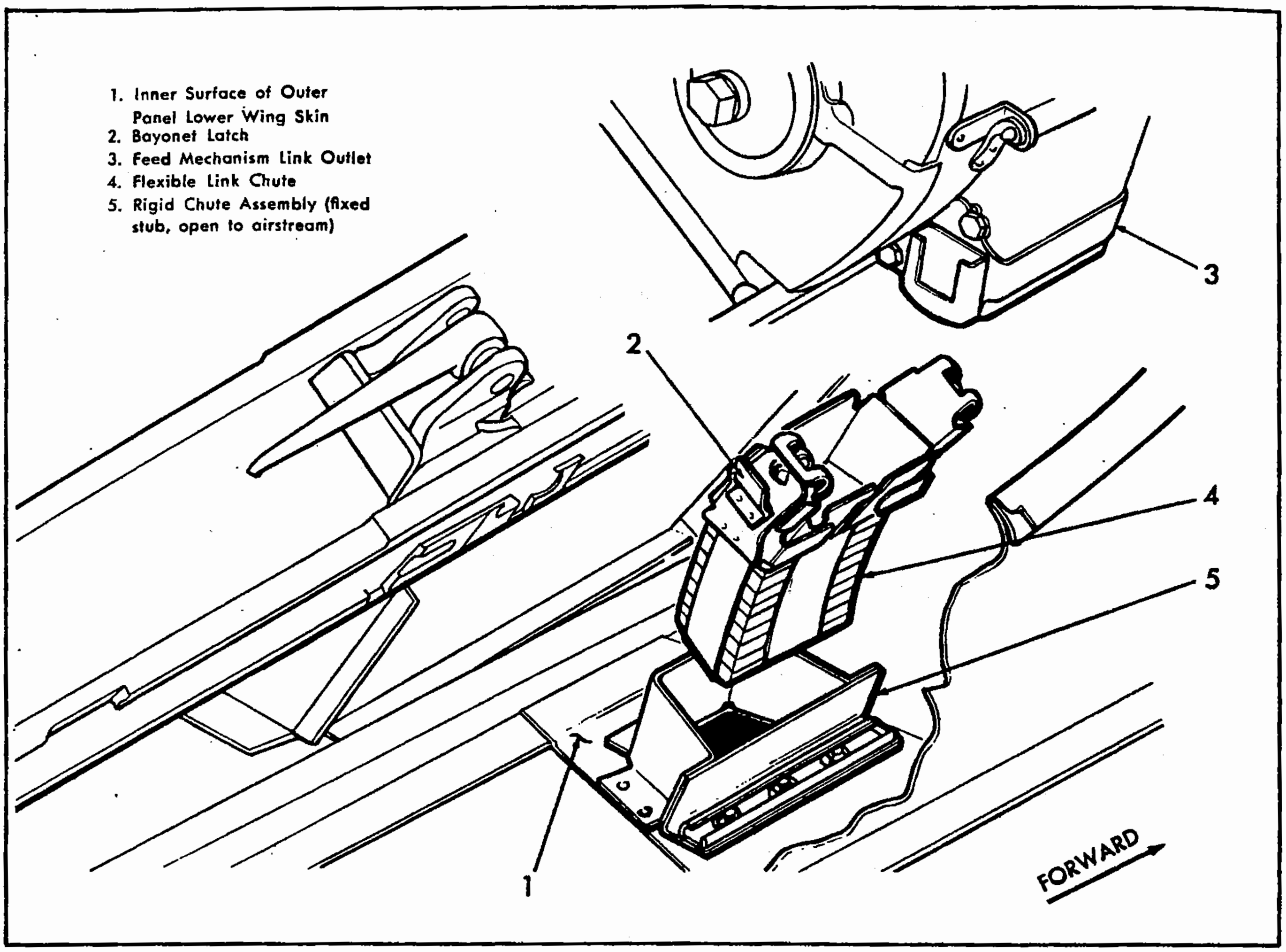


Figure 4—147. Link Ejection Chutes.

4—1747. REPAIRING AND TESTING.

a. Feed chutes must be replaced if bayonet latches are broken.

b. Chutes that become dented or distorted by rough handling may cause jams. All chutes may be checked by passing an ammunition belt through them.

c. Repair or replacement of the feed chute is necessary if the ammunition belt does not pass through easily.

4—1748. INSTALLING. To install the feed chutes, reverse the removal procedure given in paragraph 4—1729e.

4—1749. LINK EJECTION CHUTES.

4—1750. DESCRIPTION. *(See figure 4—147.)* Four flexible steel link ejection chutes direct expended links into the airstream. The top of each chute is provided with bayonet latches which are inserted into the link outlet receptacles located on the inboard side of each feed mechanism. The lower end of each flexible chute is inserted into a rigid chute which is open to the airstream. The rigid chute is a rectangular structure attached to the inner surface of the lower outer panel wing skin by screws and retaining nuts.

4—1751. REMOVING. To remove the flexible link ejection chutes, observe the removing procedure in paragraph 4—1729d. and f. The rigid chutes are not usually removed with the rest of the gun installation. If, however, damage necessitates replacing one, the rigid chute may be easily removed, after the guns have been taken out. Screws which secure the chute to the wing are accessible on the bottom surface of the outer panel. Access to the rigid chute retaining nuts is gained through the front gun bay door. To remove the chute, observe the following procedure:

a. Open the forward gun bay door. Remove gun as directed in paragraph 4—1792 to facilitate working conditions.

b. Remove the screws which secure the rigid chute to the wing.

c. Pull the rigid chute up and out of the gun bay and remove it from the airplane.

4—1752. REPAIRING AND TESTING. Flexible or rigid chutes that become dented in service may cause link jams. Check all chutes by dropping a link through them. If the link does not pass through freely, the chute must be repaired or replaced. Replace flexible chutes if bayonet latches are broken.

4—1753. INSTALLING. To install the flexible link ejection chutes, observe the installing procedure in paragraph 4—1734. To install the rigid chutes, reverse the removal procedure in paragraph 4—1751.

4—1754. CASE EJECTION CHUTES.

4—1755. DESCRIPTION. Four case ejection chutes are located under the gun receiver openings. Each chute is a rigid rectangular structure attached to the inside of the outer panel by screws and retaining nuts. The purpose of the chutes is to direct expended cartridge cases into the airstream, after they have been ejected from the guns.

4—1756. REMOVING. The case ejection chutes are not usually removed with the rest of the gun installation. If, however, damage necessitates replacing one, the chute may be removed after the guns have been taken out. Screws which secure the chute to the wing are located around the chute opening on the bottom surface of the wing. Access to the case ejection chute retaining nuts is gained through the front gun bay door. The removal procedure for the chute is identical to the rigid link chute removal procedure; see paragraph 4—1751.

4—1757. INSTALLING. To install, reverse the rigid link chute removal procedure given in paragraph 4—1751.

4—1758. GUN HEATER.

4—1759. DESCRIPTION. *(See figure 4—148.)* A T-2 electric heater attached to the underside of each gun receiver body prevents the gun oil from congealing at freezing temperatures. The heater leads are "plugged" into receptacles located on rib 10 13/16. A thermoswitch automatically closes the gun heater circuit and starts the heaters operating when the temperature in the right wing drops below 21.1°C (70°F). The heater electrical circuit can be traced by referring to paragraph 5—107.

4—1760. REMOVING. *(See figure 4—148.)* To remove each heater, proceed in the following manner:

a. Remove guns as directed in paragraph 4—1729.

b. Remove heater lead clip (1) attached to magazine slide arm by taking out screw and lockwasher.

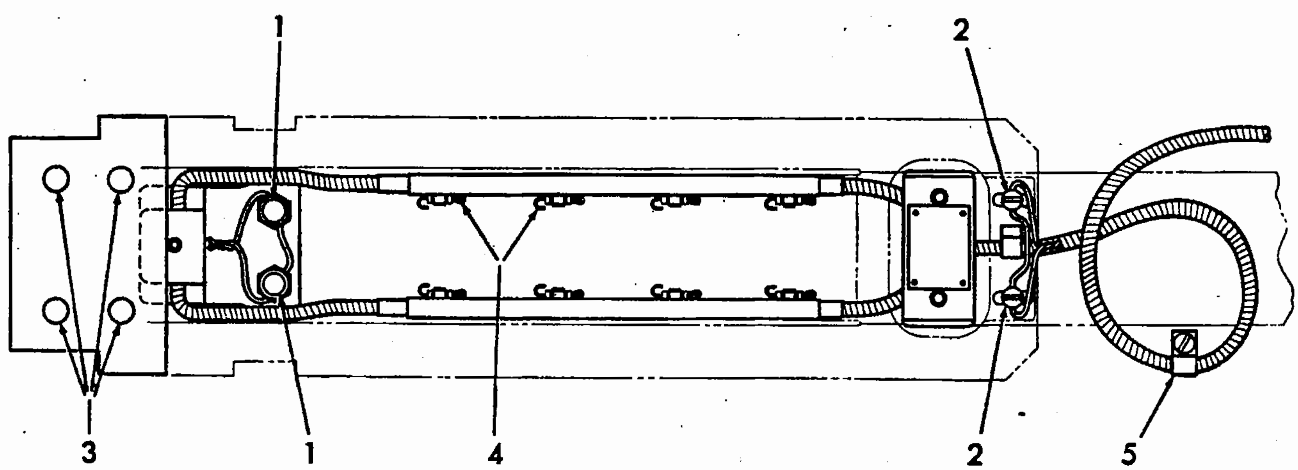
c. Remove four bolts (2) securing gun charger block to underside of receiver.

d. Break the safety wire and remove the two bolts (3) which secure the rear heating element to the breechblock locking key. Remove the breechblock locking key plate.

e. Break the safety wire and remove two screws (4) and lockwashers which secure the heater junction box to the front end of the receiver.

f. Remove cotter keys and nuts (5) which secure the two side heating elements to the breechblock slides.

g. Remove the heater assembly from the gun.



1. Bolts Securing Rear Heater Element to Breech Block Locking Key
2. Screws and Lockwashers Securing Heater Junction Box to Front End of Receiver
3. Bolts Securing Gun Charger Block to Gun
4. Cotter Keys and Nuts Securing Two Side Heating Elements to Breech Block Slides
5. Heater Lead Clip

Figure 4—148. Gun Heater.

4—1761. LUBRICATING. A thin coating of Spec. AN-C-52 anti-corrosive compound should be maintained on the heater.

CAUTION

Do not apply Spec. AN-C-52 anti-corrosive compound to the gun heater while the electrical lead is connected to the power source.

4—1762. INSTALLING. To install the gun heater, reverse the removal procedure given in paragraph 4—1760.

CAUTION

Allow enough slack in the heater lead, between the heater junction box and lead clip attached to the magazine slide arm, to provide for approximately one and one-half inches recoil of the gun.

4—1763. ELECTRIC TRIGGER SOLENOID.

4—1764. DESCRIPTION. *(See figure 4—143.)* Four T-2 electric trigger solenoids (1-T 3138-300) actuate the gun firing mechanism (sears). A solenoid is attached to the rear underside of each gun and is secured on the sear cover plate by a large retaining nut which permits quick installation and removal. The trigger switch on the control stick operates the solenoids after the master armament switch and the necessary gun selector switches have been closed. When the solenoid is energized, a magnetic field is set up which causes a downward movement of the solenoid plunger. The sear, attached to the plunger, moves down also and releases the breechblock, allowing it to go forward and fire a round. The electric trigger circuits may be traced by referring to paragraph 5—103.

4—1765. REMOVING. To remove the trigger solenoid from the gun, observe the following procedure:

Note

The electric trigger solenoid may be removed without removing the gun from the airplane.

a. Lower the outer panel flap; see paragraph 4—37.

b. Open the front gun bay door and remove the rear gun bay door.

c. Break the safety wire which safeties the electrical plug to the receptacle extending from the aft end of the solenoid.

d. Unscrew the electrical lead plug cap and pull the plug from the solenoid receptacle.

e. Break the safety wire and unscrew the large solenoid retaining nut located just forward of the solenoid housing.

f. Remove the solenoid from the gun.

4—1766. REPAIRING. The electric trigger solenoid is manufactured as an intergral unit, and if any malfunction occurs, the whole unit should be replaced and the damaged solenoid returned to ordnance personnel.

4—1767. INSTALLING. To install an electric trigger solenoid, reverse the removal procedure given in paragraph 4—1765. Note that the solenoid may be installed while the cannon is in the wing; however, safety wiring the large retaining nut is difficult under these conditions.

4—1768. HYDRAULIC GUN CHARGER.

4—1769. DESCRIPTION. *(See figure 4—143.)* A Mk. 5 (T-31) hydraulic gun charger is mounted on the outboard side of each gun to allow gun charging while the airplane is on the ground or in flight. All four chargers are operated simultaneously by the gun charger button and the gun "safe-ready" switch located in the gunnery switch box. When pressurized hydraulic fluid enters the chamber of the charging cylinder, the piston within the cylinder moves aft and forces the breechblock to its rearmost position where the breechblock lock is engaged by the sear. The gun charger is employed to retract the breechblock so that it is cocked for firing (charged), to remove a "dud" (faulty round) from the chamber, or to "safe" the gun. When the charging button in the cockpit is pushed in and released, the charging piston forces the breechblock to the rear and cocks it for firing. The piston then automatically returns to its pre-charged position, thereby clearing the path for the breechblock lug. When the gun safety switch is placed in the "SAFE" position, the charging piston moves aft and remains, holding the breechblock and prohibiting it from forward travel. Throwing the gun "safe-ready" switch from the "SAFE" to the "READY" position causes the piston to return to its pre-charged position so that the guns may be fired. For information on the gun charging hydraulic system, refer to paragraphs 4—1245 through 4—1270; for information on gun charging electrical system, refer to paragraph 5—101 and to figure 4—148A.

4—1770. REMOVING. To remove the hydraulic gun charger from the gun, observe removal procedure given in paragraph 4—1729j.

4—1771. REPAIRING. If a charger malfunctions, it should be replaced, and the damaged unit returned to qualified maintenance personnel. Chargers should not be repaired in the field.

4—1772. TESTING. The test procedure for gun charging cylinder operation is given in paragraph 4—1838.

4—1773. INSTALLING. To install a gun charger, reverse the removal procedure given in paragraph 4—1729j.

4—1774. GUN BAY DOORS.

4—1775. DESCRIPTION. *(See figure 4—143.)* A hinged front gun bay door and a removable rear gun bay door are located on the upper surface of each outer panel. The forward door provides access for general servicing of the guns. It opens to a vertical position and is supported in this position by a door strut. The door may be closed by pulling out on the spring-loaded pin on the strut, and locked to the wing by rotating the

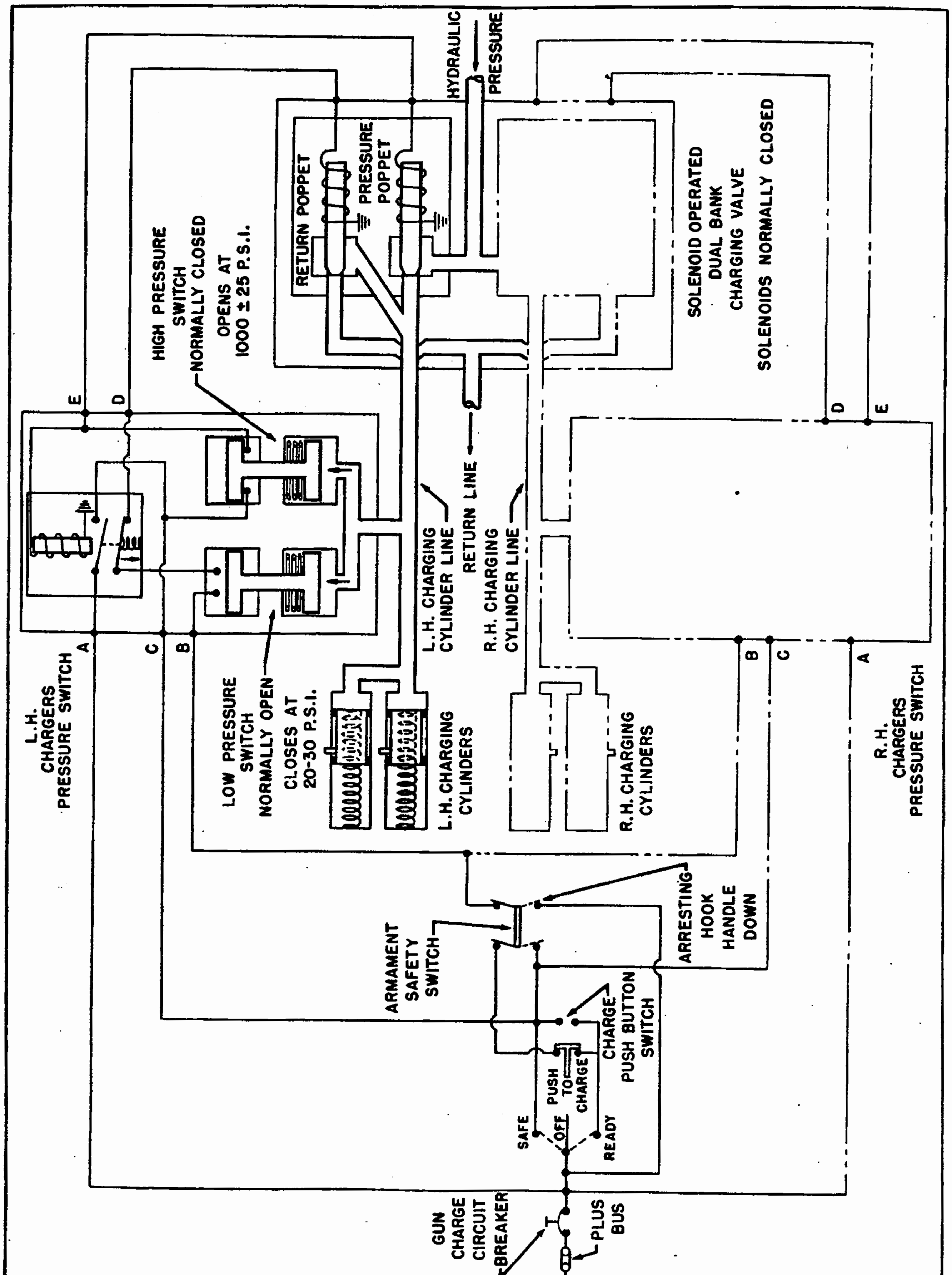


Figure 4—148A. Gun Charging System—Schematic Diagram.

door latches. The latches are secured in their locked position by Dzus fasteners which are part of the latch assembly. The rear gun bay door is a single panel which may be removed to gain access to the aft end of the guns. The door is locked to the outer panel by five rotary latches similar to those used on the front gun bay door.

4—1776. REMOVING. To remove the front gun bay door, observe the following procedure:

Note

The front gun bay door overlaps and must be opened before removal of the rear gun bay door. The rear door is then easily removed from the wing by rotating the door latches.

a. Unsnap the four Dzus fasteners and rotate the latches to unlock the forward gun bay door. Raise the door to the full open position.

b. Remove the cotter key, bolt, nut and two washers that secure the support strut to the door.

c. Remove the small piece of fairing (fillet) located just inboard of the door hinge by drilling out two rivets. The fairing is approximately an inch in length and must be removed to provide clearance when taking out the door hinge pin. Care must be exercised not to enlarge the rivet holes.

d. Force the piano hinge pin out of the inboard end of the door hinge (fillet end) by using a drift pin or other suitable tool on the outboard end of the hinge pin. The hinge pin should protrude sufficiently to permit it to be inserted into a drill motor chuck.

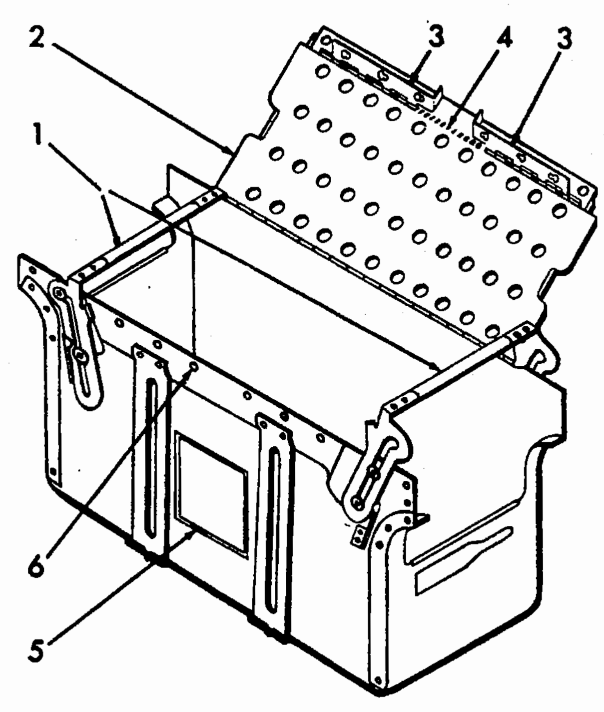
e. Attach a drill motor chuck to the hinge pin and revolve the pin out of the door hinge.

f. Lift the door from the wing and remove it from the airplane.

4—1777. INSTALLING. To install the front gun bay door reverse the removal procedure given in paragraph 4—1776. Note that the hinge pin should be lubricated with low temperature lubricant, Spec. AN-G-25 before it is inserted into the hinge.

4—1778. AMMUNITION BOXES AND BOX RETAINING DOORS.

4—1779. DESCRIPTION. *(See figures 4—143, 4—149 and 4—150.)* Four ammunition boxes, located outboard of the guns, are fitted into the upper surface of each outer panel. Two inboard boxes, one in front of the other, have a capacity for 110 rounds each, while two outboard boxes carry 100 rounds each. The guns are supplied a total of 210 rounds each from an inboard and an outboard box combined. The ammunition boxes are not interchangeable between the left and right wings. Those on the left are painted red and those on the right are green. All inboard boxes from both the right and left wings are easily recognized by a black band painted around each one. In the left wing, the numeral "1" is stamped on each of the outboard boxes and the numeral "2" on each of the inboard boxes. In the right wing, the numeral "3" is stamped on the outboard boxes and the



1. Handles
2. Cover
3. Latches
4. Latch Spring
5. Decalcomania
6. Latch Studs

Figure 4—149. Ammunition Box.

numeral "4" on the inboard boxes. Decalcomanias on the aft sides of the boxes give complete directions for loading *(see figure 4—150)*. Two holes drilled in the top of each box allow insertion of a pin to prevent ammunition belts from falling out when installing the boxes with the wings folded. Two handles attached to the boxes facilitate installation and removal. The cover of the box is hinged and may be opened after unfastening a latch. Two hinged retaining doors (strips) overlap the edges of the boxes and secure them in the wing. Braces hold the doors open in a vertical position. The doors are closed by depressing the brace, and locked by a latch and fastener assembly.

4—1780. REMOVING AMMUNITION BOXES. To remove the ammunition boxes, observe the following procedure:

Note

Loading and unloading procedures and precautions are given in paragraphs 4—1786 and 4—1787.

a. Unfasten and pull up on retaining door latches. Raise the doors. Note that the doors are located over the outboard ends of the outboard boxes and over the gap between the outboard and inboard boxes.

b. If the boxes are loaded and the belts in both boxes linked together, disconnect the belt between the inboard and outboard boxes by removing a round.

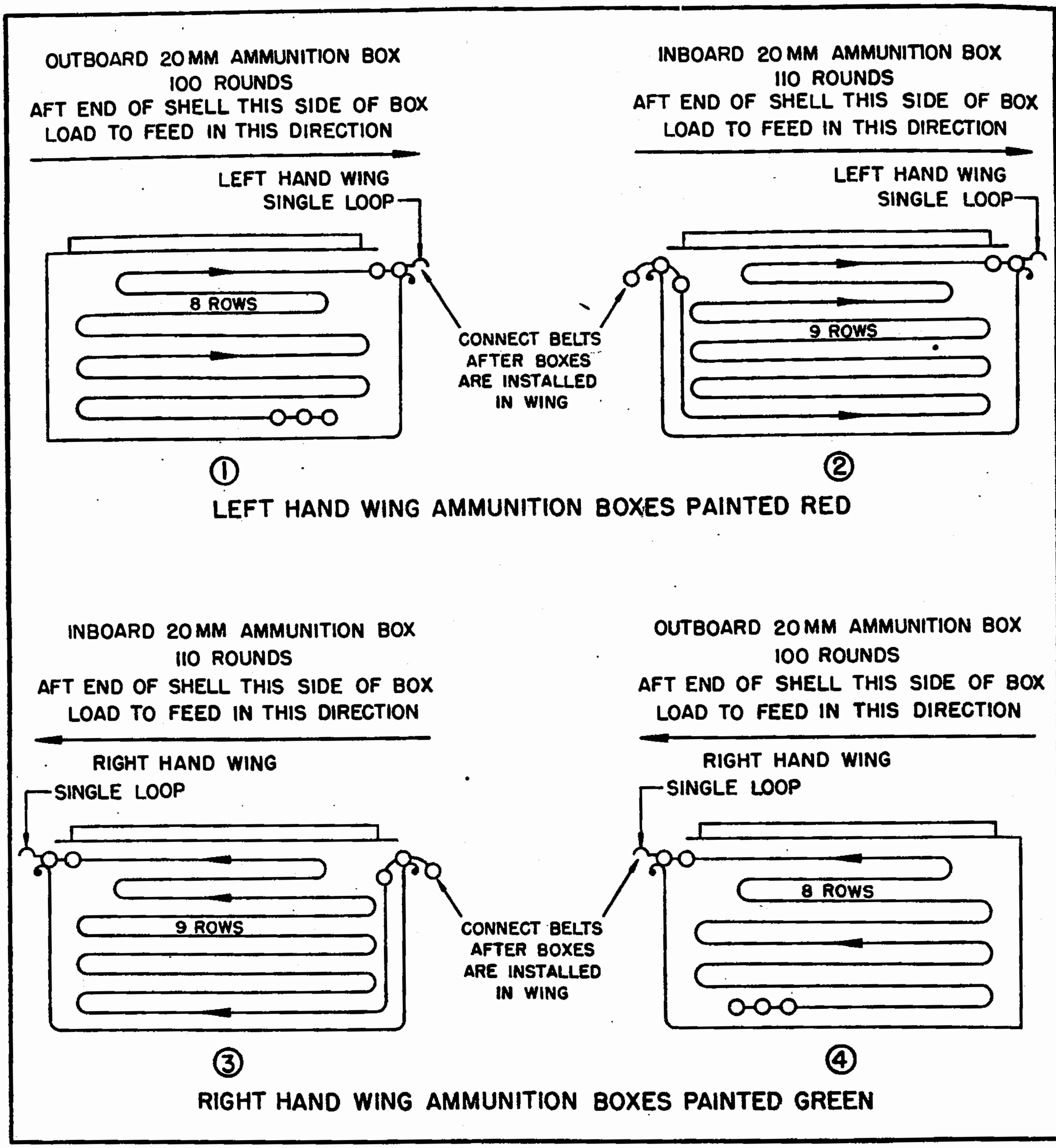


Figure 4–150. Ammunition Box Decalcomanias.

c. Grasp the two handles on each end of the box. Pull handles out and then up. The handles will extend about two inches above the box. Raise the ammunition box out of the wing and remove it from the airplane.

d. Open the ammunition box cover by squeezing the two cover sliding latches together and freeing them from the studs. Raise the cover and remove the ammunition.

4–1781. REPAIRING AND LUBRICATING. All boxes should be handled carefully to prevent distortion and must be locked securely when in place in the wing. The box covers should be flush and smooth with adjacent skin panels. Bent boxes should be hammered to proper contours with a fibre mallet. The hinges must be perfectly straight or they will fail to function. Replace plastic rollers that are cracked. Rollers are located between the outboard and inboard boxes, and between the inboard box and the feed chute. All ammunition box and retaining door hinges should be lubricated with low temperature lubricant, Spec. AN-G-25.

4—1782. INSTALLING AMMUNITION BOXES. Observe the following procedure:

Note

Loading and Unloading Procedures and Precautions are given in paragraphs 4—1786 and 4—1787.

a. Close and latch the ammunition box covers.

b. Raise the two handles on each box to their extended positions.

c. Slip each box into its proper place in the wing; see paragraph 4—1779.

d. Depress the handles to their locked position.

e. Connect the ammunition belts in the outboard and inboard boxes.

f. Close and lock the ammunition box retaining doors.

4—1783. REMOVING THE AMMUNITION BOX RETAINING DOORS. To remove the retaining doors, observe the following procedure:

Note

Removal of the retaining doors is not usual; however, damage may necessitate a replacement.

a. Unlatch and open the retaining doors.

b. Detach the door hinge plates from the wing by applying an open end wrench to the fibre locknuts while removing the screws with a Philips head screwdriver. Note that six screws and locknuts must be removed from the inboard retaining door hinge and three screws and locknuts from the outboard door hinge.

c. Remove the bolt, castle nut and washers from the door brace at the point where the two sections of the brace are attached.

d. Remove the retaining door from the wing.

4—1784. INSTALLING. To install ammunition box retaining doors, reverse the removal procedure given in paragraph 4—1783.

4—1785. AMMUNITION LOADING AND UNLOADING PROCEDURES AND PRECAUTIONS.

4—1786. LOADING. To properly load the gunnery system, observe the following procedure:

WARNING

Never attempt to load guns without a thorough knowledge of the correct procedure. Do not proceed to load without thought for the safety of all personnel in the area. Only qualified personnel should carry out loading procedures.

a. Make certain that gun is properly cleaned and lubricated; see paragraph 4—1732a.

b. Prior to belting ammuntion, all links should be dipped in oil, lubricating preservative, Spec. O.S. 1361. Drain off excess oil just before using. Lightly oil cartridge cases with a clean lintless cloth, being careful not to oil the primers or the joint where the case is crimped to the projectile. The rounds should be belted by a link loading machine. The distance from the base of the cartridge to the rear edge of the link double loop should be 2 9/32 inch (plus or minus 1/16 inch). The leading single loop of the belt must be left empty and the last double loop must have a round in it. The belt should be tested for flexibility, stiff links causing "kinks," and oversize links, also for long or short rounds. Careful handling of the belt will cause less jams when firing.

c. Stand the boxes up so that the side with the decalcomania giving complete directions for loading is in view. Unlatch and open the box covers.

d. Boxes painted red and numbered "1" and "2" (left wing boxes) are loaded so that they feed from left to right. Boxes painted green and numbered "3" and "4" (right wing boxes) are loaded to feed from right to left. Be certain that shell casings face aft. The leading single loop of the ammunition belt must be left empty, open end down, and the last double loop of the belt must contain a round. No special end link is required. Follow the detailed loading directions stamped on each box; *see figure 4—150.*

e. Close the box covers and secure the cover sliding latch on the studs.

WARNING

Before proceeding further, make sure that breechblock is in battery (forward) position and all switches are off. If it is necessary to put breeckblock in battery position (forward), follow procedure given in paragraph 4—1729g., after first checking thoroughly to make certain that no live rounds are in the chambers or in the feed mechanisms.

f. Install and secure the boxes in the wing as described in paragraph 4—1782. Make certain the link single loop ends hanging out of the inboard sides of the outboard boxes are connected to the rounds hanging out of the outboard sides of the inboard boxes.

g. Guide ammunition belts from the inboard boxes through the feed chutes and insert them into the feed mechanisms, empty single loops first with open end of loop toward the starwheels.

h. As soon as the first round of the belt has engaged the teeth of the starwheels, apply a 5/8 inch wrench to the hexagon manual drive nut on the front end of the feeder and turn, so that the ammunition belt is drawn into the gun. Continue to wind approximately three-quarters of a turn after the ammunition has been forced into the mouth of the feeder. No damage to the mechanism will result from excessive winding. For further details on feed mechanism loading, refer to paragraph 4—1739a.

WARNING

After finishing loading procedure, check again to make certain that all gun switches are "OFF."

4—1787. UNLOADING. To remove ammunition from the airplane, observe the following procedure.

WARNING

Before unloading, be positive that the airplane is in the designated loading and unloading area, is headed in a safe direction (away from congested areas) and that no one is in front of the gun openings. AFTER FIRING, THE GUNS ARE CONSIDERED TO BE LOADED. Never attempt to unload guns without a thorough knowledge of the correct procedure. In case of trouble involving unusual gun jams always consult authoritive sources before proceeding. Never proceed to unload without a thought for the safety of all personnel in the area.

a. After the airplane lands and is parked in the unloading area, check breechblocks for rearward position by looking up through case ejection chutes.

WARNING

If the breechblock is fully forward and locked, treat it as a misfire and a possible "cook-off." Be sure the gun has cooled to a temperature which is not uncomfortable to touch. Make certain all breechblocks are in the rearward position and safetied. Examine any ejected rounds. If the primer is indented, immerse the round in water. NEVER ALLOW THE BREECHBLOCKS TO GO FORWARD UNTIL ALL UNLOADING HAS BEEN COMPLETED. THEY MUST BE IN THE REARWARD POSITION AND IN "SAFE."

b. Open the gun bay doors.

c. Unload the feed mechanism by inserting a rod and pushing in the drive-spring release shaft about 3/16 inch and at the same time turning it in the direction opposite to that of winding. About three-quarters of a turn of the release shaft will completely unwind the drive-spring. With the spring unwound, the belt can be pulled from the feed mechanism as the release shaft is further rotated in the unwinding direction. For further details on feed mechanism unloading, see paragraph 4—1739b.

d. Detach the link ejection chutes from the feed mechanism by depressing the bayonet latches.

e. Detach the feed chutes from the feed mechanism by depressing the bayonet latches.

f. Remove the feed mechanism and take out the last round; see paragraph 4—1729f.

g. Re-examine the chamber to make certain it is empty.

h. Remove the ammunition boxes after first disconnecting belts. Ammunition box removal procedure is given in paragraph 4—1780.

i. Allow the breechblocks to go into battery (forward) position; see paragraph 4—1729g.

j. Clean and lubricate guns in the manner necessary after firing; see paragraph 4—1732.

Note

If the airplane is going out immediately on another firing mission, cleaning of the guns is not necessary. Re-install feed mechanism, link ejection chutes and feed chutes; see paragraph 4—1734. Load ammunition boxes as described in paragraph 4—1786c., d., and e. Install boxes in wing as described in paragraph 4—1782.

4—1788. MK 6 FIRE CONTROL SYSTEM.

4—1789. DESCRIPTION. The Mk 6 fire control system incorporates a Mk 8 gyroscopic lead computing sight unit which can be utilized for air to air firing, bombing, strafing, and rocket firing. The sight is operated by the throttle ranging control grip and four switches on the gunsight control panel located on the left hand control shelf. Current is supplied to the fire control circuits when the master armament switch is placed in the "ON" position. A Mk 1 gunsight voltage regulator maintains a closely regulated current output of 22 volts to the sight. The gunsight relays which control the circuits are contained in a Mk 7 relay box. The ranging control installation consists of a ranging throttle grip Aero 4, a gunsight controller Aero 2 (servomotor), a flexible drive shaft, and a sight gear adapter. Access to the units in the Mk 6 fire control system may be gained through the lower cockpit access door and by reaching under the instrument panel. For electrical information on the Mk 6 fire control system circuit, see paragraph 5—105.

4—1790. GUNSIGHT.

4—1791. DESCRIPTION. *(See figure 4—151.)* The Mk 8 gyroscopic lead-computing sight unit, located at the front of the cockpit, is supported on a mount which is bolted to the cockpit cowling. The gunsight is held in position by means of a disc-shaped fitting bolted to the bottom of the sight, which fits into a spherical mounting clamp. The clamp holds the gunsight securely when the clamp locking bolt is tightened. The mounting clamp can be loosened to permit limited rotation of

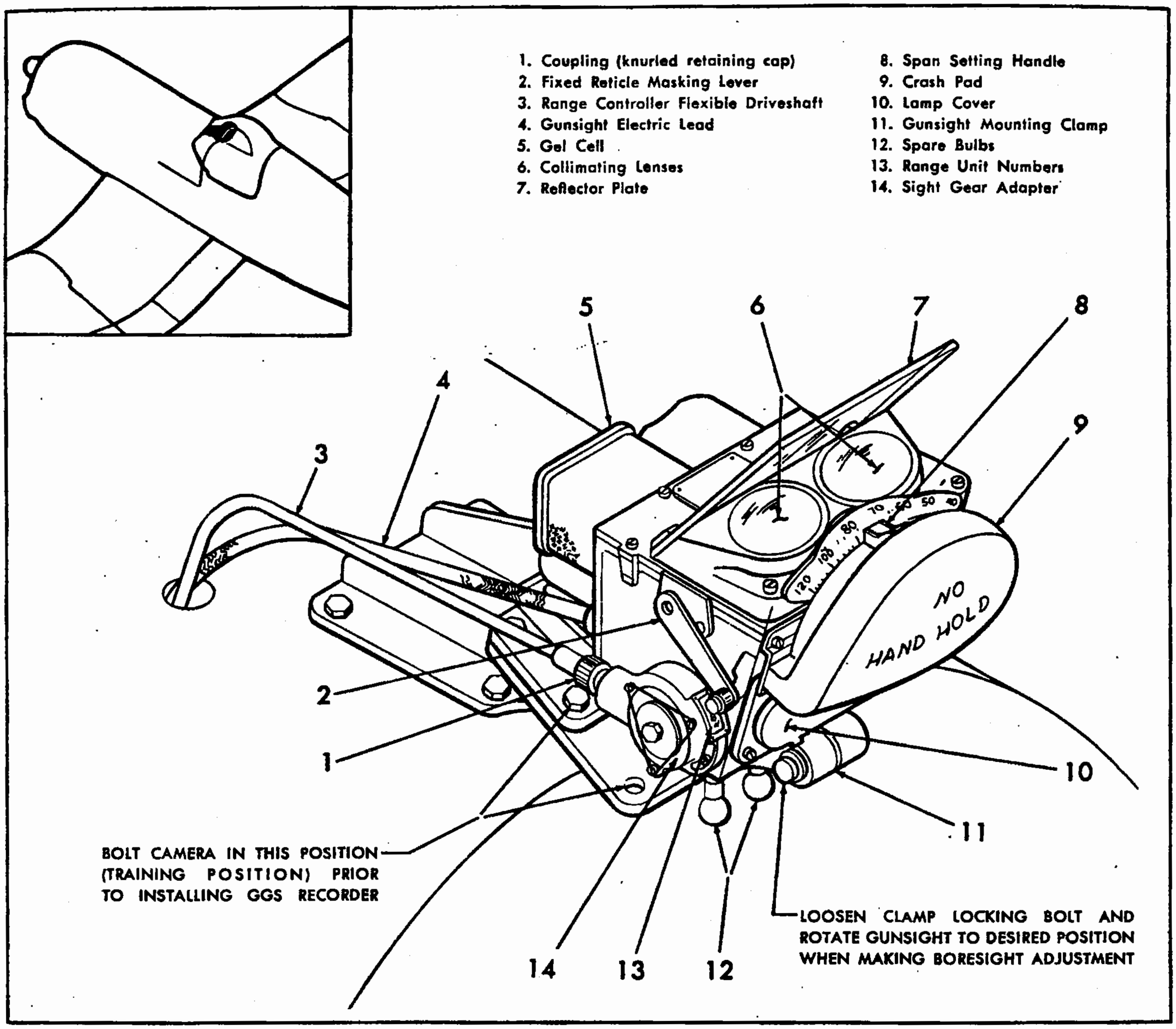


Figure 4—151. Gunsight.

the sight in any direction when a boresight adjustment is required. The gunsight may be repositioned to permit installation of a gunnery gunsight recorder. During an attack on an enemy aircraft, the sight computes the lead which must be allowed for the relative motion and range of the target. It is designed to compute for ranges varying from 600 to 2400 feet. The pilot views his target through a glass reflector in which are reflected the images of two reticle patterns projected to infinity by two independent sighting systems, contained in the gunsight housing. The fixed reticle image viewed by the pilot's left eye consists of a cross, a 45 degree radial line extending from the cross into each of the two lower quadrants, and arcs of circles from 10 to 70 mils radii in increments of 10 mils below the cross. The circular arcs are utilized when bombing, firing rocket projectiles or strafing. If desired, the entire pattern of the fixed sight, except the cross, may be blacked out by pushing down the fixed reticle masking lever. This lever is located on the upper left side of the sighting head. The fixed image remains stationary and establishes a line of sight which is boresighted with the guns. A movable or gyro reticle image is viewed by the right eye, it makes apparent the angle of lead computed by the sight and provides a means of ranging. The gyro image consists of a center pip and a surrounding circle formed by six radially disposed, diamond-shaped dots. Proper deflection (movement) of the image to compensate for target range is accomplished by rotating the throttle ranging grip after the span indicator is set to correspond with a selected dimension of the enemy aircraft, usually its wingspan. Rotation of the range grip causes variations in the diameter size of the gyro image circle and also variations in electrical current supplied to the gyro rotor magnetic field. Variations in the magnetic field cause a deflection of the gyro mirror, and hence the image. The pilot operates the range grip in an amount necessary to keep the target encircled by the inner tips of the reticle image dots. As the target is approached, it becomes larger to the eye, causing the pilot to rotate the grip so that the diameter of the image will be increased to keep the target framed within the circle. A gunsight selector switch allows the pilot to select any one of four positions: "OFF," "GYRO," "FIXED & GYRO" and "FIXED." The light intensity of the images may be varied by a rheostat control. The master armament switch must first be turned on to operate the sight. For information on the gunsight switch control panel, see paragraph 4—1798. A rubber crashpad is located on the sighting head for protection of the pilot. Directly below the crashpad there is a sight lamp cover. The lamps are readily accessible, and should one fail in flight, the pilot can replace it with one of the two spare bulbs which are held in clips located just below the sight.

Note

It is recommended that when the airplane is not in use, the Mk 8 sight unit be protected by a waterproof cover, B.O. 323384.

4—1792. REMOVING. *(See figure 4—151.)* To remove the gunsight, observe the following procedure:

a. Reach under the instrument panel and unscrew the cap on the gunsight electric lead plug. Pull the plug from the receptacle. The receptacle is secured to a bracket rivited to the top aft edge of the shelf assembly on the right hand side (station 134).

b. Pull the electric lead up through the hole provided in the cockpit cowling.

c. Disconnect the range control flexible drive shaft by unscrewing the knurled retaining cap which secures the drive shaft to the sight gear adapter. Remove the flexible drive shaft by pulling it out from the adapter. The sight gear adapter fits around the calibrated range drum located on the left side of the sight.

d. Support the gunsight and remove the bolt which secures it to the mount fitting assembly. Lift the sight from the mount and remove it from the airplane.

CAUTION

Handle the gunsight with care and stow it in a safe place.

e. Remove the four bolts which secure sight mount to cockpit cowling by applying a socket wrench to bolt heads. The bolts are screwed into anchor nut plates riveted to underside of cockpit cowling. Note that gunsight mount is not usually removed from airplane; however, damage may necessitate a replacement.

4—1793. CLEANING AND LUBRICATING. Inspect the surface of the reflector plate and collimating lenses. If the surfaces are dusty, they may be cleaned by brushing with a fine camel hair brush or by wiping lightly with lens tissue. If there are dirt streaks or smudges on the surfaces, they may be removed with a soft cloth moistened slightly. Do not rub hard or use harsh cleaners (white soap and water may be used); scratches on the polished surfaces result from improper treatment. The gyro Hooke's joint and bearing are the only units which may be lubricated in the field. Lubrication of the Hooke's joint is difficult and requires disassembly of the sight. Only qualified and experienced ordnance personnel may lubricate the Hooke's joint. Reference should be made to Ordnance Pamphlet 1216 for this procedure.

4—1794. REPAIRING.

a. Check the silica gel, in the cell at the back of the sight for color. Dry silica gel is bright blue; moisture condensation changes the gel to a lavender color. When replacement of the gel cell is indicated, the cell may be removed by unscrewing the supporting screw and lifting the cell out. If a replacement gel cell is not available, the gel may be dried out by removing the cell, then taking out the two cell filter plugs. Pour the gel out of the openings and into a small metal container. Heat the gel in an oven at a temperature between 100°C (212°F) and 204.4°C (400°F) until it regains its original blue color. When the gel is dry, as evidenced by its bright blue color, it can be replaced in the cell, and the cell secured to the sighting head.

b. Reflector plates frequently crack in service if subjected to undue strain. Remove cracked and broken plate by taking out retaining screws which secure base of plate to sighting head. Install a new reflector plate, being careful to have beveled edges toward front of airplane. The screws should be tightened evenly and not unduly, to prevent cracking of new plate.

c. The crash-pad should not require replacement; however, the backplate of the crash-pad is depended upon to hold the span-setting handle in place by friction. Any dents or kinks in the crash-pad backing may necessitate replacement of the pad, since the span lever would bind or skip under these circumstances.

d. Open lamp cover by pressing on two spring levers on lamp cover. If the lamps show signs of blackening, replace them. Care should be exercised to see that the frosted spot on the lamp faces toward the reticle. If a spare bulb is used for replacement, a new bulb should be immediately installed in the spare bulb clip.

e. If sight fails to operate correctly and the malfunction is attributed to a faulty part in the sight, the sight must be replaced with a new one; observe removal procedure in paragraph 4—1792. Make certain before removal of sight that trouble is not caused by a faulty lamp or by some external source such as the electrical circuit or range control. The Mk 6 fire control circuit may be traced by referring to paragraph 5—105.

4—1795. ADJUSTING. The procedure for a boresight adjustment of the sight is given in paragraph 4—1827. The fixed and gyro sighting systems must be aligned prior to boresighting. The sighting systems are in alignment when the central lot of the gyro reticle image and the center cross of the fixed reticle image appear to be superimposed at infinity. To check for alignment and make the necessary adjustments, proceed as follows:

a. Set the range drum at minimum range. With the ranging control grip in its furthest clockwise position, the indicator on the range drum should point to 600 feet (minimum range).

b. Secure the optical gage in position on the sighting head, with gage attaching screw on the right hand side. The gage is used to bring the images of both reticles into one line of vision without the aid of a distant reference point. The gage is provided with the squadron spare parts and tool kit. If an optical gage is not available, the alignment check can be made by observing the two reticle images simultaneously while looking at a fixed object approximately 600 feet distant. The object must be far enough to enable the eyes to superimpose the images on each other and on the object. Look at the object through the images; do not look directly at the images.

c. Turn the master armament switch "ON" and set the selector switch at "FIXED & GYRO." Throw the gunsight armament switch to "GUNS" and the dive angle switch to "BELOW 35°." For details on the gunsight switch control panel, see paragraph 4—1798.

d. Look through the optical gage or sight with the eyes, and note the position of the fixed cross in relation to the central dot of the gyro reticle image.

e. Move the range control grip from minimum to maximum range, noting the movement of the central dot in relation to the fixed cross. If the total movement is not more than four mils, and the central dot coincides with the center of the fixed cross at some range between minimum and maximum, no adjustment is necessary. The amount of movement can be gaged from the fact that the diameter of the central dot is approximately 1 1/2 mils. If the movement is less than four mils but the central dot does not coincide with the fixed cross at any one point between minimum and maximum range, an adjustment is necessary.

f. Move the range control grip until the gyro image central dot is located midway between the two extremities of its travel.

g. Adjust the fixed cross to coincide with the central dot by adjusting the two fixed mirror adjusting screws which project from the gyro-unit backplate near the gyro motor. The fixed cross is moved horizontally by adjusting the upper screw, and vertically by adjusting the lower screw.

Note

Access to the fixed mirror adjusting screws is gained after removing the gel cell.

h. If operation of the ranging control moves the central dot more than four mils (diameter of central dot is 1 1/2 mils), the electrical circuits and the gunsight voltage regulator should be checked by qualified and experienced personnel. If no defects are revealed by the gunsight voltage regulator test or by the resistance tests of the sighting head and selector dimmer circuits, the gunsight is out of calibration and should be replaced.

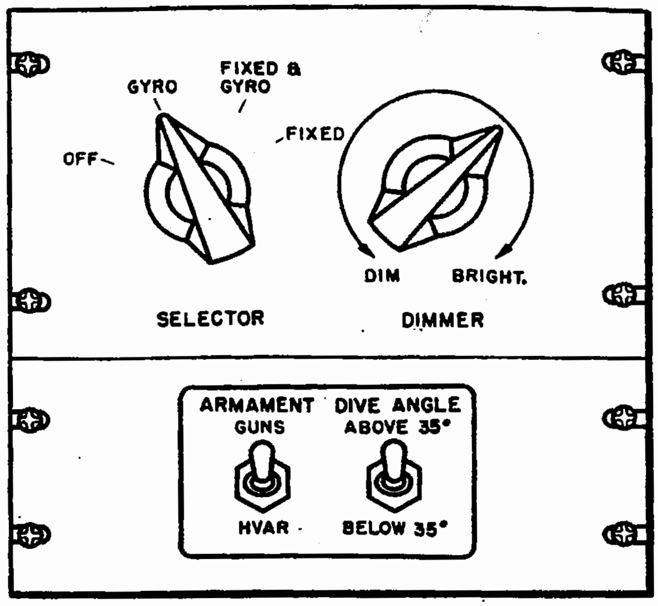


Figure 4—152. Gunsight Switch Control Panel.

4—1796. TESTING. Observe the Mk 6 fire control testing procedures given in paragraph 4—1817.

4—1797. INSTALLING. To install the gunsight, reverse the removal procedure given in paragraph 4—1792.

4—1798. GUNSIGHT SWITCH CONTROL PANEL.

4—1799. DESCRIPTION. *(See figure 4—152.)* When the master armament switch is turned to the "ON" position, electric current is transmitted to the gunsight by way of the gunsight switch panel located on the upper face of the left hand control shelf. The four switches mounted on the panel are the gunsight selector switch, the gunsight dimmer, the gunsight armament switch, and the dive angle switch. The gunsight dimmer is a rheostat which varies the light intensity of the images. It is recommended that the intensity of the image be at a maximum when facing into the sun. The two position gunsight toggle switch should be placed in the "GUNS" position when sighting for the guns, or to the HVAR (High Velocity Aerial Rocket) position when sighting for the rockets. The four position gunsight selector switch permits the pilot to turn off either the fixed or gyro image or have both on together. When the switch is in the "OFF" position, both reticle images are out. In the "FIXED" position, only the fixed image appears. This image is utilized when bombing, firing rocket projectiles or strafing. When the selector switch is in the "FIXED & GYRO" position, boths images are on and the angle, setup between the gyro pip and the fixed cross, forms the angle between the line of sight and the bore axis of the guns, thus indicating the size of the lead angle. In the "GYRO" position, only the gyro image is visible. This position is provided for pilots who prefer to use only the gyro image when tracking. At present, information on the dive angle switch is not available.

4—1800. GUNSIGHT RANGE CONTROL.

4—1801. DESCRIPTION. The gunsight range control installation provides a means for the pilot to set target range data into the sight. Ranging control is accomplished when the pilot operates the ranging throttle grip Aero 4B.

Note

> The NAF-1124-17 microphone switch assembly is installed in a number of F4U-5 aircraft until the Aero 4B ranging throttle grip becomes available, at which time the Aero 4B grip will be installed retroactively in all F4U-5 aircraft.

The ranging grip is bolted to the throttle shaft and consists of a cylindrical handle containing a potentiometer, a microphone switch and an electrical lead. Full rotation of the grip causes the potentiometer wiper to traverse from one end of the potentiometer resistance winding to the other. The grip is capable of a 60° rotation to permit range adjustments varying from 600 to 2400 feet. It is rotated to keep the target framed within the gyro image circle. Decreasing range requires clockwise rotation of the grip. An electrical lead containing the wires from the ranging grip potentiometer is connected to the gunsight controller Aero 2. The controller is an electric servo-motor located under the cockpit cowling on the left hand side. It is mounted on a bracket bolted to the aft edge of the shelf at station 140. Access to the controller is gained through the instrument panel access door. The controller, which is operated from the ranging grip potentiometer, turns a flexible drive shaft which engages a spline in the sight gear adapter. Changing current values in the controller are caused by the movement of the grip potentiometer wiper over the resistance windings. The controller rotates the flexible drive shaft at a rate proportionate to the rate of grip rotation. The flexible drive shaft is connected to the controller and sight gear adapter by means of knurled retaining caps and is readily detachable from either unit. The sight gear adapter is mounted over the gunsight range unit (calibrated range drum) and is secured in place by two screws. The range unit is rotated when the flexible drive-shaft turns the adapter gear. Movement of the range unit causes variations in electrical current supplied to the gyro-rotor magnetic field, resulting in a deflection of the gyro mirror. Movement of the mirror causes a proper deflection of the gyro image to compensate for range. A window in the adapter permits visual inspection to determine the position of the range numbers inscribed on the range drum.

4—1802. REMOVING. To remove the range control units, observe the following procedure:

a. Disconnect drive shaft by reaching under instrument panel and unscrewing knurled retaining cap which secures drive shaft to top of controller (station 134). Unscrew knurled retaining cap at opposite end of shaft which secures it to sight gear adapter. Remove shaft from airplane by pulling controller end of shaft up through hole provided in cockpit cowling.

b. Remove the sight gear adapter by taking out the two screws which secure it to the gunsight.

c. Remove the controller by reaching under the instrument panel and removing the electric leads at the inboard end of the controller. Support the controller and remove the fibre locknuts which secure the two straps around the controller. Separate the straps and remove the controller from the airplane.

CAUTION

> Make certain that the flexible drive shaft has been disconnected from the controller.

d. Remove throttle ranging grip by taking out two bolts which attach it to throttle shaft. Make certain that ranging grip electric lead has been disconnected from controller and that lead is free of obstructions.

4—1803. REPAIRING. If a ranging control unit fails to operate correctly and the malfunction is attributed to a faulty part in the unit, the unit must be replaced with a new one; observe the removal procedure in paragraph 4—1802. Make certain before removal of the unit that the trouble is not caused by some external source.

4—1804. ADJUSTING. When throttle ranging grip is against stop in extreme clockwise position, range drum on gunsight should be in minimum range position. The numeral "6" inscribed on range drum must be aligned with index mark (600 feet minimum range). When grip is in extreme counterclockwise position, numeral "24" on range drum should be aligned with index mark (2400 feet maximum range). To align range control units, observe following procedure:

a. With drive shaft attached, remove sight gear adapter from gunsight by taking out two screws. Move range drum by hand to insure that it will rotate from minimum range "6" to maximum range, "24." If drum cannot be rotated properly and binds, gunsight should be removed for repair and replaced with a new one.

b. With battery switch "OFF," attach external source of electrical power and turn master armament switch to "ON" position, turn gunsight selector switch to "GYRO" and throw gunsight armament switch to "GUNS."

c. Align the numeral "6" inscribed on the range drum with the index mark (minimum range).

d. Hold throttle ranging grip against stop in extreme clockwise position (minimum range). Mount sight gear adapter over range drum and secure it to sight with two screws. Make certain that range drum is not rotated while mounting adapter.

e. After the sight gear adapter is mounted over the range drum and secured to the gunsight, look through the adapter window to make certain that the numeral "6" is adjacent to the index mark with the throttle ranging grip in the extreme clockwise position.

f. Rotate the throttle grip counterclockwise noting the movement of the range drum. When the ranging grip is against the stop in the extreme counterclockwise position, the numeral "24" on the range drum should be aligned with the index mark (2400 feet maximum range). If the range drum fails to rotate to maximum range, the range control installation should be checked for proper operation and the unit causing the malfunction should be replaced.

4—1805. TESTING. The range control testing procedure is given in paragraph 4—1817.

4—1806. INSTALLING. To install the range control units, reverse the removal procedure given in paragraph 4—1802.

Note

When mounting the sight gear adapter, follow the alignment procedure given in paragraph 4—1804.

4—1807. GUNSIGHT VOLTAGE REGULATOR.

4—1808. DESCRIPTION. A Mk 1 gunsight voltage regulator is located below the floor on the right side of the fuselage at station 157. It is a carbon pile regulator designed for 24 to 29-volt input and provides a closely regulated power source for the gunsight. It supplies a current output of 21.7 to 22.3 volts when correctly adjusted. The regulator is mounted to the underside of the floor and is secured in position by four bolts. See paragraph 5—105 for wiring diagram information.

4—1809. REMOVING. To remove the voltage regulator, observe the following procedure:

a. Open the lower cockpit access door to gain access to the regulator.

b. Remove the regulator terminal cover by taking out two screws.

c. Disconnect the four electric lead terminals from the regulator by removing the terminal screws.

d. Support the regulator and remove the four mounting bolts. Remove the regulators from the airplane.

4—1810. REPAIRING. If the regulator malfunctions, it must be removed for repair and replaced by a new one.

4—1811. ADJUSTING AND TESTING. The regulator is adjusted on initial installation. Do not change the adjustment settings. If faulty operation or an improper adjustment is suspected, the regulator should be tested by qualified and experienced personnel.

4—1812. INSTALLING. To install the regulator, reverse the removal procedure given in paragraph 4—1809.

4—1813. GUNSIGHT RELAY BOX.

4—1814. DESCRIPTION. A Mk 7 gunsight relay box is located below the cockpit floor on the left side at station 165. The relay box mounting bracket is riveted to the fuselage frames at stations 171 and 160. Two receptacles integral with the box assembly accommodate gunsight electrical lead Cannon plugs. See paragraph 5—105 for wiring diagram information.

4—1815. REMOVING. To remove the gunsight relay box, observe the following procedure:

a. Open the lower cockpit access door to gain access to the relay box.

b. Unscrew the two electric lead plug caps. Pull the Cannon plugs from the receptacles.

c. Support the relay box and remove the four screws which secure the box to the mounting bracket. Remove the relay box from the airplane.

4—1816. INSTALLING. To install the gunsight relay box, reverse the removal procedure given in paragraph 4—1815.

4—1817. TESTING THE MK 6 FIRE CONTROL SYSTEM.

4—1818. PROCEDURE. *(See figures 4—151 and 4—152.)* To ground test the Mk 6 fire control system, observe the following procedure:

a. With battery switch "OFF," attach an external source of electrical power and turn the master armament switch to the "ON" position. Throw the gunsight armament switch to "GUNS".

b. Place the gunsight selector switch in the "FIXED" position. Only the fixed reticle image should be visible. Move the reticle masking lever up and down to determine whether it blacks out the area below the fixed cross. Check the masking lever for freedom of travel.

c. Move the selector switch to the "FIXED & GYRO" position. Both reticle images should be visible. Determine if the images are properly aligned; see paragraph 4—1795.

d. Place the selector switch in the "GYRO" position. Only the gyro image should be visible.

e. Move the selector switch back to the "FIXED & GYRO" position. Rotate the gunsight dimmer to ascertain whether it varies the light intensity of the images.

f. Check for image parallax. Examine one image at a time, moving the eye from side to side over the width of the lens opening. There should be no apparent shift of the reticle image with respect to the target as the eye is moved. If the image shifts more than three mils in any direction, the lens is out of focus and the sighting head should be replaced.

g. Operate the throttle ranging control grip. The gyro image diameter should increase as the grip is rotated clockwise, and decrease when the grip is rotated counterclockwise.

h. Place the throttle ranging grip in the extreme clockwise position and look through the window on the sight gear adapter. The range drum should be positioned so that the numeral "6" is adjacent to the index mark. Rotate the grip to the extreme counterclockwise position. Now the range drum should be positioned so that the numeral "24" is aligned with the index mark; see paragraph 4—1804. Check the grip for freedom of movement.

i. Check the movement of the span setting handle over the span dial. Movement should be free throughout the entire range. With the handle at the extreme left (high) end of the scale, turn the range drum to minimum range (600 feet). The handle should not move as the drum is turned. If the handle moves, there is not sufficient friction between the handle and crash pad plate. Pressing against the crash-pad to bend the plate slightly will usually remedy this condition.

j. Open the gunsight lamp cover and examine the lamps. If they show signs of blackening, replace them. Make certain two new spare bulbs are installed in the stowage clips.

k. Check the silica gel, in the cell at the back of the sight for color. Dry silica gel should be bright blue; see paragraph 4—1794a.

l. Check for proper operation of the armament safety limit switches which are actuated by the arresting hook handle. With both gunsight images visible, move the arresting hook handle to the "DOWN" position. If the images go out, it is an indication that the armament safety switches are operating properly.

4—1819. GUN CAMERA.

4—1820. DESCRIPTION. *(See figure 4—153.)* The AN-N-6A gun camera is located in the leading edge of the right outer panel at wing station 2. The camera is secured to a mount attached to a special fitting assembly which is supported by two trunnions mounted in a bracket. The bracket is riveted to the rib at wing station 2. The aft end of the fitting assembly and rear trunnion provide a means for horizontal and vertical adjustment of the camera. The camera mount is attached to the fitting assembly in a manner that will permit the mount, and hence the camera, to be unlocked and pivoted down through a 90° arc when the outer panel is folded. This arrangement permits access to the camera film footage reset and film speed adjusting knobs. The camera is normally held in a vertical position (upright) when the mount is locked to the fitting assembly by a Dzus fastener. The body of the camera consists principally of a shutter and lens, an electric motor to operate the drive mechanism, a reset film footage indicator and a film speed adjusting knob. The camera mechanism is electrically operated whenever the gun, bomb or rocket trigger switches are depressed. No separate camera switch is provided. An access cover, hinged to the aft end of the camera, may be opened to insert a film magazine or boresight adapter. The camera uses an AN-6A magazine with a 50 foot capacity of 16-mm film. To insure satisfactory operation at cold temperatures, a GH-1 lens heater is mounted over the lens barrel and secured to the camera by two setscrews. The heater electrical lead is "plugged" into the camera. The heater is automatically cutoff by a GP-1 thermo switch whenever the surrounding air temperature reaches 21.1°C (70°F). For electrical circuit diagram information, see paragraphs 5—107 through 5—110. If necessary, a lens filter can be installed in the front end of the heater. Access to the camera for boresighting or unloading purposes may be gained through the camera access door hinged to the lower surface of the wing. To load and adjust or remove the camera, it is necessary to fold the outer panel and rotate the camera.

4—1821. LOADING. *(See figure 4—153.)* To load the gun camera, observe the following procedure:

a. Fold the outer panels; see paragraph 4—1105.

b. Unlock the camera mount from the fitting assembly by unsnapping the fastener located on the underside of the fitting.

c. Rotate the camera down. The camera mount pivots on a fitting assembly and may be rotated through a 90° arc.

d. Adjust the film speed and film footage knobs on the camera; see paragraph 4—1824.

e. Open the film magazine access cover hinged to the aft end of the camera.

f. Insert the film magazine into the camera with the aperture towards the camera lens, and the footage indicator on the magazine toward the outboard side of the camera.

g. Close the film magazine access cover.

h. Rotate the camera to the upright position and fasten the mount to the fitting assembly.

Note

The camera may be unloaded with the wings spread, by working through the camera access door located on the lower surface of the wing.

4—1822. REMOVING. To remove the gun camera, observe the following procedure:

a. Fold outer panels; see paragraph 4—1105.

b. Disconnect the camera electrical lead by unscrewing the lead plug and pulling the plug from the receptacle located just below the camera.

c. Remove the four retaining nuts that secure the camera to the mount.

d. Unlock the camera mount from the fitting assembly by unsnapping the fastener located on the underside of the fitting.

e. Support the camera and pivot the mount down to provide enough clearance to remove the camera from the mount.

f. Disengage the camera from the mount and remove it from the airplane.

Note

To remove the lens heater from the camera, pull the heater lead plug out of the camera receptacle and loosen the two setscrews located at the base (aft end) of the heater.

4—1823. REPAIRING. If the gun camera is damaged, it must be removed for repairs and replaced with a new one. Only qualified and experienced personnel should attempt to repair the gun camera.

Note

Camera boresighting procedure is given in paragraph 4—1827.

1. Front Trunnion
2. Fitting
3. Camera Window
4. Vertical Adjusting Thumb Nuts
5. Horizontal Adjusting Screw
6. Mount
7. Magazine Cover
8. Magazine
9. Horizontal Adjustment Lock Screw
10. Electric Lead Plug
11. Rear Trunnion
12. Bracket (riveted to rib sta. 2 — outer panel)
13. Camera Mount Dzus Fastener
14. Camera Access Door
15. Film Speed Adjusting Knob
16. Film Footage Reset Knob
17. Camera

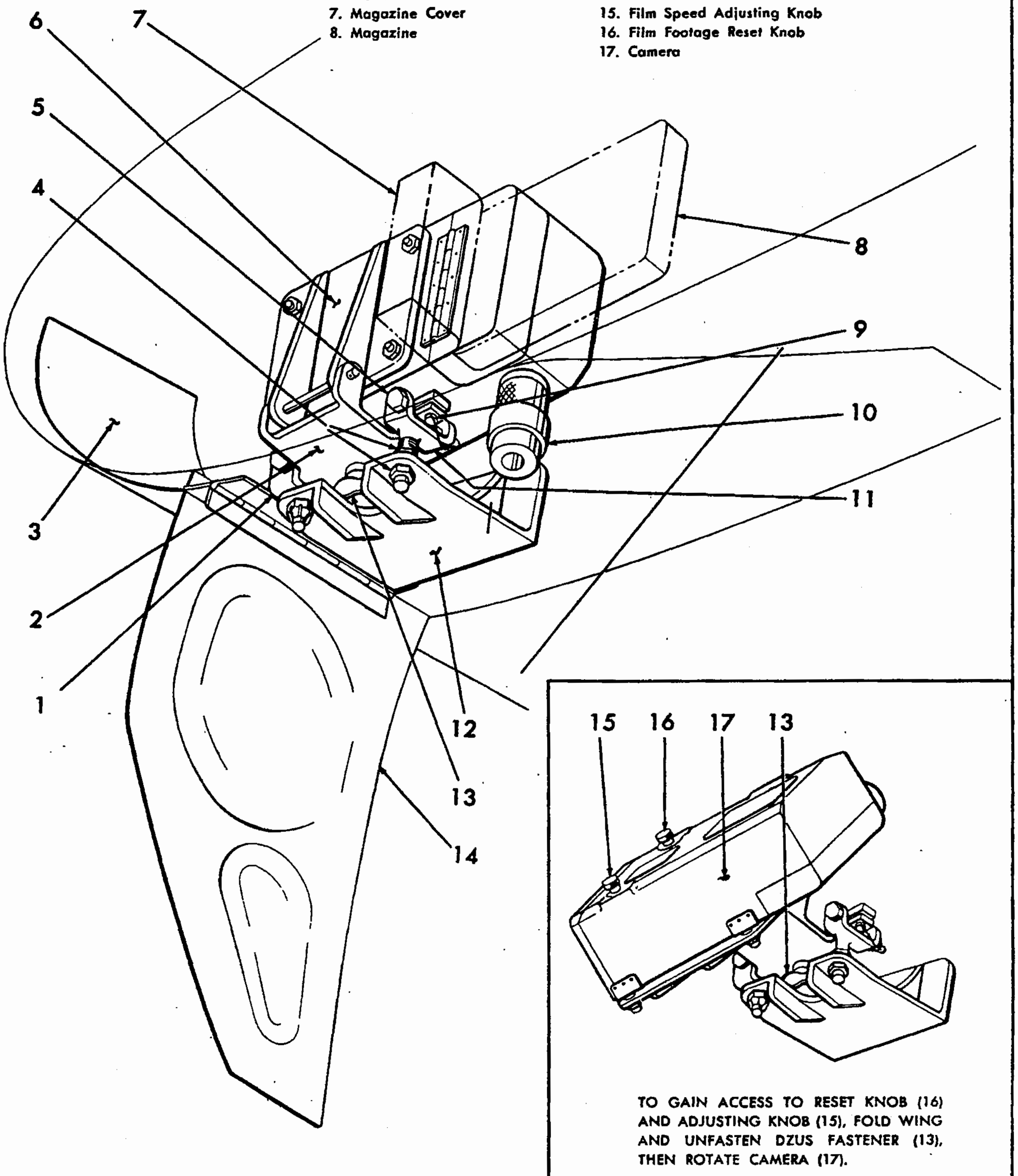


Figure 4—153. Gun Camera.

4—1824. ADJUSTING. A film speed adjusting knob is located on the outboard side of the camera below the film footage reset knob; *see figure 4—153*. Film speed adjustments range from 16 to 64 frames per second. The film footage indicator should be turned to "O" if an UNUSED film magazine is placed in the camera. This is accomplished by rotating the reset knob located directly below the indicator. Film speed settings should not be changed unless otherwise directed. To reset the film footage indicator and adjust the film speed, observe the following procedure:

a. Fold outer panels and rotate the camera to reach the film speed and film footage knobs; see paragraph 4—1821.

b. Turn the film footage indicator knob until the indicator reads "O" if loading a new, unused film magazine; otherwise it should be set to correspond within the footage of film already used in the magazine.

c. Turn the film speed adjusting knob to the speed required.

4—1825. TESTING. Test the camera for operation as directed in paragraph 4—1838. Thorough tests on the gun camera should be carried out only by qualified photographic personnel.

4—1826. INSTALLING. To install the gun camera, reverse the removal procedure given in paragraph 4—1822.

4—1827. BORESIGHTING THE GUNNERY SYSTEM.

4—1828. DESCRIPTION. When the gunnery system is properly boresighted on a target screen prepared according to the data shown in figure 4—159, the guns are boresighted to converge on a line of sight 300 yards ahead of the inboard gun rear trunnion with allowance made for a 17 inch bullet drop. The sight line (armament datum line) is parallel to the flight path which is 0° 45″ above the fuselage reference line at Vmax. (29,000 feet, 446 mph) under normal fighter load. First the airplane is roughly lined up and then correctly squared away with the face of the target screen at the proper distance. Exact airplane-to-target screen alignment is then accomplished by sighting on the screen through boresight posts inserted in the wing panels, and adjusting the screen accordingly. When the screen has been properly aligned in relation to the airplane, the guns, gunsight and camera may be adjusted so that they are properly boresighted on their respective target spots.

4—1829. SPECIAL TOOLS. A VS-34548 boresight post storage box is supplied with the Ground Handling Equipment-Loose Accumulations. The box contains four boresight posts which can be inserted into special fittings located in the lower surfaces of the outer panels. The posts are sighting devices employed to determine when the target screen is correctly aligned with the airplane, prior to boresighting the guns. Use the Mk 1 boresight kit to align the guns with the target spots, and the AN-1 boresight and magazine adapter to align the camera with the target spots. Gun front mount boresighting adjustment wrenches (VS-52536 and VS-28261) are wired together and secured to rib 3 1/2 in the left wing outer panel.

4—1830. ALIGNING THE AIRPLANE. To align the airplane with the target screen prior to boresighting the gunnery system, observe the following procedure:

a. Prepare the desired target screen in accordance with figure 4—159.

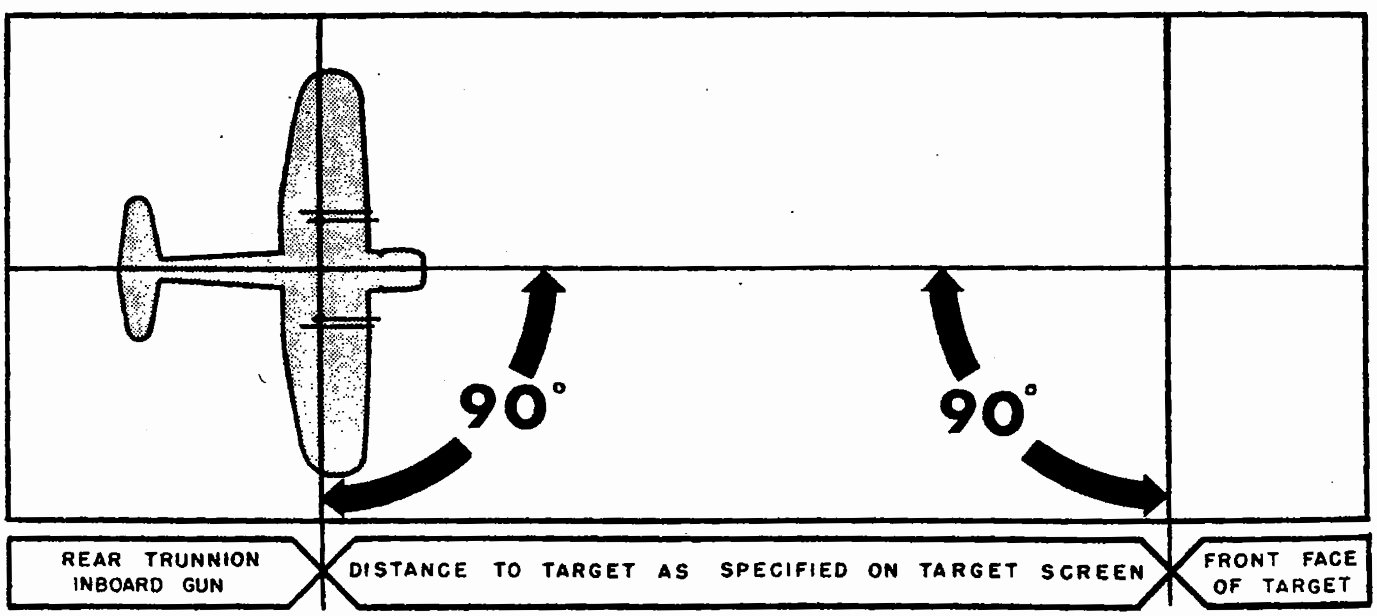


Figure 4—154. Squaring the Target Screen.

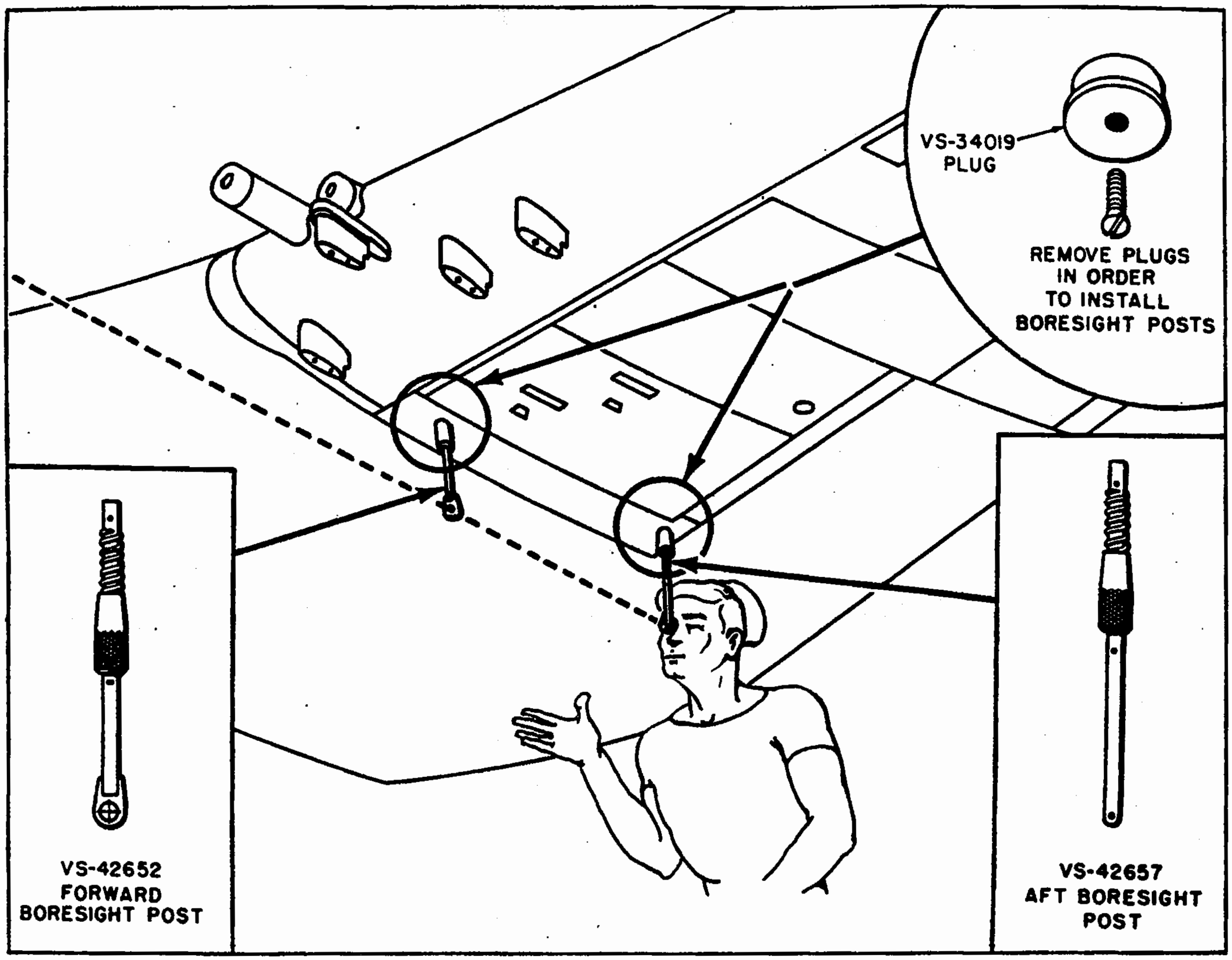


Figure 4—155. Installation and Use of Boresight Posts.

b. Align the airplane approximately with the target screen at the proper distance. Tie down tail with rope attached to tail drag link. Attach other end of rope to 600 pound weight or equivalent. Raise and secure tail to approximately thrust line level. Jack main wheels enough to ease some of the weight of the airplane off the tires; see paragraph 3—27. Shift the target screen until gun-to-target distances are correct and equal. The measurements from the airplane to target screen are made from the center of the rear mount of the inboard guns to the face of the target; *see figure 4—154.*

c. Remove the two plugs from the two boresight post receptacle holes in each panel, just outboard of the wing fold line on the under surface, one near the main beam and the other near the outboard flap hinge. Insert front and rear posts (VS-42652 and VS-42657 respectively) into forward and aft holes as far as they will go, rotating each so that the cross hairs on the forward post and the peep hole on the aft post are facing the target; *see figure 4—155.*

d. Sight through both sets of posts simultaneously and shift target screen until both sets of posts sight onto horizontal datum line on symmetrically corresponding vertical stripes located at the ends of horizontal datum line. Posts will then sight on horizontal datum line equidistant from vertical centerline on target screen. The airplane is now properly oriented to the target screen, and guns, gunsight, and camera may be aligned to their respective target spots; *see figure 4—156.*

Note

When sighting boresight posts, it will be found that the horizontal cross-hairs in the front posts will not be parallel with the horizontal datum line. This condition is the result of the design of the post installation in the wing and does not affect the accuracy of alignment, which is correct when the intersection of the horizontal and vertical cross-hairs of the front post falls on the datum line.

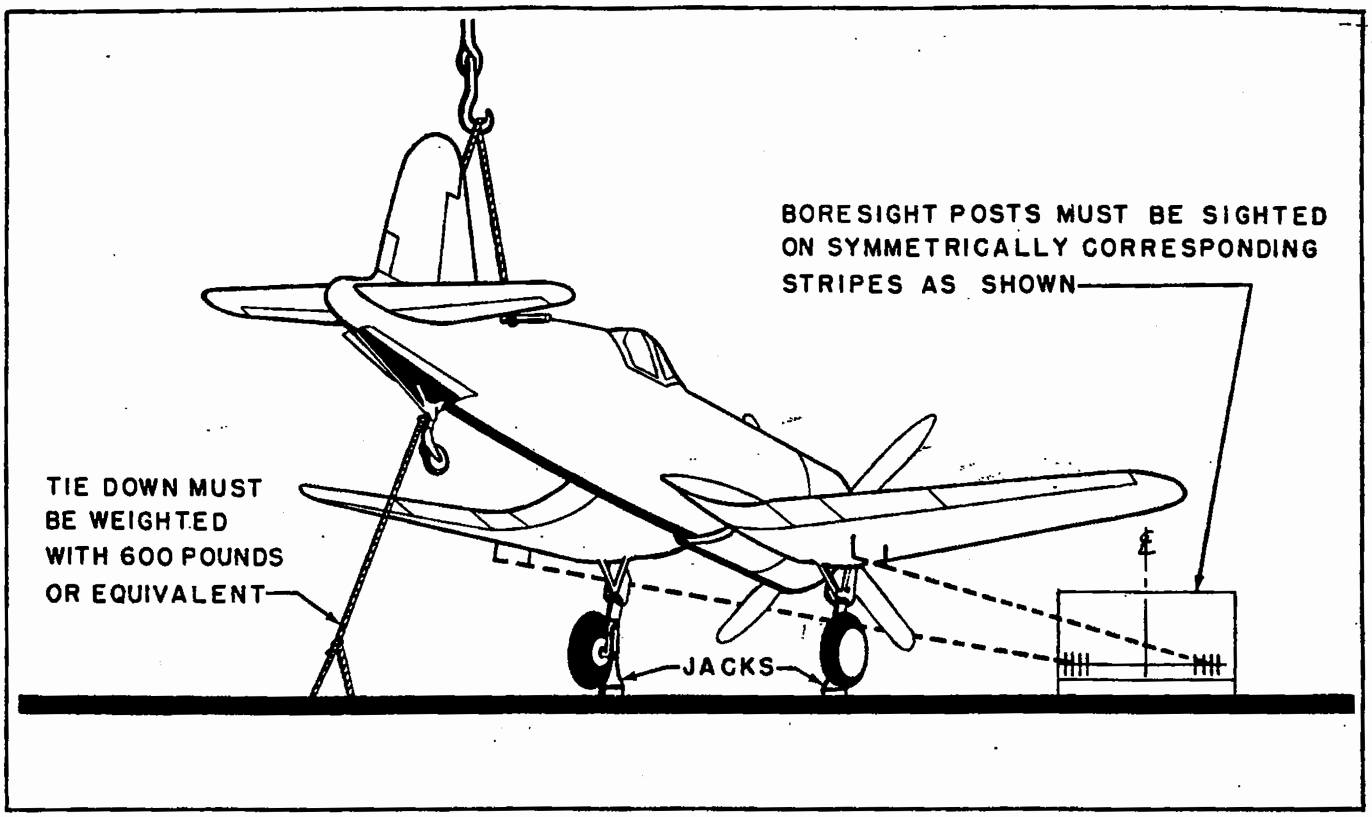


Figure 4—156. Boresight Posts Properly Sighted on Target Screen.

4—1831. BORESIGHTING THE GUNS. *(See figure 4—157.)* After squaring the airplane with the desired target screen, boresighting is accomplished from the muzzle or breech end of the gun by using the Mk 1 boresighting kit.

a. Remove the fairing and clamps (1) from the front mounts.

b. Break lockwire and loosen two capscrews on each front mount assembly.

c. Apply special wrenches to eccentrics. Use VS-52536 wrench on inner eccentric, and VS-28261 wrench on outer eccentric.

Note

Special wrenches are wired together and to rib 3 1/4 in the left wing outer panel.

d. Insert the eyepiece and muzzle adapter into end of gun.

Note

The Mk 1 boresight kit also provides an adapter which permits boresighting from the breech end of gun.

e. Using the special wrenches, and sighting through eyepiece, turn the front mount eccentrics until the desired target spot is obtained by a trial and error method.

f. After boresighting, slide the gun forward and aft to make certain no binding occurs.

g. Secure front mount assemblies by tightening capscrews and safety-wire.

h. Replace clamps and fairing assemblies.

Note

With front mount locked, gun removal and reinstallation will not affect gun boresighting.

4—1832. BORESIGHTING THE GUNSIGHT. Gunsight boresighting may be performed with the sight located in the combat (upper) position or with it in the training (lower) position. Before boresighting, check the alignment of the sight in accordance with paragraph 4—1795. *Reference should be made to figure 4—151.* Additional gunsight alignment procedure may be found in Ordnance Pamphlet 1216. To boresight the gunsight observe the following procedure:

a. Loosen the gunsight mounting clamp locking bolt located below the sight. This permits the sight to be rotated in any direction.

b. With battery switch "OFF," attach an external source of electric power and turn "ON" master armament switch. Place the gunsight selector switch in the "FIXED" position and throw the gunsight armament switch to "GUNS."

c. Rotate the sight until the fixed cross image lines up with the gunsight target spot on the screen.

d. Tighten the mounting clamp locking bolt, making

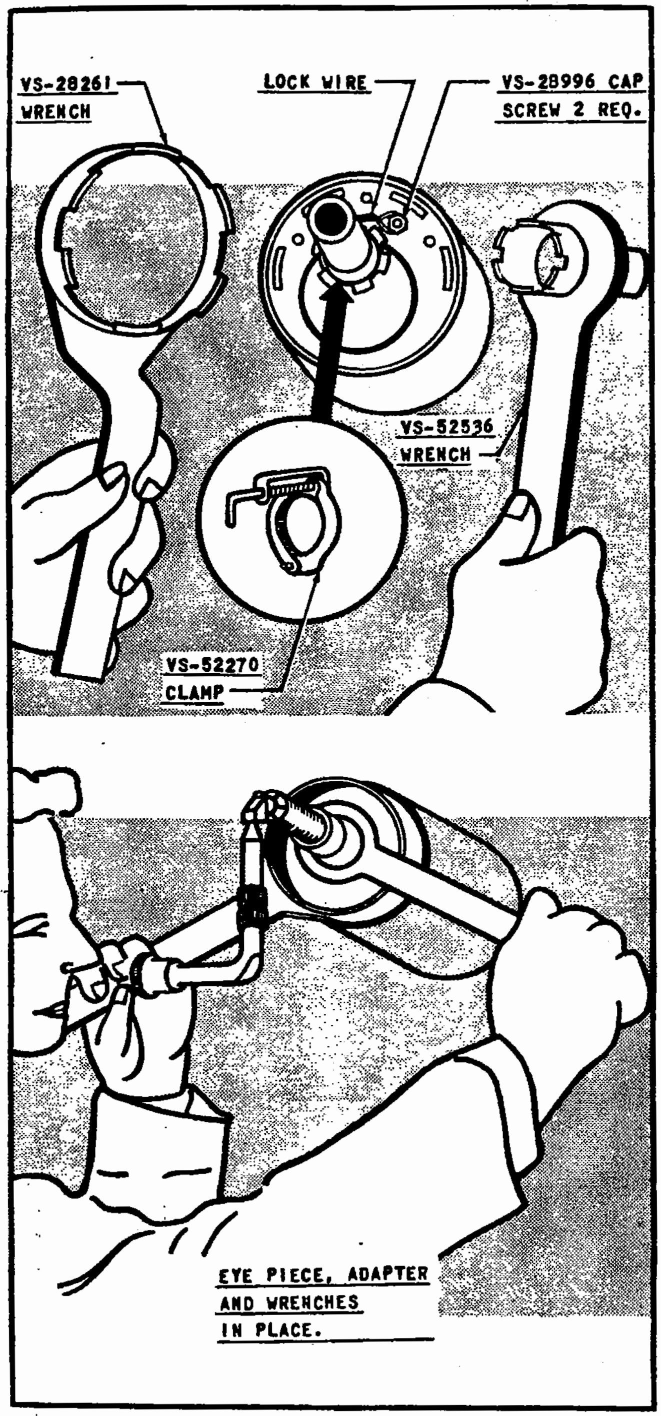


Figure 4–157. Use of Boresight Wrenches and Boresight Eyepiece.

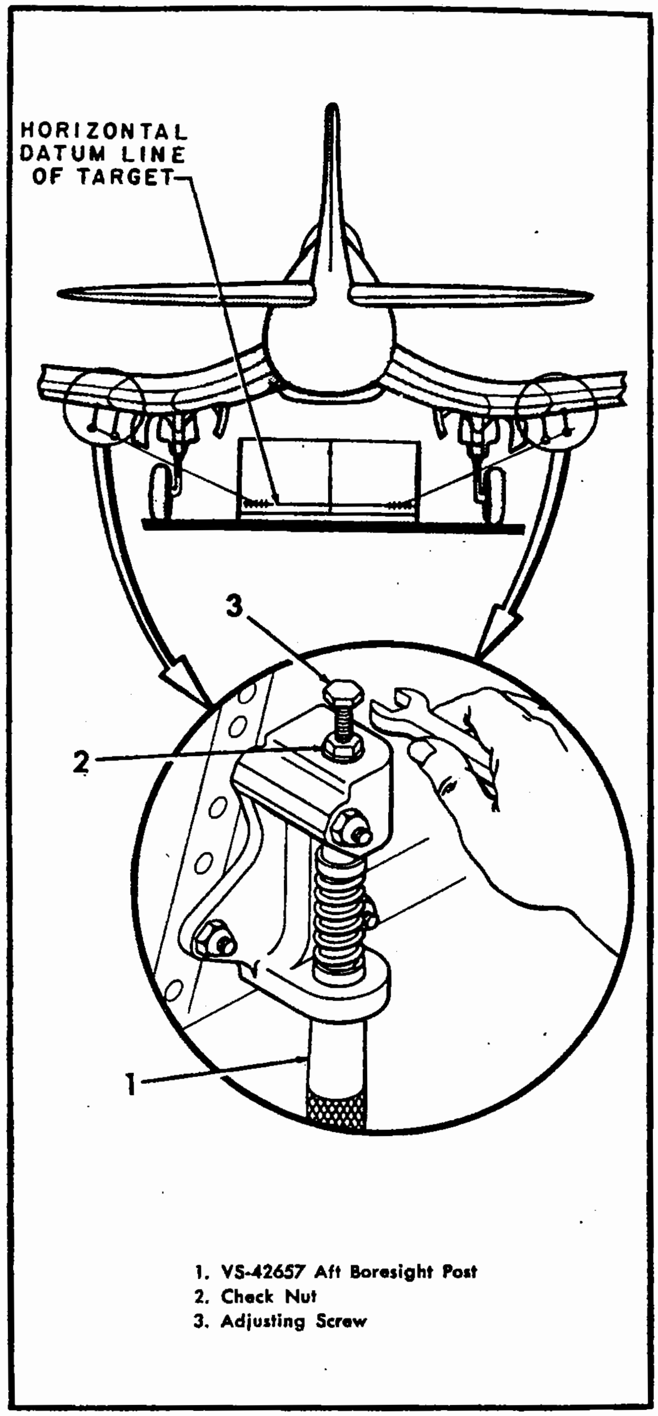


Figure 4–158. Adjustment of Aft Boresight Post.

certain that in tightening, the fixed cross does not deviate from the target spot on the screen.

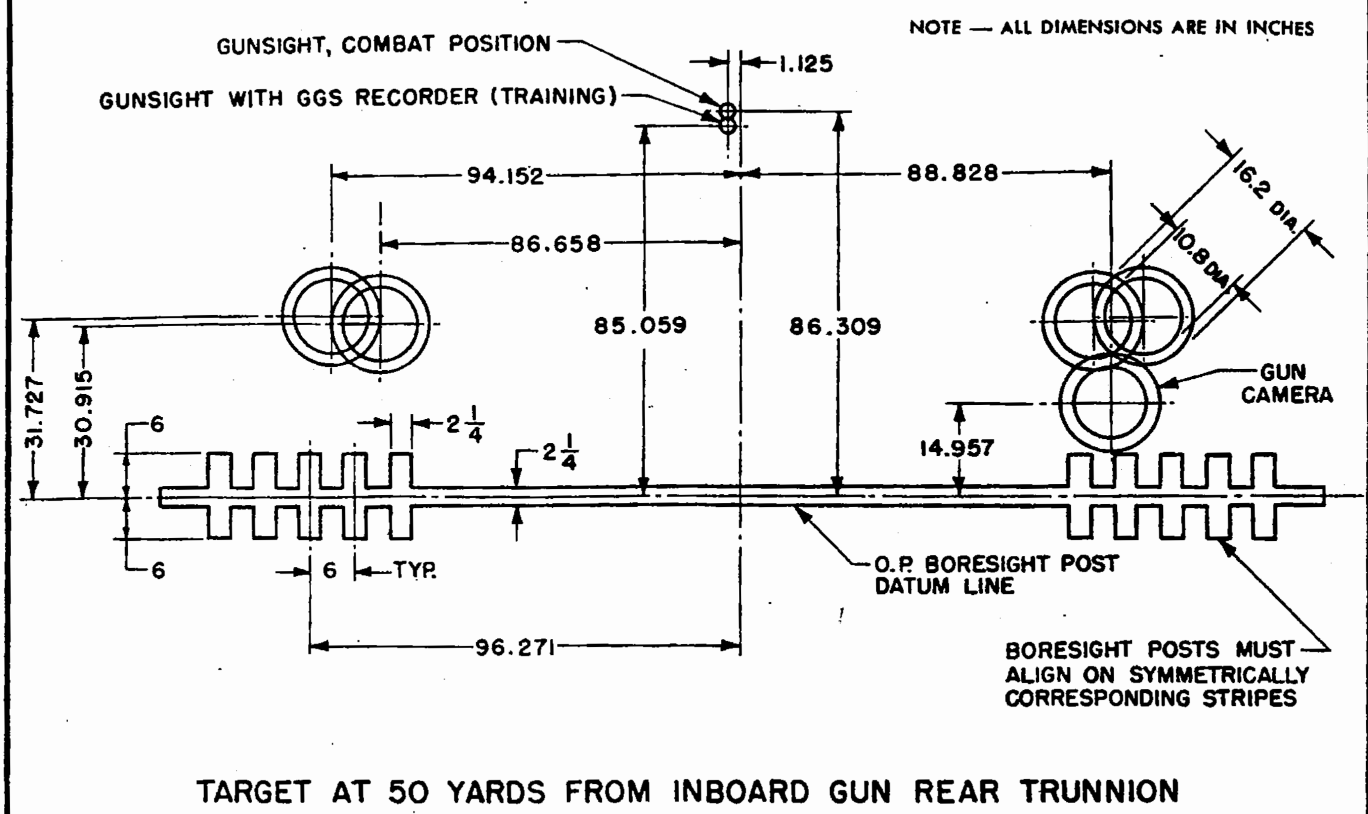
e. Turn off all switches.

4–1833. BORESIGHTING THE GUN CAMERA. Use the AN-1 boresight and magazine adapter to align the camera with the target spot. To boresight the gun camera, *refer to figure 4–153*, and observe the following procedure:

a. Unfasten and open the gun camera access door located on the under surface of the right outer panel at wing station 2.

b. Reach through the access door and open the magazine cover hinged to the aft end of the camera.

c. Open the camera shutter by operating the trigger switch momentarily. See paragraph 4–1722b.



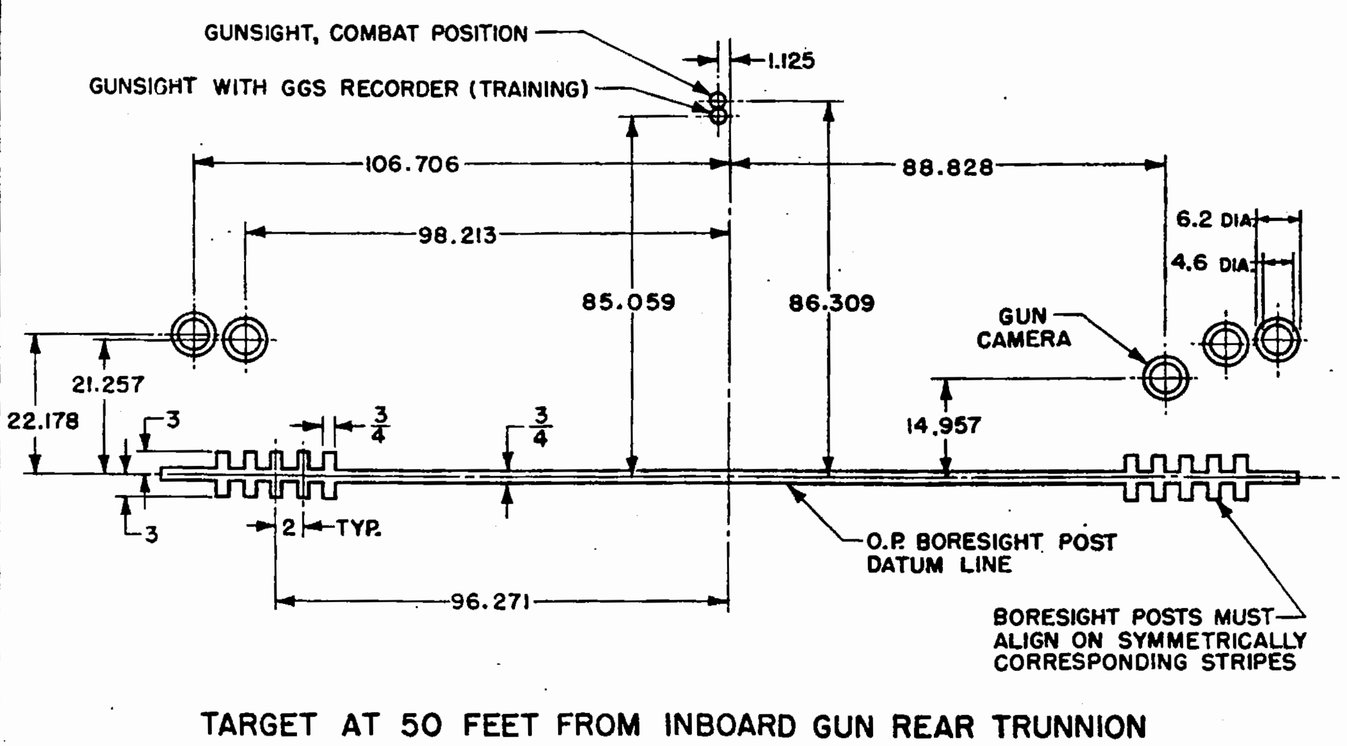


Figure 4—159. Boresight Target Screens.

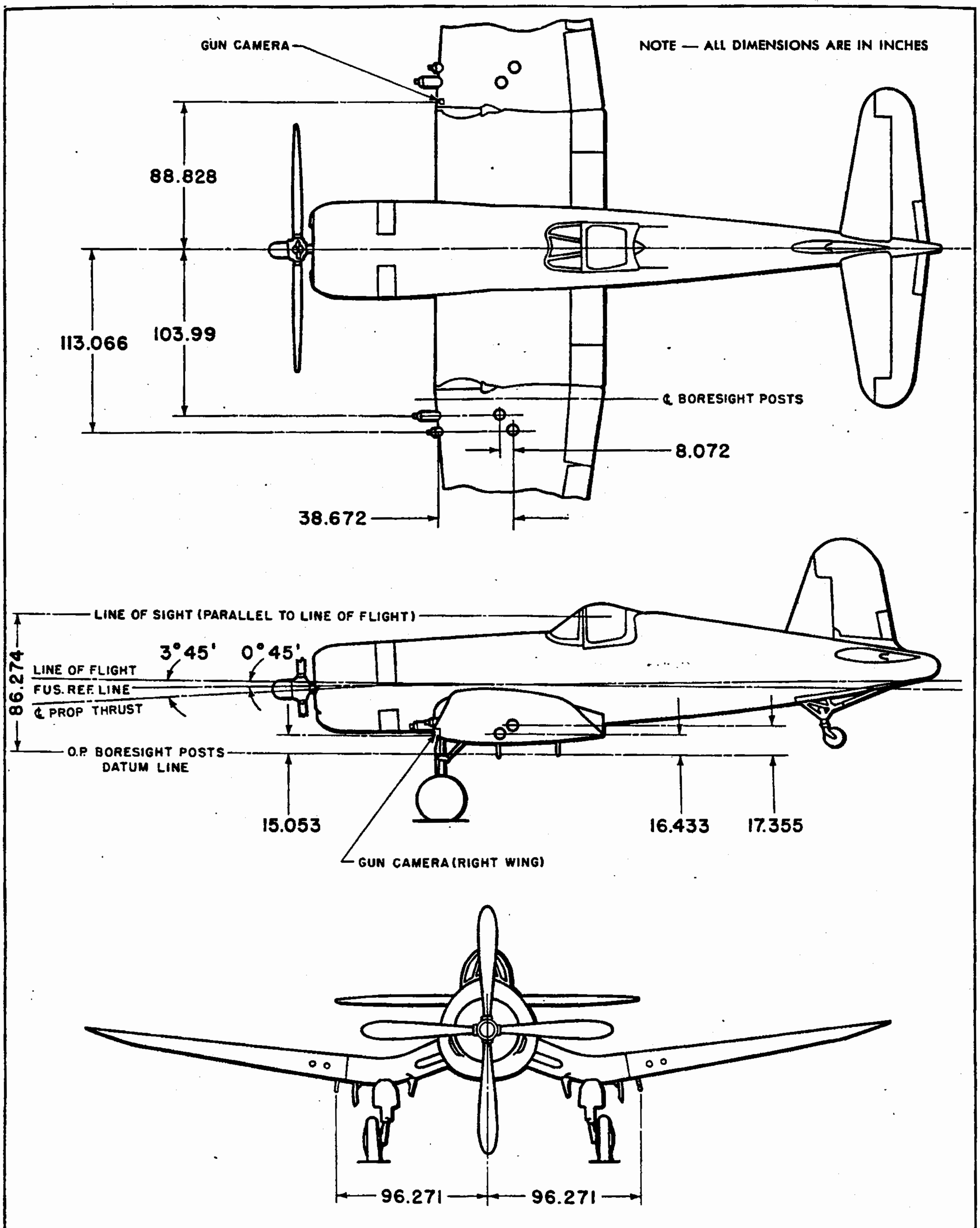


Figure 4—160. General Boresighting Data.

WARNING

If the breechblocks are not in battery (forward) position, observe the procedure in paragraph 4-1729g.

d. Insert the AN-1 boresight eyepiece adapter into the camera in place of the film magazine, making certain that the retaining spring side is toward the mount side of the camera.

e. Adjust the camera until the camera target spot is centered in the field of view. For horizontal adjustment of the camera, break the safety wire and loosen the fitting assembly lockscrew located on the aft end of the fitting. An adjusting screw secures the fitting to the aft trunnion and rotation of the screw, after the lockscrew is loosened, will cause the fitting, hence the camera to move laterally. For vertical adjustment of the camera, loosen the two adjusting nuts which secure the aft trunnion in the camera bracket and move the trunnion up and down as desired. This causes the camera to move in a vertical direction. After the camera is properly positioned, tighten the rear trunnion nuts and fitting assembly lockscrew. Safety wire the lockscrew to the end of the adjusting screw.

4—1834. ALIGNING THE BORESIGHT POSTS AFTER SERVICE REPLACEMENT OF AN OUTER PANEL.

4—1835. DESCRIPTION. Service replacement of wing outer panels necessitates proper alignment of boresighting posts before gun and sight alignment are attempted. Otherwise the guns in one panel may fire as much as ten feet higher or lower than the guns in the opposite panel, even though apparently boresighted accurately on a close range target screen. Such inaccuracy is caused by a center section wing twist (up to 1/2° from hinge line to hinge line, the maximum manufacturing tolerance). The following procedures, if used, are intended to offset the ill effects of manufacturing tolerances on gun boresighting by making both boresighting lines parallel in a side view.

4—1836. ALIGNMENT PROCEDURE ABOARD CARRIER. After a wing panel or panels have been replaced, observe the following procedure:

a. Set up a target screen on which there is a horizontal datum line at least eighteen feet long and four feet above the deck, leveling this line to the deck as closely as possible.

b. Roll the airplane into position squarely facing screen at a distance of 150 feet, if possible.

c. Install boresighting posts on the outer panels.

d. Raise tail to approximately thrust line level; be sure that tail is properly weighted (600 pounds). Jack up main wheels enough to ease some of the weight of the airplane off the tires. Adjust jacks until the forward boresighting posts are of equal height above the deck.

e. Sighting through both sets of posts simultaneously, raise weighted or tied down tail of airplane until, with both front boresighting posts still equidistant from the deck, the set of posts sighting higher on the target screen is aligned to the horizontal datum line thereon.

f. By means of the adjusting screw provided at the top of the rear post fitting, adjust the rear post on the other (low) side downward until the line of sight through these posts falls on the horizontal datum line; *see figure 4—158.*

g. It will become necessary to reduce the amount of adjustment on this (low) side and effect some upward adjustment on the rear post on the opposite (high) side if any one of the following conditions occurs: if there is insufficient adjustment on the rear post (low) to bring the sighting line onto the horizontal datum line; if the required post adjustment becomes greater than the gun elevation on this (low) side.

h. The boresighting post lines of sight in both wings will now be aligned parallel in a side view of the airplane. Guns, gunsight, and gun camera may now be aligned to the customary target screen.

4—1837. ALIGNMENT PROCEDURE ASHORE. After a wing panel or panels have been replaced, observe the following procedure:

a. Roll airplane onto the best available level area, squarely facing some object at least 300 yards away. This object must be level for a horizontal distance of at least 18 feet. The horizon, a flat roof top, or a distant spot on the landscape will serve as long as it is far enough away for a true 18 foot width to appear as a point.

b. Install boresighting posts and proceed to align the posts in the same manner as for alignment on a carrier as described in paragraph 4—1836.

4—1838. GUNNERY SYSTEM TESTING. The gunnery system may be ground tested for proper operation by observing the following procedure:

a. Open the front gun bay and remove rear gun bay doors.

b. Open camera access door and remove film magazine if camera is loaded.

c. Make certain that breechblocks are in battery (forward). If necessary to put breechblocks in battery, refer to paragraph 4—1729g. Make certain that neither the chamber nor feed mechanism is loaded.

d. Load the feed mechanism with a belt of at least five DUMMY rounds. Check for proper ejection of the belt links through the link ejection chutes. The correct procedure for loading the feed mechanism is given in paragraph 4—1739.

WARNING

Make certain that no live rounds are contained in dummy round belt.

e. With battery switch "OFF," attach an external source of electric power and turn on auxiliary hydraulic pump switch. All gunnery switches must be "OFF."

f. Place gun "safe-ready" switch in the "SAFE" position.

WARNING

Look through case ejection chutes and make certain no live rounds are in chambers.

g. Note the position of the charging lug. It should be to the rear, holding the breechblock in the aft position.

h. Turn the master armament switch to the "ON" position, the gun firing switches to their respective "INBOARD" and "OUTBOARD" positions, and throw the gun "safe-ready" switch from the "SAFE" to the "READY" position. Check to make certain that the charging lugs return to the pre-charged position when the switch is placed in the "READY" position. Depress the trigger switch on the control stick. All breechblocks should go forward. Make certain that the trigger switch does not stick when depressed.

i. Depress the charger button. As the breechblocks are retracted, a dummy round should be ejected. The charging lug should move aft to retract the bolt and then return to the precharged position (forward).

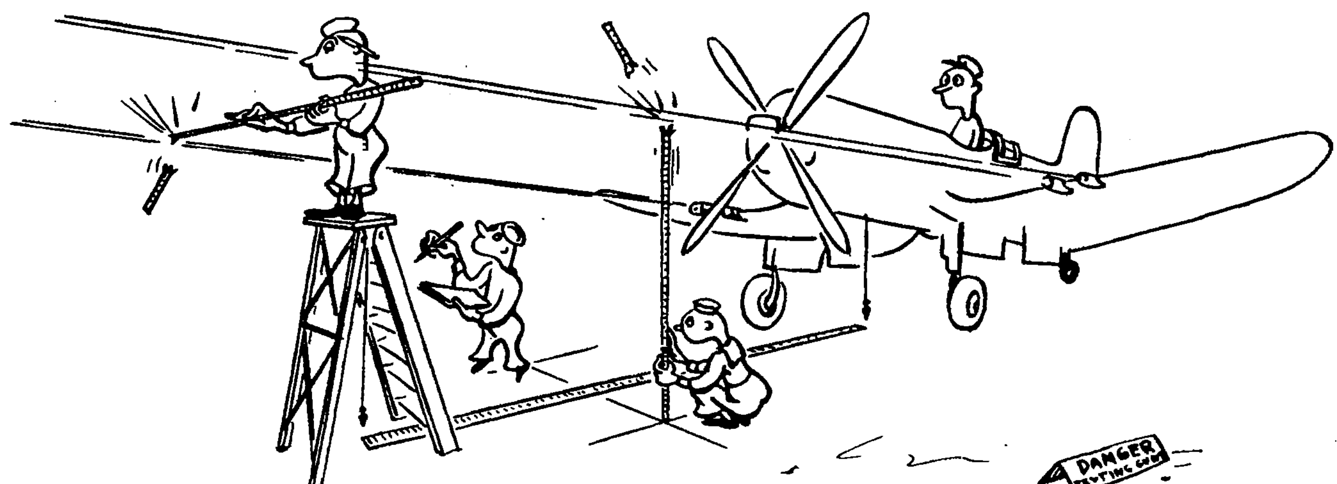
j. Lower arresting hook handle. Depress the trigger. The breechblocks should not go forward. If the breechblocks do go forward, the armament limit switches, actuated by the arresting hook handle, are not cutting out the gunnery system circuits.

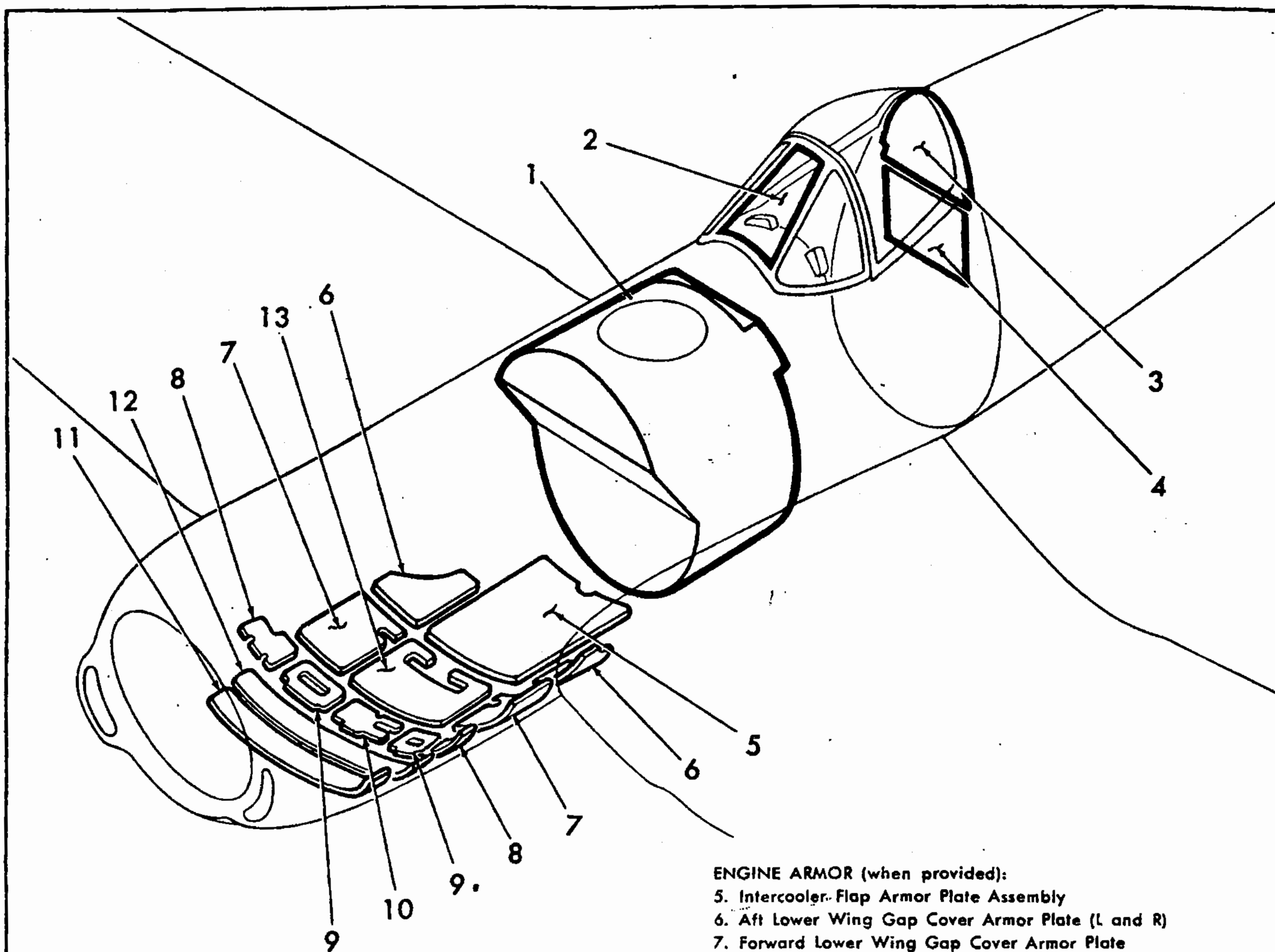
k. Raise the arresting hook handle and depress the trigger switch. The breechblocks should now go forward. Depress the trigger long enough to determine whether the camera electric motor is operating (shutter clicking).

l. Turn off all switches.

m. The test procedure for the feed mechanism is given in paragraph 4—1742.

n. The Mk 6 fire control system test procedure is given in paragraph 4—1817.





ENGINE ARMOR (when provided):
5. Intercooler Flap Armor Plate Assembly
6. Aft Lower Wing Gap Cover Armor Plate (L and R)
7. Forward Lower Wing Gap Cover Armor Plate
8. Cowl Flaps Number Four Armor Plate (L and R)
9. Cowl Flaps Number Five Armor Plate (L and R)
10. Cowl Flap Number Six Armor Plate
11. Forward Engine Cowl Armor Plate
12. Aft Engine Cowl Armor Plate
13. Forward Bottom Accessory Compartment Panel Armor Plate

1. Self-sealing Fuel Cell
2. Bullet-resistant Glass
3. Head Armor Plate
4. Armor Plate on Bulkhead 186

Figure 4—161. Armor Plate and Bullet-resistant Glass Installation.

4—1839. ARMOR PLATE AND BULLET-RESISTANT GLASS INSTALLATION.

4—1840. DESCRIPTION. *(See figure 4—161.)* The armor plate protection for the pilot consists of head armor plate and of armor plate on bulkhead 186. Both plates are located aft of the pilot's seat. The head armor plate is designed to fit the contour of the turtledeck overturn structure. The lower armor plate is an integral part of bulkhead 186. The pilot is protected from forward fire by a bullet-resistant glass panel in the center of the windshield and by the self-sealing main fuel cell which is installed forward of the instrument panel. Built into all airplanes are provisions for the installation of engine armor plates. The specially designed engine armor plates, when installed, protect the lower portion of the engine.

4—1841. HEAD ARMOR PLATE.

4—1842. DESCRIPTION. *(See figure 4—161.)* The head armor plate (3) is a sheet of homogeneous bullet proof steel, $\frac{5}{16}$ inches thick and 25$\frac{5}{16}$ x 24$\frac{1}{2}$ inches in size, weighing 36.48 pounds. It is located aft and above the pilot's seat. The plate is bolted at its lower corners to forged gussets which are installed on the upper longerons at bulkhead 186. The armor plate is fastened along its contour edge to the fuselage skin and its top is bolted to the turtledeck overturn fitting. The headrest, shoulder strap harness support, and special bolts for pilot's seat return springs are attached to the forward side of the head armor plate. A pulley support bracket is bolted to its aft side. A shim installation separates the head armor plate from the lower armor plate of bulkhead 186.

4—1843. REMOVING.

a. Remove sliding section; see paragraph 4—242.

b. Unfasten pilot's seat return springs.

c. With pilot's lower step extended, disconnect forward and aft sections of cable at turnbuckle, accessible through radio compartment access door.

d. Remove forward section of cable from pulley which is attached to aft side of plate.

e. Remove the two large and the two small bolts which attach the plate to the fittings at its lower corners.

f. Remove the bolts holding the armor plate to the fuselage stiffeners.

g. Remove pilot's headrest.

h. Unfasten the top of the plate from the overturn fitting.

i. Lift off the head armor plate.

4—1844. INSTALLING.

a. Replace shim between head armor plate and armor plate on bulkhead 186.

b. Install armor plate by reversing the removal procedure.

c. Apply fumeproof sealing compound 3M-EC-504 Thiokol Cement, over all bolts, fillets, flange of skin and heads of rivets. For further information on fumeproofing, see paragraphs 4—296 through 4—298.

4—1845. ARMOR PLATE ON BULKHEAD 186.

4—1846. DESCRIPTION. *(See figure 4—161.)* Bulkhead 186 is located aft of the pilot's seat, forming the main forward bulkhead of the mid-section at the point where front and mid-sections are joined. The armor plate (4) is made of one-half inch 24ST aluminum alloy, is 22 1/8 x 17 7/16 inches in size, and weighs 19.10 pounds. It constitutes the upper center web of bulkhead 186. It is bolted at its upper corners to the same forged gusset fittings to which the head armor plate it attached. It is secured to the bulkhead reinforcing side web plates by means of bolts and rivets. A double track and a seat adjusting support assembly are bolted and riveted to the forward side of the plate. A shelf bolted to the aft side of the plate, supports the radar equipment. A beam, also bolted to the aft side of the plate, carries the sliding section hydraulic actuating cylinder and hydraulic tubing to the tail gear.

4—1847. REMOVING.

4—1848. When it becomes necessary to remove the armor plate, begin at the forward side of the bulkhead. Access is gained through cockpit.

a. Remove sliding section; see paragraph 4—242.

b. Remove pilot's seat; see paragraph 4—1543.

c. Detach spring at shoulder harness reel installation on the forward side of the bulkhead.

d. Remove the two bolts holding the upper corners of the reel support.

e. Remove rivets attaching the bulkhead lower web and reel support to lower edge of armor plate.

f. Disconnect shoulder harness cable at top of pilot's seat adjusting support, on the forward side of the armor plate.

g. Remove bolts and rivets securing the tracks of the pilot's seat to the armor plate.

4—1849. Additional disconnects on the aft face of bulkhead 186, that must be made for armor plate removal, are accessible through the radio compartment access door.

a. Remove bolts holding armor plate to the forged gusset fittings at its upper corners.

b. Remove bolts attaching beam installation located above radar equipment.

c. Remove radar equipment and cable; see paragraph 5—198.

d. Remove bolts attaching radar support assembly to armor plate.

e. Remove sliding section drum and pinion assembly.

f. Lift the armor plate past the shelf and tracks and take it out.

4—1850. INSTALLING.

a. Replace shims between head armor and armor plate on bulkhead 186.

b. Install the armor plate on bulkhead 186, reversing the removal procedure given in paragraphs 4—1847 through 4—1849.

c. Replace fumeproof sealing compound, 3M-EC-504 Thiokol Cement, covering bolts and rivets, and around edges of web and armor plate. For further information on fumeproofing, see paragraphs 4—296 through 4—298.

4—1851. BULLET-RESISTANT GLASS.

4—1852. DESCRIPTION. *(See figure 4—161.)* The windshield center pane is bullet-resistant glass (2). It is a laminated plate glass, one-and-one-half inches thick and 15.60 x 24.25 inches in size, and weighs approximately 38 pounds. The glass is held in a welded metal frame. The channel portion of the frame is taped with Everseal tape for protection and sealing purposes. The bullet-resistant glass frame is held to the windshield by means of formers and retainers. Two flanges at the lower corners of the frame are bolted to the cowl at the base of the windshield. For information on cleaning bullet-resistant glass, refer to paragraphs 4—1903 and 4—1904.

4—1853. REMOVING.

a. Remove gunsight and mount; see paragraph 4—1792.

b. Remove the screws holding the outer retaining strips to the bullet-resistant glass frame.

c. Place matching gage marks on retaining strips and adjoining windshield frame.

d. Remove retainers and tape.

e. Remove four screws, holding the top of the glass frame to the upper windshield former.

f. Remove the four bolts attaching the flanges to the cowl at the base of the windshield.

g. Carefully slide out the bullet-resistant glass.

4—1854. INSTALLING.

a. Replace damaged tape around glass frame.

b. Place bullet-resistant glass in position and align the upper holes of the frame with the holes of the top windshield former.

c. Align holes in the flanges with holes in windshield cowl.

d. Match retainers with their original positions and attach.

e. Fill the outer joints between retainers and the glass with Aluminastic sealing compound.

4—1855. PROVISIONS FOR ENGINE ARMOR PLATE.

4—1856. DESCRIPTION. *(See figure 4—161.)* Provisions for the installation of engine armor plate are built into all airplanes. If provided, the engine armor plate installation protects the power plant section at nine vital points. Homogeneous bulletproof steel, 3/16 inches thick is used throughout, except at the accessory compartment, where a sheet of 24ST aluminum alloy, one-half inch thick, forms the outer skin of the intercooler flap armor plate assembly.

Note

The paint surfaces of the engine cowling and engine armor form the only insulation between these dissimilar metals (aluminum alloy and steel). Make sure that these surfaces are not nicked or scratched. If the paint surfaces are damaged, they must be refinished prior to installing engine armor plate; refer to paragraphs 4—1916 through 4—1919.

4—1857. FORWARD ENGINE COWL ARMOR PLATE.

4—1858. DESCRIPTION. *(See figure 4—161.)* The forward engine cowl armor plate (11) is a sheet of homogeneous bulletproof steel 3/16 inches thick, 11 x 44 inches in size, and weighing 22.85 pounds. It is bolted to clips and channels which are attached to the inside of the forward portion of the engine cowl bottom panel.

4—1859. INSTALLING.

a. Remove the lower engine cowl panel; see paragraph 4—455.

b. Locate the four left and four right attaching points on the panel.

c. Place armor plate in position and align holes with holes in clips and channels.

d. Insert the eight attaching bolts through armor plate and supports. Tighten the assembly securely.

4—1860. AFT ENGINE COWL ARMOR PLATE.

4—1861. DESCRIPTION. *(See figure 4—161.)* The aft engine cowl armor plate (12) is made of homogeneous bulletproof steel, 3/16 inches thick, 9 1/4 x 43 inches in size, weighing 18.70 pounds. The armor plate is bolted to brackets which are attached to the inside aft portion of the bottom engine cowl panel.

4—1862. INSTALLING.

a. With bottom engine cowl panel removed, locate the supporting brackets in the left and right hand sides of the bottom panel and attach the armor plate with the eight attaching bolts.

4—1863. ARMOR PLATE ON ENGINE COWL FLAPS NUMBER FOUR.

4—1864. DESCRIPTION. *(See figure 4—161.)* The Number four left and right cowl flaps are equipped with armor plate (8) made of homogeneous bulletproof steel, 3/16 inches thick, 8 3/4 x 12 1/2 inches in size, and weighing 4.04 pounds each. The plates are bolted to the flap pan assembly. Countersunk spacers are placed between the outer skin and the pan. They act as guides and retainers for the bolts and prevent crushing of the thin gage surface skin when the armor plate is installed.

4—1865. INSTALLING.

a. With cowl flaps open, detach screwjacks from flaps at quick-disconnects.

b. Manually extend flaps to a full open position.

c. Locate points of attachment and remove the four bolts installed through the spacer in each flap.

d. Align armor plate holes and attach the armor plate to the inside of each flap using the four bolts removed in step c.

4—1866. ARMOR PLATE ON ENGINE COWL FLAPS NUMBER FIVE.

4—1867. DESCRIPTION. *(See figure 4—161.)* The Number five left and right cowl flap armor plates (9) consist of two sheets of homogeneous bulletproof steel, 3/16 inches thick, 10 1/4 x 10 1/4 inches in size, weighing 3.75 pounds each. The armor plates have special cutouts along the edge and are bolted to the cowl flap pan assemblies by means of countersunk head bolts.

4—1868. INSTALLING.

a. With cowl flaps open, install armor plate, observing procedure given in paragraph 4—1865.

4—1869. ARMOR PLATE ON ENGINE COWL FLAP NUMBER SIX.

4—1870. DESCRIPTION. *(See figure 4—161.)* Engine cowl flap number six is located on the centerline of the airplane between cowl flaps number five. The armor plate (10) of flap number six is homogeneous bulletproof steel, 3/16 inch thick and 10 1/2 x 10 1/2 inches in size, weighing 6.80 pounds. The plate is bolted to the cowl flap pan assembly.

4—1871. INSTALLING.

a. With cowl flaps open, install armor plate, observing procedure given in paragraph 4—1865, using the five countersunk bolts.

4—1872. ARMOR PLATE ON FORWARD LOWER WING GAP COVERS.

4—1873. DESCRIPTION. *(See figure 4—161.)* The left and right forward wing gap cover armor plates (7) are two sheets of homogeneous bulletproof steel 3/16 inch thick, 16 x 20 inches in size and weighing 10.70 pounds each. They are bolted to the inside left and right forward portion of the lower wing gap covers.

4–1874. INSTALLING.

a. Remove the left and right lower wing gap cover panels; see paragraph 4–480 steps a., through d.

b. Locate the four attaching points on each panel.

c. Remove the four bolts provided at the corners of each panel.

d. Place armor plates in positions on forward inside portions of panels.

e. Align holes.

f. Insert bolts and fasten armor plate securely.

4–1875. ARMOR PLATE ON AFT LOWER WING GAP COVERS.

4–1876. DESCRIPTION. *(See figure 4–161.)* The left and right aft wing gap cover armor plates (6) are made of homogeneous bulletproof steel 3/16 inch thick, 14 x 15 1/2 inches in size, and weighing 8.42 pounds each. The plates are bolted to the inside skin of each panel by means of countersunk head bolts.

4–1877. INSTALLING.

a. With the left and right hand lower wing gap covers removed, note four bolts provided on aft portion of panels for armor plate installation.

b. Remove bolts from panel.

c. Align holes of panel with holes on armor plate.

d. Insert bolts and fasten armor plate securely.

4–1878. ARMOR PLATE ON FORWARD BOTTOM ENGINE ACCESSORY COMPARTMENT COWL PANEL.

4–1879. DESCRIPTION. *(See figure 4–161.)* The armor plate (13), installed on the panel just forward of the intercooler flap, is a sheet of homogeneous bulletproof steel, $\frac{3}{16}$ inch thick and $5\frac{1}{4}$ x $21\frac{1}{2}$ inches in size, weighing 13.15 pounds. The armor plate is cut out to allow access to the front pylon attachment and to the carburetor air box valve. At the center of the bottom panel, a clip is installed for armor plate attachment. Additional points of attachment for the armor plate are provided at the four corners of the panel. Bolts are used throughout the installation.

4–1880. INSTALLING.

a. Remove forward bottom panel; see paragraph 4–480e.

b. Locate the attaching points on the panel.

c. Place armor plate on inside of panel and align holes.

d. Insert bolts and fasten armor plate securely.

4–1881. INTERCOOLER FLAP ARMOR PLATE ASSEMBLY.

4–1882. DESCRIPTION. *(See figure 4–161.)* The intercooler flap armor plate assembly (5) replaces the Metalite intercooler flap when engine armor is installed. If provided, the intercooler flap armor plate assembly has all the required features of interchangeability, with respect to its three points of attachment to the bottom of the fuselage, as are found on the Metalite intercooler flap assembly. The armor plate is a sheet of 24ST aluminum alloy, 1/2 inch thick, 23 1/8 x 34 1/2 inches in size, weighing 36.31 pounds. It forms the outer surface of the intercooler flap assembly and provides the attaching point for the forward hinge and aft end lug fittings, for the water injection pump, and strainer supports.

4–1883. INSTALLING.

a. Break hose connections at water pump and strainer, mounted on Metalite intercooler flap.

b. Remove Metalite intercooler flap by making the necessary quick-disconnects in accordance with paragraph 4–480 f. and g.

c. Unfasten water pump and strainer on Metalite panel.

d. Reinstall water pump and strainer to their supporting brackets on armor plate intercooler flap.

e. Install armor plate intercooler flap assembly by reversing the removal procedure as directed in paragraph 4–480 f. and g.

4–1884. MAINTENANCE OF AIRCRAFT SURFACES.

4–1885. DESCRIPTION. The skin and structure of the fuselage and wings are constructed primarily of aluminum alloy. Ailerons are constructed of fabric-covered plywood. The movable tail surfaces, with the exception of aluminum alloy tabs, are fabricated of aluminum alloy covered with unsupported fabric. The fin is of aluminum alloy, while the stabilizers are fabricated of Metalite with replaceable aluminum alloy tips. The cockpit floor, hydraulic panel, radio compartment step, floor installation between stations 199 1/2 and 218, intercooler flap and radio compartment shelves are also fabricated of Metalite. Magnesium is used for the fuel cell access panel (top cowl cover), fuel cell access door, windshield deck cowl, windshield cowl and tail cone as well as for castings. Plexiglas is used for the canopy and side panels of the windshield.

4–1886. METALITE.

4–1887. DESCRIPTION. The stabilizers, fixed cockpit floor, hydraulic panel, radio compartment door step, floor installation between stations 199 1/2 and 218, intercooler flap, and the radio compartment shelves are constructed of Metalite. Since Metalite is a new material, it is considered advisable to acquaint personnel who will work on Metalite with the differences between riveting and bolting through Metalite and through standard aluminum alloys. Metalite is a sheet assembly, consisting of a core of low density balsa wood with high strength aluminum alloy faces bonded to each side of the core. The grain direction in the balsa core is perpendicular to the aluminum alloy faces, and the three layers are bonded firmly together by special adhesives under controlled pressures and temperatures. The skins used in the fabrication of the various Metalite portions of the airplane consist of 24ST and 24ST-81 aluminum alloy sheets of .008 to .051 gage, bonded to balsa wood cores ranging from 1/4 inch to 1 1/4 inch thick. Internal and external aluminum and phenolic reinforcements are bonded to the Metalite panels where necessary, and mahogany inserts are used in many places for the installation of rivets.

4–1888. INSPECTING. All exposed Metalite edges must be sealed to prevent corrosion. All bonds of wood-to-metal and metal-to-metal must be secure. Visual inspection will reveal any unsealed Metalite edges. Adhesion of the metal faces of Metalite to the core can be checked by lightly tapping the skin with a small piece of metal such as a coin. A sharp ringing sound indicates a satisfactory bond; where a dull, flat and blurred sound indicates unsatisfactory adhesion. Metal-to-metal bonds can be checked by using a putty knife.

4–1889. RIVETING AND BOLTING PROCEDURES.

4–1890. DRILLING. Experience has shown that it is best to use a 67° angle drill through Metalite. A little more care should be taken when drilling through Metalite than when drilling through aluminum alloy, in order to prevent the core from tearing excessively and to prevent the bottom skin from tearing away from the core. Use a full size drill for holes up to 3/16 inch diameter, but when drilling larger holes, use a slightly undersize drill first, and then ream holes to full size. All holes in external surfaces are machine countersunk for 100° head rivets or bolts. Swab all holes with zinc chromate primer before inserting rivets or bolts.

4–1891. RIVETING. Standard type solid rivets cannot be driven in Metalite with a balsa wood core because the core may crush and the rivet shank buckle due to the force required to head the rivet. Cherry, hollow, tubular, and semi-tubular rivets may be driven through Metalite because they will not crush the core. However, it is permissible to drive standard AN rivets through mahogany inserts. Since mahogany inserts are used in many of the Metalite assemblies of the airplane, all of the above-mentioned types of rivets are used. It is advisable when replacing rivets to use the same type of rivets as the replaced rivets. However, it is permissible to use the next size larger Cherry rivets in place of solid or semi-tubular rivets, if the formed head of the rivet is inaccessible.

4–1892. Rivets may be removed by drilling out the head and punching the rivet through the hole. However, use extreme care in removing rivets, so as not to elongate the hole and tear the metal face away from the core. Washers should be used under the formed head of semi-tubular rivets to insure a tight rivet.

4–1893. BOLTING. Flush head, hex head, and round head screws and bolts are all used through Metalite on the F4U-5 airplane. All bolts fastened through the balsa core must be installed with aluminum spacers as follows:

a. Drill the hole 1/16 inch oversize.

b. Install a 1/32 inch wall spacer.

c. Install the proper size zinc-chromate covered bolt.

4–1894. When installing bolts through mahogany inserts, drill the holes full size and install bolts. A certain amount of care must be exercised when installing bolts through Metalite to prevent the core from crushing.

4–1895. TORQUE VALUES.

a. The following torque values are recommended for installing bolts through Metalite with balsa core and aluminum spacers:

3/16″ bolt – 20 to 25 Pound-inches
1/4″ bolt – 30 to 35 Pound-inches
5/16″ bolt – 30 to 35 Pound-inches

b. The following torque values are recommended for installing bolts through Metalite with a mahogany insert:

3/16″ bolt – 15 to 20 Pound-inches
1/4″ bolt – 25 to 30 Pound-inches
5/16″ bolt – 25 to 30 Pound-inches

4–1896. CLEANING AND FINISHING. The general surface inspection directed in paragraphs 4–1908 through 4–1910 and the cleaning and finishing procedures given in paragraphs 4—1911, 4—1912 and 4—1914 through 4—1920 apply to Metalite.

CAUTION

When removing the finish from the surfaces of Metalite, extreme care should be exercised to remove as little of the primer as possible. This is necessary because the metal surfaces have not been anodized, and the primer has been applied by means of a special surface treating process to insure the proper adhesion to the metal. In addition, care should be exercised when handling the Metalite hydraulic panel to avoid damaging the wood edges of the panel. These edges are protected by a coat of aluminized varnish and, if damaged, should be resealed by giving the surface one coat of varnish and a second coat of aluminized varnish.

4—1897. MAGNESIUM.

4—1898. DESCRIPTION. Magnesium is used for the fuel cell access panel (top cowl), fuel tank access door, windshield deck cowl, windshield cowl, and tail cone as well as for castings.

4—1899. CLEANING. The general inspection directed in paragraphs 4—1908 through 4—1910 and the cleaning procedures given in paragraphs 4—1911, 4—1912, 4—1914 and 4—1915 apply to magnesium.

4—1900. FINISHING. Magnesium alloy parts which have been scratched or reworked, must have the bare areas treated with chrome pickle solution. Painted parts on which raw areas have been treated, shall have the complete paint schedule replaced after the chrome pickle treatment. Parts reworked after installation in the airplane which cannot be satisfactorily or safely treated in accordance with the above procedure, shall be thoroughly cleaned and touched up with a coat of primer, which will be in addition to the normal paint schedule. If any unfinished magnesium parts are installed:

a. Interior surfaces shall receive three coats of zinc chromate primer, the last of which may be "cockpit green," if desired. One coat of lacquer may be applied in addition to the three primer coats, if required, to match adjacent surfaces. It is important that at least one coat of zinc chromate primer be applied immediately following surface treatment.

b. Exterior magnesium surfaces shall receive two coats of zinc chromate primer and two or more coats of pigmented lacquer to match adjacent surfaces.

Note

Dissimilar metal contacts involving magnesium alloys shall be insulated with zinc chromate primer and Neoprene (protective and waterproof) tape, Spec. N-9 grade "A," whenever practicable.

4—1901. PLEXIGLAS.

4—1902. DESCRIPTION. Plexiglas (acrylic plastic) is used in the sliding section and the windshield. The plexiglas surfaces should be checked daily for cracks, holes, and scratches.

4—1903. CLEANING PLEXIGLAS EXTERIOR SURFACES.

a. Flush the exterior surface liberally with a spray of water, using the bare hand gently to feel and dislodge any dirt, sand, salt, or mud. A soft cloth or chamois well soaked with water may also be used.

b. Wash with soap and water. Be sure the water is free of dirt or other possible abrasive matter. A soft cloth may be used in washing, but only as a means of carrying soapy water to the plastic. Go over the surface with the bare hand only, so that any dirt can be quickly detected and removed before it scratches the plastic surface.

c. Dry, preferably with a clean, damp chamois. However, a clean, soft cloth or soft tissue may be used if care is taken not to continue rubbing the acrylic plastic after it is dry.

Note

Extreme care must be exercised in the above operations to avoid covering the surface of the plastic with numerous fine scratches.

d. Remove oil, grease, paint specks, rubber adhesive, masking material, or other foreign matter that is difficult to remove, with Noxon cleaner applied gently with a soft cloth.

CAUTION

Kerosene or aliphatic naphtha may be substituted for the Noxon; but cleaning agents such as aviation or ethyl gasoline, fire extinguisher fluids, lacquer thinners, or window sprays containing any of these solvents will soften and craze the plastic surface and must not be used.

e. Do not rub Plexiglas with a dry cloth, since this is not only likely to cause scratches, but it also builds up an electrostatic charge which attracts dust particles to the surface. If the surface does become charged, patting, or gently blotting with a clean, damp chamois will remove the charges as well as the dust.

f. If there is no water available for cleaning purposes, use a soft cloth bunched loosely in the hand and dust the surface of the Plexiglas *lightly* to remove dirt and salt particles. Shake out the cloth frequently to free it of clinging dirt. Never *rub* the surface. Cleaning acrylic plastic by dusting with a dry cloth is recommended only if water is not available. It is not considered as satisfactory a cleaning method as flushing with water.

g. If, after removing dirt and grease, no great amount of scratching is visible, the plastic should be waxed with a good grade of commercial wax (such as 3M Automotive Wax). Waxing will fill in minor scratches and help prevent further scratching. The wax should be applied in a thin, even coat and brought to a high polish by rubbing lightly with a clean, soft, dry cloth. Never *rub* a dirty surface.

h. If, after removing dirt and grease, the plastic surface is found marred by scratches, apply a suitable polish (such as 3M Synthetic Compound) by hand, using a soft, clean cloth as an applicator and another soft, clean cloth to remove the polish. Several applications may be necessary to restore suitable clarity to the scratched area. Then wax as described in step g. above.

CAUTION

Do not attempt hand polishing until the surface is clean. If dirt, grit, or sand is present during this operation, it may cause more serious damage than the original scratches. Since even skillful sanding, buffing, or polishing may introduce slight optical distortions, these operations should not be performed on the windshield or sliding section, if they will affect the pilot's visibility. Instead, these parts should be washed and waxed only. If they are damaged by a number of deep scratches, they should be replaced.

4–1904. CLEANING PLEXIGLAS INTERIOR SURFACES.

a. Dust the plastic surface lightly with a soft, clean cloth. Do not wipe the surface with a *dry* cloth.

b. Wipe carefully with a soft, *damp* cloth or sponge. Keep the cloth or sponge free of grit by rinsing it frequently in clean water.

4–1905. FABRIC.

4–1906. DESCRIPTION. Fabric is used as a covering on the movable tail surfaces with the exception of aluminum alloy tabs and ailerons.

4–1907. MAINTENANCE. Fabric patching shall be done in accordance with approved practices. Refer to Handbook of Instructions for Structural Repair, Navy Model F4U-4 Airplane (AN01-45HB-3). Note the varying methods of treatment recommended for supported fabric (on aileron) and unsupported fabric (on rudder and elevator).

4–1908. GENERAL CLEANING AND FINISHING.

4–1909. DESCRIPTION. This section has been prepared to provide field personnel with sufficient information for the cleaning and finishing of parts repaired, replaced and added in service. Materials originally used in the finishing and protection of the aircraft are specified in the text where their use is directed and in table form in paragraph 4–1921. These materials or their equivalents shall be used in all cleaning and refinishing operations whenever possible. In order to obtain highest possible speed and lowest drag, it is extremely important to provide a smooth, aerodynamically clean exterior finish. Therefore, all cleaning and finishing must be done carefully and accurately.

4–1910. GENERAL INSPECTION. Repaired parts from which the original finish has been partially or completely removed, parts with corroded, cracked or chipped finish, and unfinished replacement parts must be thoroughly cleaned before application of the new protective finish. Corrosion can be detected by its blistering discolorations of painted surfaces, and incrustations (generally white in color). Grittiness to the touch will generally confirm the presence of corrosion. Where there is excessive pitting and deterioration, the part should be repaired or replaced. However, where there is only a slight pitting, the part should be cleaned and finished in accordance with the procedures that follow. Check all seams, bolt and screw recesses, etc., for loose or missing putty filler.

4–1911. CLEANING.

4–1912. CLEANING GREASE AND OIL. Grease and oil may be removed by the use of solvents.

Care must be taken to remove all traces of this solvent from parts fabricated of aluminum alloy and to avoid bringing it into contact with rubber or synthetic rubber parts. Aqueous alkaline cleaning solutions, such as a hot Oakite Aviation Cleaner, may be used to clean aluminum alloy or magnesium alloy parts.

4–1913. REMOVING WELDING FLUX.

a. Aluminum alloy parts which have been repaired by welding, must have the flux thoroughly removed by scrubbing the welded areas with a stiff brush, using hot water and subsequently dipping in a cold 10% (by weight) sulfuric acid solution. After removal from the solution, the part shall be rinsed thoroughly with hot water and air-dried. Parts from which it is not practicable to remove all the organic finish, may have the finish removed only in the area of the weld.

b. Welded steel parts shall be cleaned by shot or sand blasting. Apply an extra coat of primer to welded replacement parts which cannot be plated after installation.

c. Stainless steel may be cleaned by blasting with clean sand grit which has not been used for blasting other carbon or alloy steels.

CAUTION

Avoid contaminating any cleaned part by touching with bare hands, dirty gloves or dirty rags during the interval between cleaning and painting.

4–1914. CLEANING EXTERIOR SURFACES. The finished exterior surface of the airplane contains at least one coat of zinc chromate primer. Two coats of zinc chromate primer are applied over all exterior surfaces of magnesium components. Two or more coats of surfacer are applied where desirable to improve surface smoothness over scratched or wire-brushed areas. Three coats of glossy sea blue gloss lacquer are applied over the surfacer except for the top area forward of the windshield which receives non-specular sea blue lacquer. The surfaces are then polished and waxed. For surfaces that are chipped, corroded, cracked, or scratched to the bare metal, it is necessary to clean off completely the old finish adjacent to the affected area before applying a new finish. However, if the surface is scratched only part of the way through the finish, it is necessary only to clean the surface to the depth of the scratch. Primer, surfacer, or lacquer can be removed by continually soaking the surface with lacquer thinner or equivalent solvents and scraping the finish with a spatula or paint scraper. Proper precautions must be taken when using these highly inflammable materials, and care should be taken not to gouge or scratch any of the metal surface when using the scraper or spatula.

4—1915. CLEANING INTERIOR SURFACES. The interior surfaces have one coat of zinc chromate primer, except for magnesium parts which have three coats of zinc chromate primer. The surfaces of the cockpit are painted with "cockpit green" or standard instrument black lacquer. The third primer coat on magnesium parts is painted "cockpit green". Interior surfaces that are chipped, corroded, cracked, or scratched should be cleaned with thinners such as toluol or dope and lacquer thinners or equivalent solvents.

4—1916. FINISHING.

4—1917. GENERAL. Clean all surfaces thoroughly (refer to paragraph 4—1908 through 4—1915) before applying any protective finish. Apply the first coat of finish immediately after cleaning or as shortly thereafter as possible. Apply protective finishes in well-ventilated and temperature-controlled rooms, if available. Avoid damp sea breezes, dusty air, and similar conditions.

Note

Insulate all dissimilar metal contacts by applying two coats of zinc chromate primer to each faying surface. Dissimilar metal contacts involving magnesium alloys require the use of neoprene (protective and waterproof) insulating tape, Spec. N-9, Grade "A", in addtion to the primer.

4—1918. FINISHING EXTERIOR METAL SURFACES. To improve the adhesion of zinc chromate primer to the metal surfaces, all exterior metal surfaces are treated *after cleaning* with surface treating solution as follows:

a. Apply a uniform, wet film of surface treating solution (made up of one part of Metalprep "Washoff" or Turco WO-1 mixed with two parts of water by volume) with a brush or with clean cloths soaked in the solution.

Note

Operators who may come in contact with the surface-treating solution shall wear rubber gloves. If the solution comes in contact with the skin, it should be immediately flushed off with water or dilute sodium bicarbonate solution. Do not touch with bare hands or contaminate the surface in any way following cleaning or the application of the surface treatment.

b. A continuous, wet film of surface treating solution shall be maintained on the surface for from three to five minutes.

c. After three to five minutes, remove the residue entirely by wiping with a clean, dry cloth.

d. Wipe surface with clean cloths dampened with water and dry with clean, dry cloths.

e. Apply zinc chromate primer immediately, as directed in paragraph 4—1919.

4—1919. After the exterior surfaces have been prepared for the application of the zinc chromate primer, they should be finished as follows :

a. Apply one thin, uniform coat of primer, which is made of two and one-half volumes of thinner (consisting of 90% toluene and 10% butyl alcohol), mixed thoroughly with one volume of zinc chromate primer paste. Allow to dry for at least two hours

b. Spray the first coat of Pratt and Lambert Surfacer No. 201-506 (dark grey) which has been thoroughly stirred and mixed with lacquer thinner (in the ratio of two parts of surfacer to one part of thinner) to all seams, rivets, joints, etc., and allow to air-dry at least fifteen minutes.

c. Apply DuPont No. 228-711 putty in excessively deep impressions, seams, etc. Use a squeegee or flexible steel putty knife to force the putty down into the seams or depressions. Smooth putty with a solvent-saturated cloth and allow to air-dry for a minimum of two hours.

d. Sand over puttied areas only with No. 280 or No. 320 Wetordry sandpaper until the putty is flush with the surface. Allow to air-dry for at least 30 minutes before proceeding with the next operation.

e. Spray the second coat of Pratt and Lambert surfacer No. 201-506 to all seams, rivets, joints, etc., and allow to dry at least fifteen minutes.

f. Sand the entire surfaced area with No. 280 or No. 320 Wetordry sandpaper. Use a squeegee or clean cloth to remove grit or dust and allow to dry at least 30 minutes.

g. Spray the additional coats of Pratt and Lambert surfacer No. 201-506 over the exterior surfaces as may be required for obtaining a satisfactory "build-up", using the spraying and sanding technique.

h. After sanding and cleaning the final coat of surfacer, allow at least 30 minutes before applying the lacquer top coats.

Note

If any sanding operation results in the removal of the primer coat, exposed metal surface shall be reworked and entire finish reapplied.

i. Prior to the application of each coat of lacquer, wipe the area with a tack rag. The high gloss lacquer shall be reduced for spraying by thoroughly mixing two volumes of sea blue high gloss lacquer with two volumes of lacquer thinner and one volume of blush-retarding thinner. Apply a full, wet coat of lacquer as heavily as the contour of the surface permits. Allow a minimum of two hours drying time.

j. Scuff-sand the second coat lightly with No. 320 Wetordry sandpaper, and wipe with soft, clean cloths.

k. Apply the third coat of lacquer and allow a minimum of 48 hours to dry prior to further handling. Apply two coats of non-specular lacquer where necessary and allow the same drying time as required above.

l. After the lacquer has dried, dry sand lightly and evenly with No. 600 Wetordry sandpaper. Particular attention shall be paid to dried overspray and to blended areas in order to remove any roughness that may exist. Special care shall be taken in sanding raised rivets, edges, and other surfaces elevated above the contour of the skin of the aircraft. Sanding shall be accomplished by using a block with all corners rounded. A power-driven sander shall not be used.

m. Glossy, lacquered surfaces should be polished by hand or machine with Lee's Automotive Rubbing Compounds or equivalent polishing compound. Hand rubbing produces a superior finish. Apply the polishing compound and then rub with a clean, dry cloth or mechanical buffer.

n. Finally, wax the surface with Aerogroom Wax or equivalent. Proper precautions should be taken throughout the cleaning and finishing of a surface to insure a smooth finish. All material and instruments should be carefully checked to insure proper operation and satisfactory results.

4—1920. FINISHING INTERIOR SURFACES. Interior surfaces, except magnesium parts, shall receive at least one coat of zinc chromate primer. Magnesium plates and fittings shall receive three coats of zinc chromate primer. Interior surfaces in the cockpit are painted with either "cockpit green" or standard instrument black lacquer top coats.

4—1921. TABLE OF CLEANING AND FINISHING MATERIALS.

MATERIAL	USE	SPECIFICATION
SURFACE TREATING SOLUTIONS.		
Metalprep "Washoff"	Surface treatment	Comm. (Neilson Chemical Co., Detroit, Michigan)
Turco WO-1	Alternate for Metalprep	Comm. (Turco Products, Inc., Philadelphia, Pa.)
3M Synthetic Compound	Clean Plexiglas	Comm. (Minnesota Mining and Mfg. Co., St. Paul, Minn.)
Aliphatic Naphtha	Clean Plexiglas	AN-N-3
Titanine "Ti-Two"	Cleaning painted surfaces	Comm. (Titanine, Inc., Union, N. J.)
"Oakite" Aviation Cleanser	Clean aluminum, steel, or magnesium alloy	Comm. (Oakite Prod. Inc., N. Y., N. Y.)
CEMENT.		
Clear Sealer Adhesive No. 5499	To attach fabric to plywood	Comm. (DuPont Finishes Div., Philadelphia, Pa.)
Clear Adhesive No. 2662	Alternate for adhesive No. 5499	Comm. (Roxalin Flexible Finishes, Elizabeth, N. J.)
DOPES.		
Cellulose Acetate Butyrate, Clear	Fabric surfaces	AN-D-1
Cellulose Acetate Butyrate, Pigmented	Fabric surfaces (all colors)	AN-D-2
Fungicidal Dope	Fabric surfaces	AN-D-34
ORGANIC FINISHES.		
Zinc Chromate Primer (plain)	All prime coats — insulation of dissimilar metals	AN-TT-P-656a
Zinc Chromate Primer (cockpit green)	Cockpit	AN-TT-P-656a

MATERIAL	USE	SPECIFICATION
Pratt & Lambert Surfacer No. 201-506	Surfacing Outer Panels	Comm. (Pratt & Lambert, Buffalo, N. Y.)
Preparakote No. 65 Line	Alternate for Pratt & Lambert Surfacer	Comm. (DuPont de Nemours, 350 5th Ave., N. Y. C.)
Lacquer (High Gloss — Color: Sea Blue, 80° to 90° Gloss)	Exterior surfaces and finish	AN-L-29
Lacquer (Non-Specular — Color: Sea Blue)	Surface fwd. of windshield to reduce glare	AN-L-21
Instrument Black	Cockpit — to reduce glare	AN-L-29
POLISHING COMPOUNDS.		
Noxon cleaner polish	To clean and polish plastic	Comm. (Noxon, Inc., Ozone Park, N. Y.)
Polishing Compound	To polish plastic	AN-C-154
Lee's Automotive Rubbing Compounds	For polishing exterior finish (machine or hand rubbing type)	Comm. (Car-Bon-Tet Co., 95 Broad St., N. Y., N. Y.)
Formax	Alternate for Lee's Automatic Rubbing Compound	Comm. (Formax Mfg. Co. Detroit, Mich.)
WAXING COMPOUNDS.		
3M Automatic Wax	To wax plastic surfaces after cleaning, for polishing external finish	Comm. (Minnesota Mining and Mfg. Co., St. Paul, Minn.)
Aerogroom Wax	For waxing exterior surface after polishing	Comm. (Autogroom Co., Inc., 68-02 38th St., Woodside, L. I., N. Y.)
THINNERS.		
Toluene		AN-R-T-541
Butyl Alcohol		AN-O-A-391
Blush Retarder	Retard "blushing" of lacquer	AN-TT-T-258
Cellulose Acetate Butyrate Blush Retarder	Retard 'blushing" of dope	AN-T-28
Cellulose Acetate Butyrate Dope	Dope thinner	AN-T-27
Gulf Solvent "B"	Paralketone thinner	Comm. (Gulf Oil Company, Devon, Conn.)
Toluol Substitute	AN-TT-P-656 primer thinner	AN-T-8B
F-5284 Special Slow Drying Thinner	For thinning exterior lacquer	Comm. (Pierce & Stevens, Inc., Buffalo, N. Y.)
Nitrocellulose	Lacquer thinner	AN-TT-T-256
F-5488 Thinner	To clean surfaces prior to application of exterior top coat	Comm. (Pierce & Stevens, Inc. Buffalo, N. Y.)
MISCELLANEOUS MATERIALS		
Putty, DuPont No. 228-711	Aerodynamic smoothness	Comm. (DuPont de Nemours, 350 5th Ave., N. Y. C.)
Sandpaper No. 280, No. 320, No. 600, No. 400, and No. 500 Wetordry	High gloss exterior finish	Comm. (Minnesota Mining & Mfg. Co., St. Paul, Minn.)
Sheep's Wool Pads		Comm.
Felt Pads		Comm.
Soft clean white cloths, first grade (tack rags)		

SECTION V

ELECTRICAL AND ELECTRONIC SYSTEMS

5-1. ELECTRICAL SYSTEM.

5-2. DESCRIPTION. The electrical power for the F4U-5 airplane is supplied by a direct current, 28 volt installation. To provide adequately for the large electrical power requirements, a 28 volt, 200 ampere generator and a 24 volt, 17 ampere hour battery have been installed. The airplane uses a one-wire system since copper wiring is provided only on the positive side of the circuit. The negative side is carried through the structure, all parts of which are bonded electrically. All wiring forward of the firewall is encased in conduit, primarily as a mechanical protection for the wiring. All other wiring is installed in open bundles supported by clamps in various places throughout the airplane. Terminal panels and disconnects are strategically located to give maximum accessibility for maintenance purposes. The greater portion of the electrical system is controlled from the electrical and radio control panel at the right hand side of the cockpit. In addition to the control switches on the electrical and radio control panels, other electrical switches are installed on the left hand shelf, and the right and left armament switch boxes, the latter two located on the cowl deck. All of the various electrical circuits of the airplane pass from the circuit-breaker panel on the vertical face of the right hand control shelf through the main junction box, located beneath the cockpit floor. All wiring to the engine section, center section wing, outer panel wing, front fuselage, or rear fuselage may easily be separated at the main junction box. All the circuits in the airplane are protected by circuit-breakers located on the vertical side panel of the right hand control shelf. The circuit-breaker will remain closed during all normal operations, but an overload of sufficient magnitude will cause an operating element in the circuit-breaker to overheat. This overheating will distort the element in such a way that it breaks a pair of contacts, interrupting the circuit and causing the operating button of the circuit-breaker to pop out. After the circuit has been broken long enough for the distorting element to cool, the breaker may be reset by pushing the button back in. If the overload was temporary, the button will stay in and the circuit will continue to function normally. However, if the overload was due to a short circuit, or other similarly serious cause which would make the overload permanent, the circuit-breaker button will pop out again. This indicates that the circuit is useless until the short is corrected.

5-3. ELECTRICAL AND RADIO CONTROL PANEL.

5-4. DESCRIPTION. *(See figure 3-11.)* The electrical and radio control panels constitute the greater portion of the right hand control shelf. The components are: the five radio console panels, the exterior lights console and the electrical switch and circuit-breaker panel. The third unit has installed on its inclined surface the voltammeter, generator warning light, switches for battery, primer, starter, oil dilution, pitot heat and auxiliary hydraulic pump. The interior lights selector switch and control rheostat are located on the horizontal surface of this unit.

5-5. REMOVING. The control panel can be removed as directed in paragraphs 4-222 and 4-223.

5-6. INSTALLING. Reverse the removal procedure.

5-7. JUNCTION BOXES.

5-8. DESCRIPTION. There are three important wiring and equipment boxes, distributing wires to all the circuits: the main junction box, the engine section junction box and the firewall junction box. Decals giving simplified wire location will be found attached to the inside of each box cover.

5-9. MAIN JUNCTION BOX. The main junction box is located below the circuit-breaker panel, under the cockpit floor. It contains wiring from controls in the cockpit to all circuits and contains also the generator cutout (reverse current relay), and the armament, starter and battery relays. The box is mounted in a slanted position on brackets to the frames at station 149. It is reached through the belly access door. The main junction box cover is fastened down by six Camloc fasteners thereby permitting quick access to the inside of the box.

5-10. ENGINE SECTION JUNCTION BOX. The engine section junction box is located in the engine accessory compartment, outboard of the generator on the right hand side of the airplane. It is the common terminal box for engine electrical units and indicators. It has terminals for generator, starter, primer, magneto, intercooler, water pump, induction vibrator, cowl flap control and motor, auxiliary hydraulic pump, carburetor air temperature indicator, "oil-in" temperature indicator, tachometer, induction vibrator, water regulator, intercooler solenoid and intercooler flap switch. The segments from here are bundled and connected back toward the control panel through the firewall junction box. The engine section junction box is accessible with engine accessory cowling removed. The interior of box may be reached by removing six fasteners securing cover.

5—11. FIREWALL JUNCTION BOX. The firewall junction box is at fuselage station 100 mounted below the centerline on the main beam of the airplane. It contains the wires coming aft from the engine section box, and also has terminals for the oil cooler door valve, oil diverter valve motor, oil diverter switch, oil dilution valve, the intercooler flap position transmitter and the oil diverter relay. The firewall junction box is accessible through the intercooler flap. The junction box cover is fastened down by six Camloc fasteners, thereby allowing easy access to the inside of the box.

5—12. VOLTAMMETER AND VOLTAGE TEST JACKS.

5—13. DESCRIPTION. The voltammeter (NAF1091 A-240) is located on the inclined portion of the right hand electrical control panel. The voltmeter indicates the voltage at the plus bus in the main junction box, whereas the ammeter indicates the output of the generator. The voltmeter test jacks are located on the inboard vertical surface of the right hand control panel and are used to check the airplane's voltmeter against a standard meter.

5—14. REMOVING. The voltammeter is removed by loosening the four Phillips head screws and a small section of the panel around the instrument in order to get at the meter retaining screws and nuts and meter terminal lugs.

5—15. INSTALLING. Connect the meter wiring and fasten the meter to its supporting bracket. Install the small panel section over the meter.

CAUTION

Be careful that all terminal wires are correct as to polarity. An error will ruin the meter as soon as current is turned on.

5—16. GENERATOR.

5—17. DESCRIPTION. *(See figures 5—1 and 5—5.)* The General Electric aircraft generator is an engine-driven, air cooled prime power source for the 28 volt dc electrical system. Aircraft Bu. Nos. 121793 through 121892 are equipped with 2CM63B4 generators; aircraft Bu. Nos. 121893 and subsequent are equipped with 2CM70C1A generators. These generators are identical except for minor external modifications. It delivers power as desired, at all times that the engine is in operation above 1400 rpm other than when power comes from an outside source through the external power receptacle. It has a continuous power output rating of 6 kilowatts, a current rating of 200 amperes and a range of from 3,000 to 8,000 rpm. Looking from the commutator toward the drive end, this generator rotates in a clockwise direction. Minimum cooling air pressure drop across the generator is 6 inches of water. Inlet air temperature (maximum at sea level) is 40° centigrade (104°F). At the commutator end of the generator, a cup shaped housing receives cooling air brought from the left hand auxiliary air inlet elbow through the generator blast tube. The blast tube is a flexible rubber hose assembly which is routed from left hand side of airplane over accessory compartment to generator.

5—18. LOCATION AND ACCESS. The generator is mounted on a pad on the forward side of the engine accessory drive housing. It is secured by nuts to four studs on the engine mounting pad. It is located in the engine accessory compartment to the right of the airplane centerline, between the starter and the engine section junction box.

5—19. TROUBLE SHOOTING. Normal service troubles of the generator will be apparent through lack of voltage, or low or irregular readings on the voltammeter. It is, however, important that the voltage regulator and reverse current relay be considered when there is trouble in the power supply circuit.

CAUTION

Turn battery switch "OFF" before attempting to service the generator.

a. Inspection should include mounting studs, generator external surfaces and electrical connections.

b. At 60 hour check remove the brush inspection band and air inlet cover. Clean the cover and inspect for any possible blocking of free passage of air.

c. Check for loose parts, broken screws, loose bearing retaining nuts, defects in the cross connector, cracks or dents in the brush rigging end shield, drive end bearing support and terminal block.

d. Examine for dust or dirt in the interior of the generator, and for grease or oil on the commutator or brushes. If oil is present on the commutator, remove the oil with a clean, lintless cloth and replace the brushes. Also, brushes worn 5/16 inches, or down to where the length of brush remaining is 9/16 inches, should be replaced. (See paragraph 5—23b.)

e. The commutator should have a smoothly worn, glossy appearance. Any nicks, scratches, dullness or sign of uneven wear should be corrected by replacement or proper adjustment of the brushes. Patches of black indicate commutator trouble and generator should have shop servicing.

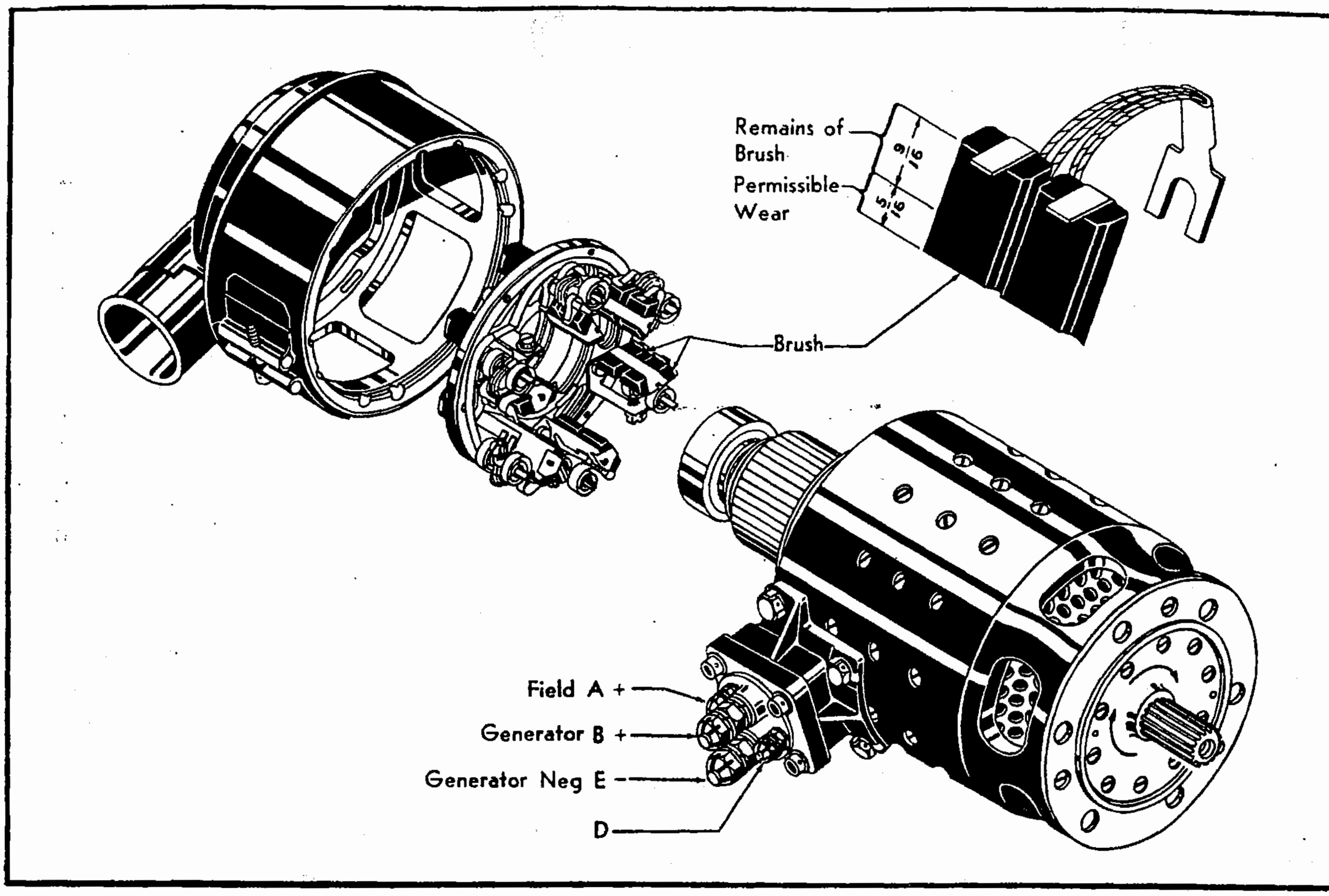


Figure 5–1. Generator Brush—Permissible Wear.

5–20. REMOVING.

a. Generator is accessible with top accessory panel and right hand upper wing gap cover removed.

b. Be sure that the battery switch is "OFF."

c. Disconnect the blast tube at air inlet coupling on generator.

d. Disconnect generator wiring.

e. Remove generator mounting nuts.

f. Support the generator until the spline shaft is fully withdrawn from engine, and lift from engine. Carelessness here will damage the generator spline.

5–21. CLEANING. Interior and exterior of generator should be kept clean and free from grease, oil, dirt or small pieces of metal worn from brushes or commutator. Such metals can cause serious damage. Accessible parts should be wiped carefully with a hard cloth soaked with unleaded gasoline, and the commutator and armature should be cleaned with a brush dipped in the fluid. All parts should be air dried. If petroleum spirits are used, for personal safety, be sure there is suitable ventilation. Also bake the armature dry at 100° to 125° C (212° to 257°F) if the latter fluid is used.

5–22. LUBRICATING. Under normal conditions the generator needs lubrication only at overhaul periods. Oil, Spec AN-G-5, is the proper lubricant for the bearing; see paragraph 5–23d.

5–23. REPAIRING.

a. Clean as directed in paragraph 5–21.

b. Permissible wear for brushes is 5/16 inch, leaving 9/16 inch remaining length of the brush; see figure 5–1. Brushes should be replaced at each 60 hour check, even though maximum wear has not occurred, in order to insure proper operation during the next 60 hours. New brushes should be broken in with generator running at 3,000 rpm. They should seat easily into the brush retainer. Clean dirt from brushes, or corrosion from retainers, with a cloth moistened in unleaded gasoline or other suitable solvent. Let the brushes dry thoroughly before they are put back, and always be sure they are put back exactly as they came out.

CAUTION

Be sure the brush leads are not twisted. Do not use sandpaper, emery cloth or other abrasive to seat the brushes. Particles of grit lodging on brush face through use of abrasives will affect commutator or seriously shorten brush life.

c. Inspect commutator; see paragraph 5–19e.

d. No oil should be found in the generator, except in and around the bearings. If oil is found on the armature of commutator, remove the generator and examine the engine oil seal.

5–24. INSTALLING.

a. Remove the shipping plug from the engine if installed.

b. Clean engine contact surfaces and apply a coat of zinc chromate primer.

c. Attach and secure the generator mounting nuts.

d. Safety wire bolts as required.

e. Attach blast tube to air inlet on generator.

f. Connect the generator wiring. *See figure 5–1 for proper terminal connections.*

5–25. TESTING. With the airplane engine running:

a. Disconnect external power supply.

b. Turn on battery switch.

c. Turn on some electrical equipment such as lights, instruments, or radio.

d. Rev up the engine past 1400 rpm to close the reverse current cutout. The generator warning light should go out.

e. As a further check, turn off the battery switch; if the lights previously turned on remain on, the reverse current cutout has closed.

f. Increase the engine rpm and watch the voltmeter. The voltage should increase to about 28 volts and stay there regardless of further increase in engine rpm.

g. If the reverse current cutout does not close, or if the voltmeter does not read between 27.5 and 28.5 volts, correction should be made prior to takeoff.

5–26. VOLTAGE REGULATOR.

5–27. DESCRIPTION. The voltage regulator *(see figure 5–5)* is a General Electric, carbon pile, 3GED2B1 type. It serves in the system to regulate the generator output to a steady level (approximately 27.5 volts) regardless of speed, load or temperature changes, by controlling the generator shunt field current. Essentially the regulator consists of a carbon pile resistor acted upon by an armature, the latter being controlled through a magnet frame and coil. The pile, supported by an insulating glass tube is compressed between the pile screw and the armature plunger. The pile screw is on the end terminal assembly and consequently its adjustment determines the working output of the generator. The plunger, mounted on the armature, transmits its movement to the pile. Magnetic attraction of the frame and core for the armature, which is opposed by the leaf spring, controls the pressure on the carbon pile. The common assembly is mounted on a shock absorbing base. The base also supports the voltage adjusting rheostat, the series resistor, the stabilizing resistor and six contact studs. The rheostat is connected in series with the potential winding and is used to adjust the regulated voltage initially to the desired level.

5–28. LOCATION AND ACCESS. The voltage regulator is installed on a bracket located on the bottom panel, between stations 193½ and 199½, slightly to the right of the airplane's centerline. The voltage regulator test jacks are mounted to the frames directly above the voltage regulator. Both the voltage regulator and the test jacks are accessible through the radio compartment access door.

5–29. TROUBLE SHOOTING.

a. Normally no maintenance between overhaul periods is required, other than occasional adjustment of the pile screw and visual inspections.

CAUTION

Do not lubricate the voltage regulator.

b. During operation, the carbon pile discs will gradually wear, and this shows up as a rise in regulated voltage over a period of time. When this occurs, the regulator should be removed from the airplane and readjusted in the shop, using procedure described in paragraph 5–32.

Note

It is *not* recommended that adjustment of the carbon pile discs be made while the voltage regulator is installed in the airplane, since excessive engine warm-up would result in order to get the regulator hot before making adjustments.

c. After 60 hours, the voltage regulator should be taken out and given a thorough bench test inspection and check; see paragraph 5–32.

Trouble	Probable Cause	Suggested Remedy
Generator Voltammeter Reads Zero, Voltage Normal.	*a.* Faulty reverse-current relay.	*a.* Replace relay.
	b. Faulty battery switch.	*b.* Replace switch.
	c. Faulty wiring.	*c.* Make sure all connections are clean and tight. Check wiring; *see figure 5-5,* Check wiring for shorts, grounds, open circuits.
No Voltage.	*a.* No excitation on generator due to shunt field circuit not being completed. Fault is in connections, regulator, or open field.	*a.* Check continuity (ohmmeter, bell or lamp circuit, or by mechanical tracing of leads) from generator field through the carbon pile and back to the generator ungrounded terminal. (Proper connections are shown in Figure 5-5.) Measure resistance of generator field. If field is open-circuited, replace generator. If regulator is open-circuited, replace it. Correct any defective wiring.
Voltammeter Reading Too Low.	*a.* Faulty regulator adjustment.	*a.* See paragraph 5-34.
	b. Engine not up to speed.	*b.* Take reading again at more than 1400 rpm.
	c. Generator brushes out of adjustment.	*c.* See paragraph 5-23b.
Voltammeter Reading Too High.	*a.* Wear in voltage regulator carbon pile.	*a.* See paragraph 5-29b.
	b. Burned out regulator coil or defective wiring.	*b.* Check wiring. If wiring is all right, remove regulator for servicing.
Unstable Operation.	*a.* Wear in carbon pile.	*a.* Adjust pile screw. See paragraph 5-29b.
	b. Incorrect generator characteristics may cause regulator instability. Check regulator on another generator to see which is faulty.	*b.* Check generator brushes as in paragraph 5-23b.

5–30. REMOVING. Access to the voltage regulator is through the radio compartment door.

a. Remove four mounting screws from the resilient mounting base.

b. Disconnect wires at terminals, and remove the regulator.

5–31. REPAIRING.

a. Tighten all screws and nuts, except the core screw, pile screw and rheostat adjustment screw.

b. Replace broken, worn, cracked or burned leads with new leads of the same size and color.

c. Replace broken terminals and resolder loose terminals.

5–32. TESTING AND ADJUSTING — VOLTAGE REGULATOR REMOVED FROM AIRPLANE.

a. Set up the voltage regulator on a test stand which has a transi-torque, operating a 200 ampere generator, and a 0-30 dc volts test standard.

b. Connect the positive and negative wires from the generator to a 160 ampere load bank. Connect the voltage regulator and voltmeter as shown in figure 5–2.

c. Warm up the voltage regulator at 1000 rpm generator speed for 30 minutes with no load on the generator.

d. Apply 160 ampere load to the generator for approximately two seconds, three successive times.

e. With no load on the generator, adjust the rheostat adjusting screw until the voltmeter reads exactly 28 volts.

Note

If the voltmeter reads above 28.5 volts or below 27.5 volts, replace the voltage regulator.

f. Apply a 160 ampere load. Voltage should not drop below 27.7 volts at this load.

Note

The testing instructions in this paragraph pertain to adjustment using the rheostat screw. The carbon pile screw should not be turned during this testing.

5–33. INSTALLING.

a. Mount the voltage regulator on the resilient mounting base and install the four screws.

b. Make the proper connections; *see figure 5–5.*

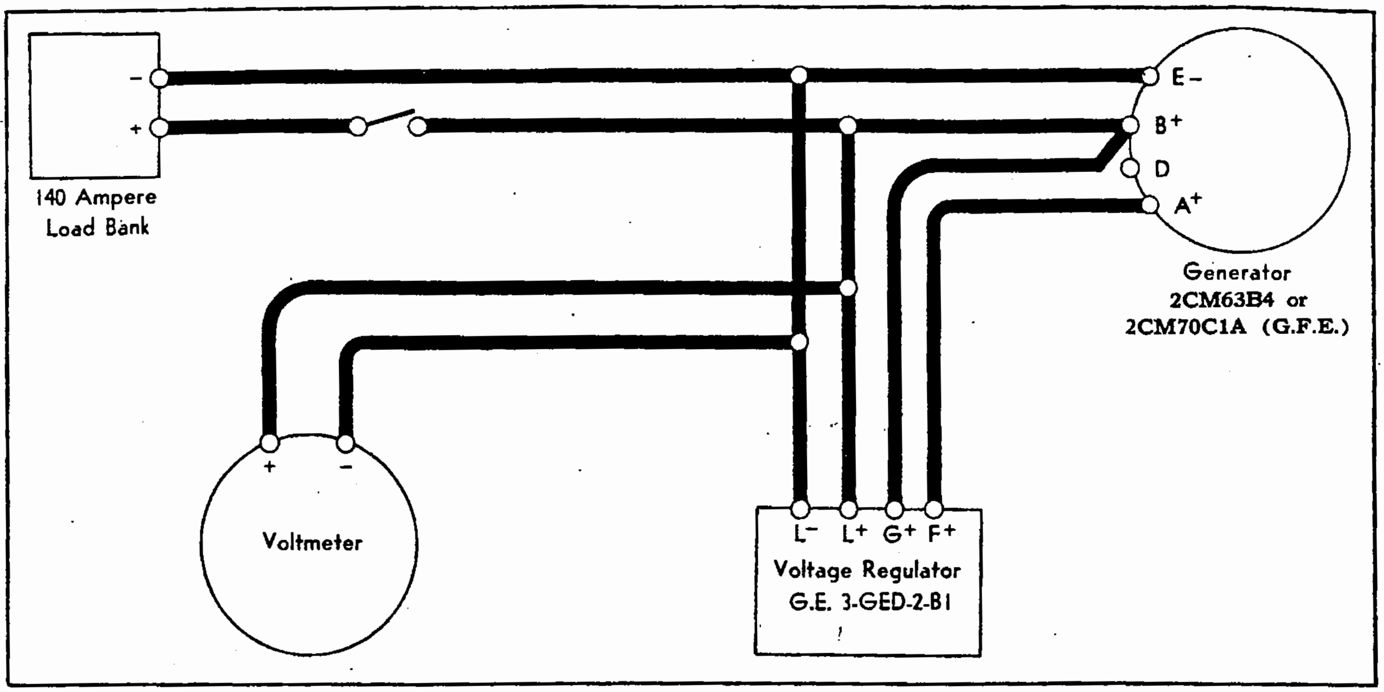


Figure 5–2. Adjustment Set-up for Voltage Regulator.

5–34. TESTING AND ADJUSTING-VOLTAGE REGULATOR INSTALLED IN ENGINE.

a. Connect a portable 0-30 volts dc test standard.

b. Run the engine up to 2400 rpm and turn off as much of the electrical load as possible.

c. The no-load or minimum-load voltage should be 28.0 volts. If the test meter reads other than 27.5-28.5 volts, loosen the lock nut and turn the rheostat adjusting screw until a reading of 28.0 volts appears on the meter. Retighten the lock nut.

Note

The rheostat is for initial adjustment only. No adjustment of the pile screw or core screw should be made at this time.

5–35. OPERATIONAL CHECK. Switch on the load, such as radio or lights. As the load is applied, the voltage on the test meter should drop not more than 0.3 volt. If the drop is greater than 0.3 volt, or if the voltage rises, the regulator should be removed and sent to the repair shop.

a. With normal airplane electrical load turned on, make the following operational check of the voltage regulator.

b. Run the engine at 2000 rpm with a minimum load. The test meter connected to the test jacks should now read between 27.5 and 28.5 volts. If voltage reads above 28.5, and this maximum has appeared gradually over a period of time, the pile screw needs adjustment (see paragraph 5–29b). If the voltage fluctuates, or is under 27 volts, remove the regulator and send it to the repair shop.

c. Load the circuit somewhat (turn on lights or radio) and watch the reading on the test meter. The drop, due to imposition of load drain, should not be more than 0.3 volts, with a reading of 27.2 volts or above. If voltage is lower, further test readings should be taken throughout the power supply, until the cause is found.

5–36. REVERSE CURRENT RELAY.

5–37. DESCRIPTION. The differential-type reverse-current relay, General Electric model 3GTR76A3, operates to connect the generator to the electrical system when generator voltage exceeds battery voltage by a given amount, and to disconnect the generator from the electrical system when a reverse current of 15 to 25 amperes is flowing from the battery. The relay (generator cut-out) prevents the battery from feeding power to the generator and running it as a motor when the voltage of the generator is below 26 volts.

5–38. LOCATION AND ACCESS. The reverse-current relay is located in the aft part of the main junction box. It can be reached through the lower cockpit access door, by removing the cover from the main junction box.

5–39. REMOVING. Take out the reverse current relay by removing terminal connections and then taking off the mounting stud nuts. Lift relay from main junction box.

CAUTION

Engine must be inoperative and battery switch "OFF."

5–40. REPAIRING. If reverse current relay is defective, it should be replaced.

5–41. INSTALLING. The relay is mounted in the aft section of the main junction box on four threaded studs, with plain washers, lock washers and square nuts. Connect battery and generator leads.

5–42. TESTING AND ADJUSTING. Testing the reverse current relay is done in the airplane by watching the voltmeter for a slight rise after generator dropout voltage has been reached. The pickup and dropout voltages are differentials, and hence are dependent upon the amount of power in the batteries at the time of test. The relay is adjusted only at the electrical shop. If it does not function correctly in the airplane, it should be replaced. See paragraph 5–25 for check of proper reverse current cutout function in system.

5–43. BATTERY SYSTEM.

5–44. DESCRIPTION. (*See figure 5–6.*) For normal operation, one 24 volt, 17 ampere-hour, standard aircraft battery (AN3151) is installed in the forward position beneath the cockpit floor at approximately station 160, slightly to the left of the centerline of the airplane. Provisions are made for carrying two batteries, however, the second battery is considered overload, and installed in the aft position in extremely cold weather or under other special operating conditions. Both batteries (when installed) are accessible through the lower cockpit (or "belly") access door. Each battery is contained in a grounded metal housing, which is vented to the airplane to provide escape for potentially dangerous gases, and secured by wing-nut fastened tie rods. The battery serves as an emergency or reserve source of power for the electrical system. It should not be used for ground operation or starting if an external power source is available. This leaves battery energy available for emergency operation in the event of generator overloading or failure. The battery switch is located on the inclined portion of the right control shelf, to the left of primer and starter switches.

5–45. TROUBLE SHOOTING. To determine that battery is in good condition, a check of specific gravity (see paragraph 5–47) should be made prior to installation of a new battery, weekly (or every 25 hours), and monthly (or every 200 hours). In addition, at the same check periods, water should be added to battery until it is 3/8 inch above protector over separators. If a battery that is thus maintained and inspected, will not hold its charge or is otherwise defective, the following trouble shooting chart will help to isolate the trouble.

Trouble	Probable Cause	Suggested Remedy
Battery Will Not Hold Its Charge.	*a.* Battery worn out.	*a.* Remove and return to battery shop for test.
	b. Equipment left on.	*b.* Remove and recharge battery; make sure all switches are off before leaving airplane.
	c. Standing idle too long.	*c.* If airplane is idle for more than one week, remove battery and return it to battery shop.
Battery Does Not Charge.	*a.* Short circuit or grounded wiring.	*a.* Check wiring and correct defect; *see figure 5-6.*
	b. Generator voltage too low to fully recharge battery.	*b.* Check and readjust voltage regulator. See paragraph 5-34.
	c. Generator reverse current cutout does not close properly.	*c.* Replace defective cutout.
	d. Discharge too great to replace in flight.	*d.* Remove for servicing. External power source should be used for starting.
Battery Life Short.	*a.* Overcharging.	*a.* Check and adjust voltage regulator. See paragraph 5-34.
	b. Electrolyte level too low.	*b.* Add water to 3/8 inch above plates; see paragraph 5-48.
Electrolyte Level Consistently Low. Battery Consumes Excessive Water.	*a.* Overcharging.	*a.* Give battery thorough testing, and check system; see paragraph 5-34.
Electrolyte On Top Of Cells.	*a.* Overfilling.	*a.* Clean off, and if necessary drain off electrolyte to 3/8 inch level.
	b. Overcharging.	*b.* Check battery system. See paragraph 5-34.
	c. Ruptured compound seal.	*c.* Replace battery.

5–46. TESTING.

5–47. CHECKING SPECIFIC GRAVITY OF ELECTROLYTE.

CAUTION

Battery electrolyte will cause painful burns to the skin. If spilled, immediately flush the affected part with water, and apply a coating of sodium bicarbonate. Later, clean the area again with water. Battery gases are highly explosive. Keep open flames or sparks away from the battery.

a. Daily hydrometer readings should be taken to check the specific gravity of at least two cells.

b. Use a temperature corrected hydrometer. The reading should be taken at eye level for greater accuracy. Be sure the float is free from (not sticking to) the side of the hydrometer. When filling the hydrometer, do not draw off too much electrolyte. Just enough should be drawn to raise the hydrometer float from its plug at the bottom of the tube. Unless the float rises, the reading will be incorrect. Always return test fluid to cell from which it was taken, in order to avoid concentrating too much or too little in different cells.

c. Correct reading for temperature. The temperature corrected hydrometer has a thermometer which reads the temperature of the electrolyte and indicates also, from the specific gravity reading, how much should be added or subtracted for temperature correction. If the electrolyte temperature is between 32° C (65° F) and 44° C (95° F), no correction need be made, as the error is negligible. However, correction should always be made for temperatures above or below these limits. If a temperature corrected hydrometer is not available, any hydrometer may be used and corrections made from the following table.

ELECTROLYTE TEMP. DEGREES F.		SPECIFIC GRAVITY CORRECTION POINTS
140°		0.024
130°	Add	0.020
120°	to reading	0.016
110°		0.012
100°		0.008
90°		No correction required
80°		here
70°		
60°		0.008
50°	Subtract from	0.012
40°	reading	0.016
30°		0.020
20°		0.024

ELECTROLYTE TEMP. DEGREES F.		SPECIFIC GRAVITY CORRECTION POINTS
10°		0.028
0°	Subtract from	0.032
−10°	reading	0.036
−20°		0.040
−30°		0.044

Note

A general rule to follow for correction factors is to add .004 points for each 10° above 80° F (26.7° C), or subtract .004 points for every 10° below 80° F. Example: A hydrometer reading of 1.240 is obtained with a battery temperature of 40° F. This temperature falls into the subtraction area. If the table is followed, the reading will be computed as follows:

Hydrometer reading	1.240
Correction factor (from table)....	0.016
Corrected specific gravity........	1.224

d. If the specific gravity, corrected for temperature, is below 1.240 or above 1.310, replace the battery.

e. Wash and clean the hydrometer barrel frequently. Dirt will affect the readings.

f. If the electrolyte level is too low to permit a hydrometer reading, the battery should be returned for shop servicing. If such service is not available, add water as directed in paragraph 5–48 and then take a reading after the electrolyte and water have become thoroughly mixed.

5–48. ADDING WATER. When necessary to add water to a battery, use clear drinking water. Distilled water should be used if available, but the impurities of good drinking water are negligible, and it can be safely used without affecting the life of the battery.

a. When adding water, try to bring the level 3/8 inch to 1/2 inch above the protector. Too much water may cause leakage when the airplane is in operation. Use a self-levelling syringe when adding water. Fill the self-levelling syringe with water and insert it into the cell. Hold in a vertical position regardless of level of battery and fill the cell. Then withdraw excess water into the syringe until air is sucked in, which leaves the electrolyte at the proper level.

b. Hydrometer readings taken too soon after adding water will be inaccurate. It takes several minutes of charging to mix the electrolyte properly.

c. If battery is exposed to freezing temperatures, do not add water unless it is to be charged immediately. In extreme cold, the water tends to stay at the top and freeze, instead of mixing with the electrolyte.

5–49. CHECK OF TERMINALS.

a. Check insulation of battery leads.

b. Inspect terminal assembly and tighten if necessary. However, excessive tightening of the hex nut will cause the terminal to draw through its bushing and short to the metal container.

c. Remove corrosion by brushing with a stiff (but not a wire) brush, then wash with a solution of ordinary sodium bicarbonate (baking soda) and water (1 pound per gallon) to neutralize any electrolyte remaining on the metal surfaces. If sodium bicarbonate is not available, use soap and water.

CAUTION

Do not use sodium bicarbonate on the battery while it is in the airplane as it is destructive to unpainted aluminum. When bubbling stops, dry the parts and apply a thin coating of petroleum jelly to the terminals. Imperfectly lead-plated parts, such as washers or wing nuts, on which the lead coating has been worn or scraped off, should be replaced.

5-50. CHECK OF BATTERY MOUNTING AND CONDITION.

a. Battery condition and mounting should be checked weekly or every 25 hours, whichever comes first. Inspect for leakage of acid due to broken case, softening or cracking of sealing compound or leakage around the terminals. If leakage is found, the battery should be replaced. Whenever a battery is removed from the metal container, corrosion on cover and top of cells should be removed with sodium bicarbonate and rinsed with water.

b. Check the mounting bolts to be sure they are safety wired and are snug enough to hold the bottom in place without putting too much strain on the battery case. Too much pressure will spring the cover, making it non-liquid tight or will bend the container.

c. Check the vents. Clean them by inserting a small glass tube and blowing, but never blow out vents without inserting a tube as there may be electrolyte in the vent and severe acid burns may result.

5-51. REMOVING.

CAUTION

When battery is removed or replaced, be sure that the battery switch has been tripped to "OFF" position.

a. Be sure battery switch is "OFF."

b. Working through the belly access door, cut the safety wire from the wing nuts and remove wing nuts and tie rods.

c. Remove terminal housing cover wing nuts and washers.

d. With housing cover removed, take wing nuts, plain washers and lock washers from terminals. Disconnect negative cables first.

e. Disconnect cables from posts and remove them from housing.

f. Remove battery.

Note

When the airplane is to be idle for more than one week, the battery should be removed and turned in to the battery room where it will be kept fully charged.

5-52. REPAIRING. Repairs to batteries, other than slight defects in new and little used batteries, should not be attempted except in great emergency.

a. A battery which under normal conditions fails to retain a charge, should be replaced.

b. Battery subjected overlong to draw of power may be down too low for safe use.

c. Battery leaking from physical damage during maneuvers, should be replaced as soon as possible.

5-53. INSTALLING. Reverse procedure given in paragraph 5-51.

5-54. COLD WEATHER OPERATION. Battery specific gravity (corrected for temperature) should be between 1.275 and 1.300, and battery should be kept, if possible, at a temperature of 30° or more. Batteries become inefficient and will not readily take a charge in very cold weather. External power should be used whenever possible for starting, etc. to conserve battery energy. Do not operate equipment not essential to flight such as electrically heated flying suits unless a generator is in operation. When airplane is not in use, and temperature is below zero, batteries should be removed to a warm place. Do not attempt to keep them warm by charging, as continued overcharging shortens the life of airplane batteries. When necessary to start the engine with battery power, do not crank the engine continuously until it starts. Crank it for short intervals only, and wait some minutes in between to allow for battery electrolyte recovery. Of prime importance to good battery operation in cold weather are, (1) a battery specific gravity of from 1.275 to 1.300, and (2) keeping the battery in a warm place when the airplane is not in use.

5-55. SOLDERING AND WATERPROOFING OF PLUGS AND RECEPTACLES.

5-56. SOLDERING.

a. Use only rosin flux for soldering. Any other flux, such as acid or commercially prepared paste, will cause corrosion of the connectors.

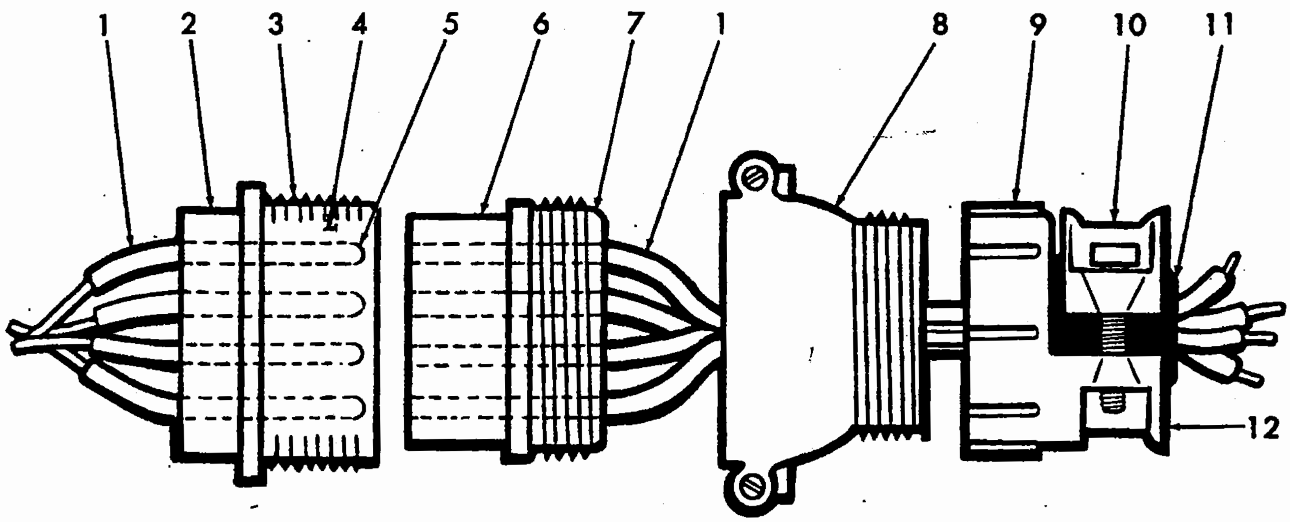
b. Disassemble connector plugs and receptacles to expose both faces of the front and rear insert and insert discs. Slide the Vinylite tubing (CVC 860) back from each terminal. Where corrosion has started, clean off the residue as thoroughly as possible, using a brush or similarly effective means. Wash with alcohol both faces of each insert disc of both plug and receptacle. Dry each thoroughly, as it is very important that no moisture be left in the connector.

CAUTION

Do not let the cable insulation get alcohol on it, as this may dissolve the waterproofing material.

c. Inspect all solder connections to both plug and receptacle, and resolder any which are found defective.

1. CVC-860 Vinylite Tubing
2. Receptacle Snap Ring (See Note B.)
3. Receptacle Threads (See Note D.)
4. AN Connector Receptacle (See Note A.)
5. Contact Pins (See Note C.)
6. AN Connector Plug (See Note A.)
7. Plug Snap Ring (See Note B.)
8. Back Shell
9. AN3057 Cable Clamp
10. Clamp Half of AN3057
11. Filler (See Note E.)
12. Nut Half of AN3057



NOTES

A. Disassemble Connector by Removing Snap Ring and Pin and Socket Inserts. Apply Compound to Front and Rear Discs of Pin Inserts.

B. Pack Compound Thoroughly Around Terminals at Rear of Plug and Receptacle.

C. Pack Contact Pins to ½ Their Depth.

D. Apply Thin Coat of Dielectric Compound to Receptacle Threads.

E. Wrap in Enough Filler to Bring Clamp Half of AN3057 Flush with Nut Half.

Figure 5—3. Waterproofing Procedure for Plugs and Receptacles.

5—57. WATERPROOFING. *(See figure 5—3.)*

a. Apply dialectric compound, Spec. AN-C-128, to the disc face at the rear of the insert, and fill the space between the front and rear discs of both plug and receptacle. Do this carefully as it is important that the surfaces be completely covered.

b. Replace the plug and receptacle inserts. Then replace the snap rings.

c. Pack the engaging pin contacts of plug or receptacle to approximately one-half of their depth with Spec. AN-C-128.

d. Pack Spec. AN-C-128 thoroughly around cable terminals at the rear of the plug and receptacle.

e. On both plug and receptacle assemblies, slide the Vinylite tubing (CVC 860) through the compound and over the terminals until contact is made with the face of the rear insert disc.

f. Repack the compound around the surfaces at rear of both plug and receptacle, and be sure there are no air spaces.

g. Keep the compound in place with an AN3057 cable clamp and secure with a grommet or tape. For plugs not using AN3057 cable clamp, apply EC-750 compound over face of the plug and around the wires for about ½ inch from the rear face. This sealing compound should not be removed at installation.

h. Lubricate receptacle threads with Spec. AN-C-128.

i. Drill a small hole at each low point in the conduit or tubing in case water should get into the system.

CAUTION

Do not drill holes in ignition system conduit.

5–58. CIRCUITS.

5–59. DESCRIPTION. Each individual circuit in the airplane is represented in the following pages. The composite electrical system has been broken down as far as possible into single-operating unit circuits containing power source, wiring, circuit controls and operating units. The unit circuits, as shown, include an isometric illustration, a wiring diagram, text, a wire table and a parts list. All electrical wiring diagram information is integrated with reference to the isometric illustration, the circuit description, the wire table and parts list. Circuit and illustration have common labels for parts. Wire numbers are arranged alphabetically in the wire table, for easy reference. Figure 5–4 shows all electrical symbols. Circuits are indexed in paragraph 5–60.

5–60. INDEX TO CIRCUITS.

Page

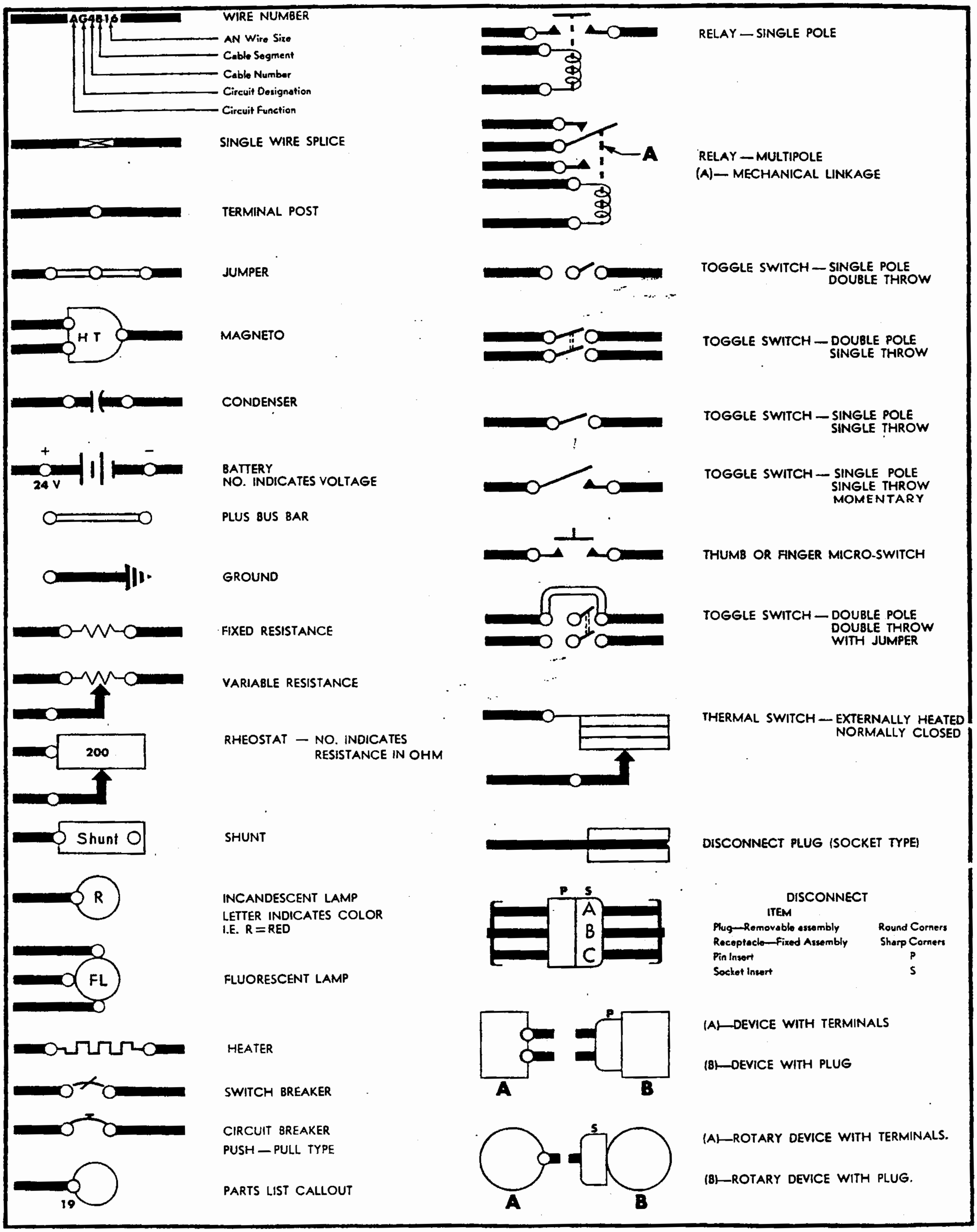
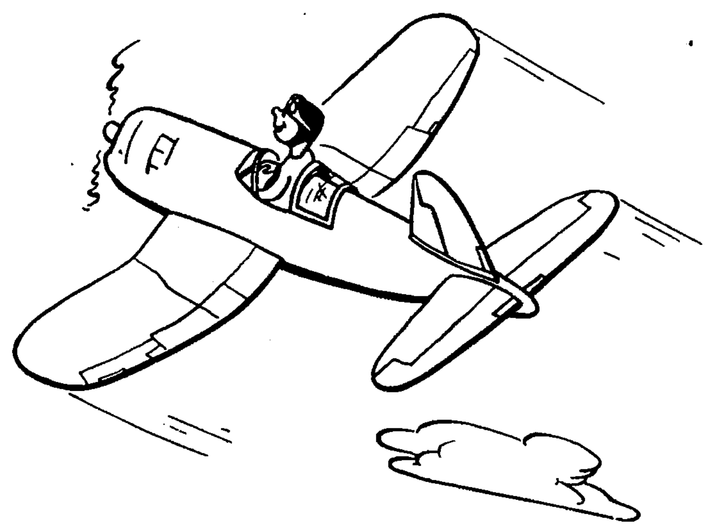


Figure 5–4. Electrical Symbols.



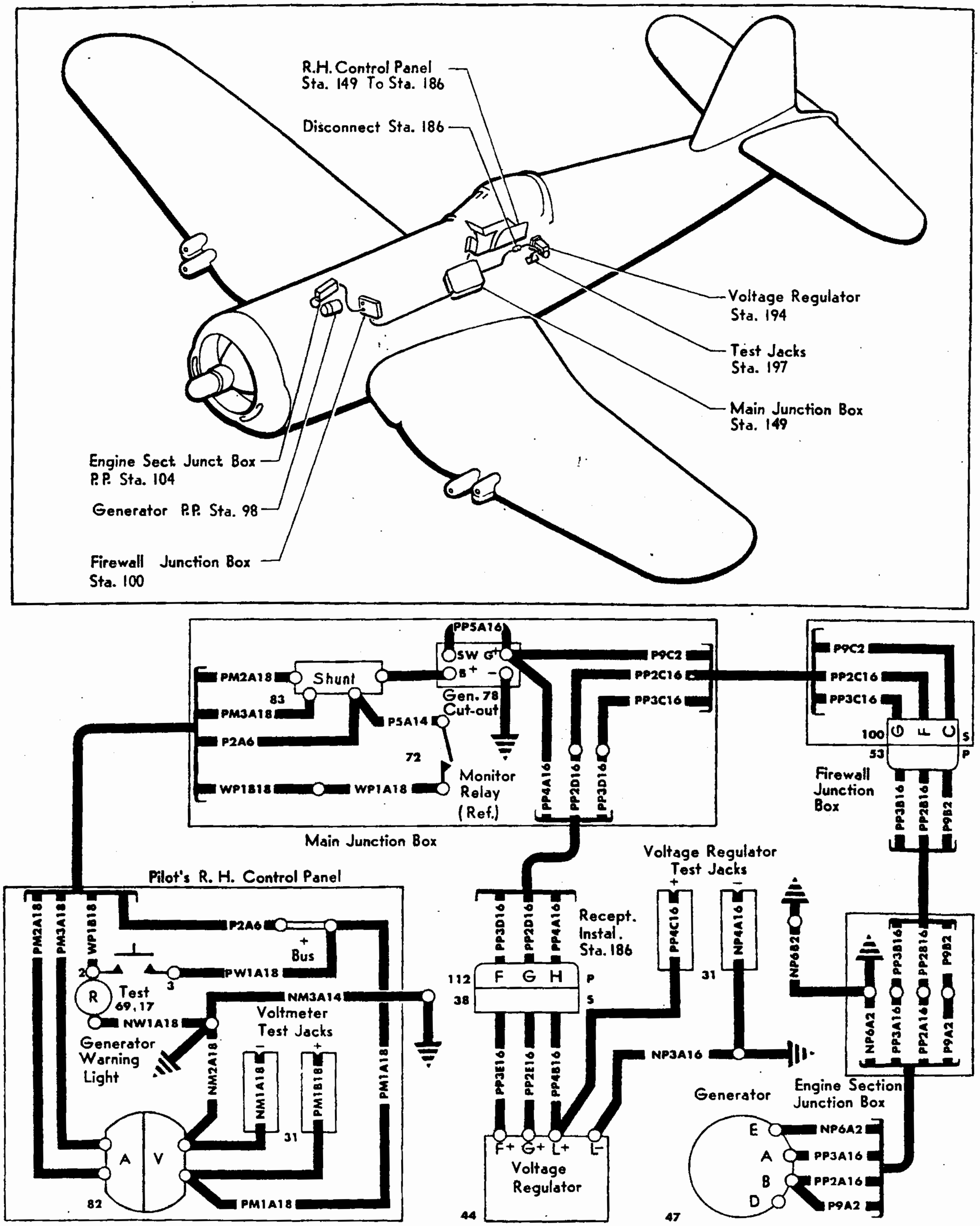


Figure 5–5. Power Supply Circuits—Generator and Voltage Regulator.

5-61. POWER SUPPLY CIRCUITS—GENERATOR AND VOLTAGE REGULATOR.

5-62. DESCRIPTION. (*See figure 5-5.*) Power is supplied to the electrical system from the generator, the battery, or the external power receptacle. These sources are brought together in the main junction box so that the system operates from the plus bus regardless of the source of power used. Power from the generator reaches the plus bus through the generator cutout. The generator output operates the electrical system of the airplane and charges the airplane battery when the generator voltage exceeds that of the battery by .35 to .65 volts. This is accomplished by the generator cutout which, when the above condition exists, closes the circuit from generator to battery and to any circuit in operation. If, however, the generator is turning slowly so that battery voltage exceeds that of the generator, the cutout isolates the generator from the battery (keeping the higher battery voltage and resultant reverse current from turning the generator as a motor) and connects the battery to the electrical system until such time as the generator output again exceeds that of the battery. Whenever generator trouble develops, causing a drop in output or when the generator output is low due to low engine rpm, a warning light located just above the voltammeter on the right hand panel lights up, indicating to the pilot that he is operating on battery power alone. This light will go out as soon as generator voltage exceeds that of the battery. If the light remains on after increasing engine rpm, it indicates trouble in the generator system and the system should be checked; see paragraph 5-19.

CAUTION

Battery is discharging when generator warning light is on. Turn off all unnecessary electrical load.

A microswitch, incorporated in the light assembly, allows testing of the light bulb by pushing the warning light in. The voltage regulator maintains a constant level output of voltage from the generator. It varies the generator shunt field current in relation to changes of speed and load of the generator, and to changes in temperature. The current is varied through increase or decrease in pressure on the carbon pile, with the flow of generator current through the coil of the regulator determining the pressure applied.

WIRE TABLE

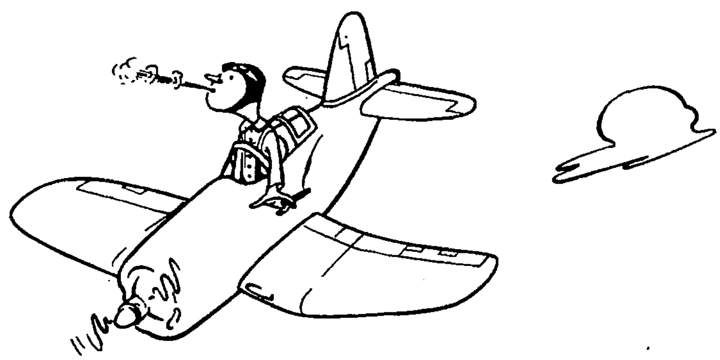
WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
NM1A18	AN18	659-2	860-16-3	659-2	860-16-3	12
NM2A18	AN18	659-2	860-16-3	659-2	860-16-3	3½
NM3A14	AN14	659-4	860-14-3	659-4	860-14-3	48
NP3A16	AN16	659-4	860-14-3	659-4	860-14-3	10
NP4A16	AN16	659-4	860-14-3	659-4	860-14-3	28
NP6A2	AN2	659-14	860-2-5	659-14	860-2-5	27
NP6B2	AN2	659-14	860-2-5	659-14	860-2-5	3
NW1A18	AN18			659-2	860-16-3	4
P2A6	AN6	659-30	860-6-3	659-30	860-6-3	40
P5A14	AN14	659-4	860-12-3			17
P9A2	AN2	659-14	860-2-5	659-14	860-2-5	28
P9B2	AN2	659-14	860-2-5		860-2-5	62
P9C2	AN2		860-2-5	659-14	860-2-5	92
PM1A18	AN18	659-2	860-16-3	659-2	860-16-3	10
PM1B18	AN18	659-2	860-16-3	659-2	860-16-3	6
PM2A18	AN18	659-2	860-16-3	659-2	860-16-3	57
PM3A18	AN18	659-2	860-16-3	659-2	860-16-3	56
PP2A16	AN16	659-25	860-14-3	659-4	860-14-3	37
PP2B16	AN16	659-4	860-14-3		860-16-3	58
PP2C16	AN16	659-4	860-14-3		860-16-3	95
PP2D16	AN16	659-4	860-14-3		860-16-3	48
PP2E16	AN16	659-4	860-14-3		860-16-3	16

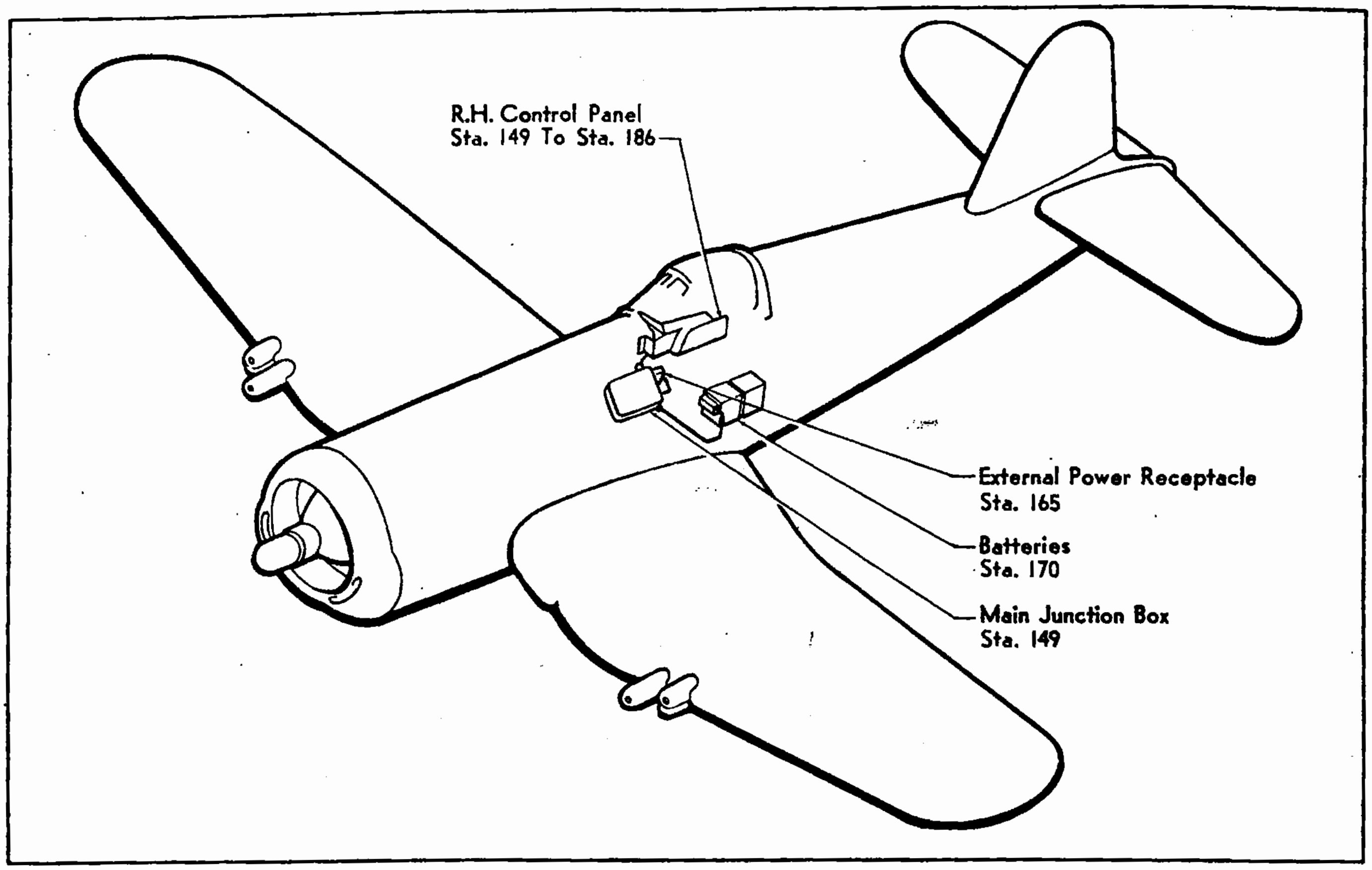
WIRE TABLE (Continued)

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
PP3A16	AN16		860-14-3	659-4	860-14-3	36
PP3B16	AN16	659-4	860-14-3		860-16-3	59
PP3C16	AN16	659-4	860-14-3		860-16-3	94
PP3D16	AN16	659-4	860-14-3		860-16-3	48
PP3E16	AN16	659-4	860-14-3		860-16-3	16
PP4A16	AN16	659-27	860-14-3		860-16-3	48
PP4B16	AN16	659-4	860-14-3		860-16-3	17
PP4C16	AN16	659-4	860-14-3	659-4	860-14-3	30
PP5A16	AN16	659-27	860-14-3	659-4	860-14-3	4
PW1A18	AN18	659-2	860-16-3			12
WP1A18	AN18			659-2	860-16-3	12
WP1B18	AN18	659-2	860-18-3			50

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
17	AN3121-313	Generator Warning Lamp
31	VS-37459 Chance Vought Harvey Hubbell BA12037	Pin Jack
38	AN3100-28-12P	Receptacle
44	3GED2B1 (G.F.E.) General Electric Co.	Voltage Regulator
47	2CM63B4 or 2CM70C1A (G.F.E.) General Electric Co.	Generator
53	AN3106-28-10P	Plug
69	VS-44422-1 Chance Vought Searle Aero Ind. VM400-2	Light Assembly Indicator
72	VS-48746 Chance Vought Phillips Control Co. Spec. 12038-1	Monitor Relay
78	VS-59948 Chance Vought 3GTR76A3 Gen. Electric Co.	Reverse Current (Generator Cut-out) Relay
82	NAF1091-A-240	Voltammeter
83	NAF1091-2-240	Shunt
100	AN3102-28-10S	Receptacle
112	AN3106-28-12S	Plug





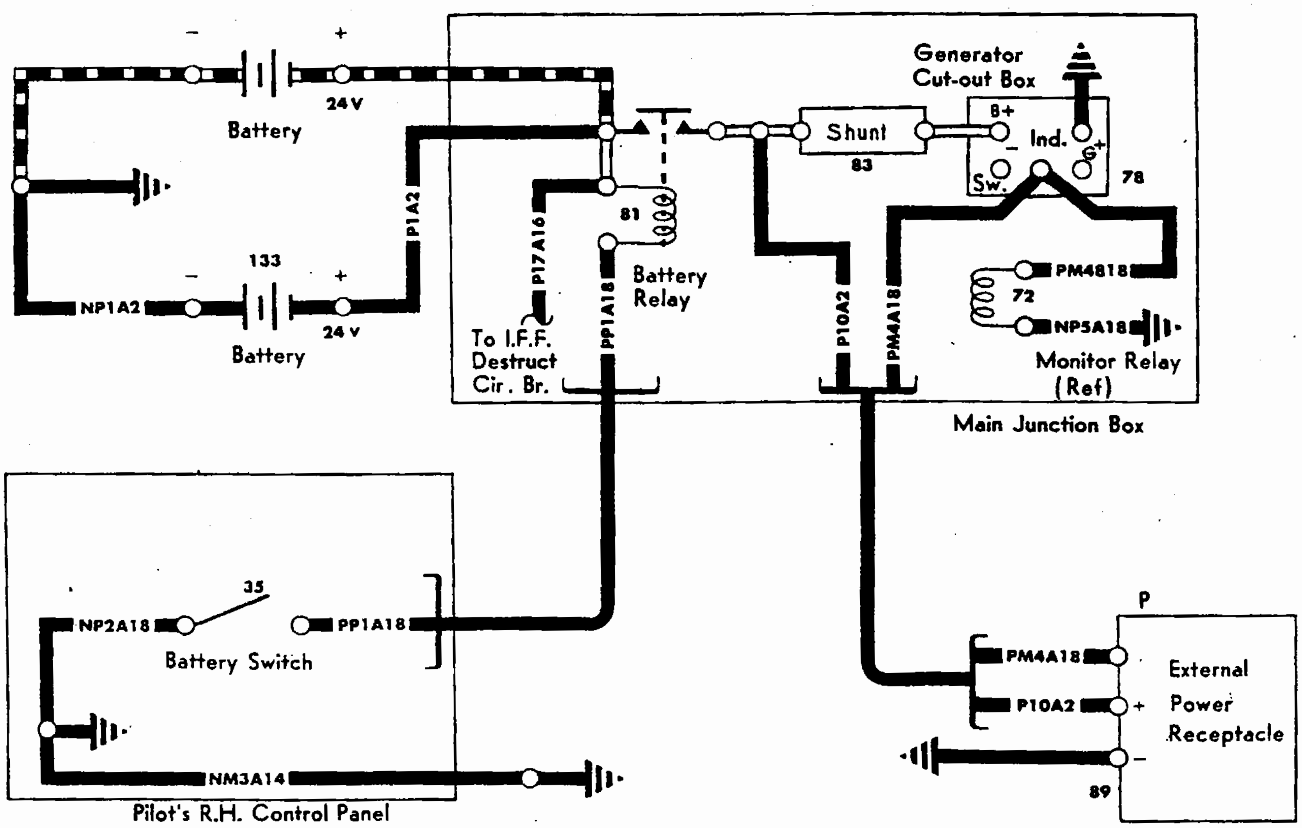


Figure 5–6. Power Supply Circuits—Battery and External Power Receptacle.

5-63. POWER SUPPLY CIRCUITS—BATTERY AND EXTERNAL POWER RECEPTACLE.

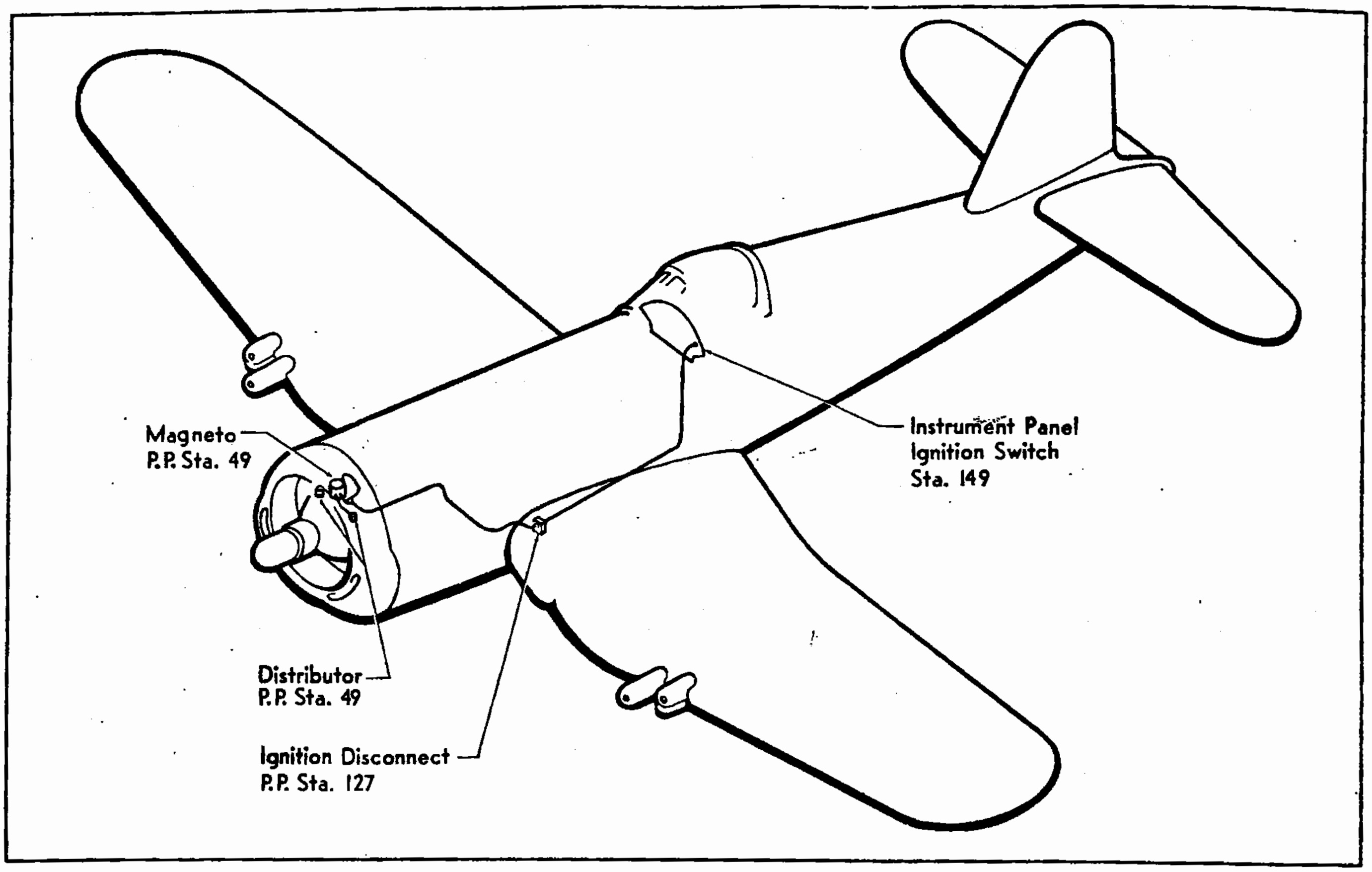
5-64. DESCRIPTION. (*See figure 5-6.*) When the airplane is on the ground, the electrical system can be energized through the external power receptacle. Power is fed through the external power receptacle to the plus bus. When external power is disconnected, and the battery switch closed, the battery relay is energized and closes, feeding full battery current to the electrical system. The battery switch should be "OFF" before external power is connected to the circuit. The external power receptacle is on the right hand side of the fuselage, at station 165, just above the flap. The battery switch is located at the bottom of the inclined panel on the right hand control shelf.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
NM3A14	AN14	659-4	860-14-3	659-4	860-14-3	48
NP1A2	AN2	659-14	860-2-4	659-14	860-2-4	12
NP2A18	AN18	659-2	860-16-3	659-2	860-16-3	4
NP5A18	AN18			659-2	860-16-3	5
P1A2	AN2	659-14	860-2-4	659-14	860-2-4	16
P10A2	AN2	CVC-880-26	860-2-5	CVC-880-12	860-2-5	18
PM4A18	AN18	659-2	860-16-3	659-2	860-16-3	24
PM4B18	AN18			659-2	860-16-3	18
PP1A18	AN18	659-2	860-16-3	659-2	860-16-3	47½

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
35	AN3022-2	Switch
72	VS-48746 Chance Vought Phillips Control Co., Spec. 12038-1	Relay
78	VS-59948 Chance Vought 3GTR76A3 Gen. Electric Co.	Reverse Current (Generator Cut-out) Relay
81	NAF1204-3	Relay
83	NAF1091-2-240	Shunt
89	AN2552-1	Receptacle
133	AN3151	Battery 24v. 17 amp.-hr.



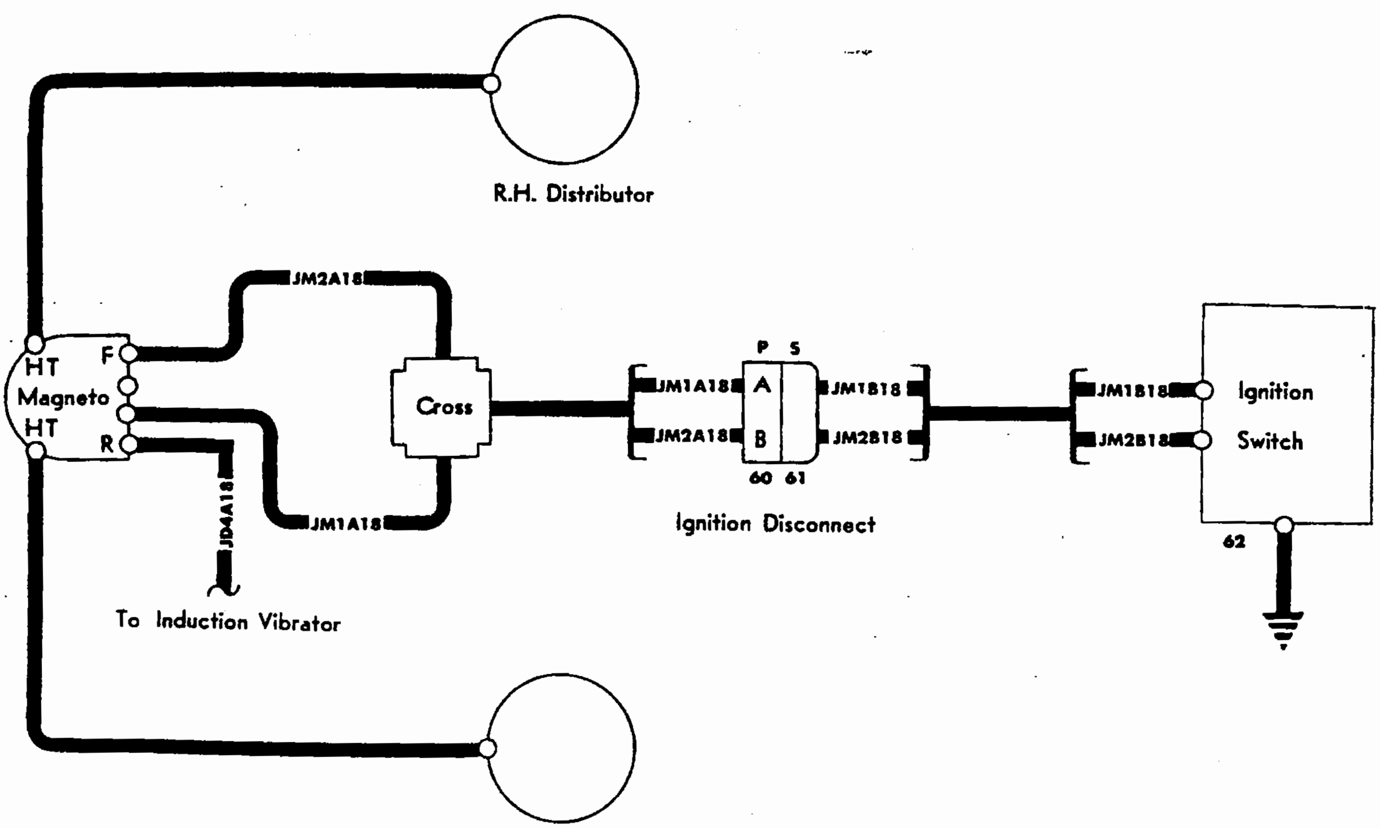


Figure 5–7. Power Plant Circuits—Ignition System.

5-65. POWER PLANT CIRCUITS—IGNITION SYSTEM.

5-66. DESCRIPTION. (*See figure 5-7.*) The ignition system includes a dual magneto unit which generates a high voltage for the spark plugs, a distributor, and spark plugs. The ignition switch, which is located at the extreme left hand side of the instrument panel, has four positions: "OFF," "RIGHT," "LEFT," and "BOTH." The "RIGHT" switch position connects the magneto electrically (through the distributor) to the spark plugs on the front of each cylinder while the "LEFT" switch position connects the magneto to the rear plugs in each cylinder. The "BOTH" position (which is normally used, except when making a magneto check) connects both front and rear plugs to the dual magneto. The "OFF" position grounds the magneto and prevents the spark plugs from firing. The ignition system induction vibrator, which is energized and de-energized by the starter switch, supplies a high voltage to the spark plugs during engine starting.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
JM1A18	AN18				860-18-3	132
JM1B18	AN18		860-18-3	659-2	860-16-3	125
JM2A18	AN18				860-18-3	137
JM2B18	AN18		860-18-3	659-2	860-16-3	125
JD4A18	AN18		860-18-3		860-18-3	80

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
60	AN3100-18-22P	Receptacle
61	AN3106-18-22S	Plug
62	AN3212-1	Ignition Switch

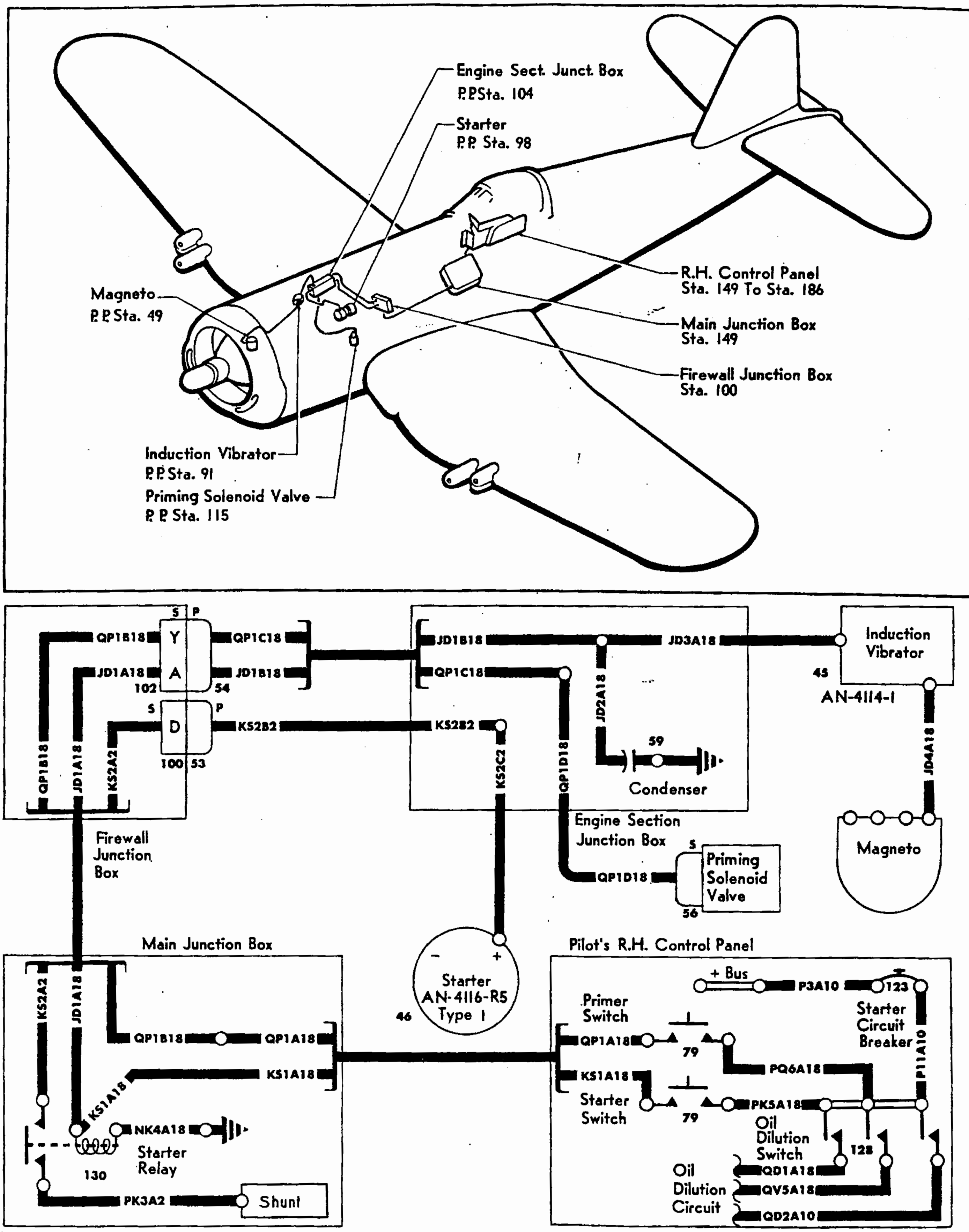


Figure 5–8. Power Plant Circuits—Starter and Primer.

5-67. POWER PLANT CIRCUITS—STARTER AND PRIMER.

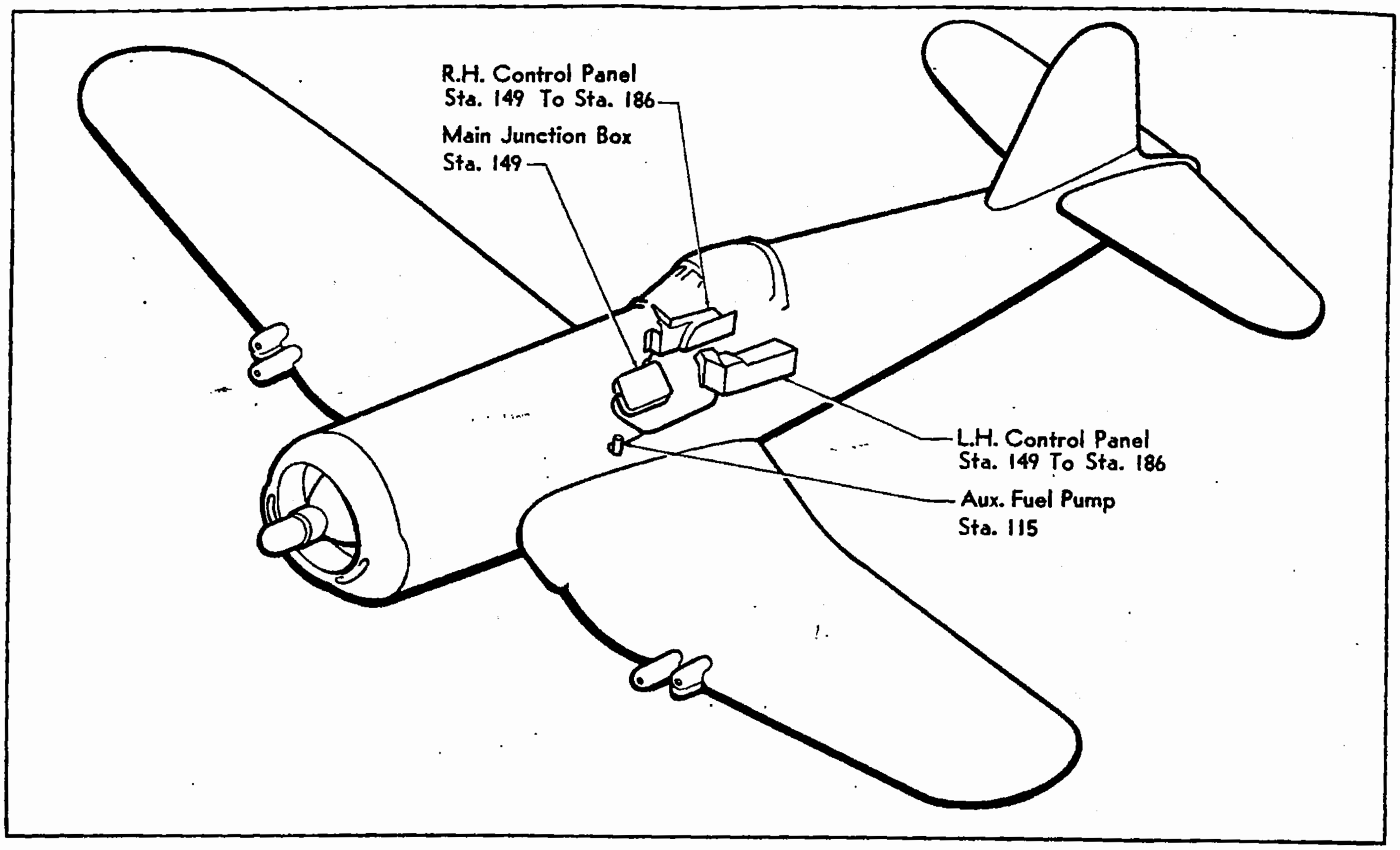
5-68. DESCRIPTION. (*See figure 5-8.*) When the primer switch button on the inclined portion of the right hand panel is pushed and held in, power is drawn from the plus bus through the starter circuit-breaker which in turn is connected to the starter and oil dilution switches. Although power for all three switches comes through the starter circuit-breaker, each switch functions independently. The primer switch closes the primer solenoid valve on the carburetor, feeding gas to the top cylinders of the engine. When the starter switch is closed, power is supplied to the starter relay, closing the relay, which energizes the starter and the induction vibrator. When external power is used for starting, power is fed directly from the external source to the starter relay without the battery switch being "ON." (The battery switch must be "OFF" when external power is used.) When the battery is used for starting, power is taken from the plus bus through the starter circuit-breaker to the starter relay. The full battery current flows through the relay and energizes the starter and the induction vibrator which supplies a pulsating dc voltage to the primary coils of the dual magneto. The magnetos in turn supply high voltage to the spark plugs through the distributor.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
JD1A18	AN18	659-2	860-16-3		860-18-3	93
JD1B18	AN18		860-16-3		860-18-3	58
JD2A18	AN18	659-2	860-16-3		860-18-3	6
JD3A18	AN18	659-2	860-16-3	659-2	860-16-3	25
JD4A18	AN18		860-18-3		860-18-3	80
KS1A18	AN18	659-2	860-16-3			60
KS2A2	AN2	659-14	860-2-5	659-14	860-2-5	84
KS2B2	AN2	659-14	860-2-5		860-2-5	60
KS2C2	AN2	659-14	860-2-5	659-14	860-2-5	29½
NK4A18	AN18	659-2	860-16-3	659-2	860-16-3	7
P3A10	AN10	659-5	860-10-3	659-5	860-10-3	9½
P11A10	AN10	659-5	860-10-3	659-5	860-10-3	17
PK3A2	AN2	659-14	860-2-5	659-14	860-2-5	9
PK5A18	AN18	659-2	860-16-3		860-18-3	5
PQ6A18	AN18	659-2	860-16-3		860-18-3	5
QD1A18	AN18	659-2	860-16-3			50
QD2A10	AN10	659-5	860-10-3	659-5	860-10-3	45
QP1A18	AN18			659-2	860-16-3	52
QP1B18	AN18	659-2	860-16-3		860-18-3	99
QP1C18	AN18	659-2	860-16-3		860-18-3	70
QP1D18	AN18	659-2	860-16-3		860-18-3	50
QV5A18	AN18	659-2	860-16-3	659-2	860-16-3	53

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
45	AN4114-1 American Bosch VJR-24C5 (G.F.E.)	Induction Vibrator
46	AN4116-R5 JH6PKR-3 (G.F.E.) Jack and Heintz	Starter
53	AN3106-28-10P	Plug
54	AN3106-28-12P	Plug
56	AN3108-12S-4S	Plug
59	VS-34986 Chance Vought Solar Mfg. Co. XDMRW-6-1-10-20	Condenser
79	VS-47951 Chance Vought	Switch
100	AN3102-28-10S	Receptacle
102	AN3102-28-12S	Receptacle
123	AN3161-P20	Circuit-breaker
128	VS-45320 Chance Vought Cutler Hammer, Inc. 8905K722	Switch
130	Type B-8 (G.F.E.)	Relay



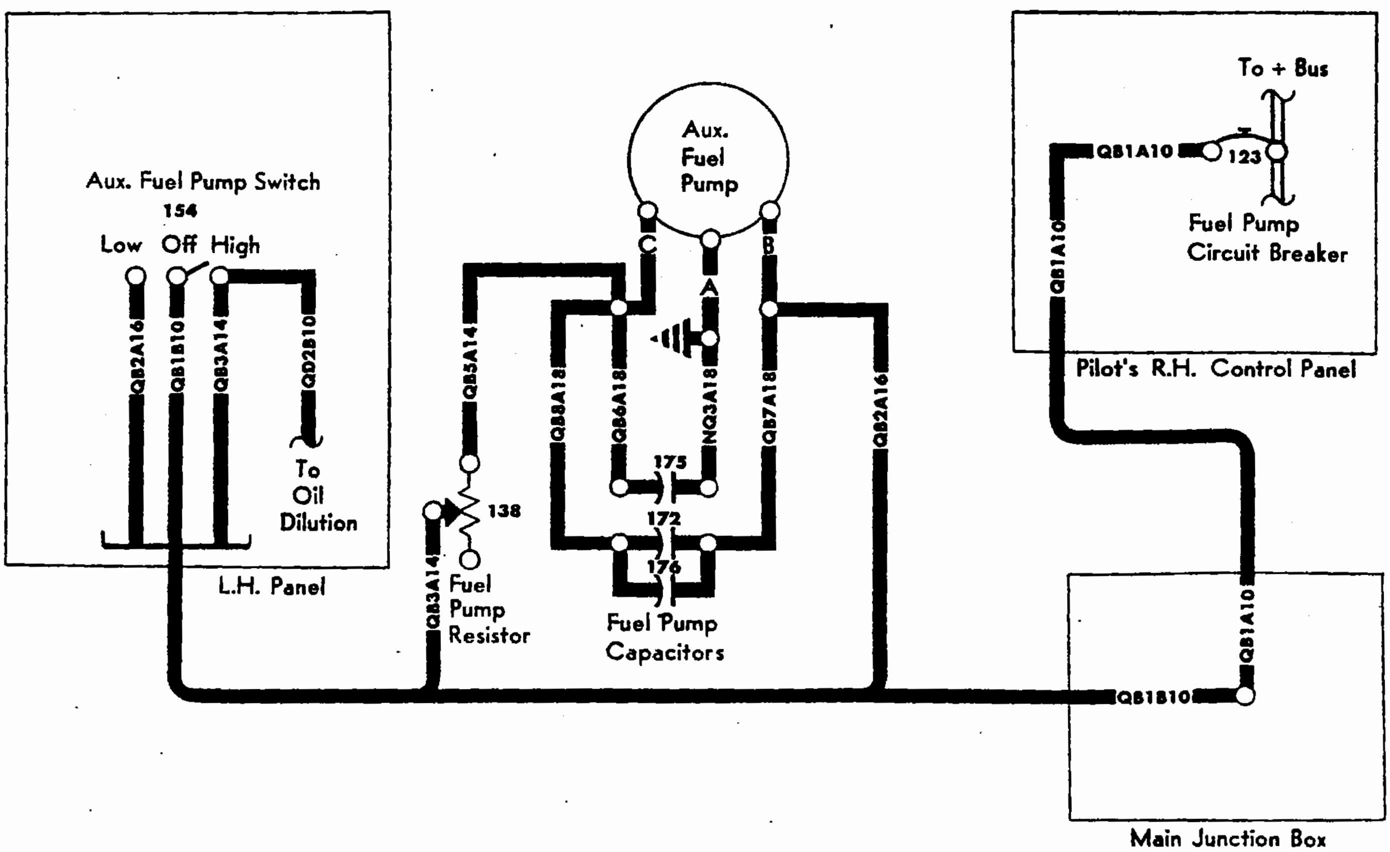


Figure 5–9. Power Plant Circuits—Auxiliary (Booster) Fuel Pump.

5–69. POWER PLANT CIRCUITS — AUXILIARY (BOOSTER) FUEL PUMP.

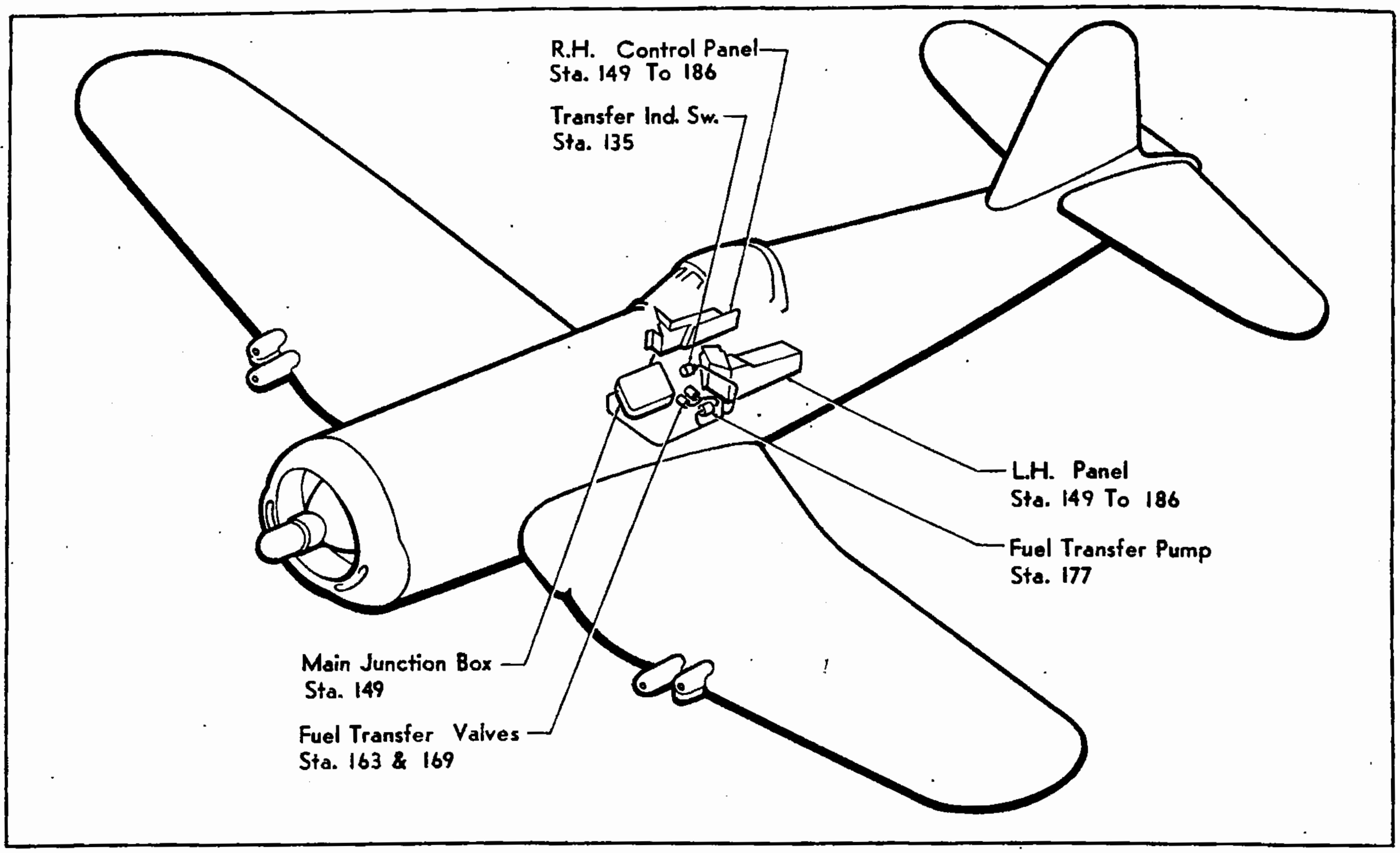
5–70. DESCRIPTION. *(See figure 5–9.)* The electric auxiliary fuel pump (or booster pump) is a deaerating centrifugal pump delivering fuel to the engine-driven pump. Power comes from the fuel pump circuit-breaker through the main junction box to the single-pole, double-throw toggle switch on the left hand control panel. The "HIGH" position is used for take-off, landing, and as an emergency fuel pump in the event of failure of engine-driven pump. The "LOW" position is used for starting, and for all normal engine operation. Wire QD2B10 comes into the "HIGH" position of the auxiliary fuel pump switch, energizing the auxiliary fuel pump when oil dilution is used, regardless of the position of the pump switch on the left hand control panel. The variable resistor in the electrical lead to the "HIGH" side of the pump is for varying fuel pump pressure output when the pump is operated in "HIGH." Three capacitors in the circuit eliminate radio noise caused by the fuel pump. Two of these are located on right hand former at station 120½. The third capacitor is mounted on a stiffener on the right hand side just forward of Sta. 120½.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
NQ3A16	AN16	659-27	860-14-3		860-16-3	9½
QB1A10	AN10	659-5	860-10-3	659-5	860-10-3	30
QB1B10	AN10	659-5	860-10-3	659-5	860-10-3	34
QB2A16	AN16			753-A2		130
QB3A14	AN14	659-4	860-12-3	659-4	860-12-3	40
QB5A14	AN14	659-4	860-12-3	753-A	860-12-16	93
QB6A16	AN16	659-4	860-14-3		860-16-3	11
QB7A16	AN16	659-4	860-14-3		860-16-3	9½
QB8A16	AN16	659-4	860-14-3		860-16-3	11

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
123	AN3161-P20	Circuit-breaker
138	VS-54411 Chance Vought Ward Leonard Elec. Co. (Type B Ribflex)	Resistor 0.25 ohm, 110 watts
154	AN3021-1	Switch
172	VS-54499-1 Chance Vought Cornell Dubilier MYR 6050	Capacitor
175	VS-54499-4 Chance Vought Cornell Dubilier MYR 6200	Capacitor
176	VS-54498 Chance Vought Cornell Dubilier ID5D6	Capacitor



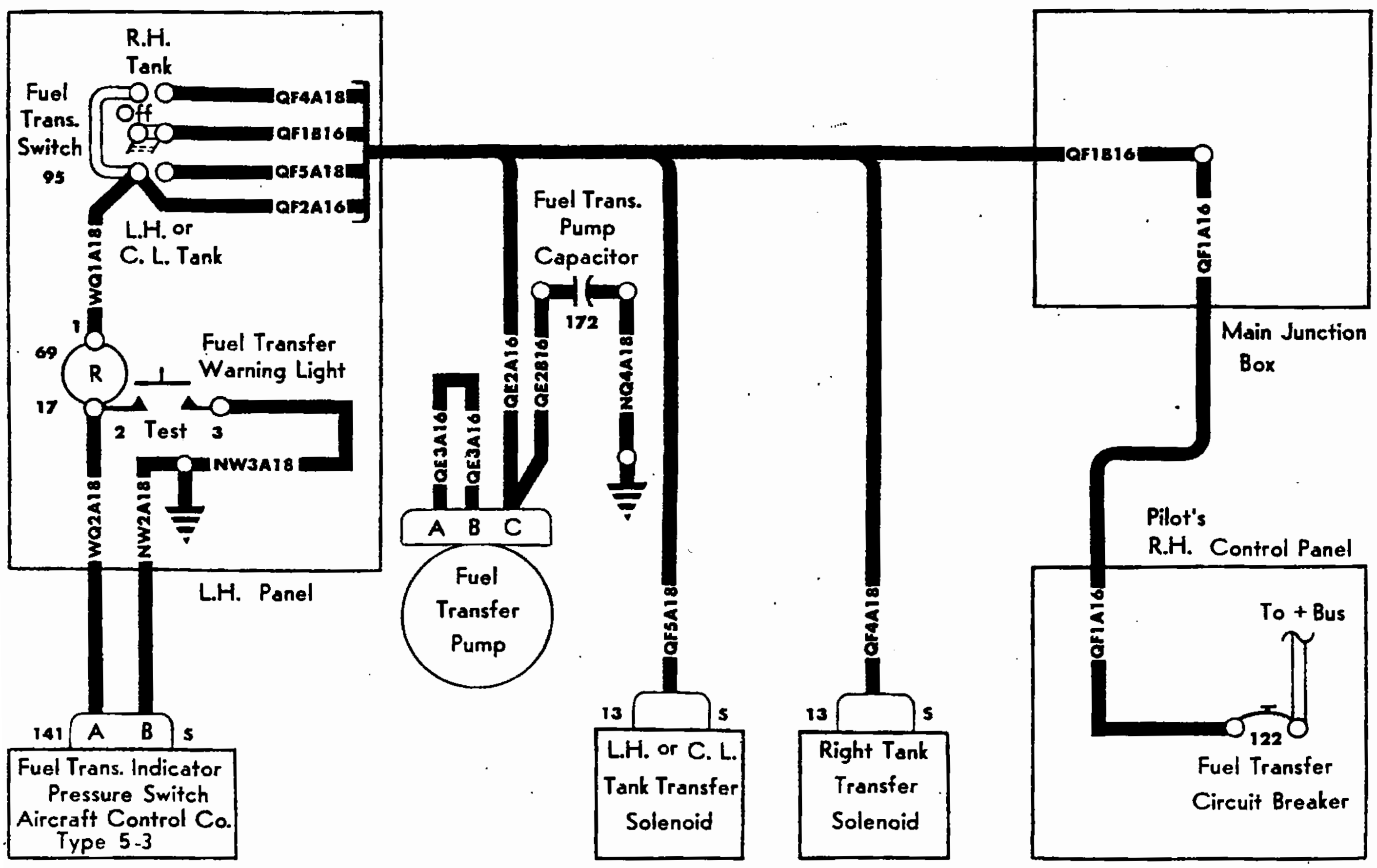


Figure 5–10. Power Plant Circuits—Fuel Transfer System.

5–71. POWER PLANT CIRCUITS – FUEL TRANSFER SYSTEM.

5–72. DESCRIPTION. *(See figure 5–10.)* This system is made up of the fuel transfer circuit-breaker on the left hand panel, the fuel transfer switch, the left or centerline external fuel tank transfer solenoid and the right external fuel tank transfer solenoid, the fuel transfer pump, the fuel transfer pressure switch and the transfer warning light. The system transfers fuel from the external auxiliary fuel tanks to the main tank. Power comes from the plus bus in the right hand control panel, through the fuel transfer circuit-breaker and thence to the double-pole, double-throw, fuel transfer switch. Turning on the fuel transfer switch starts the fuel transfer pump, turns on the fuel transfer warning light, and the transfer solenoid opens the line from the external tank selected. Pressure in the fuel line opens the transfer pressure switch and the transfer warning light on the left hand panel goes out. Fuel from the external auxiliary tank selected is pumped into the main cell until the fuel reaches a preset level, at which time the fuel transfer shutoff float valve closes. This does not stop the fuel transfer pump nor does the transfer warning light come on as long as there is fuel in the external tank. The pump has a by-pass valve which opens and permits continued operation of the pump with the fuel merely being carried around the vanes of the pump. As the fuel level in the main cell drops, the shutoff valve opens and the pump by-pass valve closes. Fuel then is once more delivered to the main cell, and the sequence continues until the external auxiliary tank is empty. When the tank is empty, the pressure in the transfer line drops, the pressure switch closes, and the transfer warning light goes on. The fuel transfer switch may then be turned to an alternate external auxiliary tank or to the "OFF" position. Once the pump has been turned on it does not stop until the switch is turned to "OFF." A capacitor, mounted at station 177½, eliminates radio noise caused by the fuel transfer pump.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
NQ4A18	AN18	659-2	860-16-3		860-18-3	4
NW2A18	AN18		860-18-3	659-2	860-16-3	17
NW3A18	AN18	659-2	860-16-3			88
QF1A16	AN16	659-4	860-14-3	659-4	860-14-3	37
QF1B16	AN16	659-4	860-14-3	659-4	860-14-3	130
QF2A16	AN16		860-16-3	659-4	860-14-3	83
QF2B18	AN18		860-18-3		860-18-3	10
QF3A16	AN16		860-16-3		860-16-3	3
QF4A18	AN18		860-18-3	659-2	860-16-3	40
QF5A18	AN18		860-18-3	659-2	860-16-3	65
WQ1A18	AN18	659-2	860-16-3			5
WQ2A18	AN18				860-18-3	87

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
13	AN3106-10S-2S	Plug
17	AN3121-313	Lamp
69	VS-44422-1 Chance Vought VM-400-2 Searle Aero Industries	Light Assembly Indicator
95	AN3027-1	Switch
122	AN3161-P15	Circuit-breaker
139	AN3108-18-4S	Plug
141	AN3106-12S-3S	Plug
172	VS-54499-1 Chance Vought Cornell Dubilier MYR6050	Capacitor

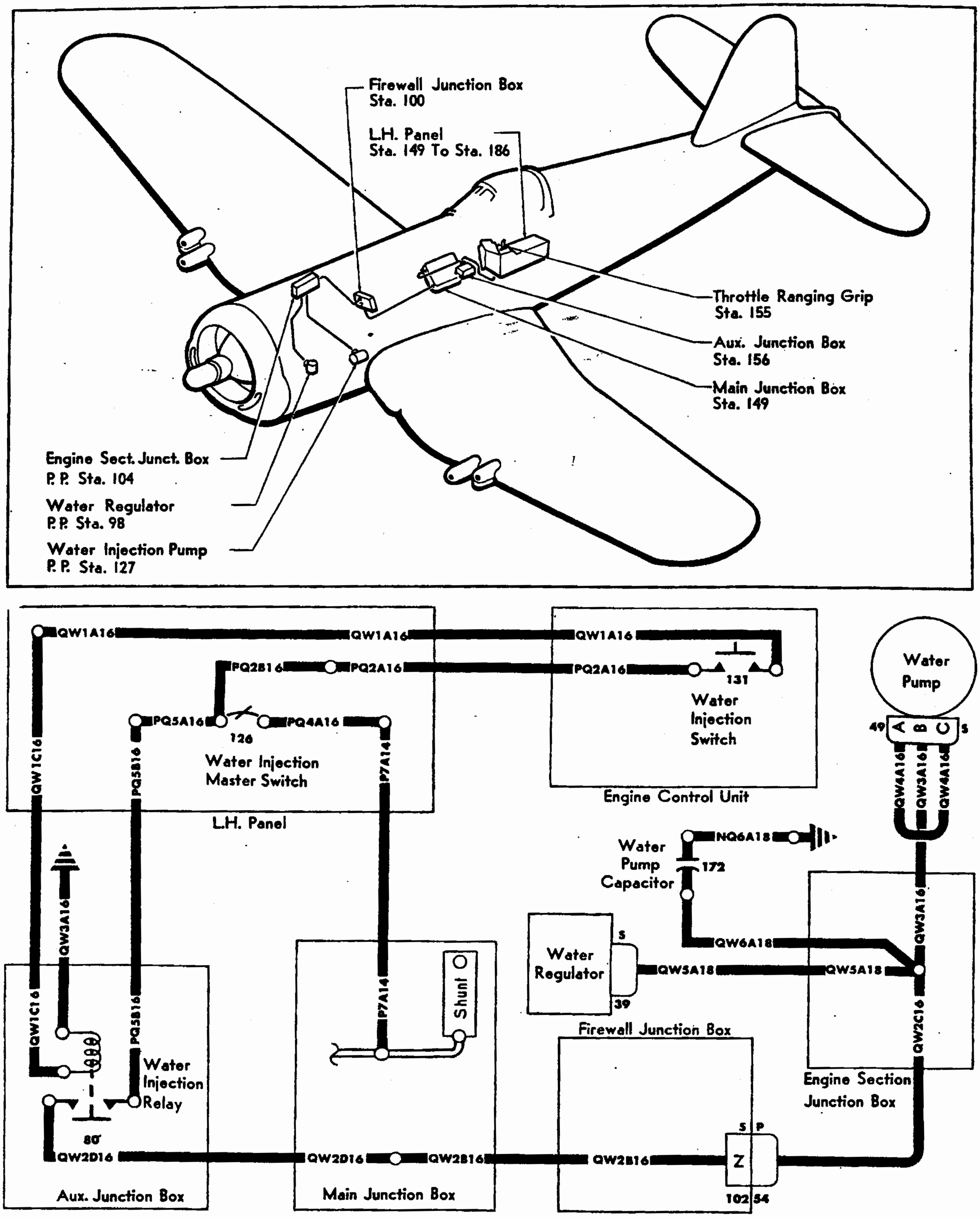


Figure 5–11. Power Plant Circuits—Water Injection System.

5–73. POWER PLANT CIRCUITS — WATER INJECTION SYSTEM.

5–74. DESCRIPTION. *(See figure 5–11.)* The water injection system has the following components: an "ON"-"OFF" master switch located on the left hand control shelf, a throttle microswitch in the engine control unit, a water injection relay, a water regulator and a water pump. For operation, the master water injection switch is turned "ON," bringing power from the shunt in the main junction box. As the throttle is advanced, the microswitch on the throttle is closed and the water injection relay energized, starting the water pump and energizing the solenoid in the regulator. When the system goes into operation the engine may be operated safely at powers higher than the present military power ratings. Water injection circuit power comes from the shunt in the main section box through a single-pole, single-throw water injection master switch on the left hand panel. The power line to the water pump is connected to the "B" terminal of the pump and the "C" and "A" terminals are connected by a jumper. A capacitor mounted on the cover of the engine section junction box eliminates radio noise caused by the water pump.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
NQ6A18	AN18	659-2	860-16-3		860-18-3	11
P7A14	AN14	659-4	860-14-3	659-4	860-14-3	92
PQ2A16	AN16			659-4	860-14-3	18
PQ2B16	AN16	659-4	860-14-3	659-4	860-14-3	15
PQ4A16	AN16	659-4	860-14-3	659-4	860-14-3	15
PQ5A16	AN16	659-4	860-14-3	659-4	860-14-3	13
PQ5B16	AN16	659-4	860-14-3	659-4	860-14-3	54
QW1A16	AN16	659-4	860-14-3	659-4	860-14-3	18
QW1C16	AN16	659-4	860-14-3	659-4	860-14-3	61
QW2B16	AN16	659-4	860-14-3		860-16-3	92
QW2C16	AN16	659-4	860-14-3		860-16-3	70
QW2D16	AN16	659-4	860-14-3	659-4	860-14-3	55
QW3A16	AN16	659-4	860-14-3		860-14-3	70
QW4A16	AN16		860-16-3		860-16-3	2
QW5A18	AN18	659-2	860-16-3		860-16-3	70
QW6A18	AN18	659-2	860-16-3		860-18-3	14

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
39	AN3108-10S-2S	Plug
49	AN3106-18-4S	Plug
54	AN3106-28-12P	Plug
80	NAF1204-1	Relay
102	AN3102-28-12S	Receptacle
126	AN3160-15	Switch-breaker
131	General Electric Co. CR1070C103C3	Switchette
172	VS-54499-1 Chance Vought Cornell Dubilier MYR6050	Capacitor

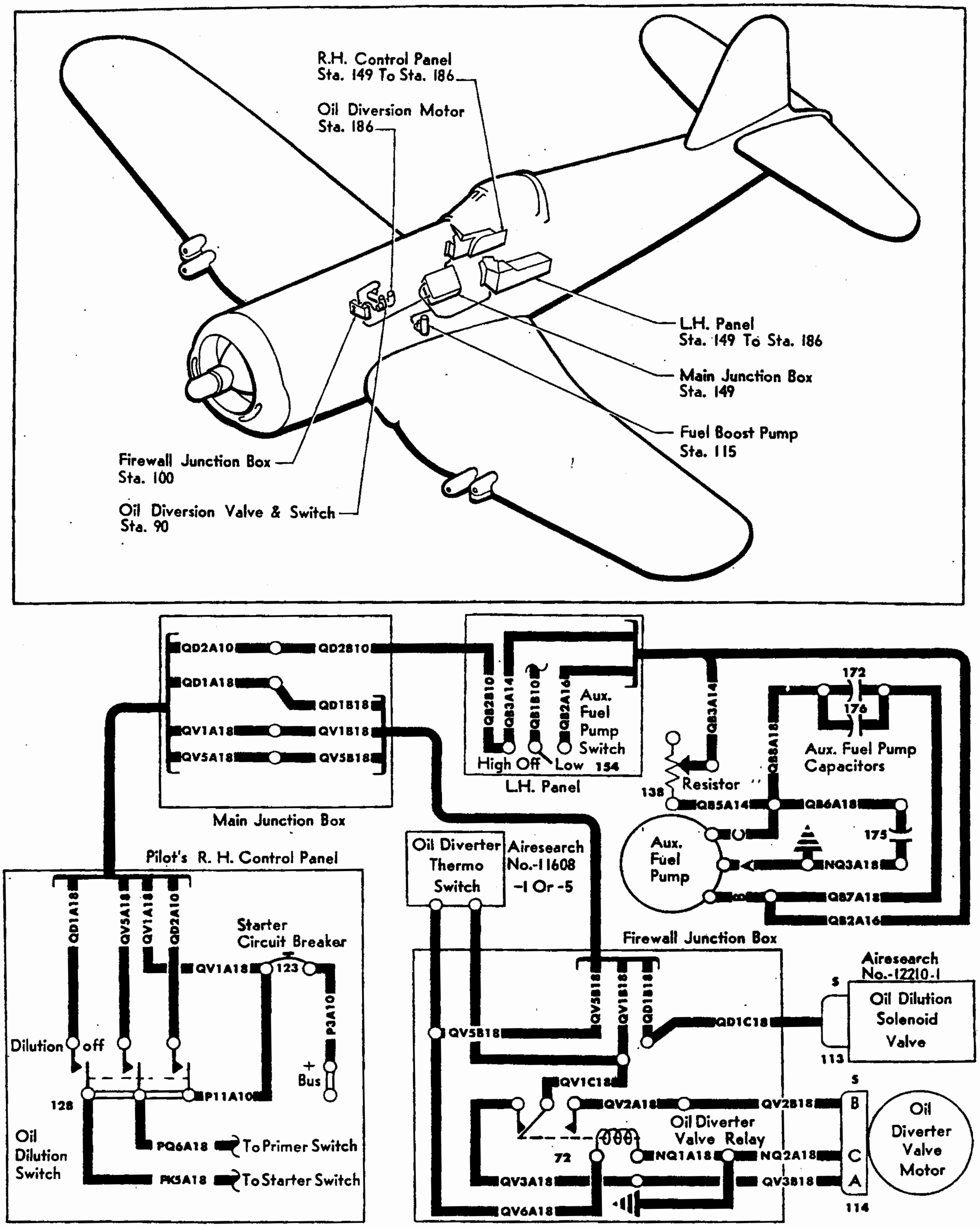


Figure 5–12. Power Plant Circuits—Oil Dilution System.

5–75. POWER PLANT CIRCUITS — OIL DILUTION SYSTEM.

5–76. DESCRIPTION. *(See figure 5–12.)* Power for the oil dilution system comes to the oil dilution switch from the plus bus through the starter circuit-breaker. The oil dilution switch is a triple-pole, single-throw switch, and it energizes the oil dilution solenoid, the oil diverter valve relay, the oil diverter valve motor, and the electric auxiliary (booster) fuel pump. Since the entire fuel pump circuit is not shown, it should be noted that only the "HIGH" side is energized when the oil dilution switch is closed. This actuation of the fuel pump is entirely independent of either the auxiliary (booster) fuel pump switch or its circuit-breaker. The thermo-switch in the circuit is so connected that during oil dilutioin, the oil dilution switch overrides the thermo-switch setting the oil diverter valve motor to close the port leading to the main tank compartment and open the port leading to the warm-up compartment. After use of oil dilution, the diverted valve remains set for a subsequent cold start (oil diverter valve port to warm-up compartment of tank open) without further manipulation of the oil dilution switch. Three capacitors in the circuit eliminate radio noise caused by the fuel pump. Two of these are located on right hand former at station 120½. The third capacitor is mounted on a stiffener on the right hand side just forward of Sta. 120½.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
NQ1A18	AN18			659-2	860-16-3	9
NQ2A18	AN18	659-2	860-16-3		860-18-3	28
NQ3A16	AN16		860-16-3	659-27	860-14-3	9½
P3A10	AN10	659-5	860-10-3	659-5	860-10-3	9½
P11A10	AN10	659-5	860-10-3	659-5	860-10-3	17
QB1B10	AN10	659-5	860-10-3	659-5	860-10-3	34
QB2A16	AN16	753-A2				130
QB3A14	AN14	659-4	860-12-3	659-4	860-12-3	40
QB4A16	AN16	659-4	860-14-3	753-A2		40
QB5A14	AN14	659-4	860-12-3	753-A	860-12-16	93
QB6A16	AN16	659-4	860-14-3		860-16-3	11
QB7A16	AN16	659-4	860-14-3		860-16-3	9½
QB8A16	AN16		860-16-3	659-4	860-14-3	11
QD1A18	AN18			659-2	860-16-3	50
QD1B18	AN18	659-2	860-16-3	659-2	860-16-3	93
QD1C18	AN18	659-2	860-16-3		860-18-3	28
QD2A10	AN10	659-5	860-10-3	659-5	860-10-3	45
QD2B10	AN10	659-5	860-10-3	659-5	860-10-3	130
QV1A18	AN18	659-2	860-16-3	659-2	860-16-3	42
QV1B18	AN18	659-2	860-16-3	659-2	860-16-3	97
QV1C18	AN18	659-2	860-16-3			9
QV2A18	AN18			659-2	860-16-3	11
QV2B18	AN18	659-2	860-16-3		860-18-3	22
QV3A18	AN18			659-2	860-16-3	11
QV3B18	AN18	659-2	860-16-3		860-18-3	22
QV5A18	AN18	659-2	860-16-3	659-2	860-16-3	53
QV5B18	AN18	659-2	860-16-3	659-2	860-16-3	80
QV6A18	AN18	659-2	860-16-3			9

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
72	VS-48746 Chance Vought Phillips Control Co. Spec. 12038-1	Relay
113	AN3108-8S-1S	Plug
114	AN3108-14S-7S	Plug
123	AN3161-P20	Circuit-breaker
128	VS-45320 Chance Vought Cutler-Hammer, Inc. 8905K722	Switch
138	VS-54411 Chance Vought Ward Leonard Elec. Co., Type B Ribflex	Resistor 0.25 ohm, 110 watt
154	AN3201-1	Switch
172	VS-54499-1 Chance Vought Cornel Dubilier MYR 6050	Capacitor
175	VS-54499-4 Chance Vought Cornel Dubilier MYR 6200	Capacitor
176	VS-54498 Chance Vought Cornell Dubilier 1D5D6	Capacitor

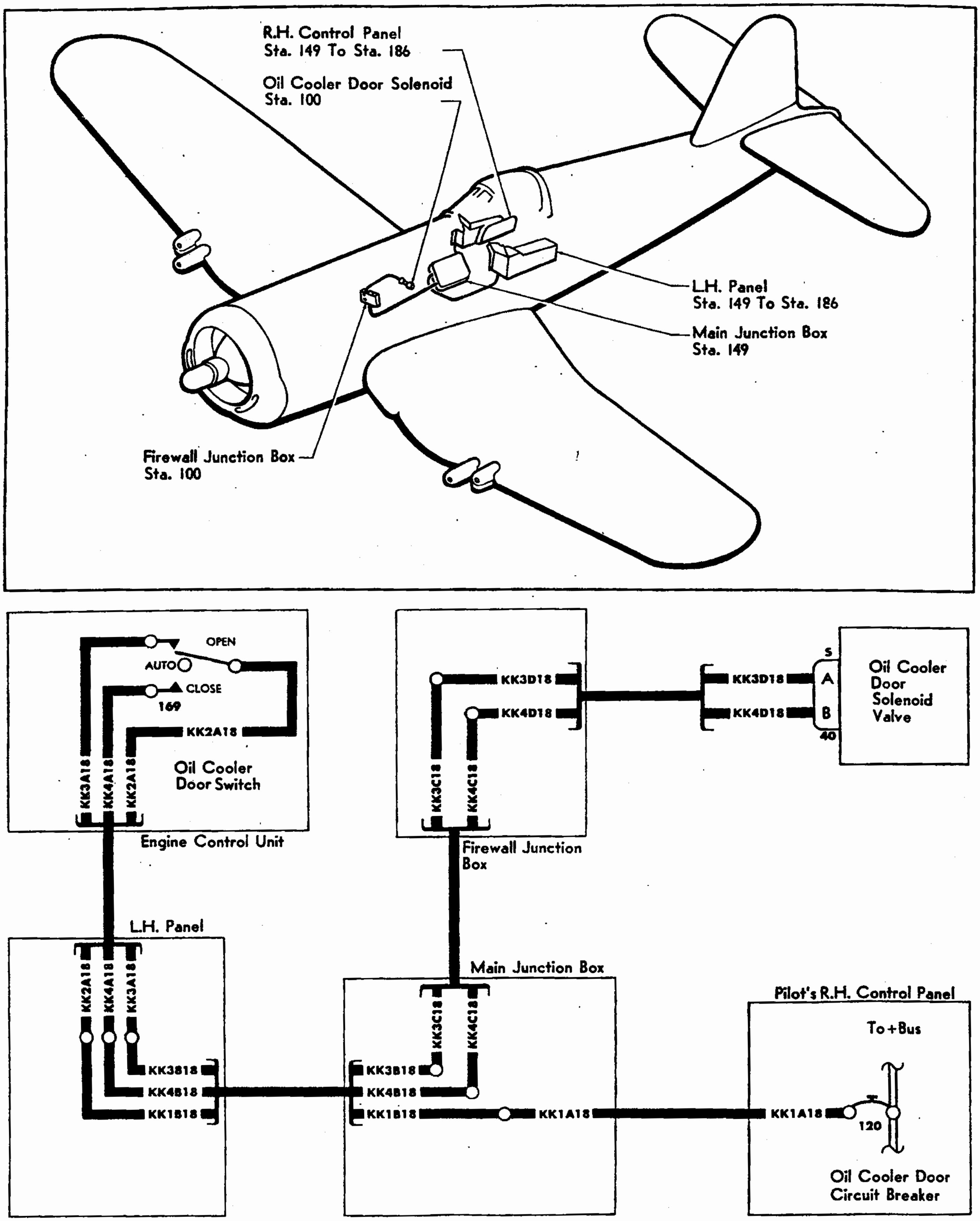


Figure 5–13. Power Plant Circuits—Oil Cooler Doors.

5-77. POWER PLANT CIRCUITS—OIL COOLER DOORS.

5-78. DESCRIPTION. (*See figure 5-13.*) With the oil cooler door switch on the left hand control panel in the "AUTOMATIC" position, the doors are controlled automatically by oil temperature through an oil temperature sensitive control, the thermal sensitive element of which is immersed in the oil tank return line. The control is set to start to open the doors at an "oil-in" temperature of approximately 75° C (167° F) and the doors reach the full open position when the temperature has risen to 95° C (203° F). The "OPEN" and "CLOSE" switch positions are manual control overrides for the system. Power from the plus bus comes in through the oil cooler door circuit-breaker to the switch, located outboard of the cowl flap switch on the rear of the engine control unit of the left hand panel, and directly controls the "A" and "B" terminals of the oil cooler door solenoid valve. Note that power for the oil cooler doors position indicator comes through the oil cooler door circuit-breaker; see paragraph 5-91.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
KK1A18	AN18	659-2	860-16-3	659-2	860-16-3	42
KK1B18	AN18	659-2	860-16-3	659-2	860-16-3	130
KK2A18	AN18	659-2	860-16-3	659-2	860-16-3	18
KK3A18	AN18	659-2	860-16-3	659-2	860-16-3	18
KK3B18	AN18	659-2	860-16-3	659-2	860-16-3	130
KK3C18	AN18	659-2	860-16-3	659-2	860-16-3	92
KK3D18	AN18	659-2	860-16-3		860-18-3	27
KK4A18	AN18	659-2	860-16-3	659-2	860-16-3	18
KK4B18	AN18	659-2	860-16-3	659-2	860-16-3	130
KK4C18	AN18	659-2	860-16-3	659-2	860-16-3	94
KK4D18	AN18	659-2	860-16-3		860-16-3	27

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
40	AN3108-12S-3S	Plug
120	AN3161-P5	Circuit-breaker
169	Cutler-Hammer 8905K671	Switch

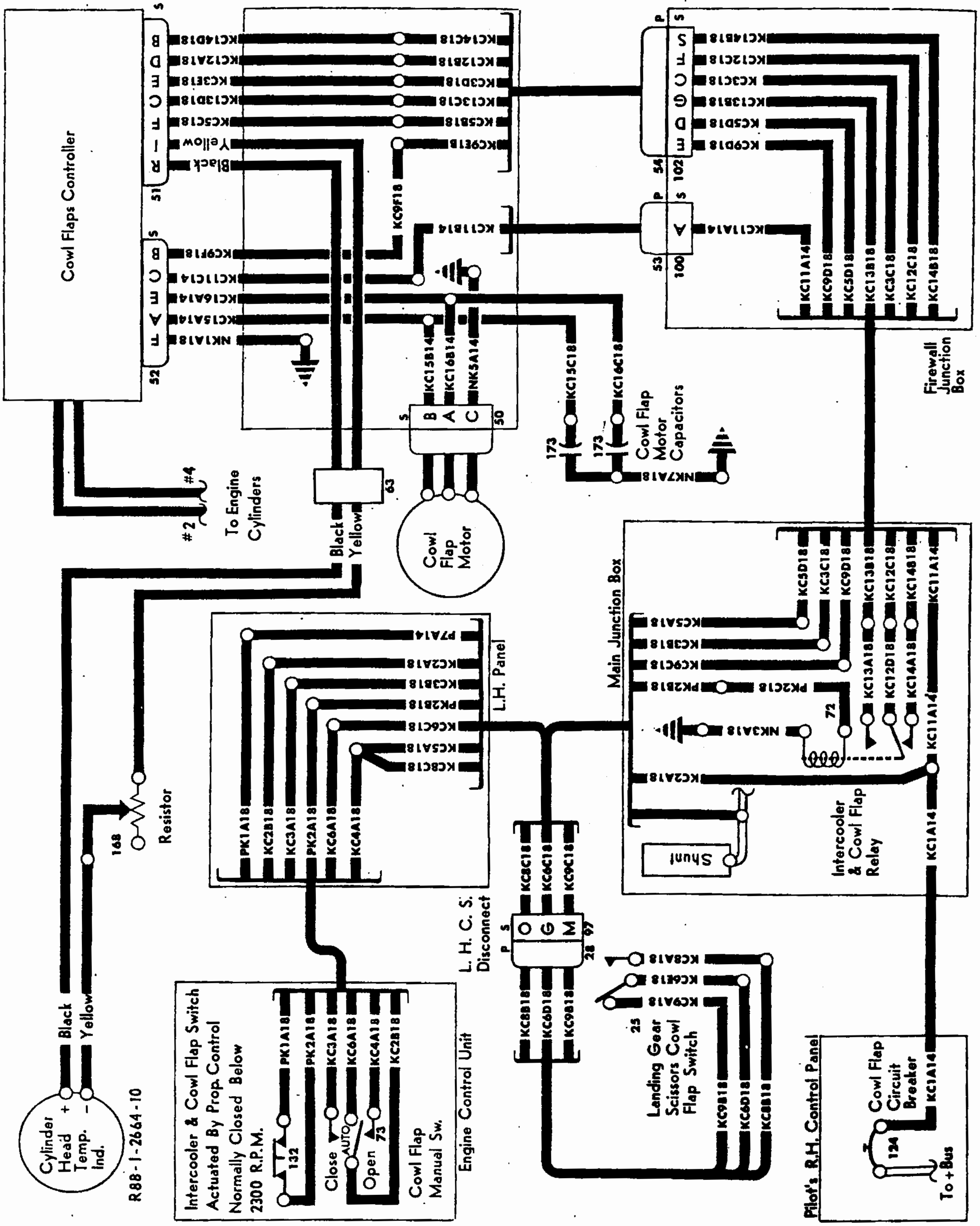


Figure 5–14. (Sheet 1 of 2 Sheets). Power Plant Circuits—Cowl Flaps.

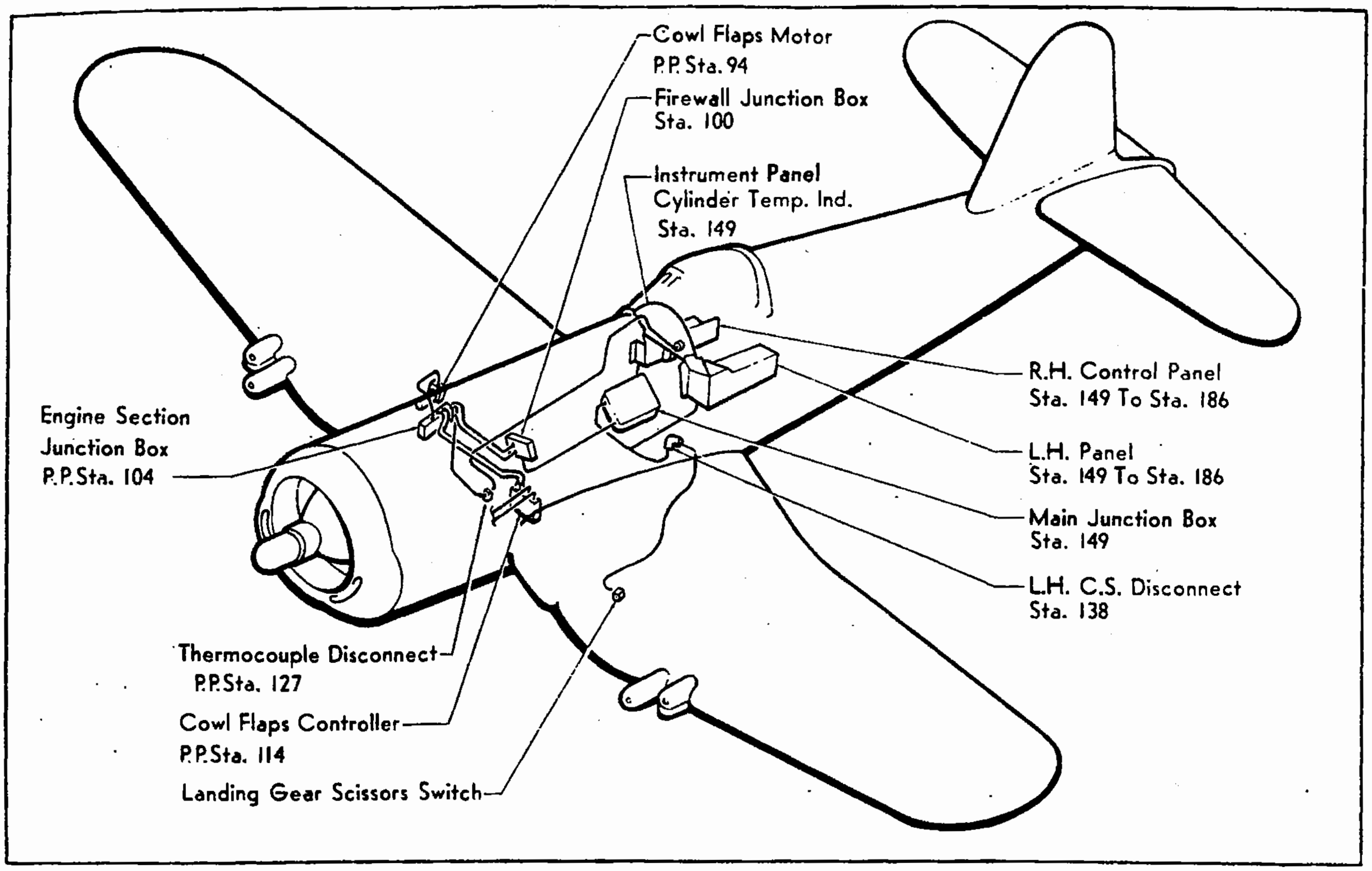


Figure 5–14. (Sheet 2 of 2 Sheets.) Power Plant Circuits—Cowl Flaps.

5–79. POWER PLANT CIRCUITS—COWL FLAPS.

5–80. DESCRIPTION. *(See figure 5–14.)* The cowl flap circuit consists of a four-position switch on the left hand control panel, a microswitch actuated by the propeller governor control lever below 2300 rpm, an override switch on the landing gear, a controller box in the engine section, an electric cowl flap motor and two thermocouples. The cylinder head temperature indicator is also included in this circuit to pick up the thermocouple connection in the cowl flap controller box. The cowl flap switch has fixed "AUTOMATIC" and "OFF" positions and momentary "OPEN" and "CLOSE" positions. When the switch is in "AUTOMATIC," the controller in the engine section and the propeller governor actuated microswitch in the engine control unit govern the position of the cowl flaps. The controller box energizes the cowl flaps motor to open and close the cowl flaps in response to cylinder head temperatures, transmitted by thermocouples located in engine cylinders No. 2 and No. 4. The landing gear microswitch closes whenever the main gear shock struts are compressed (airplane on ground) and keeps the flaps open during ground operation as long as the switch is in the "AUTOMATIC" position. Note that all automatic controls in this circuit (propeller control microswitch, cylinder head temperature and landing gear microswitch) are overridden by placing the cowl flap control switch in the engine control unit in the "OPEN" or "CLOSE" positions, thus directly energizing the cowl flap motor to open or close the flaps. A capacitor, mounted on the side of the engine section junction box, eliminates radio noise caused by the cowl flaps motor.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
KC1A14	AN14	659-4	860-14-3	659-4	860-14-3	40
KC2A18	AN18	659-2	860-16-3	659-2	860-16-3	130
KC2B18	AN18	659-2	860-16-3	659-2	860-16-3	18
KC3A18	AN18	659-2	860-16-3	659-2	860-16-3	18
KC3B18	AN18	659-2	860-16-3	659-2	860-16-3	130

WIRE TABLE (Continued)

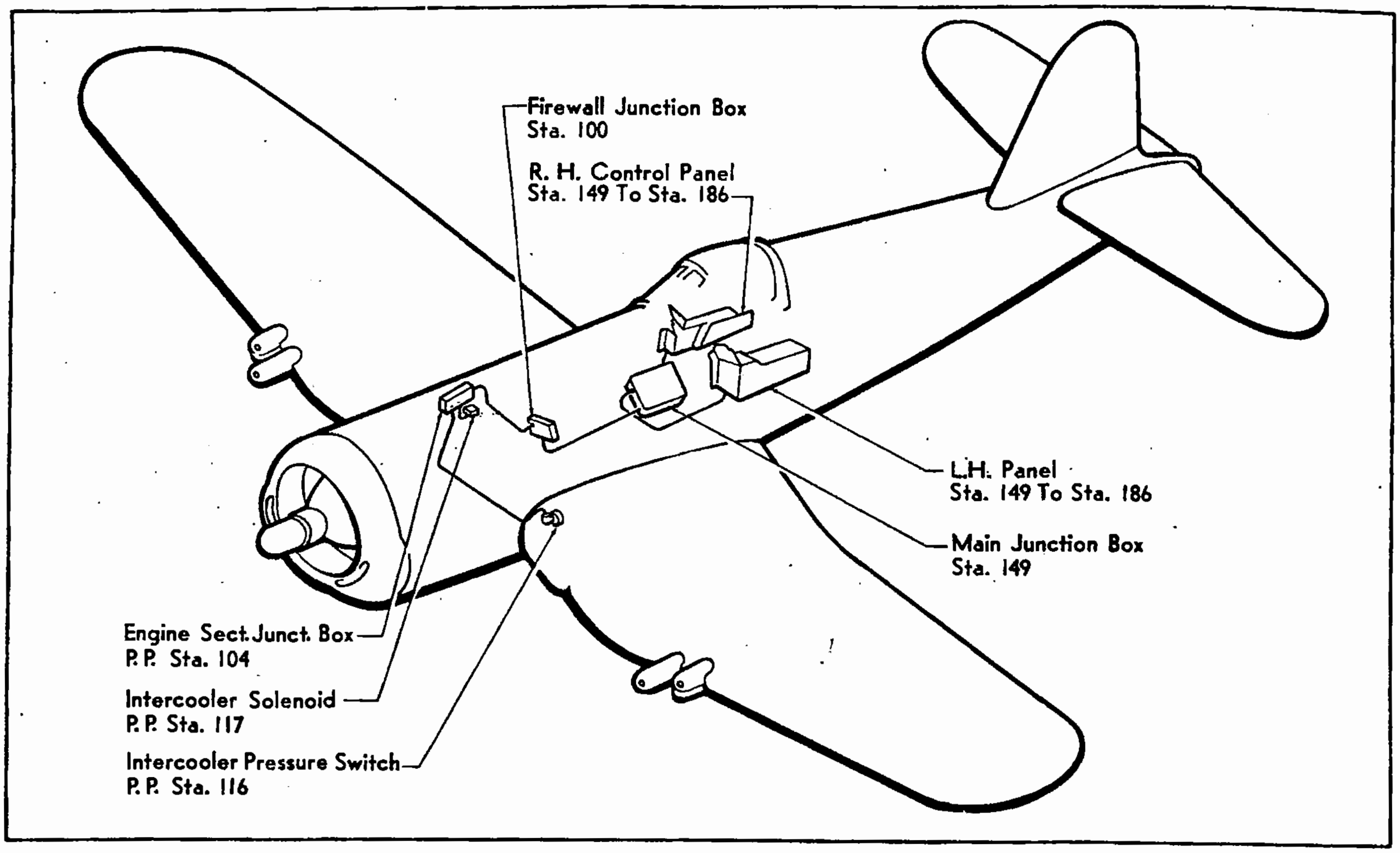
WIRE NO.	NAF 1070	END TYPE AN LUG	INS. SL. CVC	END TYPE AN LUG	INS. SL. CVC	LENGTH IN.
KC3C18	AN18	659-2	860-16-3		860-18-3	93
KC3D18	AN18		860-18-3	659-2	860-16-3	56
KC3E18	AN18	659-2	860-16-3		860-18-3	62
KC4A18	AN18	659-2	860-16-3	659-2	860-16-3	18
KC5A18	AN18	659-2	860-16-3	659-2	860-16-3	130
KC5B18	AN18		860-18-3	659-2	860-16-3	58
KC5C18	AN18	659-2	860-16-3		860-18-3	61
KC5D18	AN18	659-2	860-16-3		860-18-3	95
KC6A18	AN18	659-2	860-16-3	659-2	860-16-3	18
KC6C18	AN18	659-2	860-16-3		860-18-3	61
KC6D18	AN18		860-18-3	659-2	860-16-3	130
KC6E18	AN18	659-2	860-16-3			85
KC8A18	AN18			659-2	860-16-3	85
KC8B18	AN18	659-2	860-16-3		860-18-3	130
KC8C18	AN18		860-18-3	659-2	850-16-3	62
KC9A18	AN18			659-2	860-16-3	85
KC9B18	AN18	659-2	860-16-3		860-18-3	130
KC9C18	AN18		860-18-3	659-2	860-16-3	49
KC9D18	AN18	659-2	860-16-3		860-18-3	95
KC9E18	AN18		860-18-3	659-2	860-16-3	58
KC9F18	AN18	659-2	860-16-3		860-18-3	64
KC11A14	AN14	659-4	860-12-3		860-14-3	92
KC11B14	AN14		860-14-3	659-4	860-14-3	63
KC11C14	AN14	659-4	860-14-3		860-14-3	63
KC12A18	AN18		860-18-3	659-2	860-16-3	60
KC12B18	AN18	659-2	860-16-3		860-18-3	56
KC12C18	AN18		860-18-3	659-2	860-16-3	87
KC12D18	AN18	659-2	860-16-3			7
KC13A18	AN18			659-2	860-16-3	8
KC13B18	AN18	659-2	860-16-3		860-18-3	89
KC13C18	AN18		860-18-3	659-2	860-16-3	55
KC13D18	AN18	659-2	860-16-3		860-18-3	61
KC14A18	AN18			659-2	860-16-3	9
KC14B18	AN18	659-2	860-16-3		860-18-3	88
KC14C18	AN18		860-18-3	659-2	860-16-3	54
KC14D18	AN18	659-2	860-16-3		860-18-3	61
KC15A14	AN14		860-14-3	659-4	860-14-3	65
KC15B14	AN14	659-4	860-14-3		860-14-3	3
KC15C18	AN18	659-2	860-16-3		860-18-3	7
KC16A14	AN14		860-14-3	659-4	860-14-3	64
KC16B14	AN14	659-4	860-14-3		860-14-3	3
KC16C18	AN18	659-2	860-16-3		860-18-3	7

WIRE TABLE (Continued)

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
NK1A18	AN18		860-18-3	659-2	860-16-3	65
NK3A18	AN18			659-2	860-16-3	5
NK5A14	AN14	659-4	860-14-3		860-14-3	7
NK7A-18	AN18		860-18-3		860-18-3	15
P7A14	AN14	659-4	860-14-3	659-4	860-14-3	92
PK1A18	AN18	659-2	860-16-3			18
PK2A18	AN18			659-2	860-16-3	16
PK2B18	AN18	659-2	860-16-3	659-2	860-16-3	83
PK2C18	AN18	659-2	860-16-3			6

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
25	AN3217-1	Switch Assembly
28	AN3108-24-7P	Plug
50	AN3102-16-11S	Receptacle
51	AN3106-20-16P	Plug
52	AN3106-20-22P	Plug
53	AN3106-28-10P	Plug
54	AN3106-28-12P	Plug
63	AN5537-1	Connector Assembly
72	VS-48746 Chance Vought Phillips Control Co. Spec. 12038-1	Relay
73	Cutler Hammer, 8905K608	Switch
97	AN3100-24-7S	Receptacle
100	AN3102-28-10S	Receptacle
102	AN3102-28-12S	Receptacle
124	AN3161-P35	Circuit-breaker
132	CR1070C103F3 General Electric Co.	Switchette
168	AN5534-1	Resistor
173	VS-54499-2 Chance Vought Cornell Dubilier MYR 6055	Capacitor



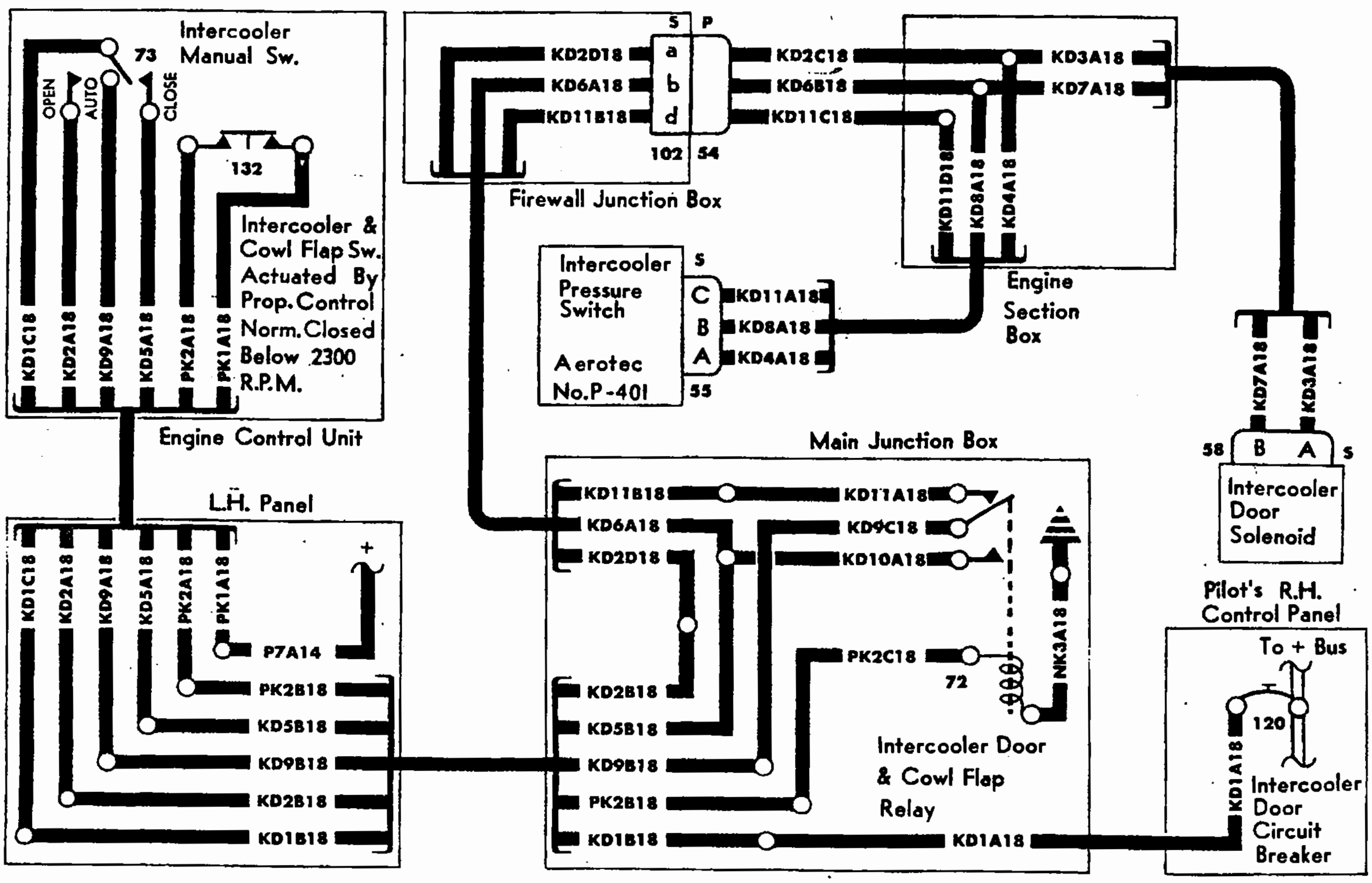


Figure 5–15. Power Plant Circuits—Intercooler Flap.

5-81. POWER PLANT CIRCUITS—INTERCOOLER FLAP.

5-82. DESCRIPTION. (*See figure 5-15.*) The intercooler flap switch is located on the left hand control panel. It is a four-position, toggle-type switch. Power is supplied through the switch from the intercooler flap circuit-breaker. The positions of the switch are "AUTOMATIC," "OFF," "OPEN" and "CLOSE." Below 2300 rpm, with intercooler flap switch on "AUTOMATIC," power comes from the circuit-breaker through the intercooler flap switch to the intercooler and cowl flap relay. The propeller governor control micro: witch is normally closed at and below 2300 rpm. This energizes the relay, which in turn, takes power to the "B" terminal of the intercooler flap solenoid, closing the flap. For all normal operation (above 2300 rpm) with intercooler flap switch on "AUTOMATIC", the current goes directly to the "C" terminal of the intercooler flap pressure switch. The pressure switch, responding to a pressure differential across the cooling air side of the intercooler, will send the current out through either the "A" terminal to the open side of the intercooler flap solenoid, or to the "B" terminal (close side) of the solenoid, controlling hydraulic actuation of the flap. When the momentary manual control positions of the intercooler flap switch are used, current from the circuit-breaker goes to the "A" (open) or "B" (close) terminal of the intercooler flap solenoid to open or close the flap during the time the switch is held to either of the manual positions.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
KD1A18	AN18	659-2	860-16-3	659-2	860-16-3	40
KD1B18	AN18	659-2	860-16-3	659-2	860-16-3	130
KD1C18	AN18	659-2	860-16-3	659-2	860-16-3	18
KD2A18	AN18	659-2	860-16-3	659-2	860-16-3	18
KD2B18	AN18	659-2	860-16-3	659-2	860-16-3	130
KD2C18	AN18		860-18-3	659-2	860-16-3	63
KD2D18	AN18	659-2	860-16-3		860-18-3	93
KD3A18	AN18		860-18-3	659-2	860-16-3	40
KD4A18	AN18	659-2	860-16-3		860-18-3	74
KD5A18	AN18	659-2	860-16-3	659-2	860-16-3	18
KD5B18	AN18	659-2	860-16-3	659-2	860-16-3	130
KD6A18	AN18	659-2	860-16-3		860-18-3	86
KD6B18	AN18		860-18-3	659-2	860-16-3	64
KD7A18	AN18	659-2	860-16-3		860-18-3	51
KD8A18	AN18	659-2	860-16-3		860-18-3	74
KD9A18	AN18	659-2	860-16-3	659-2	860-16-3	18
KD9B18	AN18	659-2	860-16-3	659-2	860-16-3	130
KD9C18	AN18	659-2	860-16-3			6
KD10A18	AN18			659-2	860-16-3	6
KD11A18	AN18			659-2	860-16-3	12
KD11B18	AN18	659-2	860-16-3		860-18-3	89
KD11C18	AN18		860-18-3	659-2	860-16-3	65
KD11D18	AN18		860-18-3	659-2	860-16-3	73
NK3A18	AN18			659-2	860-16-3	5
P7A14	AN14	659-4	860-14-3	659-4	860-14-3	92
PK1A18	AN18	659-2	860-16-3			18
PK2A18	AN18			659-2	860-16-3	16
PK2B18	AN18	659-2	860-16-3	659-2	860-16-3	83
PK2C18	AN18	659-2	860-16-3			6

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
54	AN3106-28-12P	Plug
55	AN3108-10SL-3S	Plug
58	AN3108-14S-9S	Plug
72	VS-48746 Chance Vought Phillips Control Spec. 12038-1	Relay
73	Cutler-Hammer 8905K608	Switch
102	AN3102-28-12S	Receptacle
120	AN3161-P5	Circuit-breaker
132	CR1070C103F3 General Electric Co.	Switchette

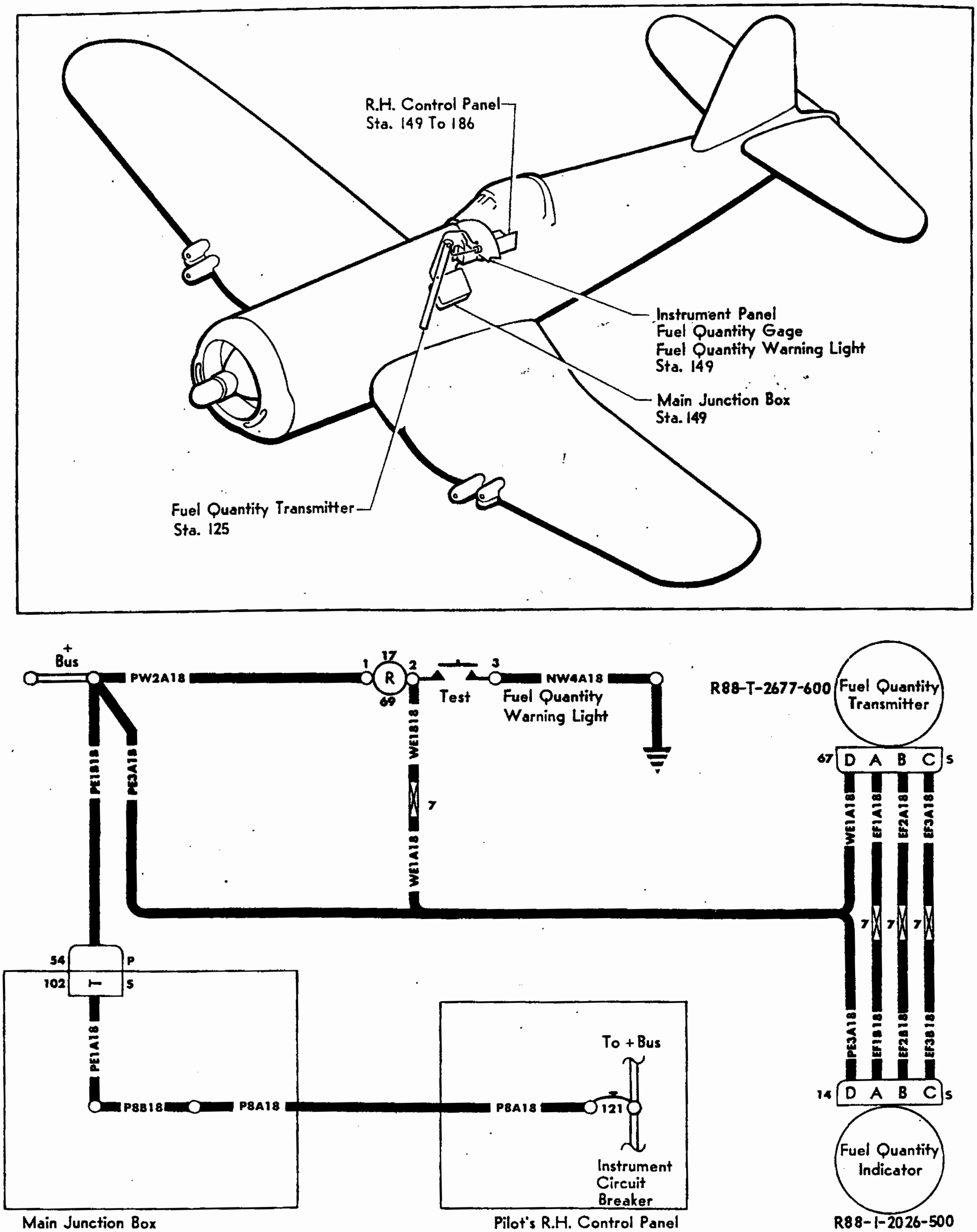


Figure 5–16. Engine Indicator Circuits—Fuel Quantity Gage.

5-83. ENGINE INDICATOR CIRCUITS—FUEL QUANTITY GAGE.

5-84. DESCRIPTION. (*See figure 5-16.*) The fuel quantity gage, indicating fuel content of the main cell, is of the remote indicating type, consisting of a transmitter in the main fuel cell, connected electrically to an indicator on the instrument panel. A red warning light in the circuit, goes on when the fuel level drops to 50 gallons or below. The indicator is connected by three wires to a tapped resistance (not shown on the diagram) in the transmitter and a constant voltage is applied across the resistance. The travel of a sliding arm along this resistance causes a change in the current passing to the indicator and thus varies the readings on the dial. Power is taken from the instrument circuit-breaker.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
EF1A18	AN18	753-A1		753-A1		29
EF1B18	AN18		860-18-3	753-A1		118
EF2A18	AN18	753-A1	860-18-3	753-A1		29
EF2B18	AN18		860-18-3	753-A1		18
EF3A18	AN18	753-A1	860-18-3	753-A1		29
EF3B18	AN18		860-18-3	753-A1		18
NW4A18	AN18			659-2	860-16-3	18
P8A18	AN18	659-2	860-16-3	659-2	860-16-3	38
P8B18	AN18	659-2	860-16-3	659-2	860-16-3	3
PE1A18	AN18	659-2	860-16-3		860-18-3	12
PE1B18	AN18	659-2	860-16-3		860-18-3	46
PE3A18	AN18	659-2	860-16-3		860-18-3	18
PW2A18	AN18	659-2	860-16-3			34
WE1A18	AN18		860-18-3	753-A1		28
WE1B18	AN18		860-18-3	753-A1		4

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
7	AN753B1	Coupler
14	AN3106-14S-2S	Plug
17	AN3121-313	Lamp
54	AN3106-28-12P	Plug
67	AN3108-14S-2S	Plug
69	VS-44422-1 Chance Vought Searle Aero. Ind. VM-400-2	Light Assembly—Ind.
102	AN3102-28-12S	Receptacle
121	AN3161-P10	Circuit-breaker

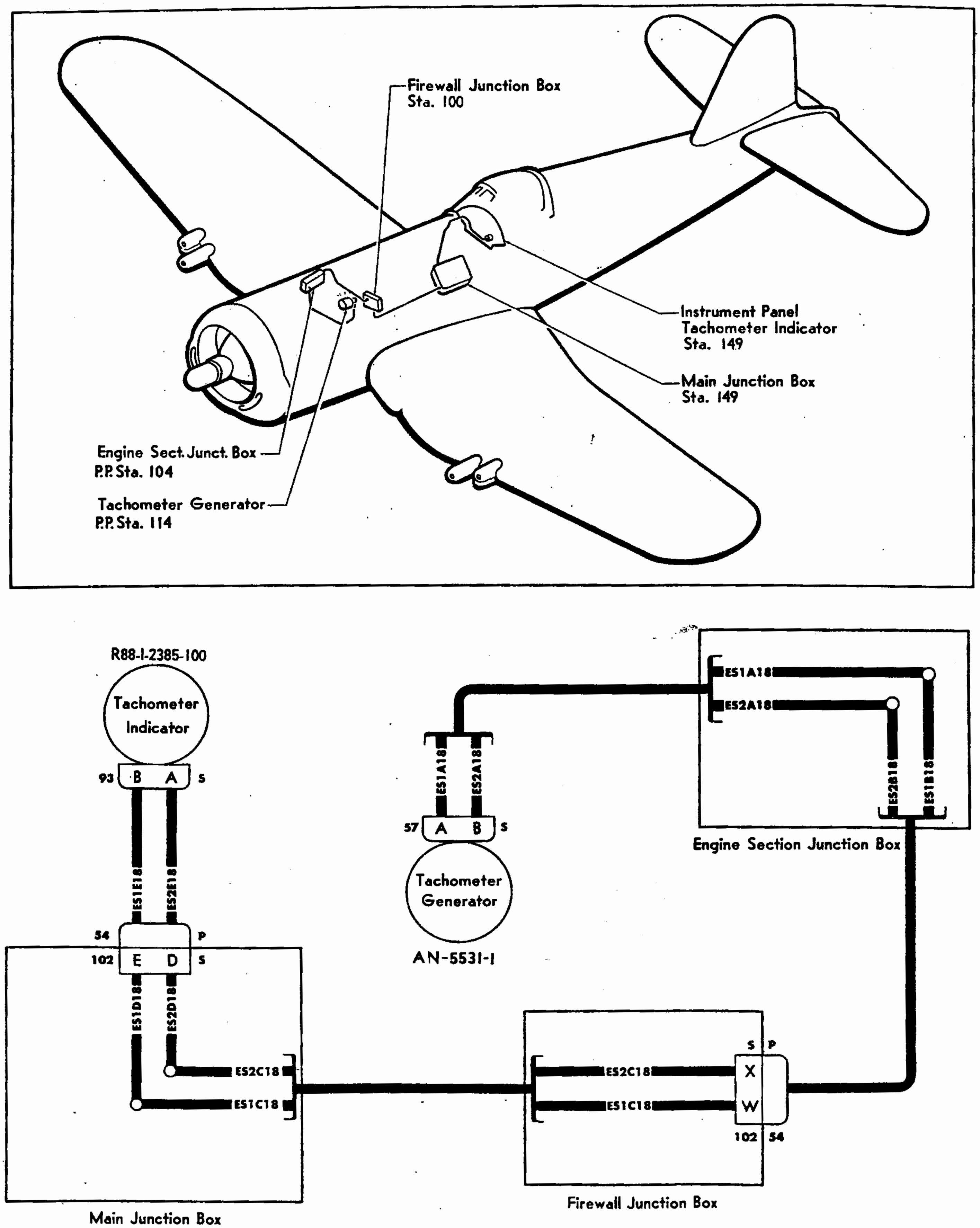


Figure 5–17. Engine Indicator Circuits—Tachometer.

5-85. ENGINE INDICATOR CIRCUITS—TACHOMETER.

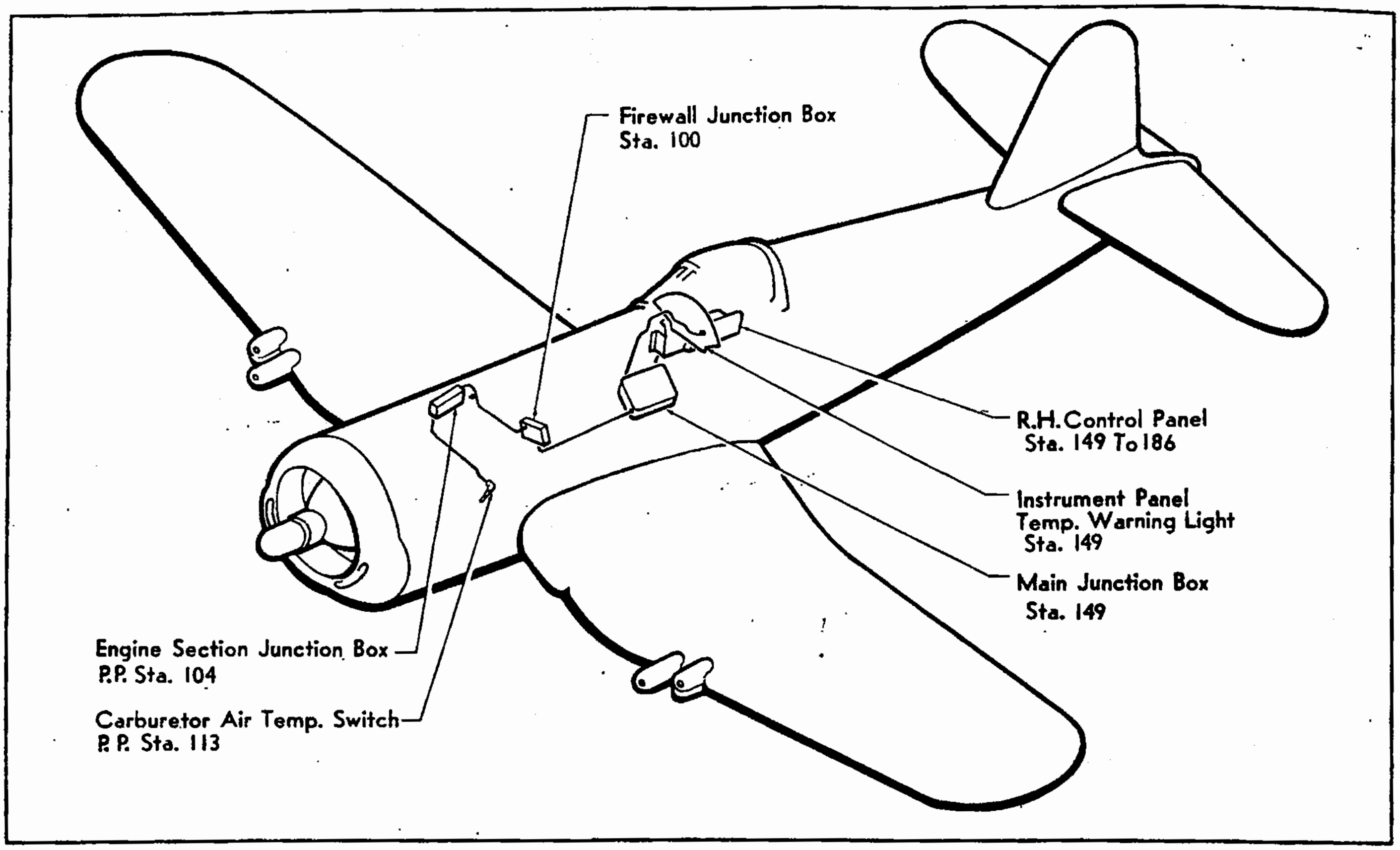
5-86. DESCRIPTION. (*See figure 5-17.*) The tachometer installation, consisting of the tachometer generator and the tachometer indicator, is an independent system which indicates the rpm of the engine crankshaft. The tachometer generator, located on the engine accessory section to the right of the automatic manifold pressure control, is driven at one-half engine speed and generates an alternating current proportional to the speed at which it is rotating. Current from the tachometer generator passes through two wires to the engine section junction box, the firewall junction box, the main junction box, and to the tachometer indicator on the instrument panel to the left of the altimeter. The tachometer indicator contains a rotor element which, when activated by the tachometer generator output, registers rotor speed in terms of engine rpm on the indicator dial.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	INS. SL. CVC	END TYPE AN LUG	INS. SL. CVC	LENGTH IN.
ES1A18	AN18		860-18-3	659-2	860-16-3	41
ES1B18	AN18	659-2	860-16-3		860-18-3	60
ES1C18	AN18	659-2	860-16-3		860-18-3	92
ES1D18	AN18	659-2	860-16-3		860-18-3	17
ES1E18	AN18	659-2	860-16-3		860-18-3	61
ES2A18	AN18		860-18-3	659-2	860-16-3	41
ES2B18	AN18	659-2	860-16-3		860-18-3	61
ES2C18	AN18	659-2	860-16-3		860-18-3	94
ES2D18	AN18	659-2	860-16-3		860-18-3	16½
ES2E18	AN18	659-2	860-16-3		860-18-3	61

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
54	AN3106-28-12P	Plug
57	AN3108-14S-1S	Plug
93	AN3106-14S-1S	Plug
102	AN3102-28-12S	Receptacle



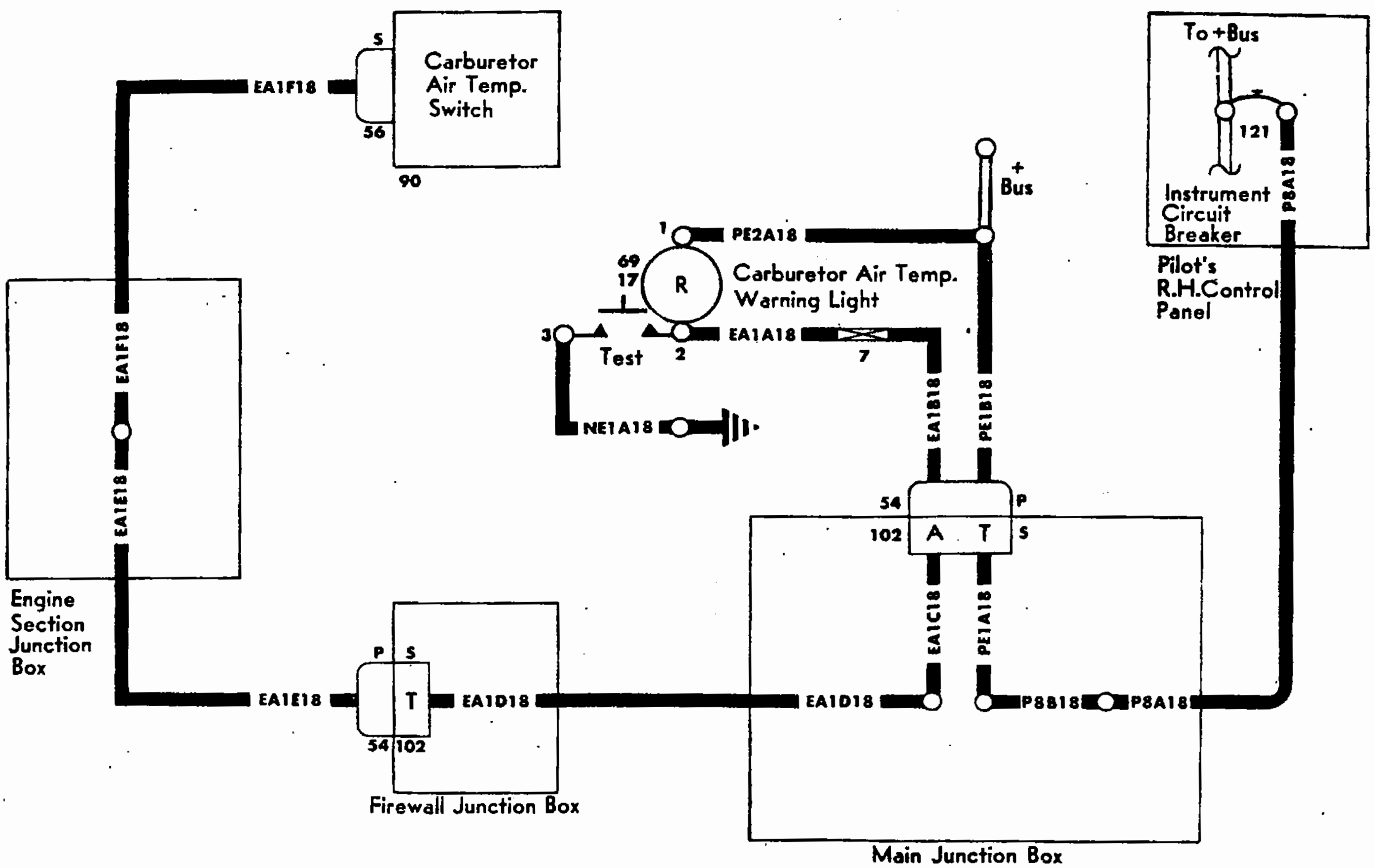


Figure 5—18. Engine Indicator Circuits—Carburetor Air Temperature Warning Light.

5-87. ENGINE INDICATOR CIRCUITS—CARBURETOR AIR TEMPERATURE WARNING LIGHT.

5-88. DESCRIPTION. (*See figure 5-18.*) The carburetor air temperature warning light on the main instrument panel, indicates critical temperature of the carburetor air. The system consists of a red warning light and a contact switch installed in the carburetor air box. The power comes from the plus bus to the instrument circuit-breaker. When the temperature surrounding the switch reaches 51° C (124° F), the temperature-responsive contacts in the switch close, and complete the warning light circuit. The warning light bulb may be tested by pressing the light toward the panel. This completes a circuit to ground and the lamp will light.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
EA1A18	AN18	753-A1				3
EA1B18	AN18	753-A1			860-18-3	65
EA1C18	AN18		860-18-3	659-2	860-16-3	15
EA1D18	AN18	659-2	860-16-3		860-18-3	90
EA1E18	AN18		860-18-3	659-2	860-16-3	61
EA1F18	AN18	659-2	860-16-3		860-16-3	64
NE1A18	AN18			659-2	860-16-3	32
P8A18	AN18	659-2	860-16-3	659-2	860-16-3	38
P8B18	AN18	659-2	860-16-3	659-2	860-16-3	3
PE1A18	AN18	659-2	860-16-3		860-18-3	12
PE1B18	AN18		860-18-3	659-2	860-16-3	46
PE2A18	AN18	659-2	860-16-3			30

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
7	AN753B1	Coupler
17	AN3121-313	Lamp
54	AN3106-28-12P	Plug
56	AN3108-12S-4S	Plug
69	VS-44422-1 Chance Vought Searle Aero. Ind. VM-400-2	Light Assembly Indicator
90	VS-54495 Chance Vought Fenwal 18301-3	Thermo-switch
102	AN3102-28-12S	Receptacle
121	AN3161-P10	Circuit-breaker

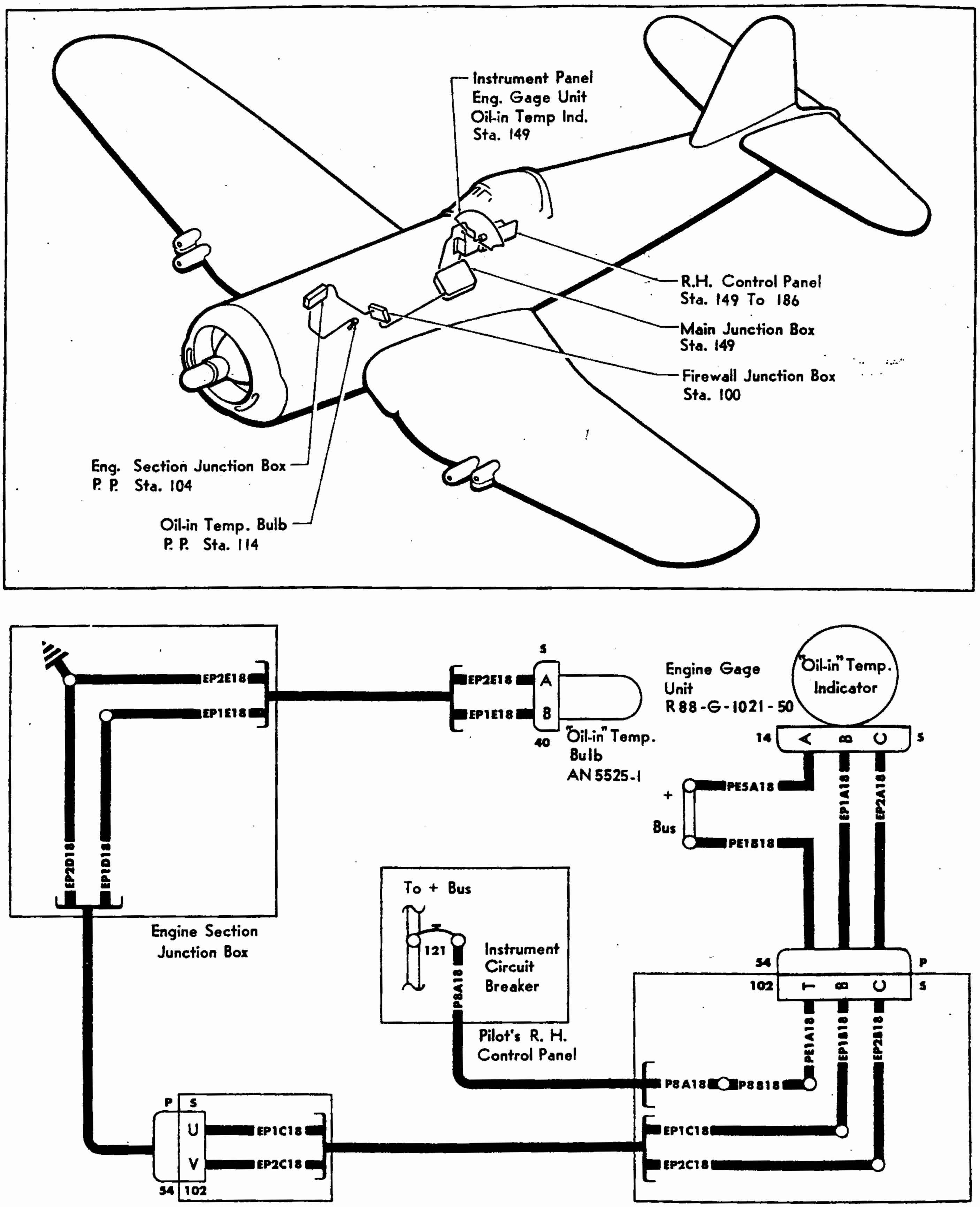


Figure 5–19. Engine Indicator Circuits—"Oil-in" Temperature Indicator.

5-89. ENGINE INDICATOR CIRCUITS—"OIL-IN" TEMPERATURE INDICATOR.

5-90. DESCRIPTION. (*See figure 5-19.*) The oil temperature gage, which is part of the engine gage unit, is a ratiometric type galvanometer which measures electrically the temperature of the oil entering the engine, by means of a thermocouple housed in a plug inserted in the oil inlet connection of the engine. Current flows from the plus bus in the right hand control shelf to the main junction box and then to the "A" terminal on the indicator. From the indicator, current is directed to the temperature bulb (located in the engine beneath the tachometer generator), through the main, firewall, and engine section junction boxes. The current then returns to the indicator along the same route, registering on the indicator in terms of degrees of temperature. A rise in oil temperature causes a rise in the temperature of a resistance winding contained within the bulb, and correspondingly, a decrease in oil temperature decreases the temperature of the resistance winding, the differences in temperatures being shown on the indicator in degrees centigrade.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
EP1A18	AN18		860-18-3		860-18-3	55
EP1B18	AN18		860-18-3	659-2	860-16-3	16
EP1C18	AN18	659-2	860-16-3		860-18-3	89
EP1D18	AN18		860-18-3	659-2	860-16-3	57
EP1E18	AN18	659-2	860-16-3	659-2	860-18-3	62
EP2A18	AN18		860-18-3	659-2	860-18-3	55
EP2B18	AN18		860-16-3	659-2	860-18-3	16½
EP2C18	AN18	659-2	860-16-3		860-18-3	90
EP2D18	AN18	659-2	860-16-3		860-18-3	51
EP2E18	AN18	659-2	860-16-3		860-18-3	67
P8A18	AN18	659-2	860-16-3	659-2	860-16-3	38
P8B18	AN18	659-2	860-16-3	659-2	860-16-3	3
PE1A18	AN18	659-2	860-16-3		860-18-3	12
PE1B18	AN18	659-2	860-16-3		860-18-3	46
PE5A18	AN18	659-2	860-16-3		860-18-3	21

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
14	AN3106-14S-2S	Plug
40	AN3108-12S-3S	Plug
54	AN3106-28-12P	Plug
102	AN3102-28-12S	Receptacle
121	AN3161-P10	Circuit-breaker

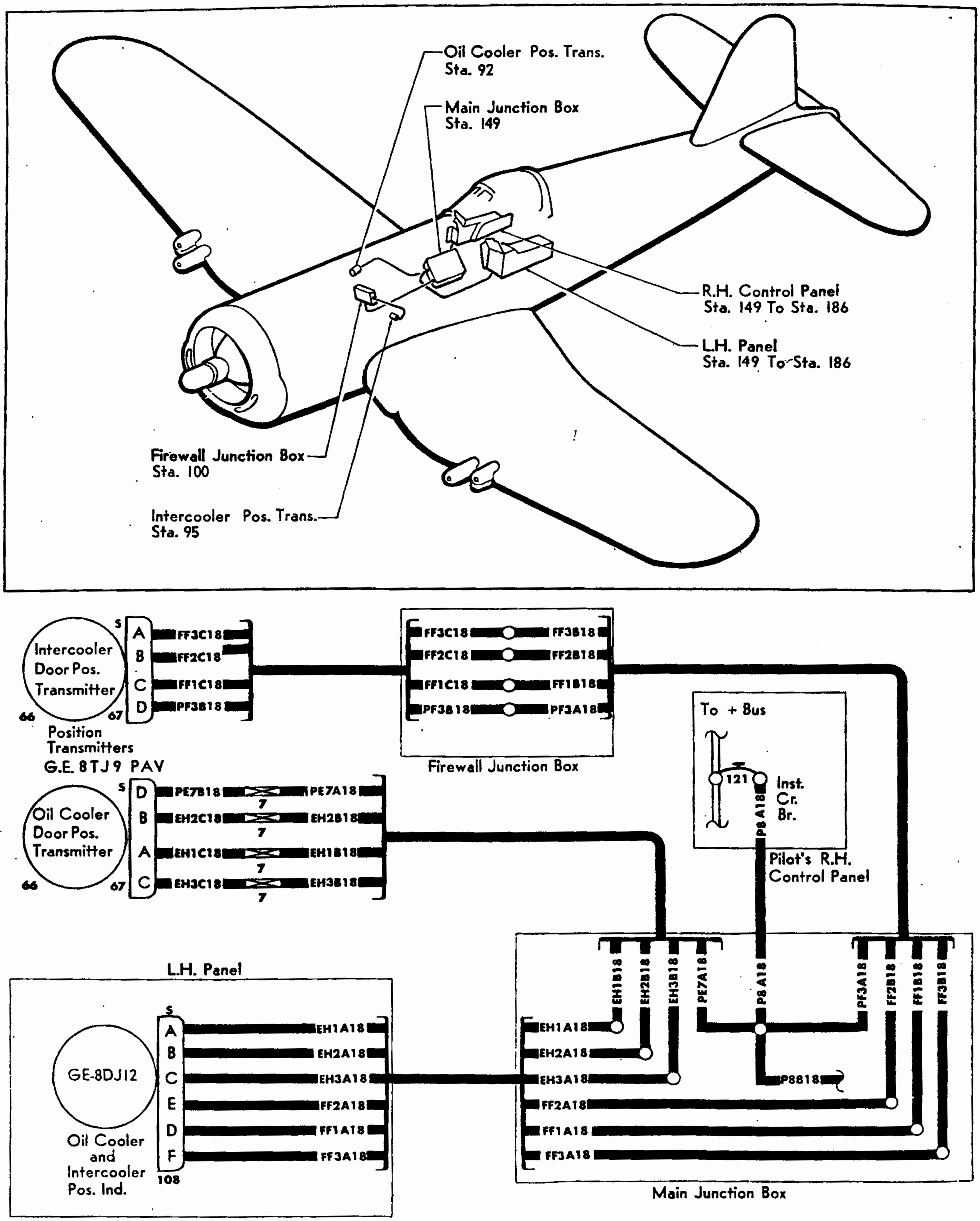


Figure 5–20. Engine Indicator Circuits—Intercooler Flap and Oil Cooler Doors Position Indicator.

5-91. ENGINE INDICATOR CIRCUITS—INTERCOOLER FLAP AND OIL COOLER DOORS POSITION INDICATOR.

5-92. DESCRIPTION. (*See figure 5-20.*) This combined gage is operated by two separate transmitters, one for the oil cooler doors and one for the intercooler flap. Power comes from the instrument circuit-breaker to the transmitters. Each transmitter consists of a variable resistor with a floating arm which increases or decreases the resistance with opening or closing of the doors. The transmitters are wired directly to the indicator, and a rise or drop in current flow, caused by movement of the intercooler flap and oil cooler doors, is transmitted electrically to the Selsyn windings which are parts of the indicator. The coils, when energized, provide a flux which turns a rotor shaft to which each separate indicator pointer is attached. The circuit is operative whenever the battery switch is turned "ON."

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE		END TYPE		LENGTH IN.
		AN LUG	INS. SL. CVC	AN LUG	INS. SL. CVC	
EH1A18	AN18		860-18-3	659-2	860-16-3	98
EH1B18	AN18	659-2	860-16-3	753-A1		63
EH1C18	AN18	753-A1			860-18-3	30
EH2A18	AN18		860-18-3	659-2	860-16-3	97
EH2B18	AN18	659-2	860-16-3	753-A1		64
EH2C18	AN18	753-A1			860-18-3	29
EH3A18	AN18		860-18-3	659-2	860-18-3	97
EH3B18	AN18	659-2	860-16-3	753-A1	860-18-3	60
EH3C18	AN18	753-A1			860-18-3	30
FF1A18	AN18		860-18-3	659-2	860-16-3	94
FF1B18	AN18	659-2	860-16-3	659-2	860-16-3	94
FF1C18	AN18	659-2	860-16-3		860-18-3	20
FF2A18	AN18		860-18-3	659-2	860-16-3	95
FF2B18	AN18	659-2	860-16-3	659-2	860-16-3	94
FF2C18	AN18	659-2	860-16-3		860-18-3	21
FF3A18	AN18		860-18-3	659-2	860-16-3	95
FF3B18	AN18	659-2	860-16-3	659-2	860-16-3	104
FF3C18	AN18	659-2	860-16-3		860-16-3	22
P8A18	AN18	659-2	860-16-3	659-2	860-16-3	38
PE7A18	AN18	659-2	860-16-3	753-A1	860-18-3	70
PE7B18	AN18	753-A1			860-18-3	27
PF3A18	AN18	659-2	860-16-3	659-2	860-16-3	97
PF3B18	AN18	659-2	860-16-3		860-18-3	21

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
7	AN753B1	Coupler
66	VS-59914 Chance Vought 8TJ9PAV Gen. Electric Co.	Transmitter
67	AN3108-14S-2S	Plug
108	AN3106-16S-2S	Plug
121	AN3161-P10	Circuit-breaker

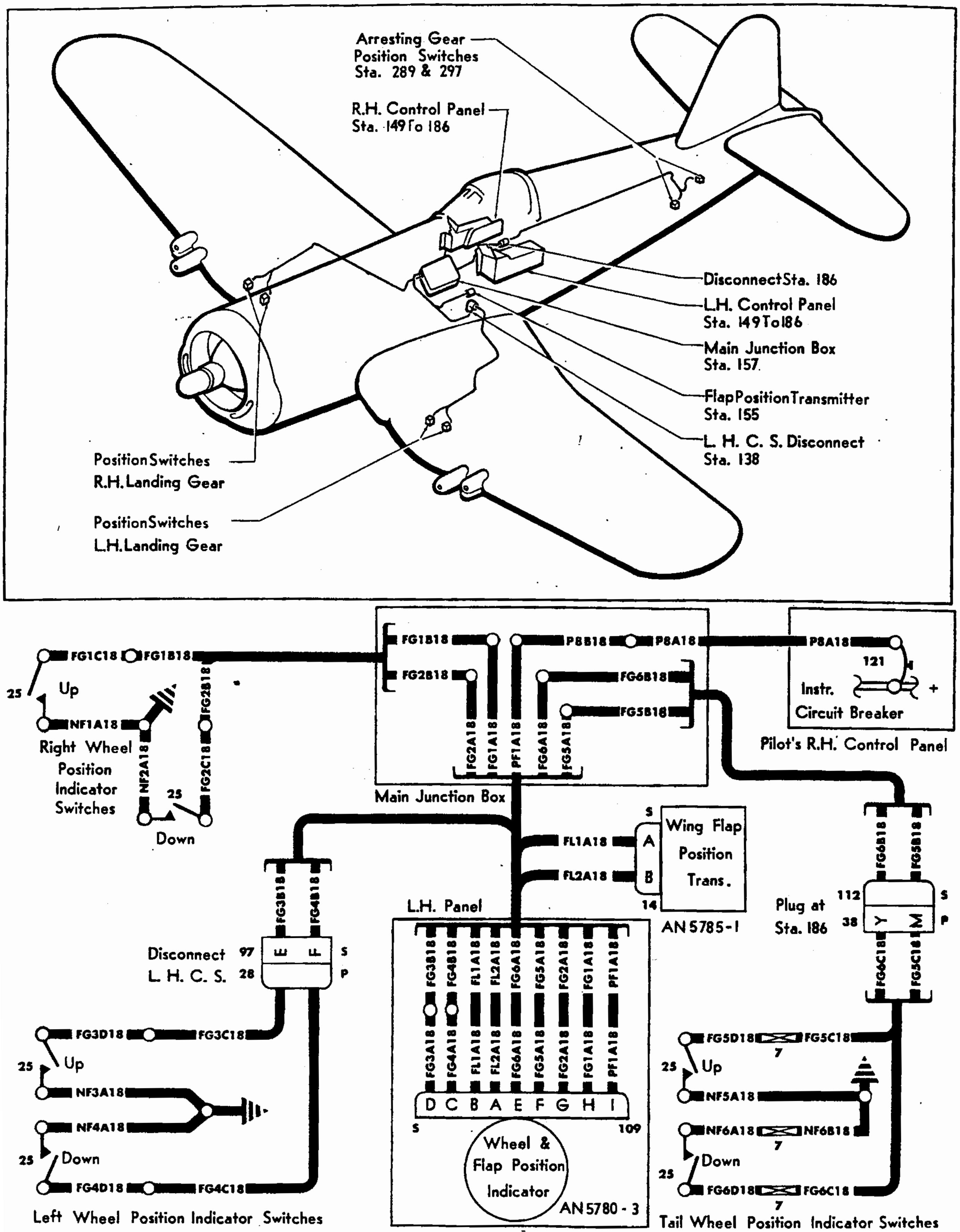


Figure 5–21. Flight Indicator Circuits—Wing Flap and Landing Gear Position Indicator.

5-93. FLIGHT INDICATOR CIRCUITS—WING FLAP AND LANDING GEAR POSITION INDICATOR.

5-94. DESCRIPTION. (*See figure 5-21.*) The wing flap and landing gear position indicator gives a visual indication as to the position of each wheel and the position of the wing flaps. Each main gear and the tail gear have microswitches which are actuated when each respective gear is in the "up and locked" or "down and locked" position. When the "up and locked" position microswitches are actuated, they close a circuit to the indicator, causing the riders on the gage face to show an "up and locked" position. When the "down and locked" microswitchces are actuated, another circuit is closed, causing the riders to go to the "down and locked" position. No intermediate landing gear positions are shown. A wire-wound variable resistor (transmitter) has a rotatable contact arm which moves with any change in wing flap position. Any change in the contact arm position varies the amount of current which flows to the field coil in the indicator element. This changes the position of the polarized rotor to which the indicator pointer is attached and thus gives the pilot an accurate indication of wing flap position. Current for the operation of the wing flap and landing gear indicator is taken from the instrument circuit breaker on the right hand control panel, and the indicator is operative when the battery switch is turned "ON."

WIRE TABLE

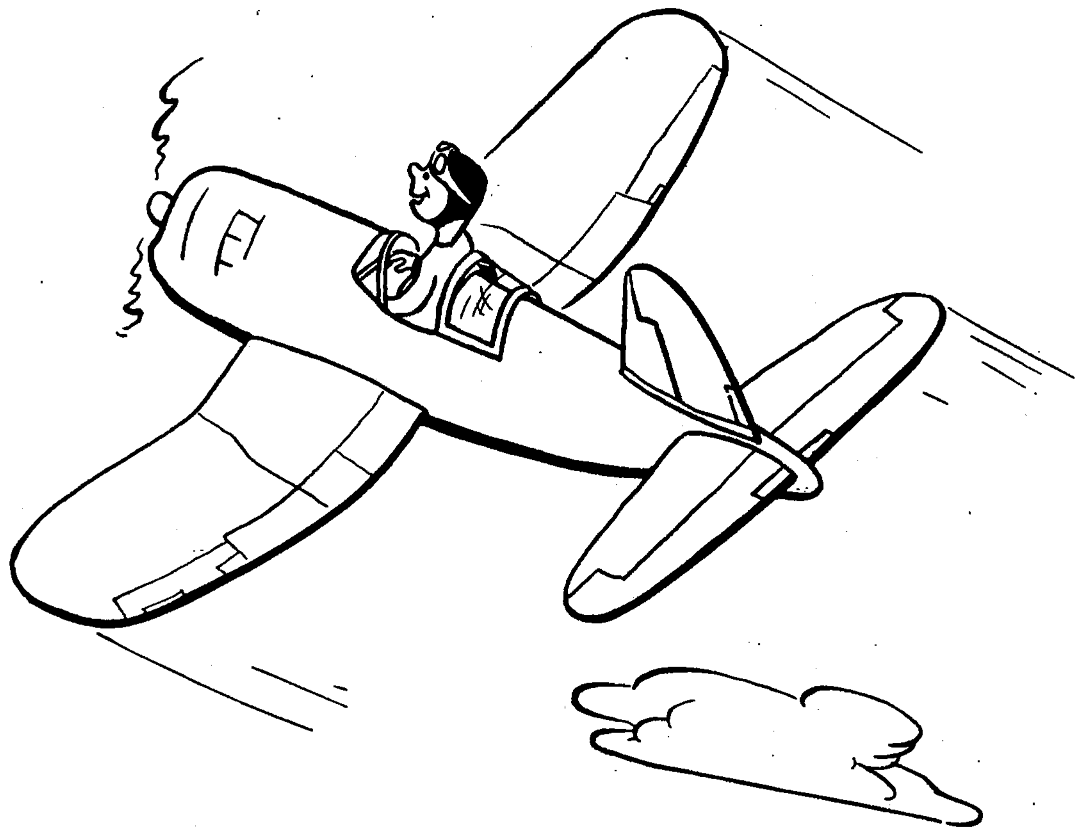
WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
FG1A18	AN18		860-18-3	659-2	860-16-3	94
FG1B18	AN18	659-2	860-16-3	659-2	860-16-3	134
FG1C18	AN18	659-2	860-16-3			21
FG2A18	AN18		860-18-3	659-2	860-16-3	95
FG2B18	AN18	659-2	860-16-3	659-2	860-16-3	133
FG2C18	AN18	659-2	860-16-3			46
FG3A18	AN18		860-18-3	659-2	860-16-3	24
FG3B18	AN18	659-2	860-16-3		860-18-3	70
FG3C18	AN18			659-2	860-16-3	130
FG3D18	AN18	659-2	860-16-3			21
FG4A18	AN18		860-18-3	659-2	860-16-3	24
FG4B18	AN18	659-2	860-16-3		860-18-3	70
FG4C18	AN18			659-2	860-16-3	130
FG4D18	AN18	659-2	860-16-3			48½
FG5A18	AN18		860-18-3	659-2	860-16-3	93
FG5B18	AN18	659-2	860-16-3		860-18-3	49
FG5C18	AN18		860-18-3	753-A1		144
FG5D18	AN18	753-A1		CVC-880-22	860-16-3	26
FG6A18	AN18		860-18-3	659-2	860-16-3	94
FG6B18	AN18	659-2	860-16-3		860-18-3	49
FG6C18	AN18		860-18-3	753-A1		143
FG6D18	AN18	753-A1		CVC-880-22	860-16-3	34
FL1A18	AN18		860-18-3		860-18-3	54
FL2A18	AN18		860-18-3		860-18-3	54
NF1A18	AN18		860-18-3	659-2	860-16-3	21
NF2A18	AN18		860-18-3	659-2	860-16-3	46
NF3A18	AN18			659-2	860-16-3	21
NF4A18	AN18			659-2	860-16-3	48½
NF5A18	AN18			659-2	860-16-3	26
NF6A18	AN18			753-A1		34

WIRE TABLE (Continued)

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
NF6B18	AN18	753-A1		659-2	860-16-3	15
P8A18	AN18	659-2	860-16-3	659-2	860-16-3	38
P8B18	AN18	659-2	860-16-3	659-2	860-16-3	3
PF1A18	AN18	659-2	860-16-3		860-18-3	93

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
7	AN753-B1	Coupler
14	AN3106-14S-2S	Plug
25	AN3217-1	Switch Assembly
28	AN3108-24-7P	Plug
38	AN3100-28-12P	Receptacle
97	AN3100-24-7S	Receptacle
109	AN3108-18-1S	Plug
112	AN3106-28-12S	Plug
121	AN3161-P10	Circuit-breaker



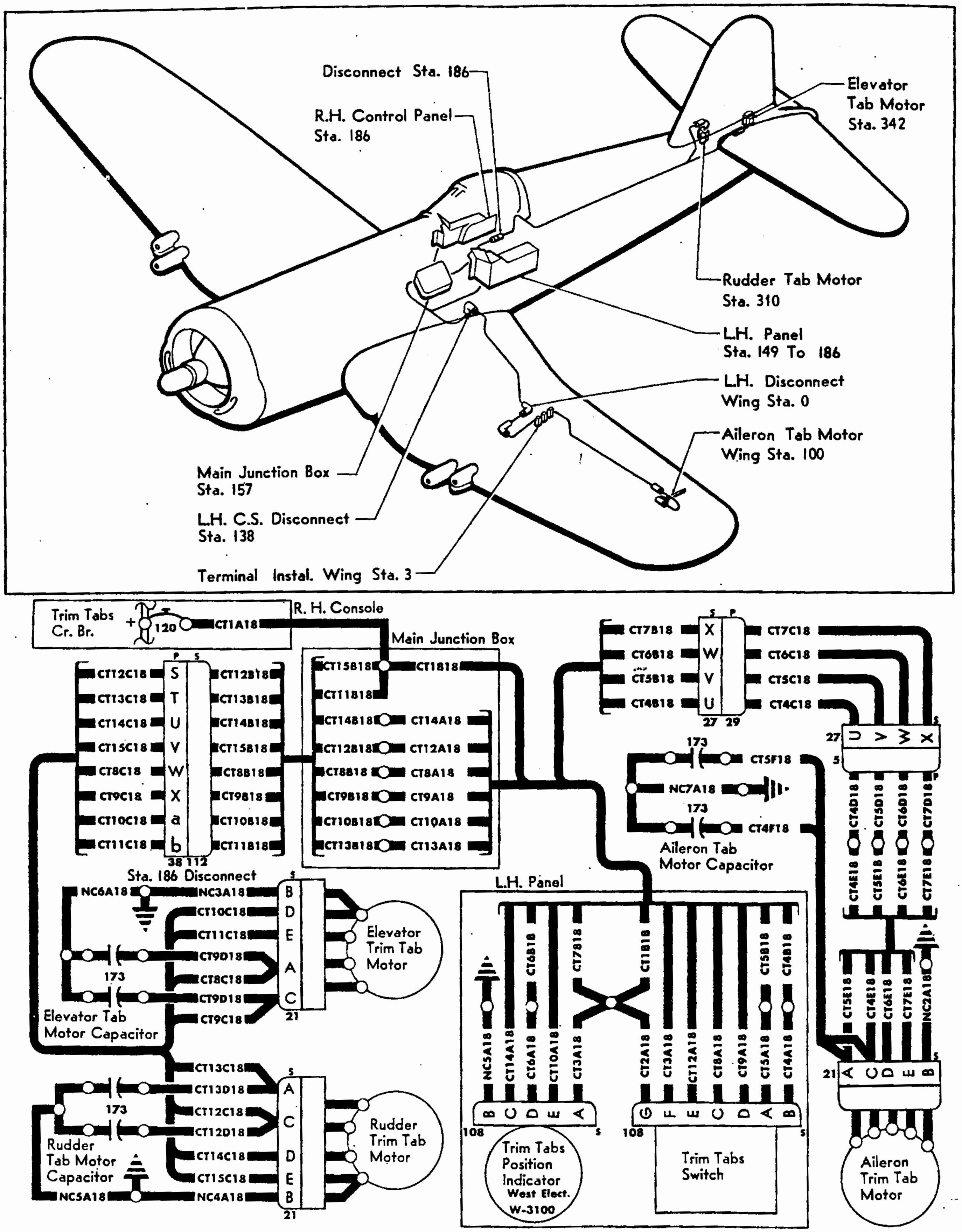


Figure 5–22. Flight Indicator Circuits—Trim Tab Control and Position Indicator.

5–95. FLIGHT INDICATOR CIRCUITS – TRIM TAB CONTROL AND POSITION INDICATOR.

5–96. DESCRIPTION. *(See figure 5–22.)* The trim tabs on the elevators, rudder, and left hand aileron, are individually actuated by screwjacks driven by electric motors. An assembly, consisting of two momentary-type switches, which controls the motors, and a tab position indicator are located on the left hand control panel. Movement of the forward three-position momentary switch to the left or right will close a circuit to the reversible electric motor, causing the rudder trim tab to turn to the left or right. Upon release of the switch, it will return to the neutral position, opening the circuit, and causing the tab to cease movement. The elevator and aileron trim tabs are controlled similarly by a five-position momentary-type switch on the assembly. Limit switches are provided to stop each electric motor when the related tab is fully deflected. Potentiometers, geared to the Lear actuators on each motor, will vary the current flow to the tab position indicator as the trim tab moves. The tab position indicator has four separate dial segments, each reading the current flow from the individual potentiometers. These dials are calibrated in degrees and indicate the position of each tab. Power for these circuits is drawn from the trim tabs circuit-breaker and all cables to circuit units stem from the main junction box. Three capacitors in the circuit eliminate radio noise caused by the trim tab motors. The rudder trim tab motor capacitor and the elevator trim tab motor capacitor are located on frames at stations 301½ and 334 respectively. The aileron trim tab motor capacitor is mounted on a rib at wing station 100 in the left outer panel.

WIRE TABLE

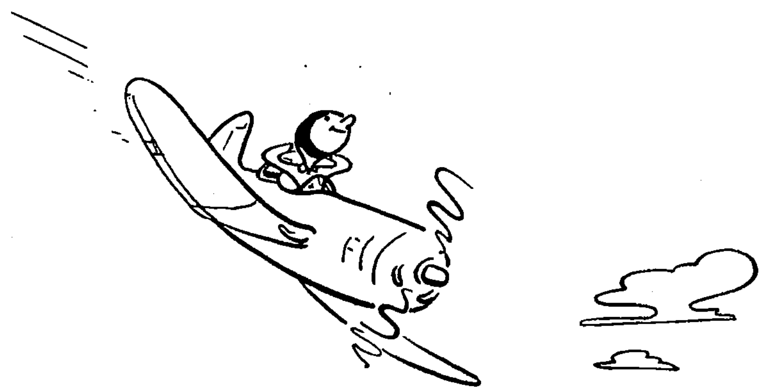
WIRE NO.	NAF 1070	END TYPE AN LUG	INS. SL. CVC	END TYPE AN LUG	INS. SL. CVC	LENGTH IN.
CT1A18	AN18	659-2	860-16-3	659-2	860-16-3	35
CT1B18	AN18	659-2	860-16-3	659-2	860-16-3	120
CT2A18	AN18		860-18-3	659-2	860-16-3	24
CT3A18	AN18	659-2	860-16-3		860-18-3	20
CT4A18	AN18		860-18-3	659-2	860-16-3	23
CT4B18	AN18	659-2	860-16-3		860-18-2	56
CT4C1 8	AN18		860-18-3		860-18-3	102
CT4D18	AN18	659-2	860-16-3		860-18-3	60
CT4E18	AN18	659-2	860-16-3		860-18-3	108
CT4F18	AN18		860-18-3		860-18-3	11
CT5A18	AN18		860-18-3	659-2	860-16-3	22
CT5B18	AN18	659-2	860-16-3		860-18-3	56
CT5C18	AN18		860-18-3		860-18-3	102
CT5D18	AN18		860-18-3	659-2	860-16-3	61
CT5E18	AN18	659-2	860-16-3		860-18-3	108
CT5F18	AN18		860-18-3		860-18-3	11
CT6A18	AN18		860-18-3	659-2	860-16-3	24
CT6B18	AN18	659-2	860-16-3		860-18-3	60
CT6C18	AN18		860-18-3		860-18-3	102
CT6D18	AN18		860-18-3	659-2	860-16-3	63
CT6E18	AN18	659-2	860-16-3		860-18-3	110
CT7B18	AN18	659-2	860-16-3		860-18-3	59
CT7C18	AN18		860-18-3		860-18-3	102
CT7D18	AN18		860-18-3	659-2	860-16-3	64
CT7E18	AN18	659-2	860-16-3		860-18-3	112
CT8A18	AN18		860-18-3	659-2	860-16-3	82
CT8B18	AN18	659-2	860-16-3		860-18-3	52

WIRE TABLE (Continued)

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
CT8C18	AN18		860-18-3		860-18-3	202
CT8D18	AN18		860-18-3		860-18-3	17
CT9A18	AN18		860-18-3	659-2	860-16-3	82
CT9B18	AN18		860-18-3		860-18-3	52
CT9C18	AN18		860-18-3		860-18-3	202
CT9D18	AN18		860-18-3		860-18-3	17
CT10A18	AN18		860-18-3	659-2	860-16-3	60
CT10B18	AN18	659-2	860-16-3		860-18-3	51
CT10C18	AN18		860-18-3		860-18-3	202
CT11B18	AN18	659-2	860-16-3		860-18-3	45
CT11C18	AN18		860-18-3		860-18-3	202
CT12A18	AN18		860-18-3	659-2	860-16-3	84
CT12B18	AN18	659-2	860-16-3		860-18-3	46
CT12C18	AN18		860-18-3		860-18-3	187
CT12D18	AN18		860-18-3		860-18-3	9
CT13A18	AN18		860-18-3	659-2	860-16-3	87
CT13B18	AN18	659-2	860-16-3		860-18-3	44
CT13C18	AN18		860-18-3		860-18-3	187
CT13D18	AN18		860-18-3		860-18-3	9
CT14A18	AN18		860-18-3	659-2	860-16-3	92
CT14B18	AN18	659-2	860-16-3		860-18-3	44
CT14C18	AN18		860-18-3		860-18-3	187
CT15B18	AN18	659-2	860-16-3		860-18-3	43
CT15C18	AN18		860-18-3		860-18-3	187
NC2A18	AN18	CVC-880-22	860-16-3	659-2	860-16-3	130
NC3A18	AN18		860-18-3	659-2	860-16-3	7
NC4A18	AN18		860-18-3	659-2	860-16-3	15
NC5A18	AN18		860-18-3	659-2	860-16-3	20
NC6A18	AN18		860-18-3	659-2	860-16-3	20
NC7A18	AN18		860-18-3	659-2	860-16-3	20
NC8A18	AN18		860-18-3	659-2	860-16-3	20

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
5	VS-59909 Chance Vought (made from AN3108-28-12P)	Plug
21	AN3100-14S-5S	Receptacle
27	AN3100-28-12S	Receptacle
29	AN3108-28-12P	Plug
38	AN3100-28-12P	Receptacle
108	AN3106-16S-1S	Plug
112	AN3106-28-12S	Plug
120	AN3161-P5	Circuit-breaker
173	VS-54499-2 Chance Vought Cornell Dubilier MYR 6055	Capacitor



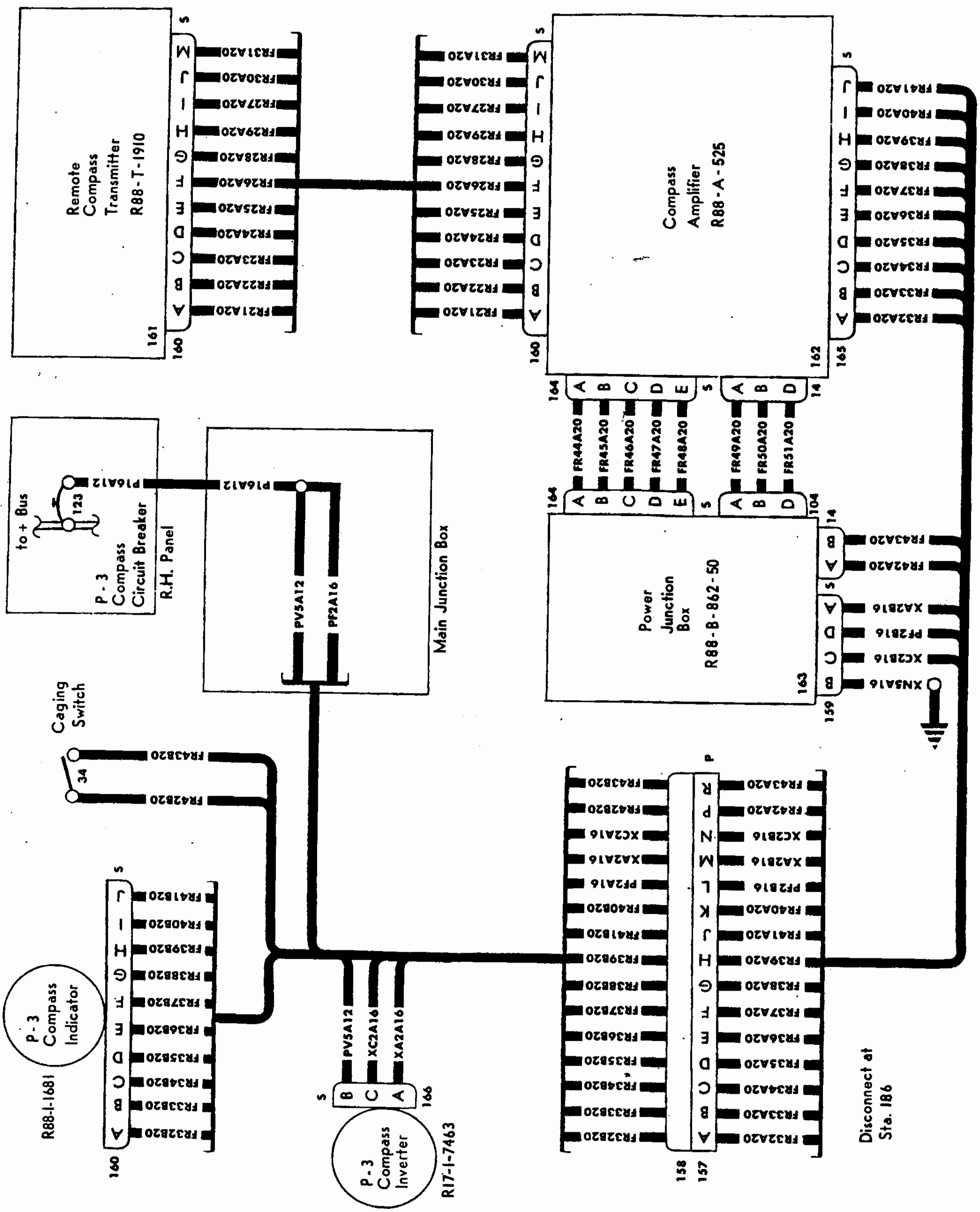


Figure 5–23. (Sheet 1 of 2 Sheets). Flight Indicator Circuits—P-3 Compass.

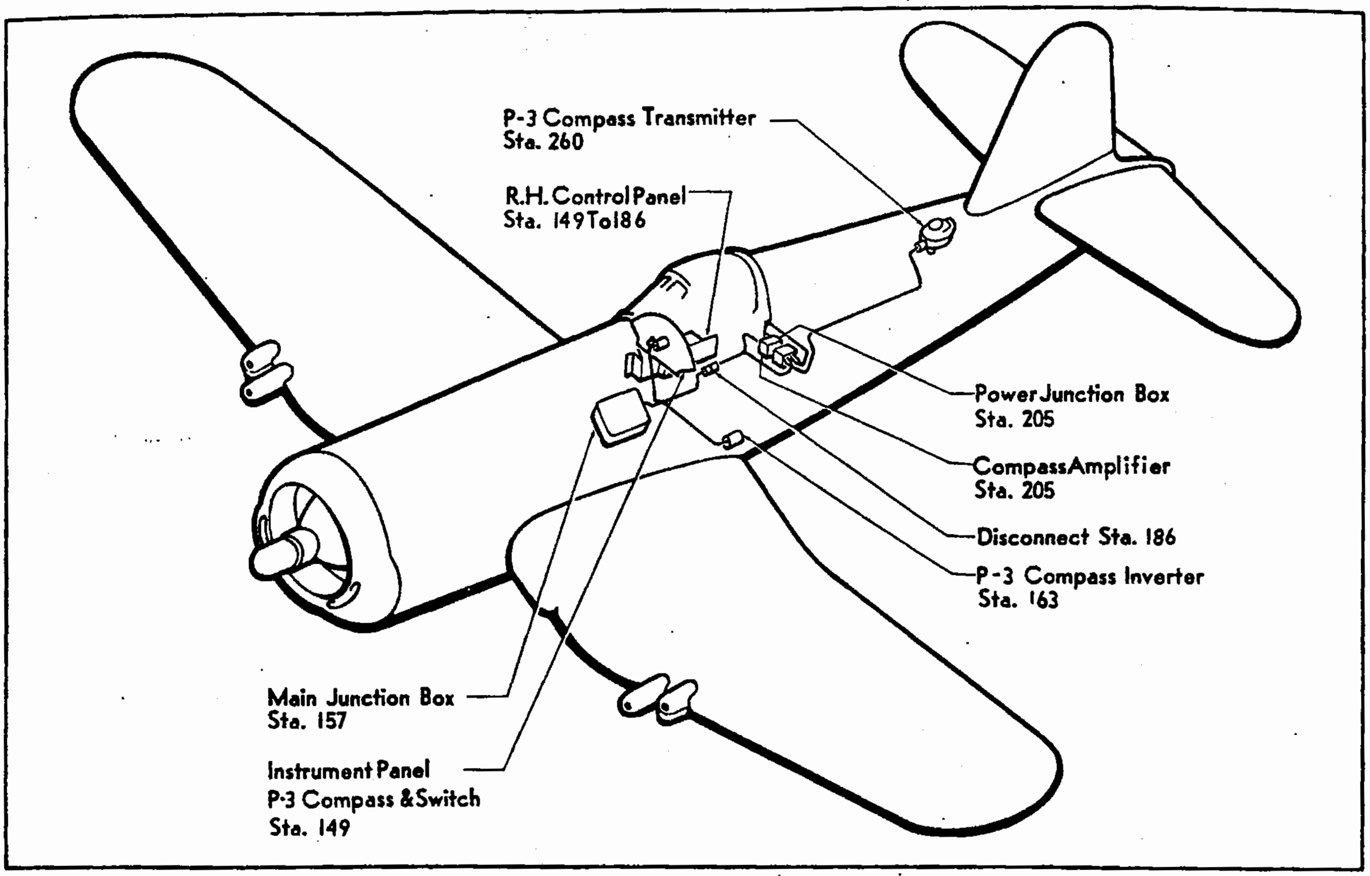


Figure 5–23. (Sheet 2 of 2 Sheets). Flight Indicator Circuits—P-3 Compass.

5–97. FLIGHT INDICATOR CIRCUITS—P-3 COMPASS.

5–98. DESCRIPTION. (*See figure 5–23.*) Electromagnetic fields and masses of metal cause distortion in compass readings. To provide an accurate directional indication for navigation, a remote indicating type compass is installed on the F4U-5 airplane. Paragraphs 4–1366 to 4–1405 should be referred to for further information on the P-3 compass system. All electrical power for the circuits is taken from the power junction box which is supplied with 115 volt, 400 cycle, three-phase power, and also with 27.5 volts dc. The vertical seeking gyro, which is in the remote transmitter, operates on 26 volt, 400 cycle, three-phase power, and keeps the windings of the flux gate in a level position. The flux gate primary circuit is alternately under the influence of the earth's magnetic field and the 1½ volt 487½ cycle power fed from the power junction box. The secondary flux gate winding reacts to these periodic magnetic charges and the windings of these coils are so arranged that a different voltage is fed to the indicator autosyn and signal amplifier with every change in aircraft direction. These varying voltages are amplified, through a signal-power amplifier, and rotate a low inertia motor within the indicator which, through a gear train, rotates the indicator pointer. A caging motor within the transmitter operates on 26 volt, 400 cycle, three-phase power and on 26 volt dc power. It is used to erect the gyro after gyro run-up, and after extreme airplane maneuvers. A toggle switch located on the instrument panel to the right of the compass indicator is used to cage and uncage the gyro. An inverter which operates on 26 volts dc supplies 115 volts ac at 400 cycles to the power junction box, and is turned on when the battery switch is on.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
FR21A20	AN20		860-20-3		860-20-3	130
FR22A20	AN20		860-20-3		860-20-3	130
FR23A20	AN20		860-20-3		860-20-3	130
FR24A20	AN20		860-20-3		860-20-3	130

WIRE TABLE (Continued)

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
FR25A20	AN20		860-20-3		860-20-3	130
FR26A20	AN20		860-20-3		860-20-3	130
FR27A20	AN20		860-20-3		860-20-3	130
FR28A20	AN20		860-20-3		860-20-3	130
FR29A20	AN20		860-20-3		860-20-3	130
FR30A20	AN20		860-20-3		860-20-3	130
FR31A20	AN20		860-20-3		860-20-3	130
FR32A20	AN20		860-20-3		860-20-3	40
FR32B20	AN20		860-20-3		860-20-3	100
FR33A20	AN20		860-20-3		860-20-3	40
FR33B20	AN20		860-20-3		860-20-3	100
FR34A20	AN20		860-20-3		860-20-3	40
FR34B20	AN20		860-20-3		860-20-3	100
FR35A20	AN20		860-20-3		860-20-3	40
FR35B20	AN20		860-20-3		860-20-3	100
FR36A20	AN20		860-20-3		860-20-3	40
FR36B20	AN20		860-20-3		860-20-3	100
FR37A20	AN20		860-20-3		860-20-3	40
FR37B20	AN20		860-20-3		860-20-3	100
FR38A20	AN20		860-20-3		860-20-3	40
FR38B20	AN20		860-20-3		860-20-3	100
FR39A20	AN20		860-20-3		860-20-3	40
FR39B20	AN20		860-20-3		860-20-3	100
FR40A20	AN20		860-20-3		860-20-3	40
FR40B20	AN20		860-20-3		860-20-3	100
FR41A20	AN20		860-20-3		860-20-3	41
FR41B20	AN20		860-20-3		860-20-3	100
FR42A20	AN20		860-20-3		860-20-3	44
FR42B20	AN20		860-20-3	659-2	860-16-3	102
FR43A20	AN20		860-20-3		860-20-3	44
FR43B20	AN20		860-20-3	659-2	860-16-3	102
FR44A20	AN20		860-20-3		860-20-3	16
FR45A20	AN20		860-20-3		860-20-3	16
FR46A20	AN20		860-20-3		860-20-3	16
FR47A20	AN20		860-20-3		860-20-3	16
FR48A20	AN20		860-20-3		860-20-3	16
FR49A20	AN20		860-20-3		860-20-3	19
FR50A20	AN20		860-20-3		860-20-3	19
FR51A20	AN20		860-20-3		860-20-3	19
P16A12	AN12	659-5	860-10-3	659-5	860-10-3	40
PF2A16	AN16	659-4	860-14-3		860-16-3	30
PF2B16	AN16		860-16-3		860-16-3	44
PV5A12	AN12	659-5	860-10-3		860-12-3	82
XA2A16	AN16		860-16-3		860-16-3	82

WIRE TABLE (Continued)

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
XA2B16	AN16		860-16-3		860-16-3	44
XC2A16	AN16		860-16-3		860-16-3	82
XC2B16	AN16		860-16-3		860-16-3	44
XN5A16	AN16		860-16-3	659-4	860-14-3	30

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
14	AN3106-14S-2S	Plug
34	AN3021-2	Switch
104	AN3106-14S-2P	Plug
123	AN3161-P20	Circuit-breaker
157	AN3100-22-14P	Receptacle
158	AN3106-22-14S	Plug
159	AN3106-20-4S	Plug
160	AN3106-18-1S	Plug
161	FSSC-R88-T-1910	Transmitter
162	FSSC-R88-A-525	Amplifier
163	FSSC-R88-B-862-50	Power Junction Box
164	AN3106-18-12S	Plug
165	AN3106-18-1S	Plug
166	AN3106-22-4S	Plug

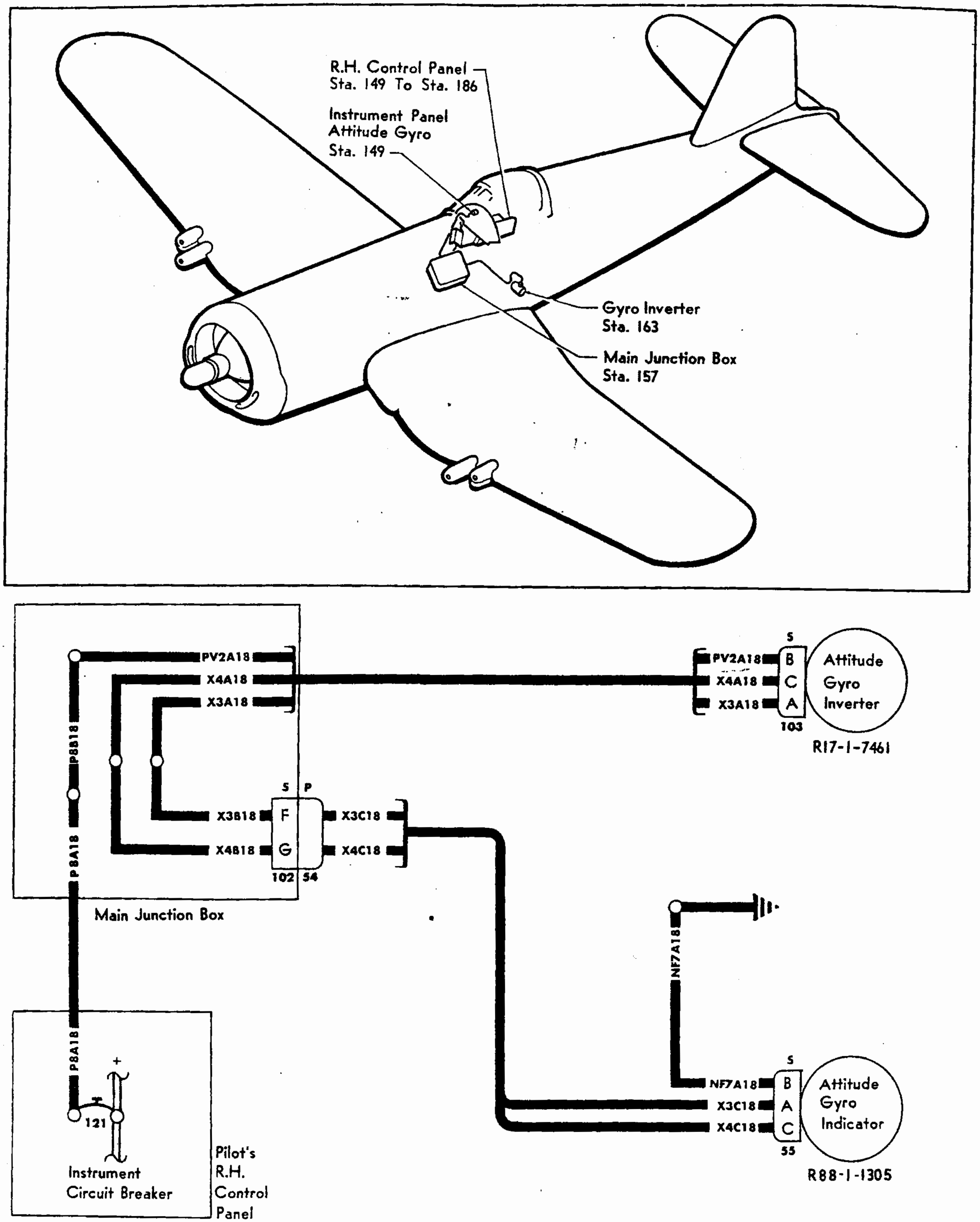


Figure 5–24. Flight Indicator Circuits—Attitude Gyro.

5-99. FLIGHT INDICATOR CIRCUITS—ATTITUDE GYRO.

5-100. DESCRIPTION. (*See figure 5-24.*) The attitude gyro provides to the pilot, a continuous indication of the aircraft's attitude in pitch and bank (without angular limitations). The indicator houses a sphere which is held level regardless of the airplane's attitude by a gyro motor within the sphere. An inverter is necessary to supply 26 volt, 400 cycle, alternating current for operation of the gyro motor. Power is supplied to energize the inverter from the instrument circuit-breaker on the pilot's right hand control panel. The attitude gyro is operative whenever the battery switch is in the "ON" position.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
NF7A18	AN18		860-18-3	659-2	860-16-3	21
P8A18	AN18	659-2	860-16-3	659-2	860-16-3	38
P8B18	AN18	659-2	860-16-3	659-2	860-16-3	3
PV2A18	AN18	659-2	860-16-3		860-18-3	70
X3A18	AN18		860-18-3	659-2	860-16-3	69
X3B18	AN18	659-2	860-16-3		860-18-3	12
X3C18	AN18		860-18-3		860-18-3	59
X4A18	AN18		860-18-3	659-2	860-16-3	69
X4B18	AN18	659-2	860-16-3		860-18-3	12
X4C18	AN18		860-18-3		860-18-3	59

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
54	AN3106-28-12P	Plug
55	AN3108-10SL-3S	Plug
102	AN3102-28-12S	Receptacle
103	AN3106-10SL-3S	Plug
121	AN3161-P10	Circuit-breaker

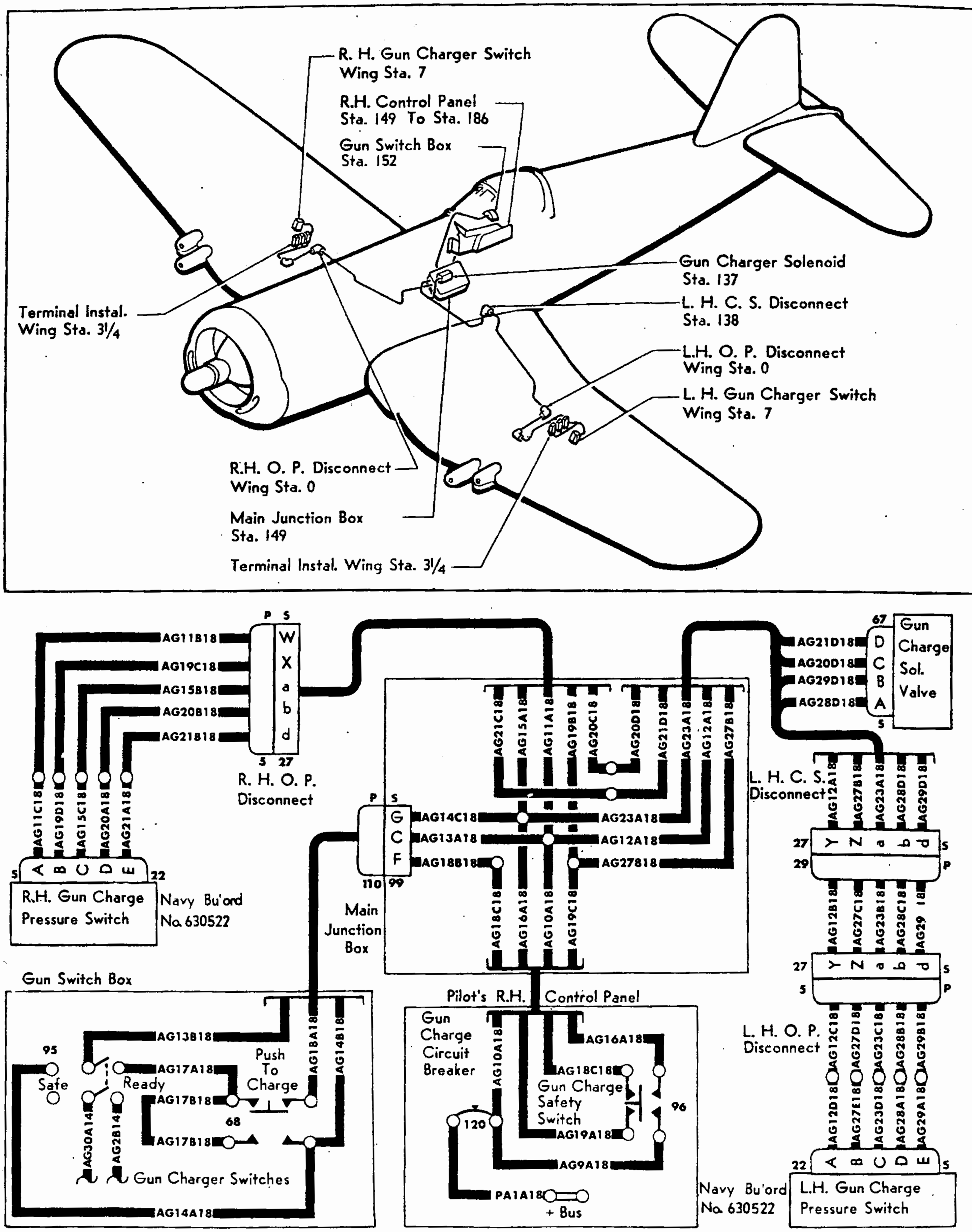


Figure 5–25. Armament Circuits—Guns Charging.

5-101. ARMAMENT CIRCUITS—GUNS CHARGING.

5-102. DESCRIPTION. (*See figure 5-25.*) The charging system permits simultaneous charging or safetying of all four guns on the ground or in flight. The entire system is pilot-operated by the "safe-ready" switch and the charging push button switch. The master armament switch does not control these circuits. An armament safety switch, actuated by the arresting hook handle, closes and automatically "safes" the guns when the arresting hook handle is lowered, prior to a carrier landing. The charging circuits are automatically controlled by two hydraulically actuated pressure switch units, one located in each outer wing panel. The pressure switch unit in the left wing controls the charging circuits for the left guns, and the one in the right wing controls the circuits for the right guns. Each unit consists of an aluminum casting containing two pressure operated electrical switches and a single-pole double-throw relay. Hydraulic pressure causes the high pressure switch (normally closed) to open at 1000 psi and the low pressure switch (normally open) to close at 20 psi. An electrically operated dual bank solenoid selector valve controls the flow of hydraulic fluid to all gun chargers. This valve is located on the underside of the cockpit floor and consists of four solenoid operated poppets. Two are pressure poppets which, when open, permit the flow of pressurized hydraulic fluid to the gun charging cylinders. The other two are return poppets which permit the fluid to return to the main system; see paragraph 4-1246 through paragraph 4-1257. Electrical power for the charging circuits is taken from the plus bus in the right hand control panel. From here, current flows directly to the gun charge circuit-breaker. The circuit splits here so that current simultaneously flows to: *1*—the "safe-ready" switch *2*—the armament safety switch, and *3*—the relay switches ("A" terminals on the pressure switch units). With this arrangement, current is available at each of these points whenever the battery switch is "ON." Beyond this, current flow is dependent on the position of the charging switches.

Note

It is assumed that all gunnery switches are "OFF" and the breechblocks forward, that the hydraulic system is pressurized, and that either battery or generator current is available.

a. TO SAFE THE GUNS. The "safe-ready" switch is thrown to the "SAFE" position. Current flows from the plus bus through the "SAFE" side of the switch, then directly to the high pressure switches (normally closed). From the pressure switches, current flows directly to the solenoid-operated pressure poppets which open and permit pressurized hydraulic fluid to flow to the gun charging cylinders. The charging cylinders force the gun breechblocks to the rear and lock them in this position. When the hydraulic pressure builds up to 1000 psi, the high pressure switches open and break the circuits to the pressure poppets. The poppets close and lock the hydraulic fluid in the charging lines, with the result that the charging cylinders remain in the aft position and prohibit forward travel of the gun-breechblocks. When the armament safety switch is actuated by the arresting hook handle, it closes a circuit which leads directly from the plus bus and in effect by-passes the safe-ready switch; so that the guns will be automatically safetied in the same manner as described above, even when the "safe-ready" switch is in the "OFF" or "READY" position.

b. CHARGING THE GUNS. The standard procedure for charging the guns when the breechblocks are in battery (forward) is to place the "safe-ready" switch in the "READY" position and momentarily depress the charging button. Current flows through the "READY" side of the "safe-ready" switch to the charge push button switch. When the push button is depressed, current flows to the high pressure switches (normally closed), then to a point where the circuit splits and permits current to flow simultaneously to the solenoid-operated pressure poppets and to the relay coils. The relays close and permit current to flow directly from the plus bus into the same circuit closed by the charge push button switch. When the push button switch is released, the relays remain closed, having completed the circuit from the armament bus which in effect by-passes the push button switch and through the closed relay switch, maintains current flow to the relay coils and to the solenoid-operated pressure poppets. Pressurized hydraulic fluid flows to the charging cylinders which force the breechblocks to the rear to be engaged with the firing mechanisms. When the pressure builds up to 1000 psi, the high pressure switches open and break the circuits to the relay coils and to the solenoid-operated pressure poppets. The relays in becoming de-energized, automatically close an alternate circuit leading from the low pressure switches to the solenoid-operated return poppets. The return poppets energize and open permitting the hydraulic fluid to return to the main system. As the pressure decreases, the charging cylinders return to their normal position, thereby permitting unobstructed forward travel of the breechblocks when they are released by the firing mechanisms. When the pressure drops to 20 psi, the low pressure switches open and automatically break the circuits leading to the solenoid-operated return poppets. To charge the guns when the breechblocks are in safe (charging piston maintained in rearward stroke), it is only necessary to place the safe-ready switch in the "READY" position. This permits current to flow from the "safe-ready" switch to the low pressure switches, then through the de-energized relays and finally to the solenoid-operated return poppets. As the hydraulic fluid returns to the main system, the charging pistons return to their normal position, and the guns are charged as described above. Note that in this case, depressing the charge push button switch should not be necessary, except as a precaution to insure that breechblocks are fully aft. See paragraph 4-1721 and figure 4-148A for further information on switch operation.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	INS. SL. CVC	END TYPE AN LUG	INS. SL. CVC	LENGTH IN.
AG9A18	AN18	659-2	860-16-3	659-2	860-16-3	25
AG10A18	AN18	659-2	860-16-3	659-2	860-16-3	41
AG11A18	AN18	659-2	860-16-3		860-18-3	95
AG11B18	AN18		860-16-3	659-2	860-14-3	61
AG11C18	AN18	659-2	860-16-3		860-18-3	15
AG12A18	AN18	659-2	860-16-3		860-18-3	43
AG12B18	AN18		860-18-3		860-18-3	102
AG12C18	AN18		860-18-3	659-2	860-16-3	58
AG12D18	AN18	659-2	860-16-3		860-18-3	9
AG13A18	AN18	659-2	860-16-3		860-18-3	11
AG13B18	AN18		860-18-3	659-2	860-16-3	72
AG14A18	AN18	659-2	860-16-3	659-2	860-16-3	4
AG14B18	AN18	659-2	860-16-3		860-18-3	72
AG14C18	AN18		860-18-3	659-2	860-16-3	10
AG15A18	AN18	659-2	860-16-3		860-18-3	95
AG15B18	AN18		860-18-3	659-2	860-16-3	63
AG15C18	AN18	659-2	860-16-3		860-18-3	17
AG16A18	AN18	659-2	860-16-3	659-2	860-16-3	55
AG17A18	AN18	659-2	860-16-3	659-2	860-16-3	4
AG17B18	AN18	659-2	860-16-3	659-2	860-16-3	2
AG18A18	AN18	659-2	860-16-3		860-18-3	72
AG18B18	AN18		860-18-3	659-2	860-16-3	11
AG18C18	AN18	659-2	860-16-3	659-2	860-16-3	53
AG19A18	AN18	659-2	860-16-3	659-2	860-16-3	59
AG19B18	AN18	659-2	860-16-3		860-18-3	92
AG19C18	AN18		860-18-3	659-2	860-16-3	61
AG19D18	AN18	659-2	860-16-3		860-18-3	16
AG20A18	AN18		860-18-3	659-2	860-16-3	18
AG20B18	AN18	659-2	860-16-3		860-18-3	65
AG20C18	AN18		860-18-3	659-2	860-16-3	98
AG20D18	AN18	659-2	860-16-3		860-18-3	43
AG21A18	AN18		860-18-3	659-2	860-16-3	8
AG21B18	AN18	659-2	860-16-3		860-18-3	64
AG21C18	AN18		860-18-3	659-2	860-16-3	103
AG21D18	AN18	659-2	860-16-3		860-18-3	40
AG23A18	AN18	659-2	860-16-3		860-18-3	43
AG23B18	AN18		860-18-3		860-18-3	102
AG23C18	AN18		860-18-3	659-2	860-16-3	60
AG23D18	AN18	659-2	860-16-3		860-18-3	10½
AG26A18	AN18	659-2	860-16-3		860-18-3	63
AG27B18	AN18	659-2	860-16-3	659-2	860-16-3	41
AG27C18	AN18		860-18-3	659-2	860-16-3	102
AG27D18	AN18	659-2	860-16-3		860-18-3	59
AG27E18	AN18	659-2	860-16-3		860-18-3	9¾

WIRE TABLE (Continued)

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
AG28A18	AN18	659-2	860-16-3		860-18-3	11¼
AG28B18	AN18	659-2	860-16-3		860-18-3	61
AG28C18	AN18		860-18-3	659-2	860-16-3	102
AG28D18	AN18		860-18-3		860-18-3	30
AG29A18	AN18		860-18-3	659-2	860-16-3	12
AG29B18	AN18	659-2	860-16-3		860-18-3	62
AG29C18	AN18		860-18-3		860-18-3	102
AG29D18	AN18		860-18-3		860-18-3	37
PA1A18	AN18	659-2	860-16-3	659-2	860-16-3	4

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
5	VS-59905 Chance Vought (made from AN3108-28-12P)	Plug
22	AN3108-14S-5S	Plug
27	AN3100-28-12S	Receptacle
29	AN3108-28-12P	Plug
67	AN3108-14S-2S	Plug
68	CV4-60738 Chance Vought Hetherington & Son Type HVMDT	Switch
95	AN3027-1	Switch
96	AN3216-1	Switch
99	AN3102-24-7S	Receptacle
110	AN3106-24-7P	Plug
120	AN3161-P5	Circuit-breaker

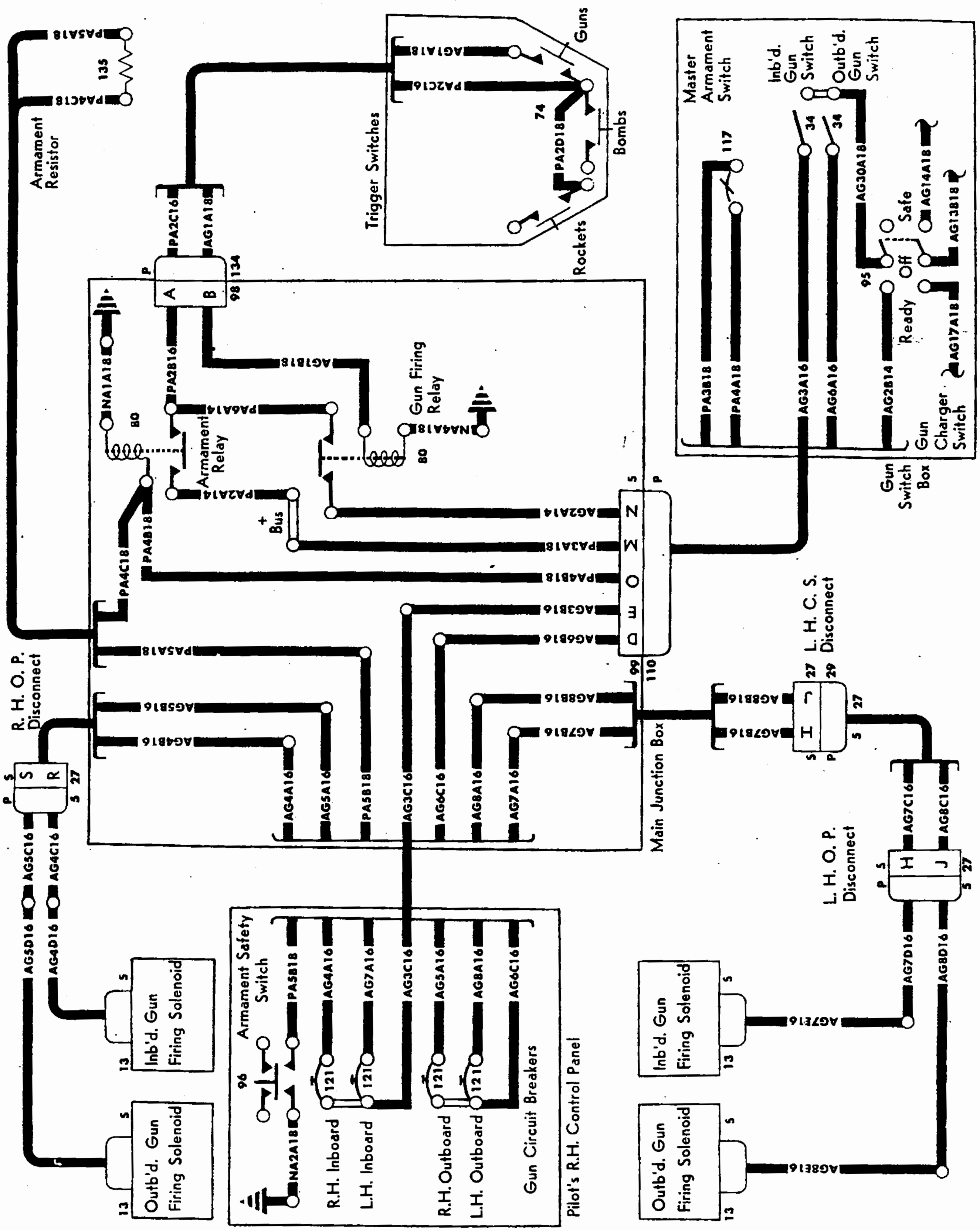


Figure 5-26. (Sheet 1 of 2 Sheets). Armament Circuits—Guns Firing.

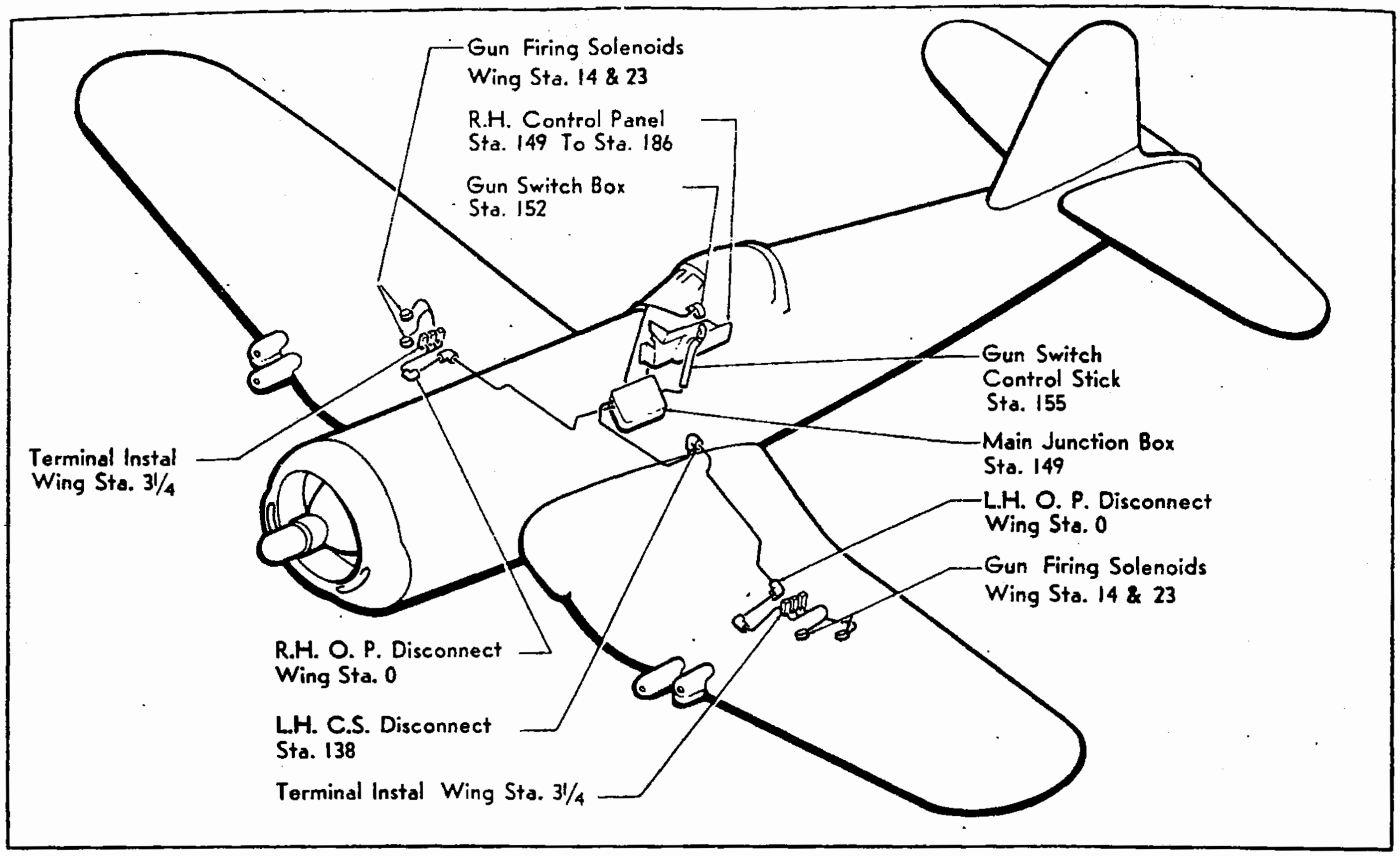


Figure 5–26. (Sheet 2 of 2 Sheets). Armament Circuits—Guns Firing.

5–103. ARMAMENT CIRCUITS—GUNS FIRING.

5–104. DESCRIPTION (*See figure 5–26.*) The firing circuits are designed to permit simultaneous firing of all guns or the independent firing of either the inboard or outboard guns. All gun firing is controlled by the master armament switch. A safety switch which turns off all gun firing circuits during carrier landings is actuated by the arresting hook control handle when the handle is placed in the "DOWN" position. When the safety switch is closed, current flows from the armament relay, through a resistor which passes a current greater than the rating of the master armament switch breaker opening the breaker and thus shutting off all gun firing circuits.

Note

When the arresting hook control handle is returned to the "UP" position, it is necessary to close the master armament switch breaker in order to energize the armament electrical system again.

Turning on the master armament switch energizes the armament relay and with the "safe-ready" switch in the "READY" position, operating the trigger switch will energize the gun firing relay and, depending on whether the inboard, outboard, or both gun selector switches are closed, will energize the inboard, outboard, or both gun firing solenoids. Circuit-breakers protect each gun firing circuit from current overload. For information on operation of gunnery switches, refer to paragraph 4–1721.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
AG1A18	AN18		860-18-3	659-2	860-16-3	55
AG1B18	AN18	659-2	860-16-3		860-18-3	17
AG2A14	AN14	659-4	860-14-3	659-4	860-14-3	4
AG2B14	AN14	659-4	860-14-3		860-14-3	72

WIRE TABLE (Continued)

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
AG3A16	AN16	659-4	860-14-3		860-16-3	72
AG3B16	AN16		860-16-3	659-4	860-14-3	12
AG3C16	AN16	659-4	860-14-3	659-4	860-14-3	43½
AG4A16	AN16	659-4	860-14-3	659-4	860-14-3	46
AG4B16	AN16	659-4	860-14-3		860-16-3	96
AG4C16	AN16	659-4	860-14-3		860-16-3	60
AG4D16	AN16	659-4	860-14-3		860-16-3	38
AG5A16	AN16	659-4	860-14-3	659-4	860-14-3	49
AG5B16	AN16	659-4	860-14-3		860-16-3	93
AG5C16	AN16		860-16-3	659-4	860-14-3	58
AG5D16	AN16	659-4	860-14-3		860-16-3	52
AG6A16	AN16	659-4	860-14-3		860-16-3	72
AG6B16	AN16	659-4	860-14-3		860-16-3	14½
AG6C16	AN16	659-4	860-14-3	659-4	860-14-3	38
AG7A16	AN16		860-16-3	659-4	860-14-3	51
AG7B16	AN16	659-4	860-14-3		860-16-3	42
AG7C16	AN16		860-16-3		860-16-3	102
AG7D16	AN16		860-16-3	659-4	860-14-3	56
AG7E16	AN16	659-4	860-14-3		860-16-3	41
AG8A16	AN16		860-16-3	659-4	860-14-3	47
AG8B16	AN16	659-4	860-14-3		860-16-3	43
AG8C16	AN16		860-16-3		860-16-3	102
AG8D16	AN16		860-16-3	659-4	860-14-3	58
AG8E16	AN16	659-4	860-14-3		960-16-3	54
AG13B18	AN18	659-2	860-16-3	659-2	860-18-3	72
AG14A18	AN18	659-2	860-16-3	659-2	860-16-3	4
AG17A18	AN18	659-2	860-16-3	659-2	860-16-3	4
AG30A14	AN14	659-4	860-14-3	659-4	860-14-3	4
NA1A18	AN18	659-2	860-16-3	659-2	860-16-3	5½
NA2A18	AN18	659-2	860-16-3	659-2	860-16-3	5
NA4A18	AN18	659-2	860-16-3	659-2	860-16-3	2
PA2A14	AN14	659-2	860-12-3	659-4	860-12-3	12
PA2B16	AN16	659-4	860-14-3		860-16-3	17
PA2C16	AN16		860-16-3	CVC-880-22	860-14-3	55
PA2D18	AN18	CVC-880-22	860-14-3	659-2	860-16-3	3
PA3A18	AN18	659-2	860-16-3		860-18-3	19
PA3B18	AN18		860-18-3	659-2	860-16-3	72
PA4A18	AN18	659-2	860-16-3		860-18-3	72
PA4B18	AN18		860-18-3	659-2	860-16-3	12
PA4C18	AN18	659-2	860-16-3	659-2	860-16-3	22
PA5A18	AN18	659-2	860-14-3	659-2	860-16-3	36
PA5B18	AN18	659-2	860-16-3	659-2	860-16-3	60
PA6A14	AN14	659-4	860-12-3	659-4	860-14-3	6

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
5	VS-59909 Chance Vought (made from AN3108-28-12P)	Plug
13	AN3106-10S-2S	Plug
27	AN3100-28-12S	Receptacle
29	AN3108-28-12P	Plug
34	AN3021-2	Switch
74	VS-58835 Chance Vought Plastic Mfgrs. P1456E	Grip Assembly
80	NAF1204-1	Relay
95	AN3027-1	Switch
96	AN3216-1	Switch
98	AN3102-18-4S	Receptacle
99	AN3102-24-7S	Receptacle
110	AN3106-24-7P	Plug
117	AN3160-5	Switch-breaker
121	AN3161-P10	Circuit-breaker
134	AN3106-18-4P	Plug
135	VS-44196 Chance Vought Ward Leonard Co. Type WX	Resistor 2 ohm, 100 watt

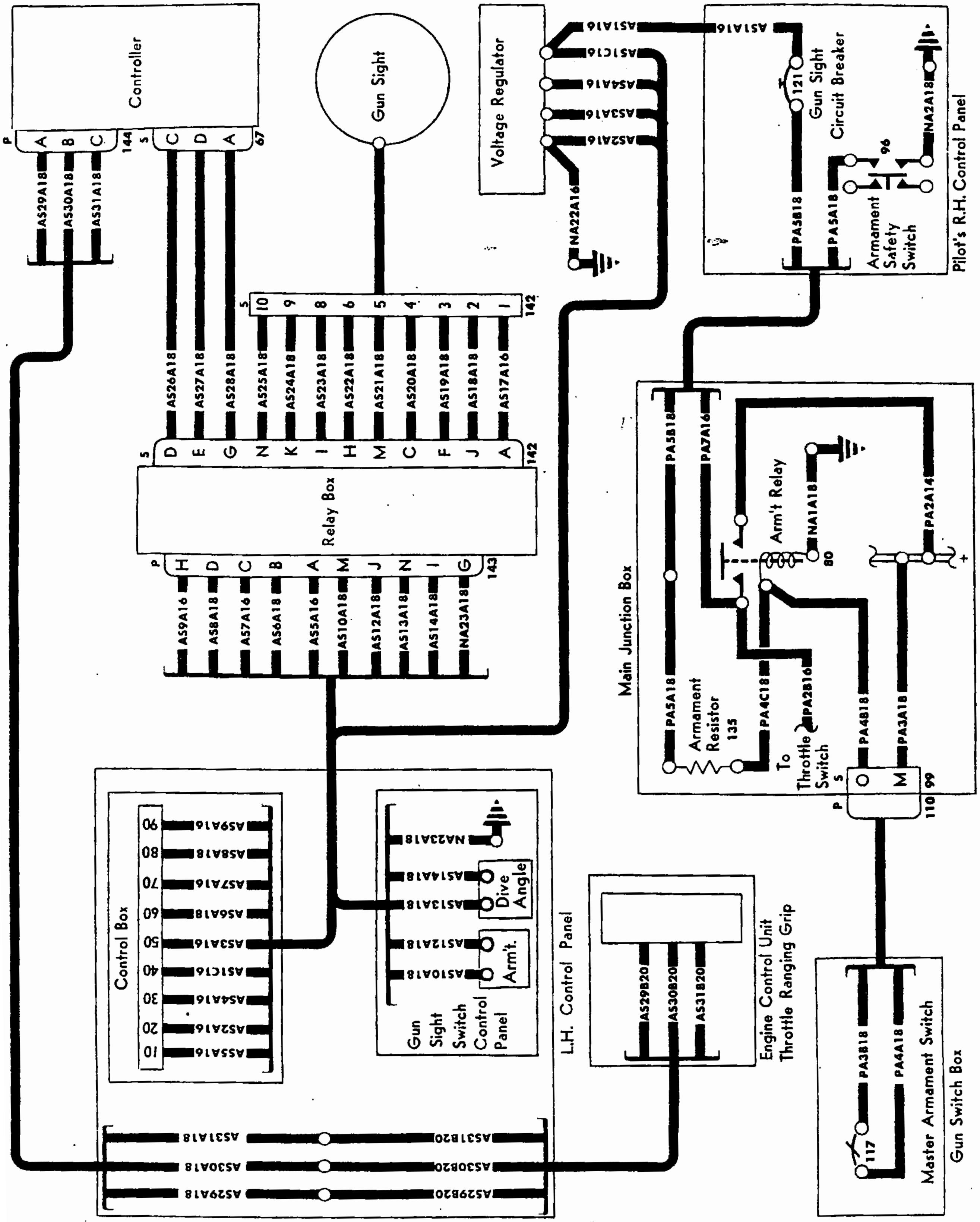


Figure 5-27. (Sheet 1 of 2 Sheets). Armament Circuits—Mk6 Fire Control (Gunsight).

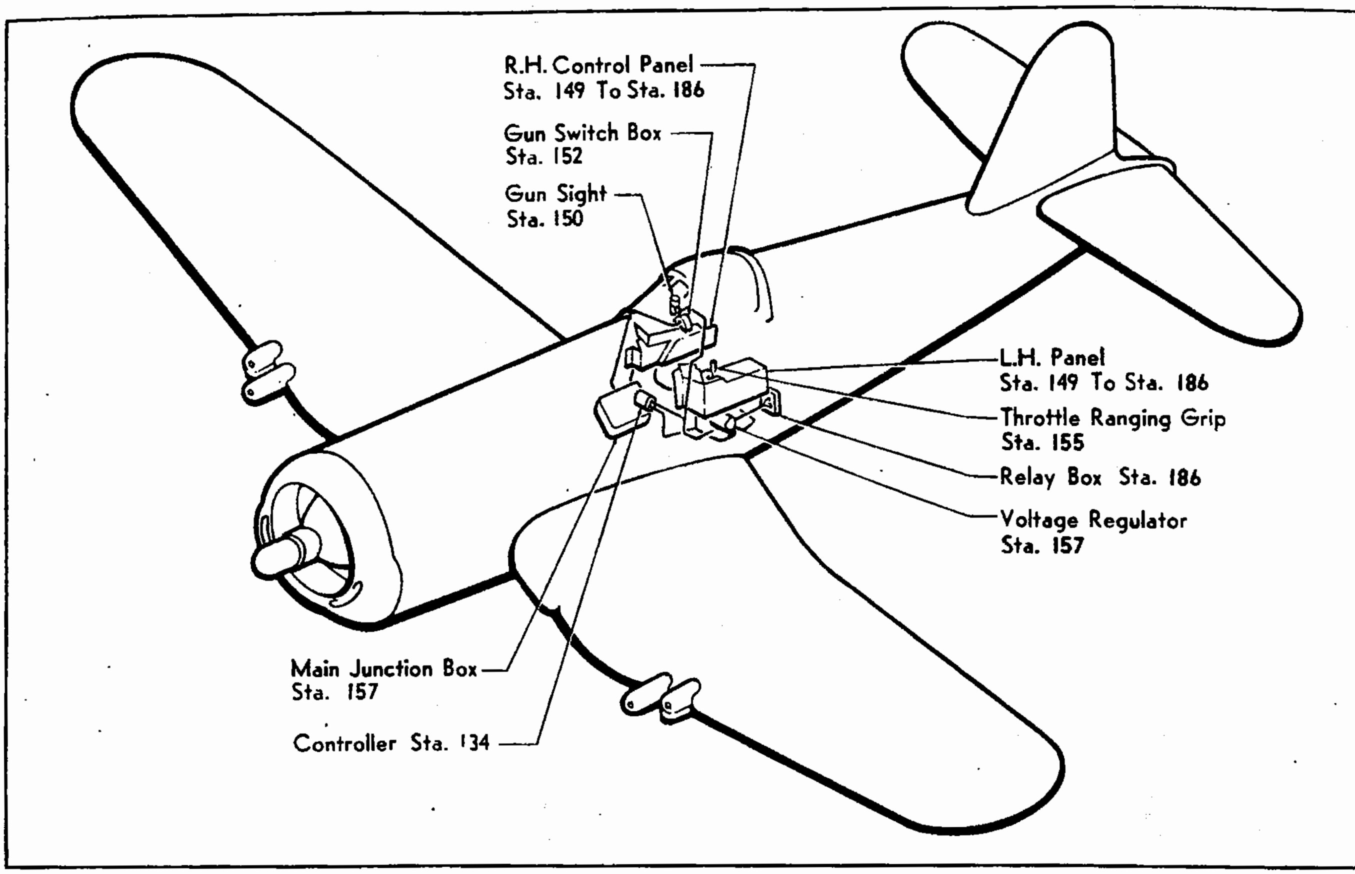


Figure 5–27. (Sheet 2 of 2 Sheets). Armament Circuits—Mk 6 Fire Control (Gunsight).

5–105. ARMAMENT CIRCUITS—MK 6 FIRE CONTROL (GUNSIGHT).

5–106. DESCRIPTION. (*See figure* 5–27.) The master armament switch provides "ON-OFF" control for gunsight circuits. Closing the master armament switch energizes the armament relay and allows current to flow through the gunsight circuit-breaker to the "IN" contact of the gunsight voltage regulator. The output of the gunsight voltage regulator supplies a steady 22 volts for use in the gunsight circuit. Further electrical information on the gunsight is unobtainable at the present time. For operation of the gunsight switches, refer to paragraph 4–1798. The armament safety switch protects these circuits in a manner similar to the guns firing circuits; see paragraph 5–103.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
AS1A16	AN16	659-4	860-16-3	659-4	860-18-3	109
AS1C16	AN16	659-4	860-14-3	659-4	860-14-3	37
AS2A16	AN16	659-4	860-14-3	659-4	860-14-3	36
AS3A16	AN16	659-4	860-14-3	659-4	860-14-3	37
AS4A16	AN16	659-4	860-14-3	659-4	860-14-3	36
AS5A16	AN16		860-16-3	659-4	860-14-3	37
AS6A18	AN18	659-2	860-16-3	659-4	860-18-3	38
AS7A16	AN16	659-4	860-16-3	659-4	860-14-3	38
AS8A18	AN18	659-4	860-18-3	659-2	860-16-3	38

WIRE TABLE (Continued)

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
AS9A16	AN16	659-4	860-16-3	659-4	860-18-3	36½
AS10A18	AN18	659-4	860-18-3	659-2	860-16-3	37
AS12A18	AN18	659-4	860-18-3	659-2	860-16-3	37
AS13A18	AN18	659-4	860-18-3	659-2	860-16-3	37
AS14A18	AN18	659-4	860-18-3	659-2	860-16-3	37
AS17A16	AN16		860-16-3		860-16-3	100
AS18A18	AN18		860-18-3		860-18-3	100
AS19A18	AN18		860-18-3		860-18-3	100
AS20A16	AN16		860-16-3		860-16-3	100
AS21A18	AN18		860-18-3		860-18-3	100
AS22A16	AN16		860-16-3		860-16-3	100
AS23A18	AN18		860-18-3		860-18-3	100
AS24A18	AN18		860-18-3		860-18-3	100
AS25A18	AN18		860-18-3		860-18-3	100
AS26A18	AN18		860-18-3		860-18-3	113
AS27A18	AN18		860-18-3		860-18-3	113
AS28A18	AN18		860-18-3		860-18-3	113
AS29A18	AN18	659-2	860-16-3		860-18-3	100
AS29B20	AN20	659-2	860-16-3			24
AS30A18	AN18	659-2	860-16-3		860-18-3	100
AS30B20	AN20	659-2	860-16-3			24
AS31A18	AN18	659-2	860-16-3		860-18-3	100
AS31B20	AN20	659-2	860-16-3			24
NA1A18	AN18	659-2	860-16-3	659-2	860-16-3	5½
NA2A18	AN18	659-2	860-16-3	659-2	860-16-3	5
NA22A16	AN16	659-4	860-14-3	659-4	860-14-3	27
NA23A18	AN16	659-2	860-16-3		860-18-3	27
PA2A14	AN14	659-4	860-12-3	659-4	860-12-3	12
PA3A18	AN18		860-18-3	659-2	860-16-3	19
PA3B18	AN18		860-18-3	659-2	860-16-3	72
PA4A18	AN18		860-18-3	659-2	860-16-3	72
PA4B18	AN18		860-18-3	659-2	860-16-3	12
PA4C18	AN18	659-2	860-16-3	659-2	860-16-3	22
PA5A18	AN18	659-2	860-16-3	659-2	860-16-3	36
PA5B18	AN18	659-2	860-16-3	659-2	860-16-3	60
PA7A16	AN16	659-4	860-14-3	659-4	860-14-4	38

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
67	AN3108-14S-2S	Plug
80	NAF1204-1	Relay
96	AN3216-1	Switch
99	AN3102-24-7S	Receptacle
110	AN3106-24-7P	Plug
117	AN3160-5	Switch-breaker
121	AN3161-P10	Circuit-breaker
135	VS-44196 Chance Vought Ward Leonard Type WX	Resistor 2 ohm, 100 watts
142	AN3106-20-27S	Plug
143	AN3106-20-27P	Plug
144	AN3108-14S-7P	Plug

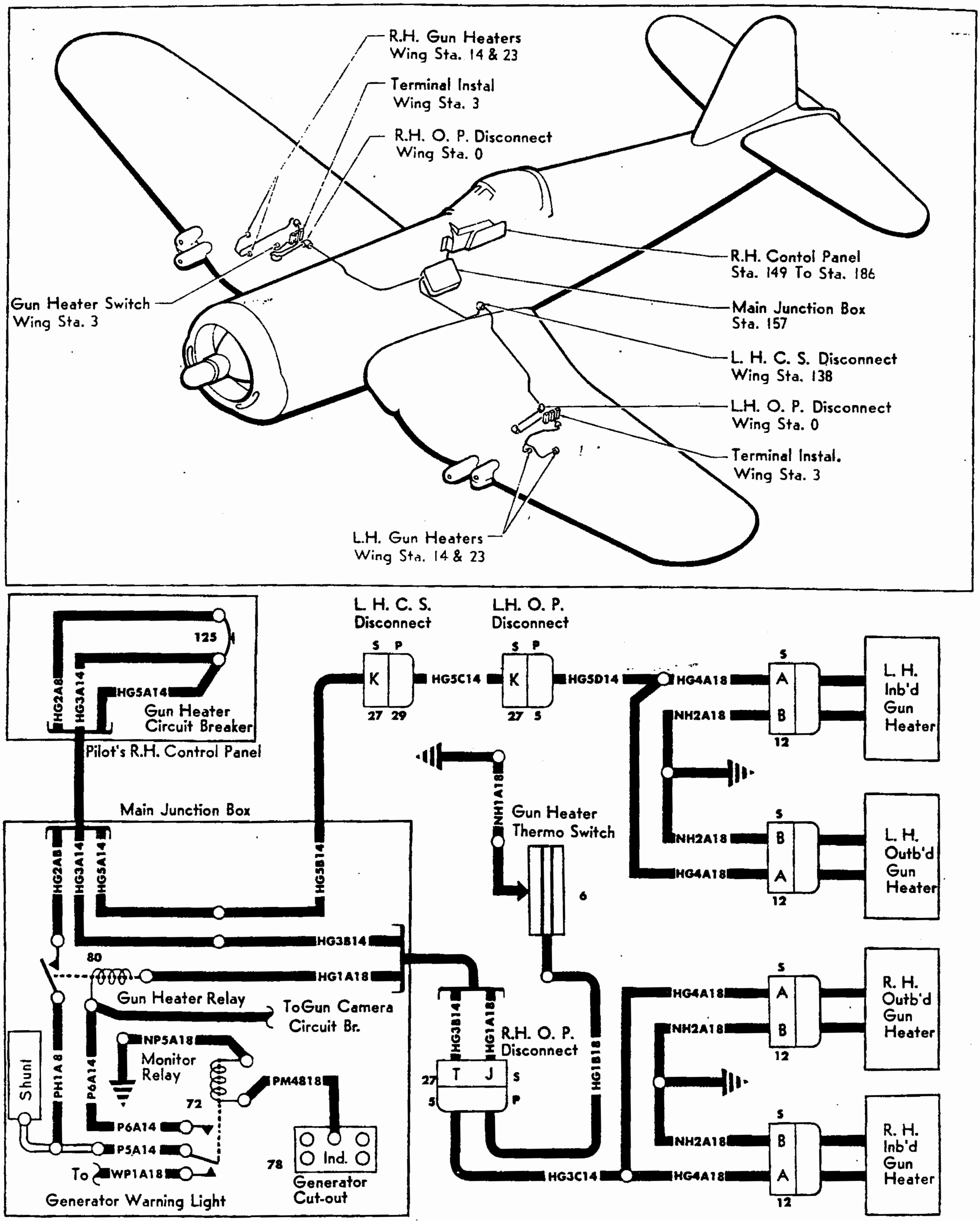


Figure 5–28. Armament Circuits—Gun Heater.

5-107. ARMAMENT CIRCUITS—GUN HEATER.

5-108. DESCRIPTION. (*See figure 5-28.*) The gun heater circuit is in operation when the generator is carrying the airplane's electrical loads. A connection from the indicator terminal on the generator cut-out energizes the monitor relay when the generator is charging. This provides a path for current to the gun heater relay which energizes all four gun heaters when the gun heater thermo switch, located in the right wing panel, is on. The gun heater thermo switch automatically turns on the heaters when the temperature drops below 21.2° C (70° F).

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
HG1A18	AN18	659-2	860-16-3		860-18-3	108
HG1B18	AN18		860-18-3	659-2	860-16-3	48
HG2A8	AN8	659-7	860-6-3	659-7	860-6-3	34
HG3A14	AN14	659-4	860-14-3	659-4	860-14-3	40
HG3B14	AN14	659-4	860-12-3		860-14-3	93
HG3C14	AN14		860-14-3	659-4	860-14-3	58
HG4A18(2)	AN18	659-2	860-16-3		860-18-3	17
HG5A14	AN14	659-4	860-14-3	659-4	860-14-3	40
HG5B14	AN14	659-4	860-14-3		860-14-3	45
HG5C14	AN14		860-14-3		860-14-3	102
HG5D14	AN14		860-14-3	659-4	860-14-3	56
NH1A18	AN18	659-2	860-16-3	659-2	860-16-3	12
NH2A18(4)	AN18		860-18-3	659-2	860-16-3	17
NP5A18	AN18	659-2	860-16-3			5
P5A14	AN14			659-4	860-14-3	17
P6A14	AN14	659-4	860-12-3		860-14-3	23
PH1A8	AN8	659-7	860-8-3	659-29	860-8-3	6
PM4B18	AN18			659-2	860-16-3	18

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
5	VS-59909 Chance Vought (made from AN3108-28-12P)	Plug
6	VS-59911 Chance Vought Mansfield Elec. Co. GP-1	Thermo-switch
12	AN3100-12S-3S	Receptacle
27	AN3100-28-12S	Receptacle
29	AN3108-28-12P	Plug
72	VS-48746 Chance Vought Phillips Control Co. Spec. 12038-1	Relay
78	VS-59948 Chance Vought General Electric 3GTR76A3	Reverse Current (Generator Cut-out) Relay
80	NAF1204-1	Relay
125	AN3161-P50	Circuit-breaker

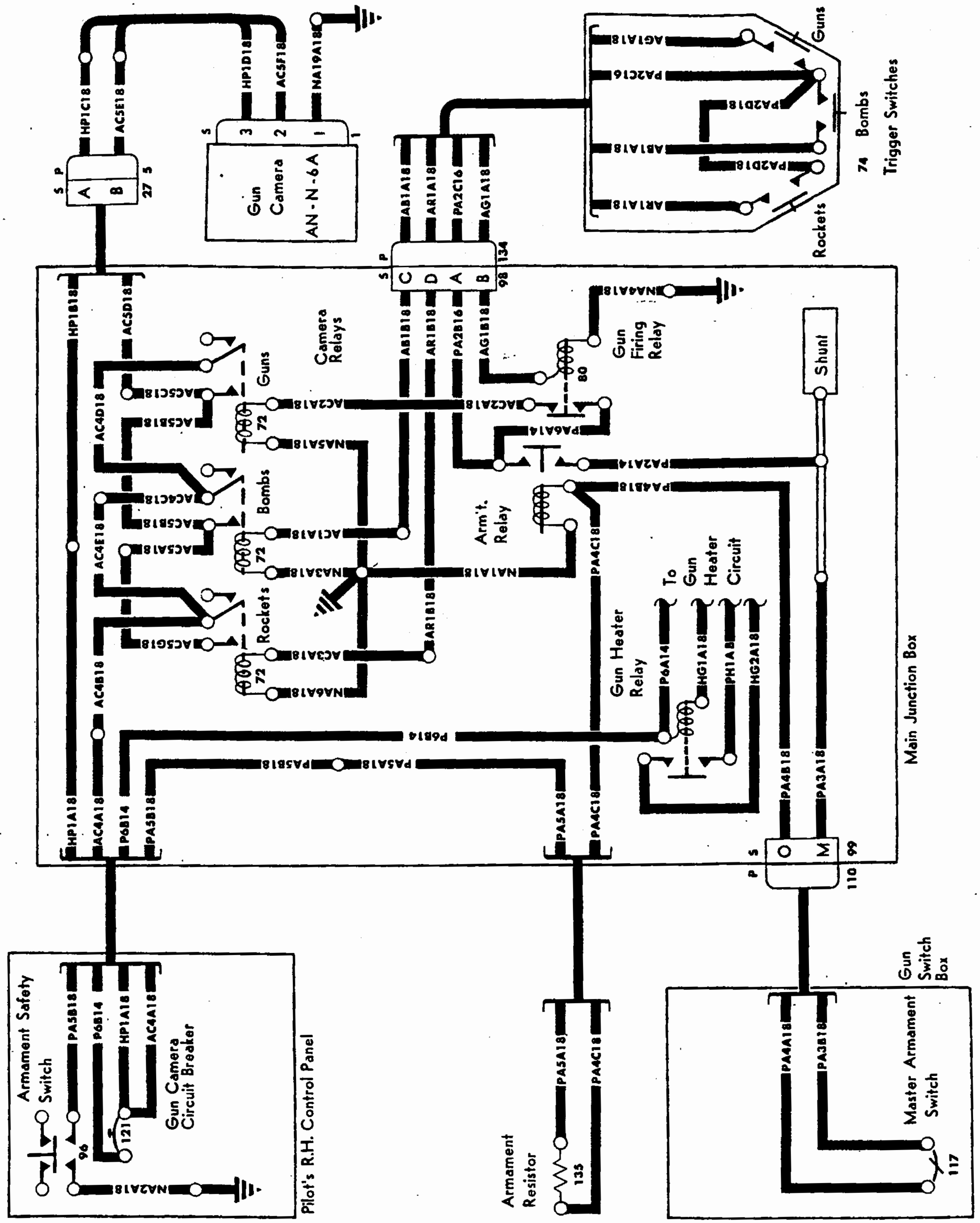


Figure 5–29. (Sheet 1 of 2 Sheets). Armament Circuits—Gun Camera and Gun Camera Heater.

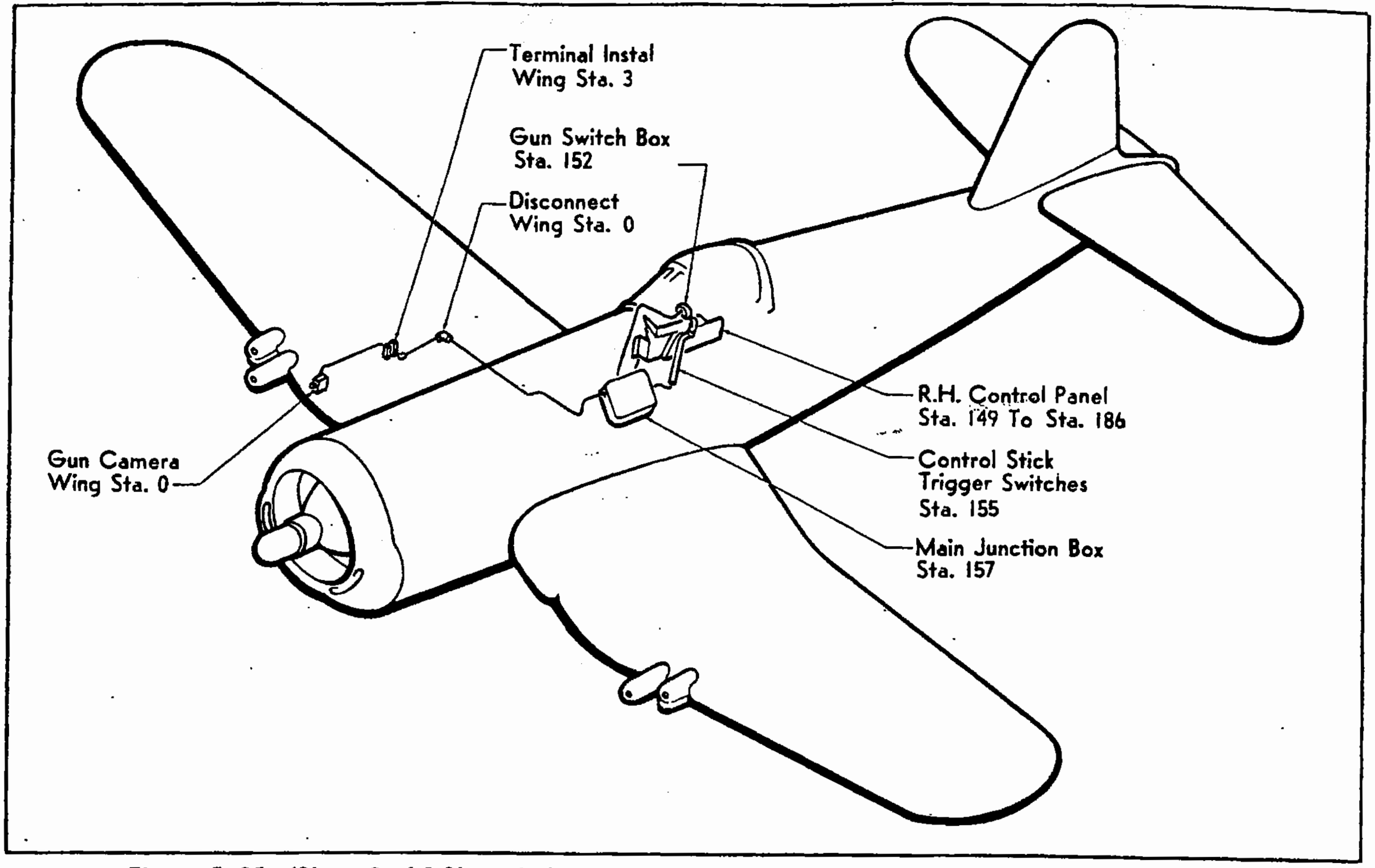


Figure 5–29. (Sheet 2 of 2 Sheets). Armament Circuits—Gun Camera and Gun Camera Heater.

5–109. ARMAMENT CIRCUITS—GUN CAMERA AND GUN CAMERA HEATER.

5–110. DESCRIPTION. (*See figure 5–29.*) The gun camera is in operation when any of the camera relays are energized and the master armament switch is "ON." When the gun "safe-ready" switch is in the "READY" position, turning on the master armament switch will energize the armament relay which, when any one of the trigger switches (bomb, rocket or gun) is depressed, closes the circuit to the respective camera relay (bomb, rocket or gun), and thus puts the camera in operation. A safety switch which is in the circuit when the arresting hook control handle is in the "DOWN" position, shuts off all armament circuits during carrier landing; see paragraph 5–103 for further information on the safety switch. The gun camera is protected from electrical overload by a circuit-breaker located on the vertical sheathing of the right hand control panel. A lens heater for the gun camera is energized by a circuit which stems from the gun heater circuit. The lens heater is operating when the airplane generator is charging and the heater is protected from overload by the circuit-breaker.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
AB1A18	AN18		860-18-3	659-2	860-16-3	56
AB1B18	AN18		860-18-3	659-2	860-16-3	17
AC1A18	AN18			659-2	860-16-3	8½
AC2A18	AN18	659-2	860-16-3			15
AC3A18	AN18	659-2	860-16-3			20
AC4A18	AN18	659-2	860-16-3	659-2	860-16-3	44

WIRE TABLE (Continued)

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
AC4B18	AN18	659-2	860-16-3			20
AC4C18	AN18	659-2	860-16-3			12
AC4D18	AN18					3
AC4E18	AN18	659-2	860-16-3			18
AC5A18	AN18	659-2	860-16-3			15
AC5B18	AN18					3
AC5C18	AN18			659-2	860-16-3	9
AC5D18	AN18	659-2	860-16-3		860-18-3	95
AC5E18	AN18		860-18-3	659-2	860-16-3	42
AC5F18	AN18	659-2	860-16-3		860-18-3	59
AC5G18	AN18	659-2	860-16-3			17
AG1A18	AN18	659-2	860-16-3		860-18-3	55
AG1B18	AN18		860-18-3	659-2	860-16-3	17
AR1A18	AN18	659-2	860-16-3		860-18-3	54
AR1B18	AN18	659-2	860-16-3	659-2	860-18-3	17
HP1A18	AN18	659-2	860-16-3	659-2	860-16-3	47
HP1B18	AN18	659-2	860-16-3		860-18-3	95
HP1C18	AN18		860-18-3	659-2	860-16-3	42
HP1D18	AN18	659-2	860-18-3		860-18-3	60
NA1A18	AN18	659-2	860-16-3	659-2	860-16-3	5½
NA2A18	AN18	659-2	860-16-3	659-2	860-16-3	5
NA3A18	AN18	659-2	860-16-3			6½
NA4A18	AN18	659-3	860-16-3	659-2	860-16-3	2
NA5A18	AN18			659-2	860-16-3	5
NA6A18	AN18			659-2	860-16-3	8
NA19A18	AN18		860-18-3	659-2	860-16-3	8
P6B14	AN14	659-4	860-14-3	659-4	860-14-3	37½
PA2A14	AN14	659-4	860-14-3	659-4	860-14-3	12
PA2C16	AN16	CVC-880-22	860-14-3		860-16-3	55
PA2D18	AN18	CVC-880-22	860-14-3			3
PA3A18	AN18	659-2	860-16-3		860-18-3	19
PA3B18	AN18		860-18-3	659-2	860-16-3	72
PA4A18	AN18	659-2	860-16-3		860-18-3	72
PA4B18	AN18		860-18-3	659-2	860-16-3	12
PA4C18	AN18	659-2	860-16-3	659-2	860-16-3	22
PA5A18	AN18	659-2	860-16-3	659-2	860-16-3	36
PA5B18	AN18	659-2	860-16-3	659-2	860-16-3	60
PA6A14	AN14	659-4	860-14-3	659-4	860-14-3	6

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
1	VS-15442 Chance Vought Breeze Corp. E-1002-3-160	Plug
5	VS-59909 Chance Vought (made from AN3108-28-12P)	Plug
27	AN3100-28-12S	Receptacle
72	VS-48746 Chance Vought Phillips Control Co. Spec. 12038-1	Relay
74	VS-58835 Chance Vought Plastic Mfgrs. P1456E	Grip Assem.
80	NAF1204-1	Relay
96	AN3216-1	Switch
98	AN3102-18-4S	Receptacle
99	AN3102-24-7S	Receptacle
110	AN3106-24-7P	Plug
117	AN3160-5	Switch-breaker
121	AN3161-P10	Circuit-breaker
134	AN3106-18-4P	Plug
135	VS-44196 Chance Vought Ward Leonard Type WX	Resistor—2 ohm, 100 watts

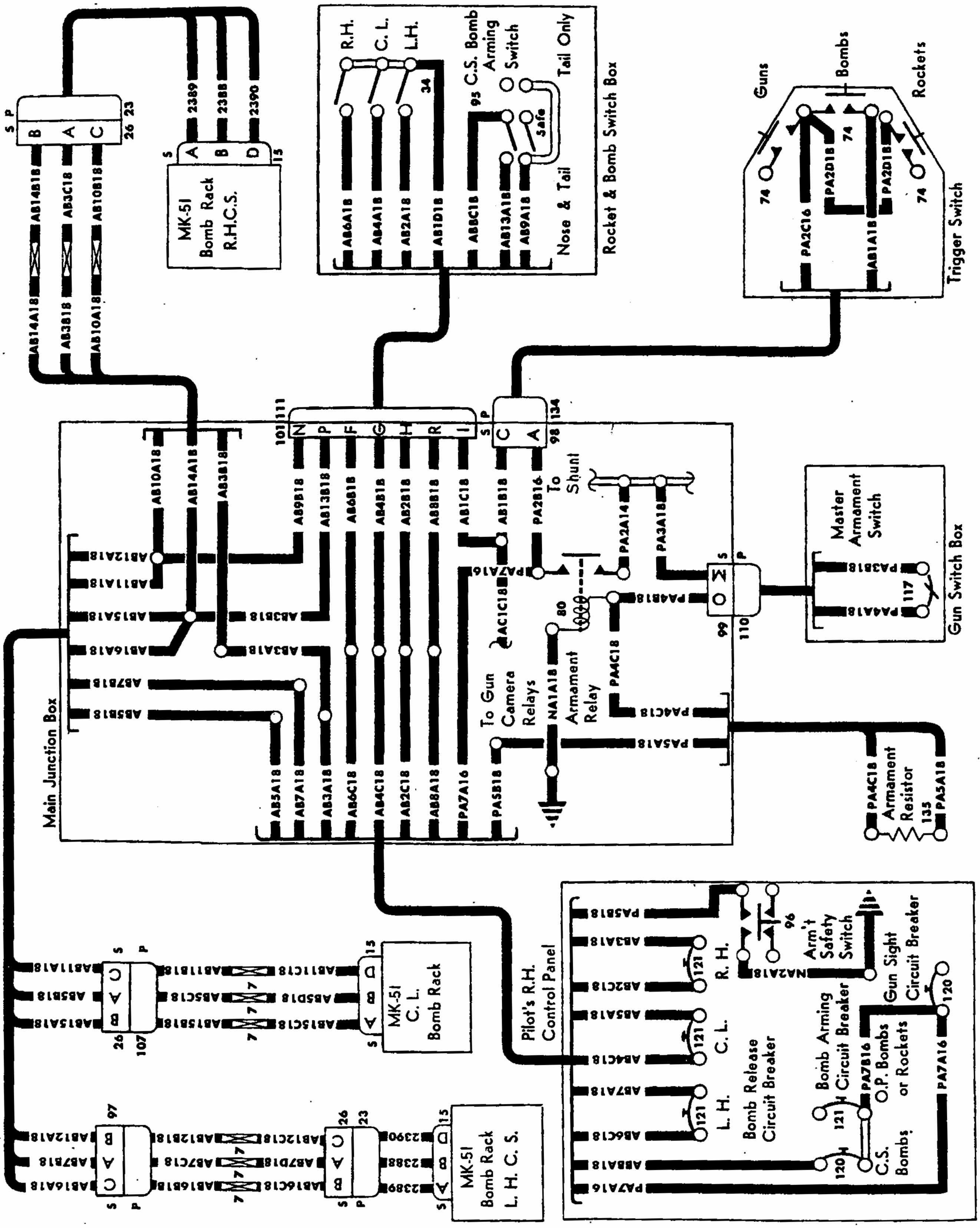


Figure 5–30. (Sheet 1 of 2 Sheets). Armament Circuits—Bomb Arming and Release.

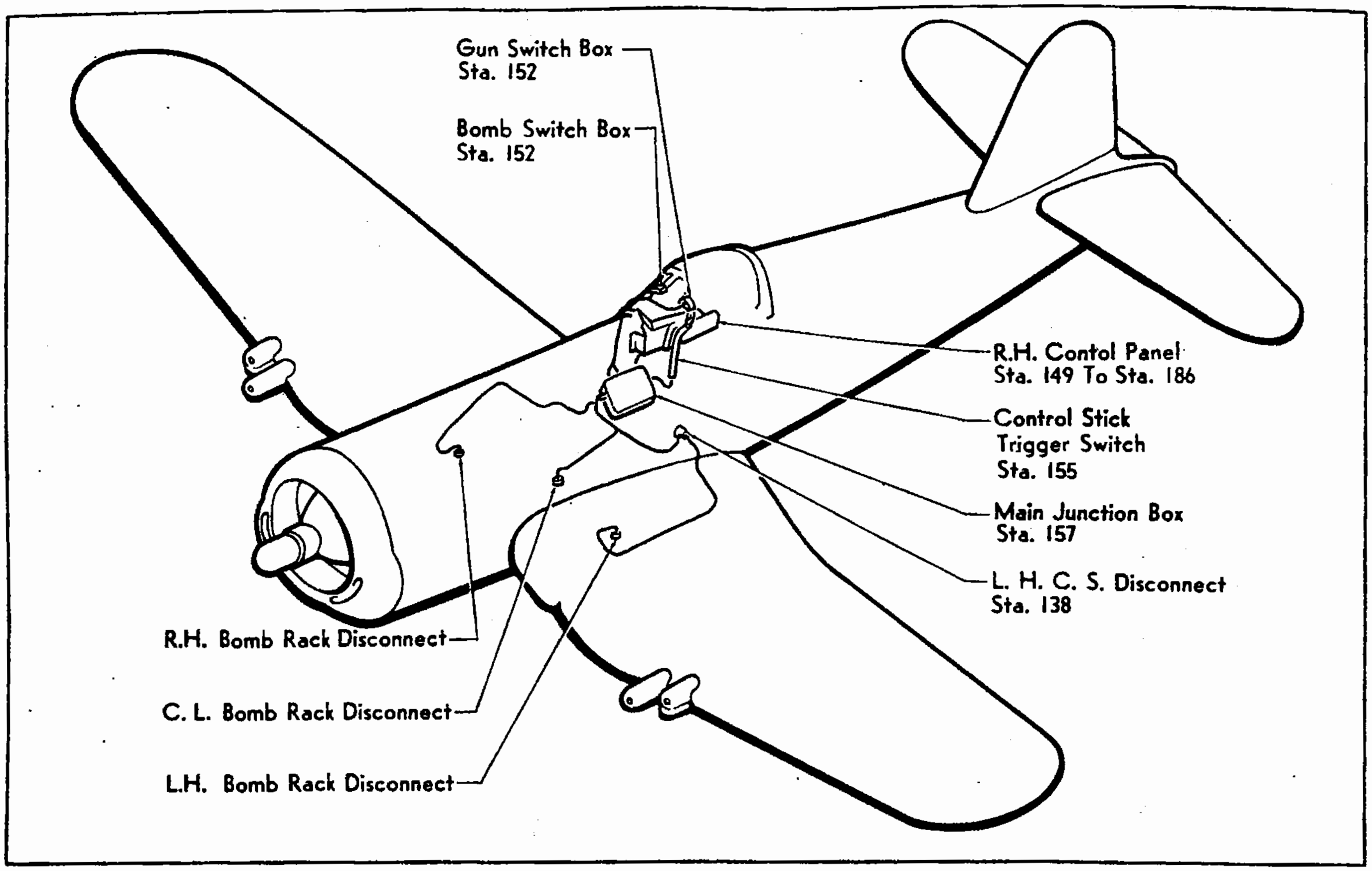


Figure 5–30. (Sheet 2 of 2 Sheets). Armament Circuits—Bomb Arming and Release.

5–111. ARMAMENT CIRCUITS—BOMB ARMING AND RELEASE.

5–112. DESCRIPTION. (*See figure 5–30.*) All bomb arming and release electrical circuits are controlled by the master armament switch. When the master armament switch is turned "ON," the armament relay is energized; this closes the power circuit to the trigger switches for the bombs, guns, and rockets. The rocket and bomb switch box contains the bomb arming switch which arms either nose and tail of bombs, or tail only. In this same box are the selector switches for individual control of the bomb release circuits. The bomb arming circuits and the bomb release circuits are protected by individual circuit-breakers and the complete circuit is shut off during carrier landings by the armament safety switch (see paragraph 5–103 for information on the safety switch).

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
2388			860-18-3		860-18-3	11
2389			860-18-3		860-18-3	11
2390			860-18-3		860-18-3	11
AB1A18	AN18	659-2	860-16-3		860-18-3	56
AB1B18	AN18		860-18-3	659-2	860-16-3	17
AB1C18	AN18	659-2	860-16-3		860-18-3	6
AB1D18	AN18	659-2	860-16-3		860-18-3	62
AB2A18	AN18	659-2	860-16-3		860-18-3	64
AB2B18	AN18		860-18-3	659-2	860-16-3	12

WIRE TABLE (Continued)

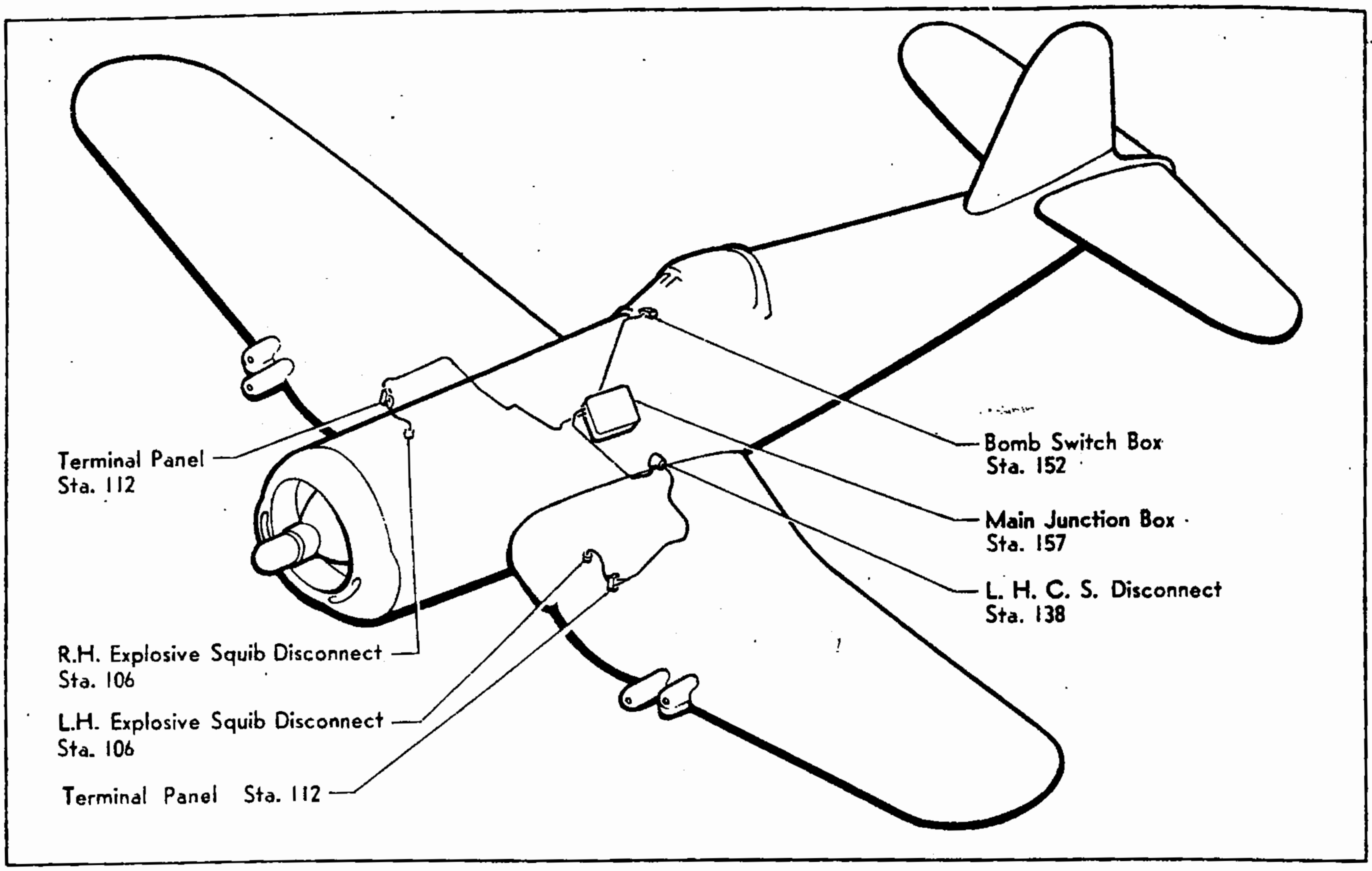
WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
AB2C18	AN18	659-2	860-16-3	659-2	860-16-3	36
AB3A18	AN18	659-2	860-16-3	659-2	860-16-3	43
AB3B18	AN18	659-2	860-16-3	753-A1		63
AB3C18	AN18	753-A1			860-18-3	25
AB4A18	AN18	659-2	860-16-3		860-18-3	64
AB4B18	AN18		860-18-3	659-2	860-16-3	12
AB4C18	AN18	659-2	860-16-3	659-2	860-16-3	39
AB5A18	AN18	659-2	860-16-3	659-2	860-16-3	46
AB5B18	AN18	659-2	860-16-3		860-18-3	100
AB5C18	AN18		860-18-3	753-A1		30
AB5D18	AN18	753-A1			860-18-3	30
AB6A18	AN18	659-2	860-16-3		860-18-3	65
AB6B18	AN18		860-18-3	659-2	860-16-3	8½
AB6C18	AN18	659-2	860-16-3	659-2	860-16-3	42½
AB7A18	AN18	659-2	860-16-3	659-2	860-16-3	44
AB7B18	AN18	659-2	860-16-3		860-18-3	42
AB7C18	AN18		860-18-3	753-A1		62
AB7D18	AN18	753-A1			860-18-3	37
AB8A18	AN18	659-2	860-16-3	659-2	860-16-3	37
AB8B18	AN18	659-2	860-16-3		860-18-3	11
AB8C18	AN18	659-2	860-16-3		860-18-3	62
AB9A18	AN18	659-2	860-16-3		860-18-3	62
AB9B18	AN18		860-18-3	659-2	860-16-3	9
AB10A18	AN18	659-2	860-16-3	753-A1		63
AB10B18	AN18	753-A1		659-2	860-16-3	23
AB11A18	AN18	659-2	860-16-3		860-18-3	100
AB11B18	AN18		860-18-3	753-A1		30
AB11C18	AN18	753-A1			860-18-3	30
AB12A18	AN18	659-2	860-16-3		860-18-3	42
AB12B18	AN18		860-18-3	753-A1		62
AB12C18	AN18	753-A1			860-18-3	37
AB13A18	AN18		860-18-3	659-2	860-16-3	62
AB13B18	AN18		860-18-3	659-2	860-16-3	10
AB14A18	AN18	659-2	860-16-3	753-A1		65
AB14B18	AN18	753-A1			860-18-3	27
AB15A18	AN18	659-2	860-16-3		860-18-3	100
AB15B18	AN18		860-18-3	753-A1		30
AB15C18	AN18	753-A1			860-18-3	30
AB16A18	AN18	659-2	860-16-3		860-18-3	42
AB16B18	AN18		860-18-3	753-A1		62
AB16C18	AN18	753-A1			860-18-3	37
NA1A18	AN18	659-2	860-16-3	659-2	860-16-3	5½
NA2A18	AN18	659-2	860-16-3	659-2	860-16-3	5
PA2A14	AN14	659-4	860-12-3	659-4	860-14-3	12

WIRE TABLE (Continued)

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
PA2B16	AN16	659-4	860-14-3		860-16-3	17
PA2C16	AN16	CVC-880-22	860-14-3		860-16-3	55
PA2D18	AN18	CVC-880-22	860-14-3	659-2	860-16-3	3
PA3A18	AN18	659-2	860-16-3		860-18-3	19
PA3B18	AN18		860-18-3	659-2	860-16-3	72
PA4A18	AN18	659-2	860-16-3		860-18-3	72
PA4B18	AN18		860-18-3	659-2	860-16-3	12
PA4C18	AN18	659-2	860-16-3	659-2	860-16-3	22
PA5A18	AN18	659-2	860-16-3	659-2	860-16-3	36
PA5B18	AN18	659-2	860-16-3	659-2	860-16-3	60
PA7A16	AN16	659-4	860-14-3	659-4	860-14-3	38
PA7B16	AN16	659-4	860-14-3	659-4	860-14-3	2½

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
7	AN753B1	Coupler
15	AN3106-14S-5S	Plug
23	VS-38499 Chance Vought (made from AN3106-14S-7P)	Plug
26	AN3100-14S-7S	Receptacle
34	AN3021-2	Switch
74	VS-58835 Chance Vought Plastic Mfgrs. P1456E	Grip Assem.
80	NAF1204-1	Relay
95	AN3027-1	Switch
96	AN3216-1	Switch
97	AN3100-24-7S	Receptacle
98	AN3102-18-4S	Receptacle
99	AN3102-24-7S	Receptacle
101	AN3102-28-11S	Receptacle
107	AN3106-14S-7P	Plug
110	AN3106-24-7P	Plug
111	AN3106-28-11P	Plug
117	AN3160-5	Switch-breaker
120	AN3161-P5	Circuit-breaker
121	AN3161-P10	Circuit-breaker
134	AN3106-18-4P	Plug
135	VS-44196 Chance Vought Ward Leonard Co. Type WX	Resistor—2 ohm, 100 watts



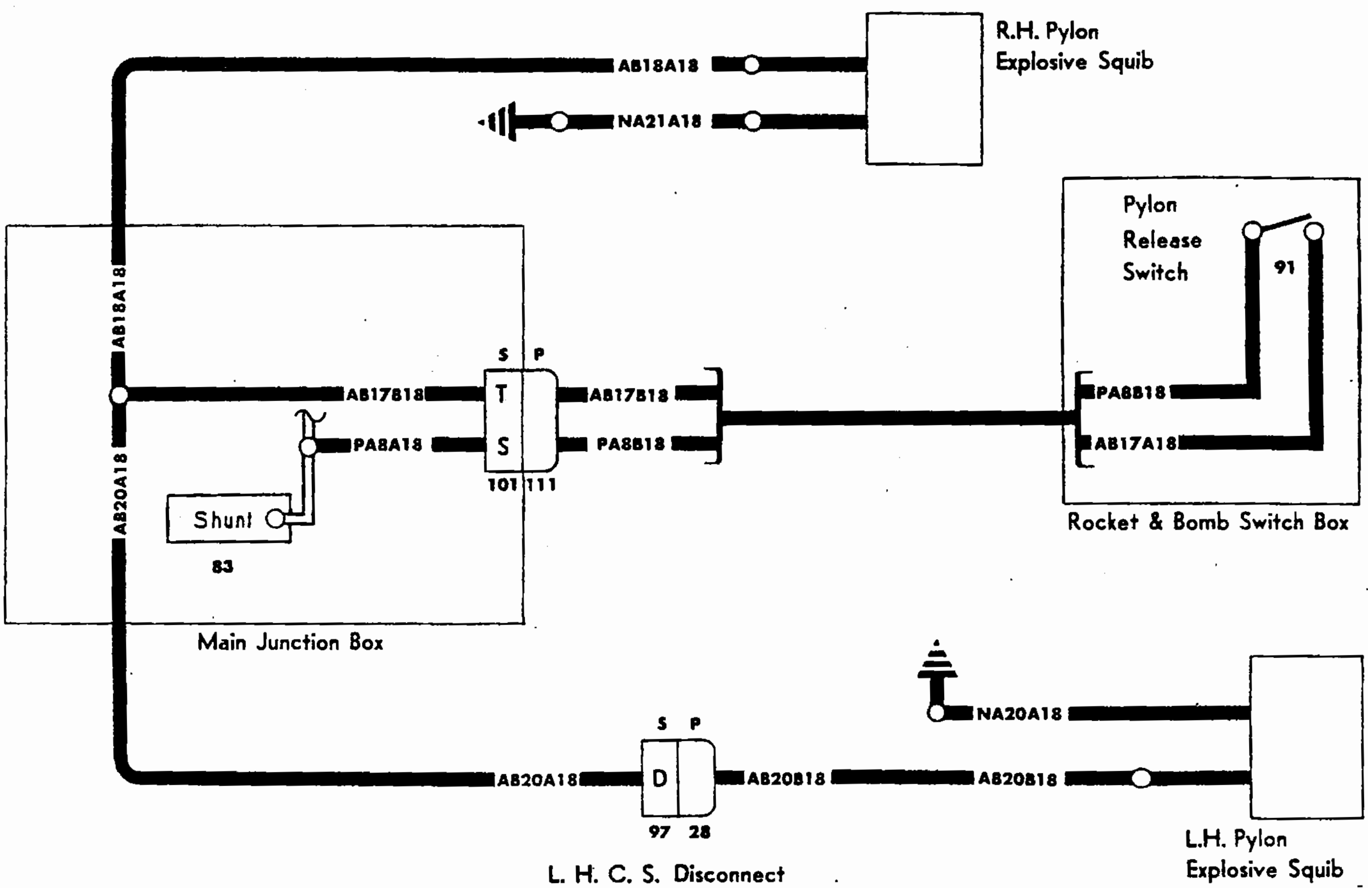


Figure 5–31. Armament Circuits—Center Section Pylon Release.

5–113. ARMAMENT CIRCUITS—CENTER SECTION PYLON RELEASE.

5–114. DESCRIPTION. (*See figure 5–31.*) The pylon release circuit in this airplane is inoperative. Normally, this circuit provides a means of jettisoning the center section pylons while in flight. The pylon release switch is contained in the armament switch box located on the right hand side of the cockpit cowling. The switch is safety-wired, and the wiring is complete only to the center section pylon receptacles. The explosive squibs are not installed in the pylons. Power for the pylon release circuit is taken from the shunt in the main junction box.

WIRE TABLE

Wooten T. Floyd

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
AB17A18	AN18	659-2	860-16-3		860-18-3	62
AB17B18	AN18		860-18-3	659-2	860-16-3	10
AB18A18	AN18	659-2	860-16-3	659-2	860-16-3	72
AB20A18	AN18	659-2	860-16-3		860-18-3	40
AB20B18	AN18		860-18-3	659-2	860-16-3	130
NA20A18	AN18	659-2	860-16-3	659-2	860-16-3	6
NA21A18	AN18	659-2	860-16-3	659-2	860-16-3	6
PA8A18	AN18	659-2	860-16-3		860-18-3	16
PA8B18	AN18		860-18-3	659-2	860-16-3	62

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
28	AN3108-24-7P	Plug
83	NAF1091-2-240	Shunt
91	AN3021-8	Switch
97	AN300-24-7S	Receptacle
101	AN3102-28-11S	Receptacle
111	AN3106-28-11P	Plug

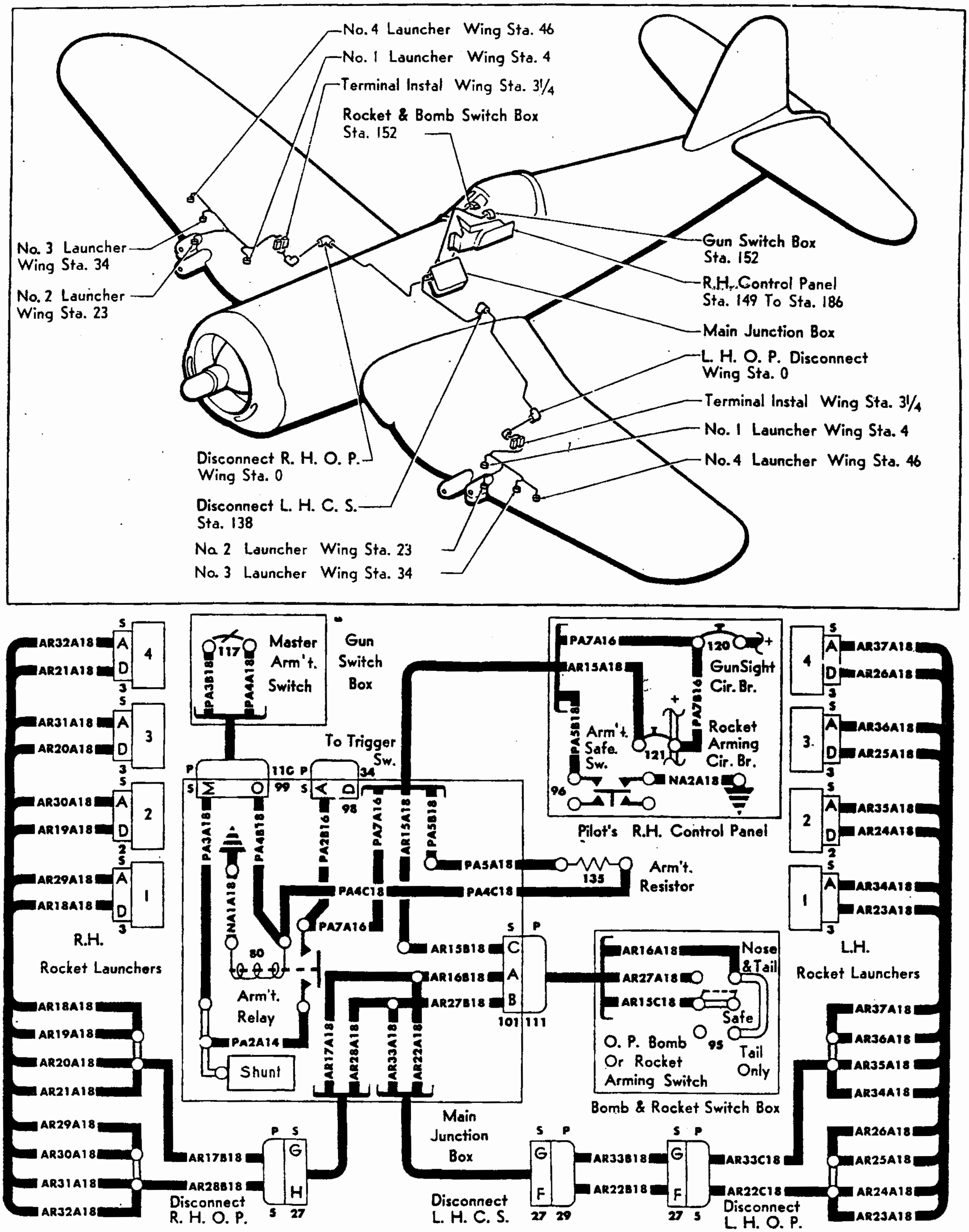


Figure 5–32. Armament Circuits—Rocket Arming.

5-115. ARMAMENT CIRCUITS—ROCKET ARMING.

5-116. DESCRIPTION. (*See figure 5-32.*) The rocket launchers incorporate nose arming solenoids to accommodate rockets equipped with nose fuses. Tail arming solenoids are not provided, the rocket base fuses being automatically armed when the rocket is fired. The arming circuit is designed, however, to accommodate the installation of bomb racks incorporating nose and tail arming units in place of the launchers. Therefore, the rocket arming switch has three positions: "NOSE AND TAIL ARMING," "SAFE," and "TAIL ARMING." To arm the rockets, the switch must be placed in the "NOSE AND TAIL ARMING" position. Current will flow only in the nose arming solenoid circuit, the tail arming circuit being incomplete unless bomb racks are installed. To fire rockets with the nose fuse unarmed, the arming switch may be placed in either the "SAFE" or "TAIL ARMING" position. Note, however, that the rockets are never fired in a "SAFE" condition, due to the fact that the tail fuse is an integral part of the rocket and arms automatically. The rocket arming circuit is primarily controlled by the master armament switch and the armament safety switch which is actuated by the arresting hook handle; see paragraph 5-103. When the master armament relay is closed, it permits current to flow from the plus bus in the main junction box to the rocket arming circuit-breaker. From here current flows to the rocket arming switch. If this switch is in the "NOSE AND TAIL ARMING" position, the circuits are completed to the nose arming solenoids, which close and lock the arming wires to the launchers.

WIRE TABLE

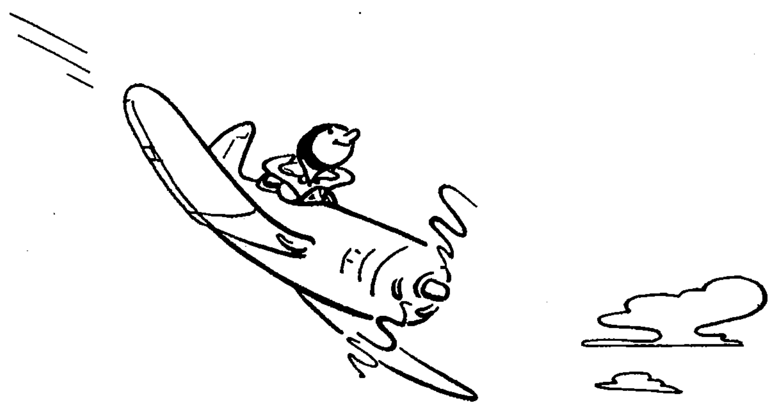
WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
AR15A18	AN18	659-2	860-16-3	659-2	860-16-3	36
AR15B18	AN18	659-2	860-16-3		860-18-3	12
AR15C18	AN18	659-2	860-16-3		860-18-3	66
AR16A18	AN18	659-2	860-16-3		860-18-3	66
AR16B18	AN18	659-2	860-16-3		860-18-3	10½
AR17A18	AN18	659-2	860-16-3		860-18-3	93
AR17B18	AN18	659-2	860-16-3		860-18-3	42
AR18A18	AN18	659-2	860-16-3		860-18-3	41
AR19A18	AN18	659-2	860-16-3		860-18-3	82
AR20A18	AN18	659-2	860-16-3		860-18-3	67
AR21A18	AN18	659-2	860-16-3		860-18-3	77
AR22A18	AN18	659-2	860-16-3		860-18-3	41
AR22B18	AN18		860-16-3		860-18-3	102
AR22C18	AN18	659-2	860-18-3		860-18-3	42
AR23A18	AN18	659-2	860-16-3		860-18-3	39
AR24A18	AN18	659-2	860-16-3		860-18-3	79
AR25A18	AN18	659-2	860-16-3		860-18-3	64
AR26A18	AN18	659-2	860-16-3		860-18-3	75
AR27A18	AN18	659-2	860-16-3		860-18-3	66
AR27B18	AN18	659-2	860-16-3		860-18-3	11
AR28A18	AN18	659-2	860-16-3		860-18-3	42
AR28B18	AN18	659-2	860-16-3		860-18-3	42
AR29A18	AN18	659-2	860-16-3		860-18-3	39
AR30A18	AN18	659-2	860-16-3		860-18-3	81
AR31A18	AN18	659-2	860-16-3		860-18-3	65
AR32A18	AN18	659-2	860-16-3		860-18-3	76
AR33A18	AN18	659-2	860-16-3		860-18-3	40
AR33B18	AN18		860-18-3		860-18-3	102
AR33C18	AN18	659-2	860-16-3		860-18-3	40

WIRE TABLE (Continued)

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
AR34A18	AN18	659-2	860-16-3		860-18-3	36
AR35A18	AN18	659-2	860-16-3		860-18-3	78
AR36A18	AN18	659-2	860-16-3		860-18-3	62
AR37A18	AN18	659-2	860-16-3		860-18-3	72
NA1A18	AN18	659-2	860-16-3	659-2	860-16-3	5½
NA2A18	AN18	659-2	860-16-3	659-2	860-16-3	5
PA2A14	AN14	659-4	860-12-3	659-4	860-14-3	2
PA2B16	AN16	659-4	860-14-3		860-16-3	17
PA3A18	AN18	659-2	860-16-3		860-18-3	19
PA3B18	AN18	659-2	860-16-3		860-18-3	72
PA4A18	AN18	659-2	860-16-3		860-18-3	72
PA4B18	AN18	659-2	860-16-3		860-18-3	12
PA4C18	AN18	659-2	860-16-3	659-2	860-16-3	22
PA5A18	AN18	659-2	860-16-3	659-2	860-16-3	36
PA5B18	AN18	659-2	860-16-3	659-2	860-16-3	60
PA7A16	AN16	659-4	860-14-3	659-4	860-14-3	38
PA7B16	AN16	659-4	860-14-3	659-4	860-14-3	2½

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
2	VS-29105 Chance Vought	Receptacle
3	VS-45838 Chance Vought	Receptacle
5	VS-59909 Chance Vought (made from AN3108-28-12P)	Plug
27	AN3100-28-12S	Receptacle
29	AN3108-28-12P	Plug
34	AN3021-2	Switch
80	NAF1204-1	Relay
95	AN3027-1	Switch
96	AN3216-1	Switch
98	AN3102-18-4S	Receptacle
99	AN3102-24-7S	Receptacle
101	AN3102-28-11S	Receptacle
110	AN3106-24-7P	Plug
111	AN3106-28-11P	Plug
117	AN3160-5	Switch-breaker
120	AN3161-P5	Circuit-breaker
121	AN3161-P10	Circuit-breaker
135	VS-44196 Chance Vought Ward Leonard Co., Type WX	Resistor, 2 ohms, 100 watts



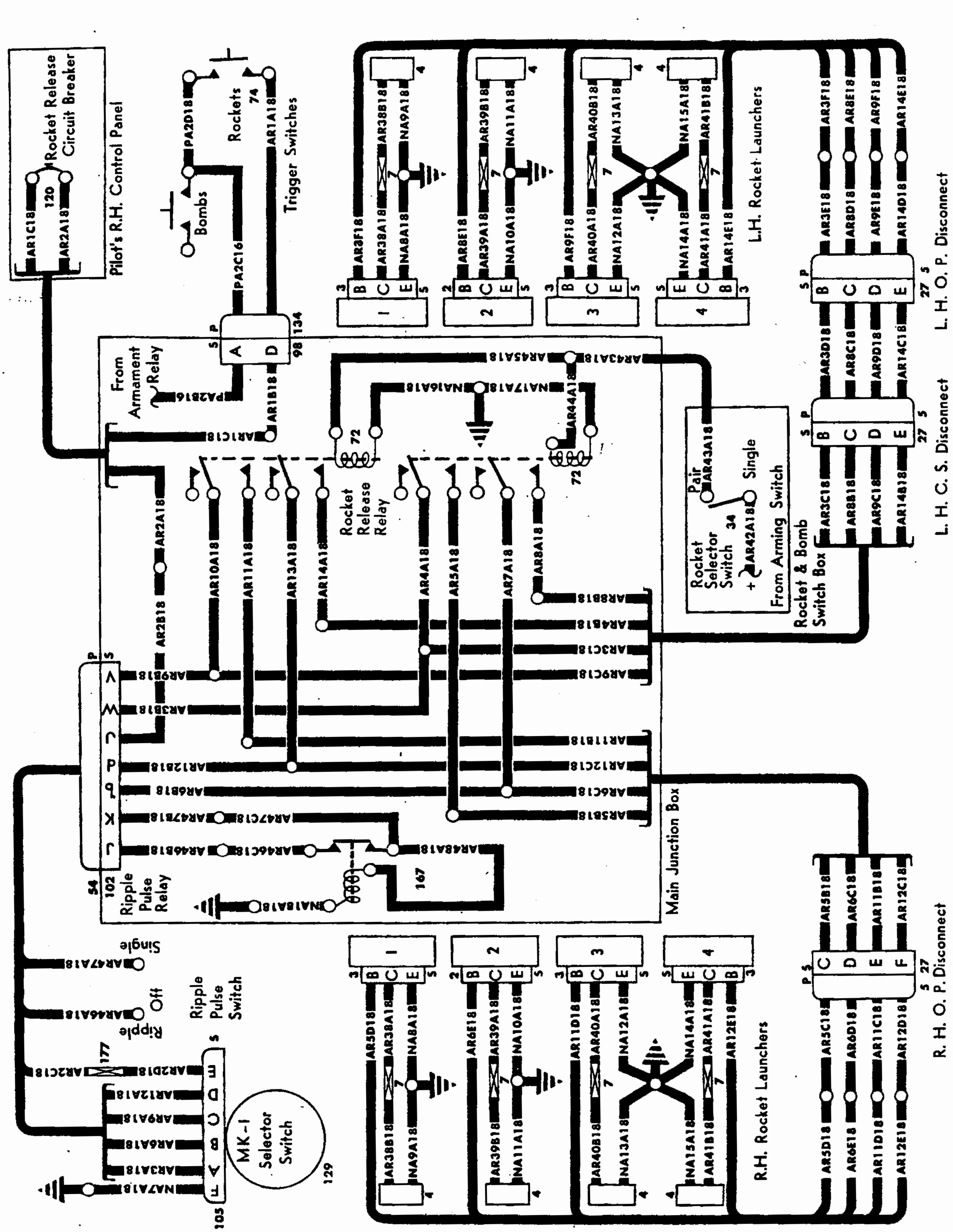


Figure 5–33. (Sheet 1 of 2 Sheets). Armament Circuits—Rocket Launching.

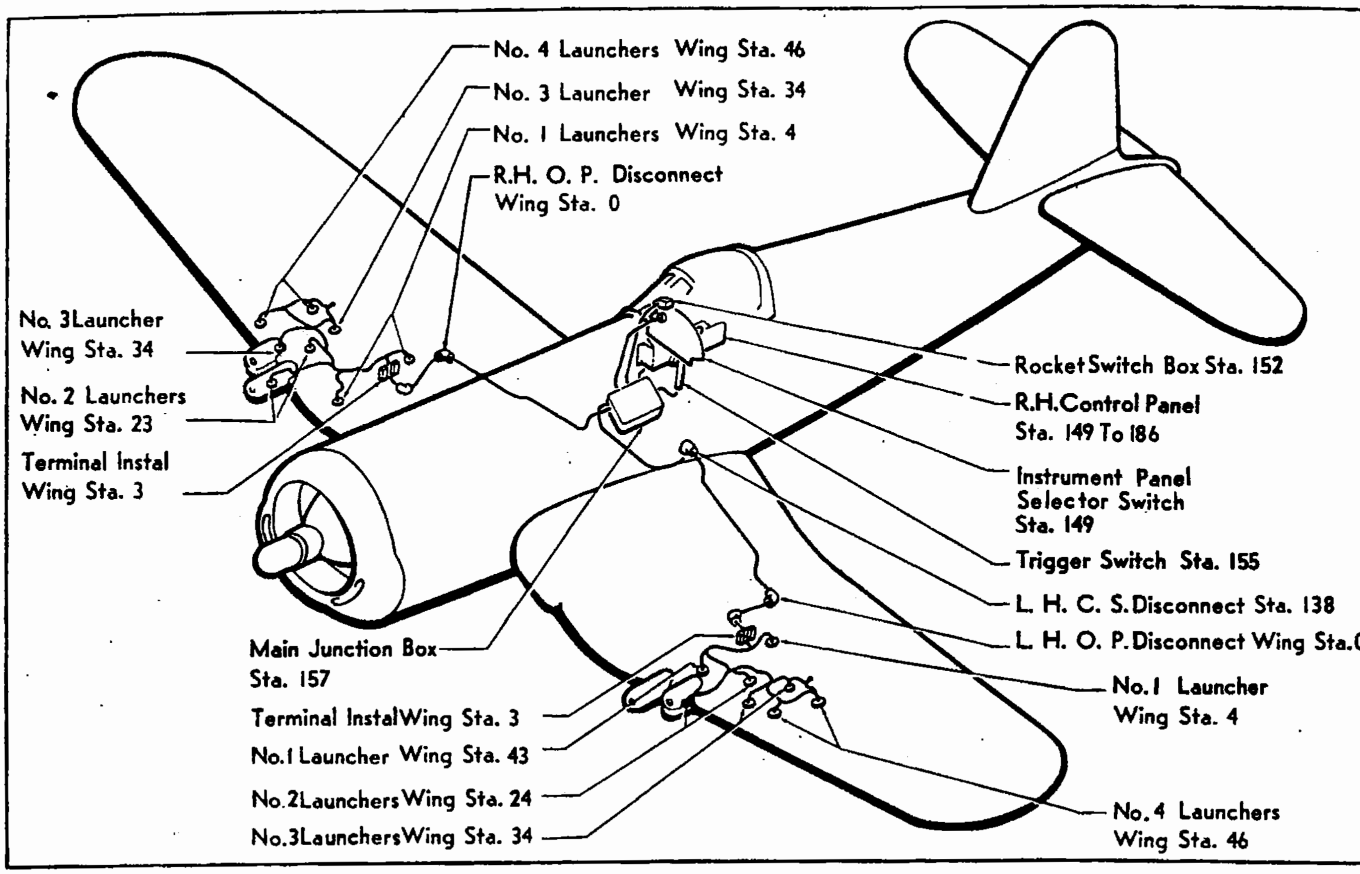


Figure 5—33. (Sheet 2 of 2 Sheets.) Armament Circuits—Rocket Launching.

5—117. ARMAMENT CIRCUITS — ROCKET LAUNCHING.

5—118. DESCRIPTION. *(See figure 5—33.)* The rocket firing circuits permit the rockets to be launched in singles or in pairs (simultaneous firing of one rocket from each outer panel), either at rapid automatically controlled intervals or at pilot-controlled intervals. The rocket firing circuits are controlled by the rocket firing button, the Mk 1 station selector switch, the rocket selection switch, and the "single pulse-ripple pulse" switch. For further information describing the operation of the rocket firing circuits, see paragraphs 4—1706 through 4—1708. Power for the rocket firing circuits is supplied when the master armament relay is closed. From the armament relay, current flows to the rocket firing button, then directly to the "ripple pulse-single pulse" switch. When this switch is in the "SINGLE PULSE" position, current flows directly to the Mk 1 selector switch. When it is in the "RIPPLE PULSE" position, current flows first to the ripple pulse relay, then to the Mk 1 selector switch. The ripple pulse relay intermittently opens and closes the circuit to the selector, permitting it to step from one station to the next in rapid succession while the rocket firing button remains depressed.

Note

Ripple pulse switch is inoperative pending completion of firing test; see diagram.

Four circuits lead from the Mk 1 selector switch to the rocket launchers and rocket firing receptacles. Each circuit supplies current to two launchers (corresponding left hand and right hand launchers). One of the two launchers in each circuit is controlled by the rocket selection switch. When this switch is in the "FOUR SINGLES position, it causes a relay to open and break the circuit to one of the launchers so that only one rocket instead of two will be fired at each station on the Mk 1 selector switch. When the rocket selection switch is in the "PAIRS" position, the relay closes making the circuit complete to two launchers, so that a pair of rockets will be fired at each station on the Mk 1 station selector switch.

WIRE TABLE

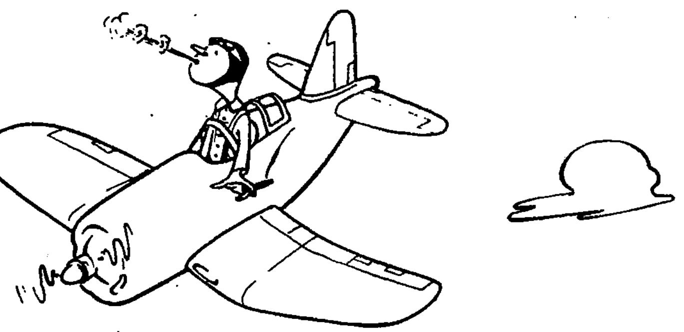
WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
AR1A18	AN18		860-18-3	659-2	860-16-3	54
AR1B18	AN18		860-18-3	659-2	860-16-3	17
AR1C18	AN18	659-2	860-16-3	659-2	860-16-3	40
AR2A18	AN18	659-2	860-16-3	659-2	860-16-3	42
AR2B18	AN18	659-2	860-16-3		860-18-3	9
AR2C18	AN18				860-18-3	20
AR2D18	AN18				860-18-3	8
AR3A18	AN18		860-18-3		860-18-3	52
AR3B18	AN18	659-2	860-16-3		860-18-3	11
AR3C18	AN18	659-2	860-16-3		860-18-3	40
AR3D18	AN18		860-18-3		860-18-3	102
AR3E18	AN18		860-18-3	659-2	860-16-3	41
AR3F18	AN18	659-2	860-16-3		860-18-3	36
AR4A18	AN18			659-2	860-16-3	6
AR5A18	AN18			659-2	860-16-3	9
AR5B18	AN18	659-2	860-16-3		860-18-3	92
AR5C18	AN18		860-18-3	659-2	860-16-3	42
AR5D18	AN18	659-2	860-16-3		860-18-3	38
AR6A18	AN18		860-18-3		860-18-3	52
AR6B18	AN18		860-18-3	659-2	860-16-3	11
AR6C18	AN18	659-2	860-16-3		860-18-3	92
AR6D18	AN18		860-18-3	659-2	860-16-3	40
AR6E18	AN18	659-2	860-16-3		860-18-3	77
AR7A18	AN18			659-2	860-16-3	7
AR8A18	AN18			659-2	860-16-3	10
AR8B18	AN18	659-2	860-16-3		860-18-3	42
AR8C18	AN18		860-18-3		860-18-3	102
AR8D18	AN18		860-18-3	659-2	860-16-3	41
AR8E18	AN18	659-2	860-16-3		860-18-3	76
AR9A18	AN18		860-18-3		860-18-3	52
AR9B18	AN18		860-18-3	659-2	860-16-3	10½
AR9C18	AN18	659-2	860-16-3		860-18-3	41
AR9D18	AN18		860-18-3		860-18-3	102
AR9E18	AN18		860-18-3	659-2	860-16-3	39
AR9F18	AN18	659-2	860-16-3		860-18-3	61
AR10A18	AN18	659-2	860-16-3			10
AR11A18	AN18			659-2	860-16-3	9½
AR11B18	AN18	659-2	860-16-3		860-18-3	91
AR11C18	AN18		860-18-3	659-2	860-16-3	39
AR11D18	AN18	659-2	860-16-3		860-18-3	64
AR12A18	AN18		860-18-3		860-18-3	52
AR12B18	AN18		860-18-3	659-2	860-16-3	12
AR12C18	AN18	659-2	860-16-3		860-18-3	93
AR12D18	AN18		860-18-3	659-2	860-16-3	38

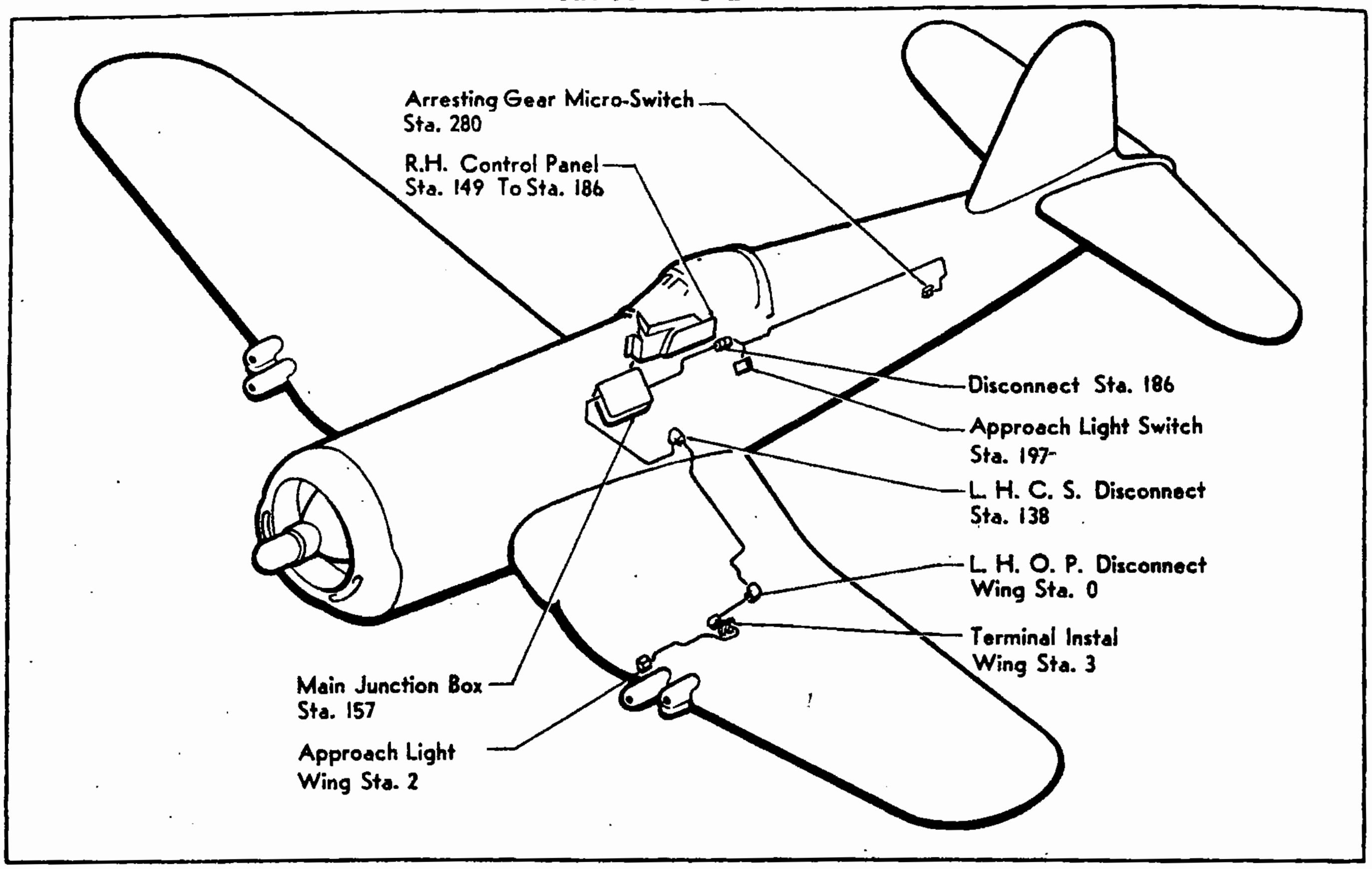
WIRE TABLE (Continued)

WIRE NO.	NAF 1070	END TYPE AN LUG	INS. SL. CVC	END TYPE AN LUG	INS. SL. CVC	LENGTH IN.
AR12E18	AN18	659-2	860-16-3		860-18-3	73
AR13A18	AN18	659-2	860-16-3		860-18-3	8
AR14A18	AN18			659-2	860-16-3	8
AR14B18	AN18	659-2	860-16-3		860-18-3	41
AR14C18	AN18		860-18-3		860-18-3	102
AR14D18	AN18		860-18-3	659-2	860-16-3	38
AR14E18	AN18	659-2	860-16-3		860-18-3	70
AR37A18	AN18	659-2	860-16-3		860-18-3	72
AR38A18(2)	AN18		860-18-3	753-A1		37
AR38B18(2)	AN18	753-A1			860-18-3	11
AR39A18(2)	AN18		860-18-3	753-A1		57
AR39B18(2)	AN18	753-A1			860-18-3	7
AR40A18(2)	AN18		860-18-3	753-A1		69
AR40B18(2)	AN18	753-A1			860-19-3	7
AR41A18(2)	AN18		860-18-3	753-A1		98
AR41B18(2)	AN18	753-A1			860-18-3	4
AR42A18	AN18	659-2	860-16-3	659-2	860-16-3	2
AR43A18	AN18		860-18-3	659-2	860-16-3	66
AR44A18	AN18	659-2	860-16-3			8
AR45A18	AN18	659-2	860-16-3			8
AR46B18	AN18		860-18-3	659-2	860-16-3	20
AR46C18	AN18	659-2	860-16-3			24
AR47B18	AN18		860-16-3	659-2	860-16-3	19
AR47C18	AN18	659-2	860-16-3			19
AR48A18	AN18		860-18-3		860-18-3	2
NA7A18	AN18		860-18-3	659-2	860-16-3	15
NA8A18(2)	AN18	659-2	860-16-3		860-18-3	40
NA9A18(2)	AN18	659-2	860-16-3		860-18-3	12
NA10A18(2)	AN18		860-18-3	659-2	860-16-3	78
NA11A18(2)	AN18	659-2	860-16-3		860-18-3	28
NA12A18(2)	AN18		860-18-3	659-2	860-16-3	68
NA13A18(2)	AN18		860-18-3	659-2	860-16-3	17
NA14A18(2)	AN18		860-18-3	659-2	860-16-3	78
NA15A18(2)	AN18		860-18-3	659-2	860-16-3	7
NA16A18	AN18			659-2	860-16-3	7
NA17A18	AN18			659-2	860-16-3	5
NA18A18	AN18	659-2	860-16-3	659-2	860-18-3	13
PA2B16	AN16	659-4	860-14-3		860-16-3	17
PA2C16	AN16		860-16-3	CVC-880-22	860-14-3	55
PA2D18	AN18	659-2	860-16-3	CVC-880-22	860-14-3	3

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
2	VS-29105 Chance Vought	Receptacle
3	VS-45838 Chance Vought	Receptacle
4	VS-45957 Chance Vought No. 13359 Cannon Electric Development Co	Receptacle
5	VS-59909 Chance Vought (made from AN3108-28-12P)	Plug
7	AN753B1	Coupler
27	AN3100-28-12S	Receptacle
34	AN3121-2	Switch
54	AN3106-28-12P	Plug
72	VS-48746 Chance Vought Phillips Control Co. Spec. 12038-1	Relay
74	VS-58835 Chance Vought Plastic Mfgrs. P1456E	Grip Assem.
98	AN3102-18-4S	Receptacle
102	AN3102-28-12S	Receptacle
105	AN3106-14S-6S	Plug
120	AN3161-P5	Circuit-breaker
129	Mark I (G F E)	Selector Switch
134	AN3106-18-4P	Plug
167	VS-54433 Chance Vought Guardian Elec. Co. No. G-34464-B-9	Relay
177	CVC-878-1	Splice





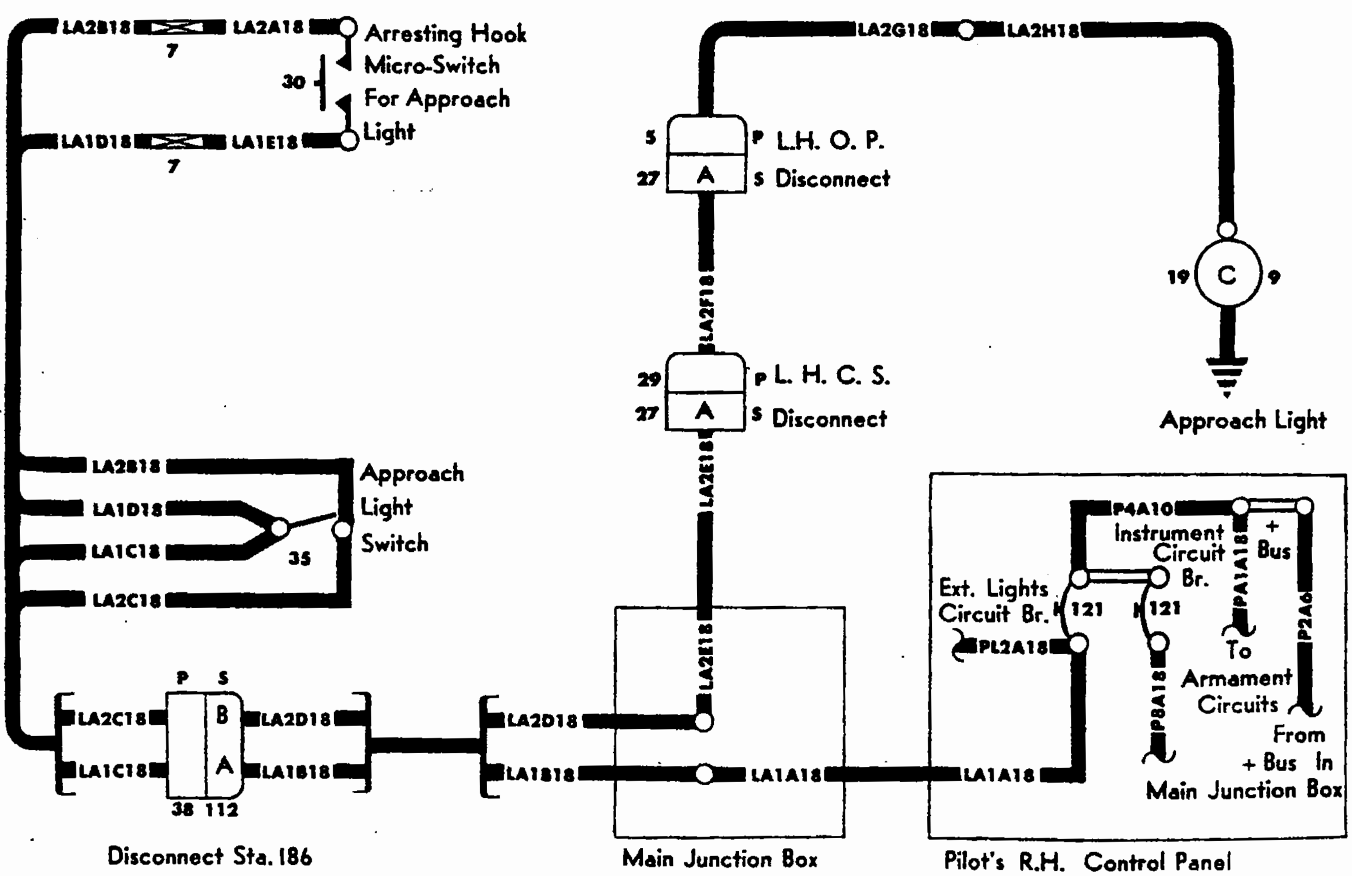


Figure 5–34. Exterior Lights Circuit—Approach Light.

5-119. EXTERIOR LIGHTS CIRCUITS— APPROACH LIGHT.

5-120. DESCRIPTION. (*See figure 5-34.*) The approach light is located on the leading edge of the left outer panel at wing station 2. It obtains power from the exterior lights circuit-breaker and is turned on automatically, or manually by switches in the circuit. A microswitch, located under and actuated by the arresting hook locking strut at station 280, will automatically turn on the approach light when the arresting hook is extended, and shut it off on retraction of the arresting hook. If it is desired to have the approach light on regardless of arresting hook position, the approach light switch at station 197 adjacent to the voltage regulator beneath the radio deck may be turned on before take-off.

Note

The following procedure is used in adjusting the approach light. With the airplane in a three-point attitude, the observer positions himself directly in front of and facing the approach light, at the same time adjusting his distance ahead of the airplane so that he lines up the upper surface of the left stabilizer with the leading edge of the gull section of the wing. Moving his head vertically, the observer sees the AMBER portion of the approach light just as the left stabilizer drops from view below the gull wing upper skin. This indicates a properly adjusted approach light. If the approach light is improperly adjusted, the beam angle may be changed by turning a screwdriver adjustment under the light which is accessible through a hole in the bottom wing surface.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
LA1A18	AN18	659-2	860-16-3	659-2	860-16-3	43
LA1B18	AN18	659-2	860-16-3		860-18-3	49
LA1C18	AN18		860-18-3	659-2	860-16-3	20
LA1D18	AN18	659-2	860-16-3	753-A1		156
LA1E18	AN18	753-A1		CVC-880-22	860-16-3	18
LA2A18	AN18	CVC-880-22	860-16-3	753-A1		18
LA2B18	AN18	753-A1		659-2	860-16-3	154
LA2C18	AN18	659-2	860-16-3		860-18-3	20
LA2D18	AN18		860-18-3	659-2	860-16-3	46
LA2E18	AN18	659-2	860-16-3		860-18-3	50
LA2F18	AN18		860-18-3		860-18-3	110
LA2G18	AN18		860-18-3	659-2	860-16-3	41
LA2H18	AN18			659-2	860-16-3	61

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
5	VS-59909 Chance Vought (made from AN3108-28-12P)	Plug
7	AN753B1	Coupler
9	NAF1024-2	Approach Light
19	AN3124-307	Lamp
27	AN3100-28-12S	Receptacle
29	AN3108-28-12P	Plug
30	VS-3974-2 Chance Vought Microswitch Corp. Type YZ-R31	Microswitch
35	AN3022-2	Switch
38	AN3100-28-12P	Receptacle
112	AN3106-28-12S	Plug
121	AN3161P-10	Circuit-breaker

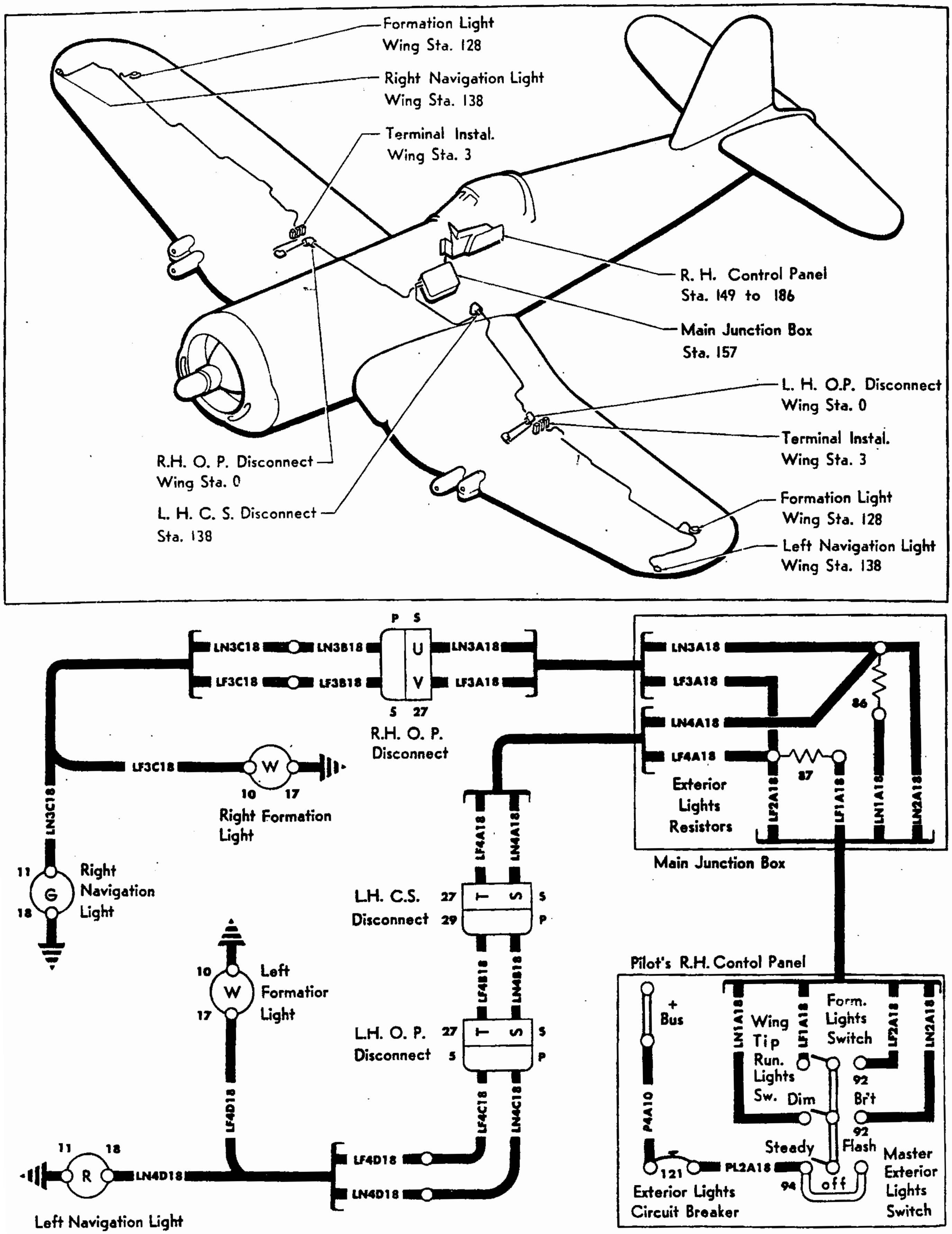


Figure 5-35. Exterior Lights Circuits—Navigation and Formation Lights.

5-121. EXTERIOR LIGHTS CIRCUITS — NAVIGATION AND FORMATION LIGHTS.

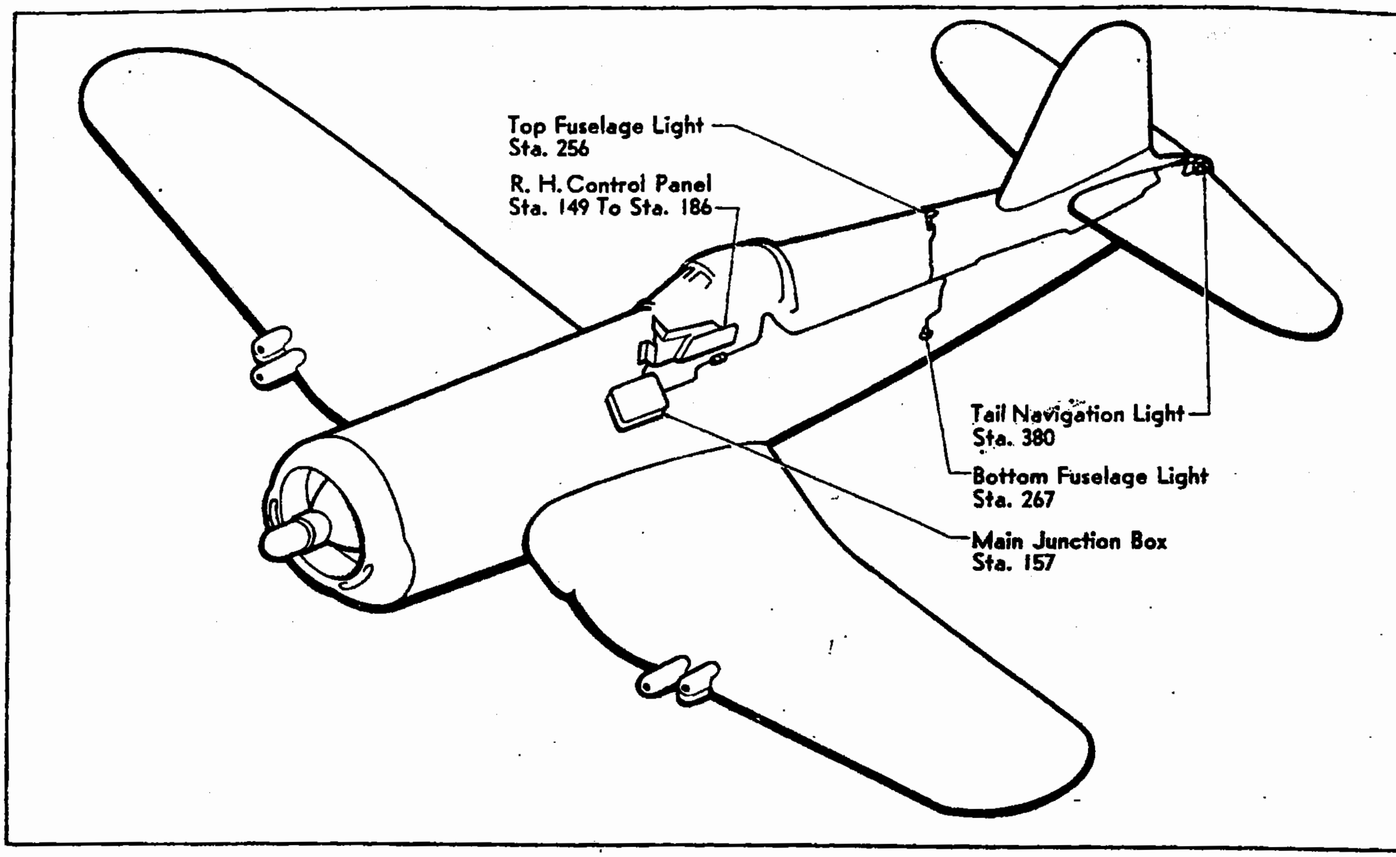
5-122. DESCRIPTION. (*See figure 5-35.*) The right navigation light (green), the left navigation light (red), and the two formation lights (white) are controlled by switches on the pilot's right hand control panel and derive power from the exterior lights circuit-breaker. The exterior lights switch turns on both formation and navigation lights and has three positions: "STEADY," "FLASH," and "OFF." In the "STEADY" position, the lights burn constantly, while in the "FLASH" position, the lights go on and off momentarily, each time the switch is thrown. Two-position "DIM" and "BRIGHT" switches for both the navigation and formation lights allow the pilot to control the brilliance of these lights. This brilliance control is accomplished by fixed resistors which are in the circuits when the brilliance control switches are in the "DIM" position. Refer to paragraph 5-123 for information on tail navigation light and on section lights.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
LF1A18	AN18	659-2	860-16-3	659-2	860-16-3	38½
LF2A18	AN18	659-2	860-16-3	659-2	860-16-3	45
LF3A18	AN18	659-2	860-16-3		860-18-3	96
LF3B18	AN18		860-18-3	659-2	860-16-3	62
LF3C18	AN18			659-2	860-16-3	150
LF4A18	AN18	659-2	860-16-3		860-18-3	48
LF4B18	AN18		860-18-3		860-18-3	102
LF4C18	AN18		860-18-3	659-2	860-16-3	59
LF4D18	AN18			659-2	860-16-3	150
LN1A18	AN18	659-2	860-16-3	659-2	860-16-3	37½
LN2A18	AN18	659-2	860-16-3	659-2	860-16-3	46½
LN3A18	AN18	659-2	860-16-3		860-18-3	98
LN3B18	AN18		860-18-3	659-2	860-16-3	61
LN3C18	AN18			659-2	860-16-3	195
LN4A18	AN18	659-2	860-16-3		860-18-3	48
LN4B18	AN18		860-18-3		860-18-3	102
LN4C18	AN18		860-18-3	659-2	860-16-3	57
LN4D18	AN18			659-2	860-16-3	200
P4A10	AN10	659-5	860-10-3	659-5	860-10-3	12
PL2A18	AN18	659-2	860-16-3	659-2	860-16-3	18

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
5	VS-59909 Chance Vought (made from AN3108-28-12P)	Plug
10	AN3030-9	Formation Light
11	AN3032-5	Wing Position Light
17	AN3121-313	Lamp
18	AN3122-1524	Lamp
27	AN3100-28-12S	Receptacle
29	AN3108-28-12P	Plug
86	RW15F160	Resistor—16 ohm
87	RW15F800	Resistor—85 ohm
92	AN3022-1	Switch
94	AN3022-6	Switch
121	AN3161-P10	Circuit-breaker



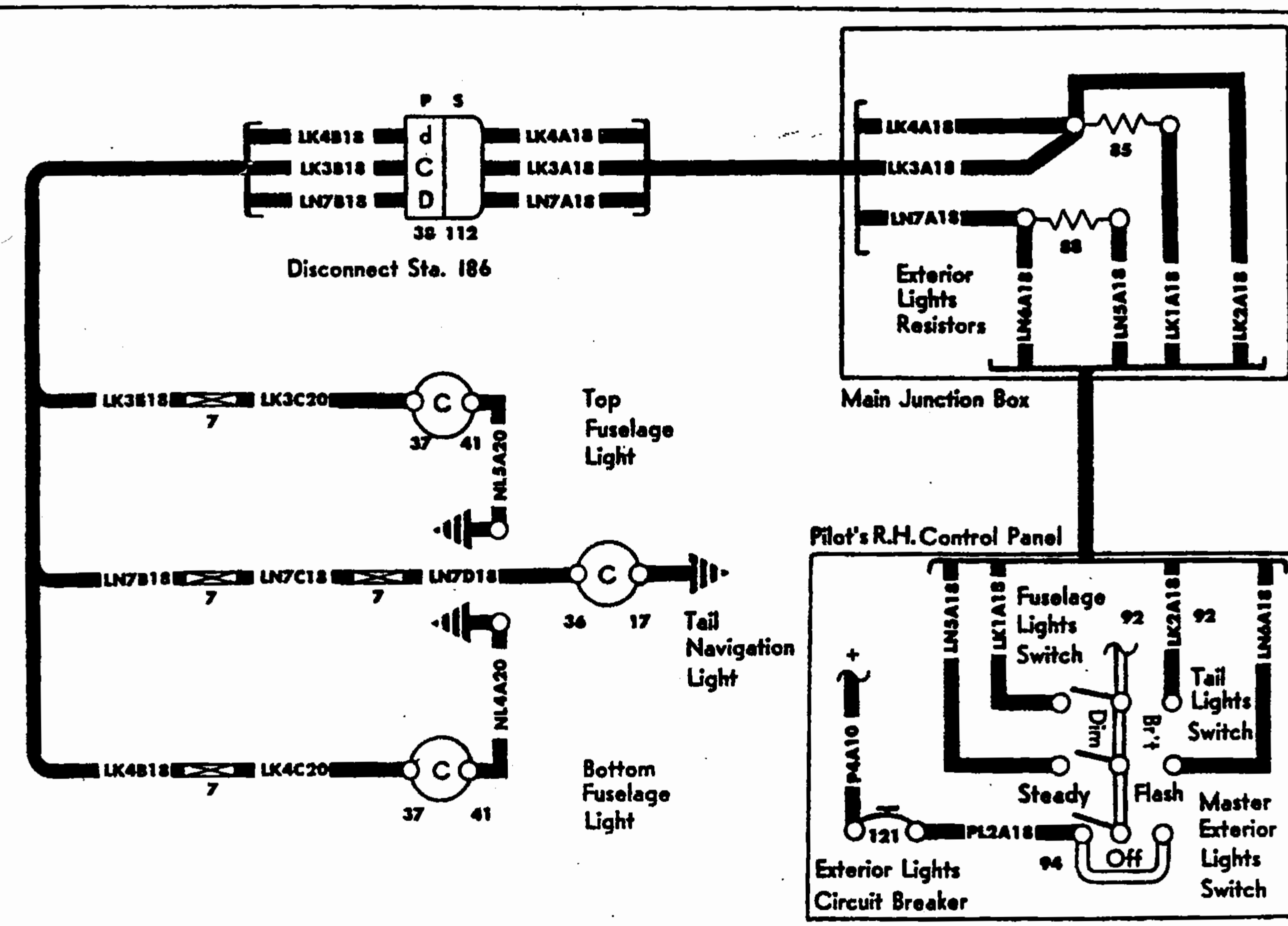


Figure 5–36. Exterior Lights Circuits—Tail and Section Lights.

5–123. EXTERIOR LIGHTS CIRCUITS – TAIL AND SECTION LIGHTS.

5–124. DESCRIPTION. *(See figure 5–36.)* The tail navigation light and both the top and bottom fuselage lights are controlled by switches on the pilot's right hand control panel and derive power from the exterior lights circuit-breaker. The exterior lights switch turns on both the navigation and fuselage lights and has three positions: "STEADY," "FLASH," and "OFF." In the "STEADY" position, the lights burn constantly. The "FLASH" position of the switch is momentary on position; the switch must be thrown for each flash. Two-position "DIM" and "BRIGHT" switches for both the navigation and fuselage lights, allow the pilot to control the brilliance of these lights. The brilliance control is accomplished by fixed resistors which are in the circuits when the brilliance control switches are in the "DIM" position. Refer to paragraph 5–121 for information on right and left navigation lights and on formation lights.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
LK1A18	AN18	659-2	860-16-3	659-2	860-16-3	42
LK2A18	AN18	659-2	860-16-3	659-2	860-16-3	49
LK3A18	AN18	659-2	860-16-3		860-18-3	50
LK3B18	AN18			753-A1		72
*LK3C20	AN20	753-A1				50
LK4A18	AN18	659-2	860-16-3		860-18-3	50
LK4B18	AN18		860-18-3	753-A1		72
*LK4C20	AN20	753-A1				67
LN5A18	AN18	659-2	860-16-3	659-2	860-16-3	37½
LN6A18	AN18	659-2	860-16-3	659-2	860-16-3	45
LN7A18	AN18	659-2	860-16-3		860-18-3	48
LN7B18	AN18		860-18-3	753-A1		163
LN7C18	AN18	753-A1				124
LN7D18	AN18	753-A1				20
*NL4A20	AN20	659-2	860-16-3	659-2	860-16-3	67
*NL5A20	AN20	659-2	860-16-3	659-2	860-16-3	50
P4A10	AN10	659-5	860-10-3	659-5	860-10-3	12
PL2A18	AN18	659-2	860-16-3	659-2	860-16-3	18

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
7	AN753B1	Coupler
17	AN3121-313	Lamp
36	AN3092-3	Tail Position Light
37	AN3097-3	Fuselage Light
38	AN3100-28-12P	Receptacle
41	AN3120-1047	Lamp
85	RW15F6R3	Resistor—6.3 ohm
88	RW15F161	Resistor—160 ohm
92	AN3022-1	Switch
94	AN3022-6	Switch
112	AN3106-28-12S	Plug
121	AN3161-P10	Circuit-breaker

* Wires LK3C20, NL5A20 and LK4C20, NL4A20 are two No. 20 twisted wires and may be purchased from the Electric Auto-Lite Company.

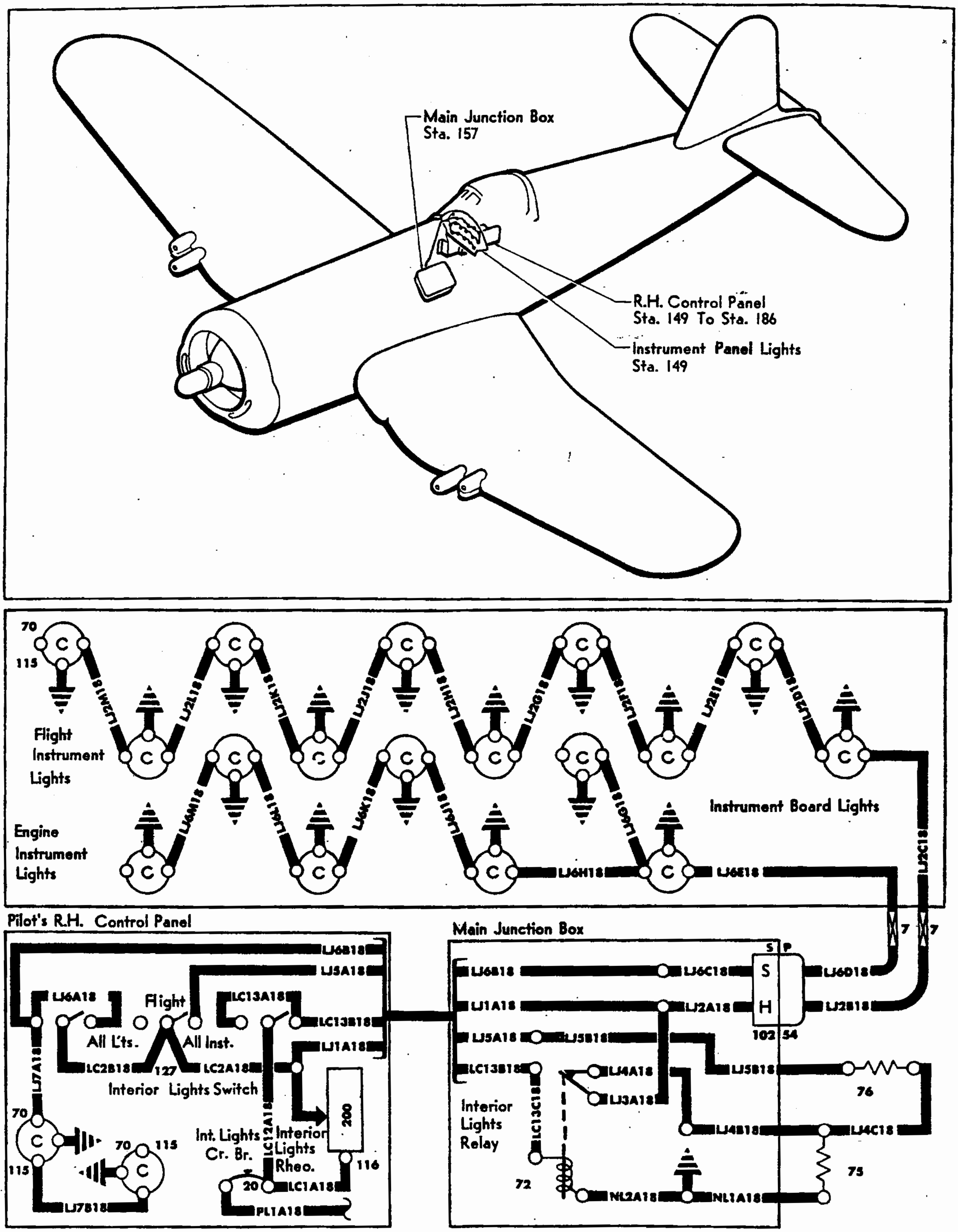


Figure 5–37. Interior Lights Circuits—Instrument Panel Lights.

5-125. INTERIOR LIGHTS CIRCUITS — INSTRUMENT PANEL LIGHTS.

5-126. DESCRIPTION. (*See figure 5-37.*) The instrument panel lights consist of those which illuminate the flight instruments, engine instruments and the voltammeter. These lights are controlled by the interior lights rheostat and a triple-pole, double-throw interior lights switch. When this switch is in the "FLIGHT" position, the flight instruments may be illuminated by the use of the interior lights rheostat which is located on the pilot's right hand control panel. The "FLIGHT" switch position causes the interior lights relay to be de-energized and a dimming resistor keeps the lights at the proper intensity. When the switch is in the "ALL LIGHTS" position, the interior lights relay is energized, one dropping resistor is in the circuit, and all interior lights are on. When the switch is thrown to the "ALL INSTRUMENTS" position, the interior lights relay remains energized, two dropping resistors are in the circuit, and both the flight and engine instruments are illuminated and controllable by the interior lights rheostat.

WIRE TABLE

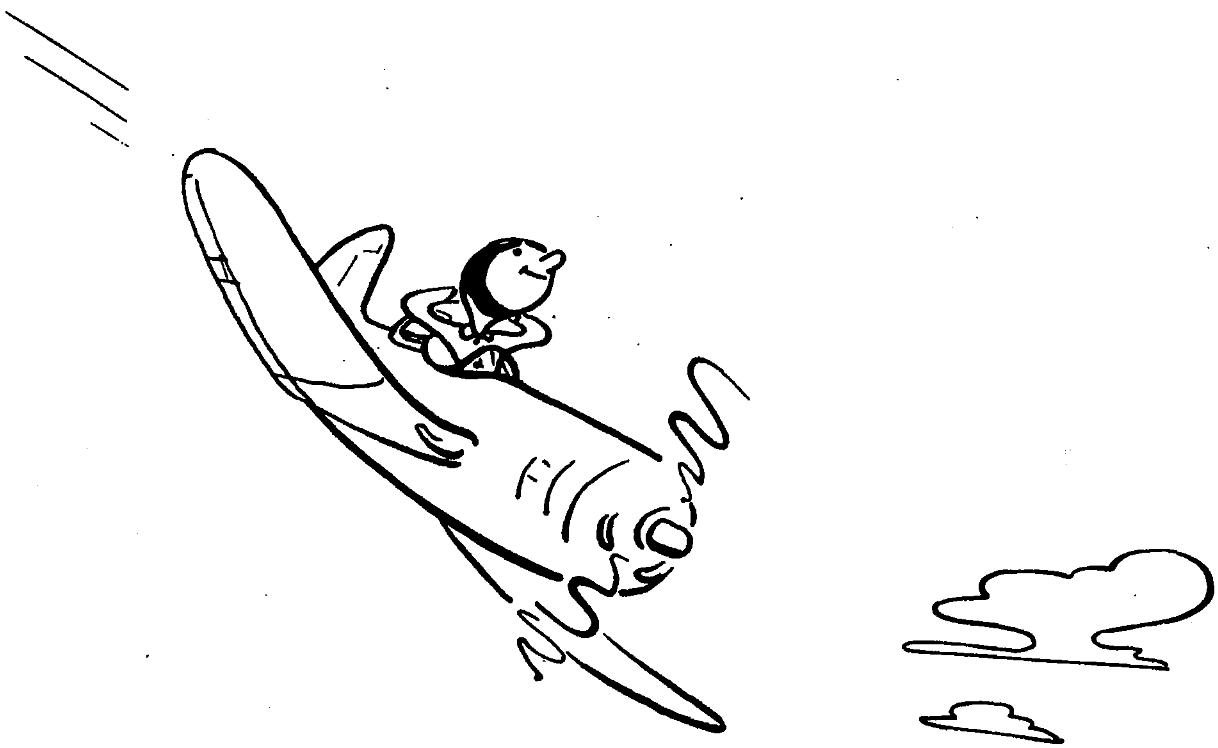
WIRE NO.	NAF 1070	END TYPE		END TYPE		LENGTH IN.
		AN LUG	INS. SL. CVC	AN LUG	INS. SL. CVC	
LC1A18	AN18	659-2	860-16-3	659-2	860-16-3	4½
LC2A18	AN18	659-2	860-16-3	659-2	860-16-3	4
LC2B18	AN18	659-2	860-16-3	659-2	860-16-3	4
LC12A18	AN18	659-2	860-16-3	659-2	860-16-3	3
LC13A18	AN18	659-2	860-16-3	659-2	860-16-3	2
LC13B18	AN18	659-2	860-16-3	659-2	860-16-3	47
LC13C18	AN18	659-2	860-16-3			10
LJ1A18	AN18	659-2	860-16-3	659-2	860-16-3	48
LJ2A18	AN18	659-2	860-16-3		860-18-3	11
LJ2B18	AN18		860-18-3	753-A1		42
LJ2C18	AN18	753-A1				11
LJ2D18	AN18					4
LJ2E18	AN18					4
LJ2F18	AN18					4
LJ2G18	AN18					4
LJ2H18	AN18					6
LJ2J18	AN18					4
LJ2K18	AN18					4
LJ2L18	AN18					4
LJ2M18	AN18					4
LJ3A18	AN18	659-2	860-16-3			11
LJ4A18	AN18			659-2	860-16-3	12
LJ4B18	AN18	659-2	860-16-3			19
LJ4C18	AN18					2
LJ5A18	AN18	659-2	860-16-3	659-2	860-16-3	46
LJ5B18	AN18	659-2	860-16-3		860-18-3	18
LJ6A18	AN18	659-2	860-16-3	659-2	860-16-3	2
LJ6B18	AN18	659-2	860-16-3	659-2	860-16-3	46
LJ6C18	AN18	659-2	860-16-3		860-18-3	10
LJ6D18	AN18		860-18-3	753-A1		42
LJ6E18	AN18			753-A1		7
LJ6G18	AN18					7
LJ6H18	AN18					5

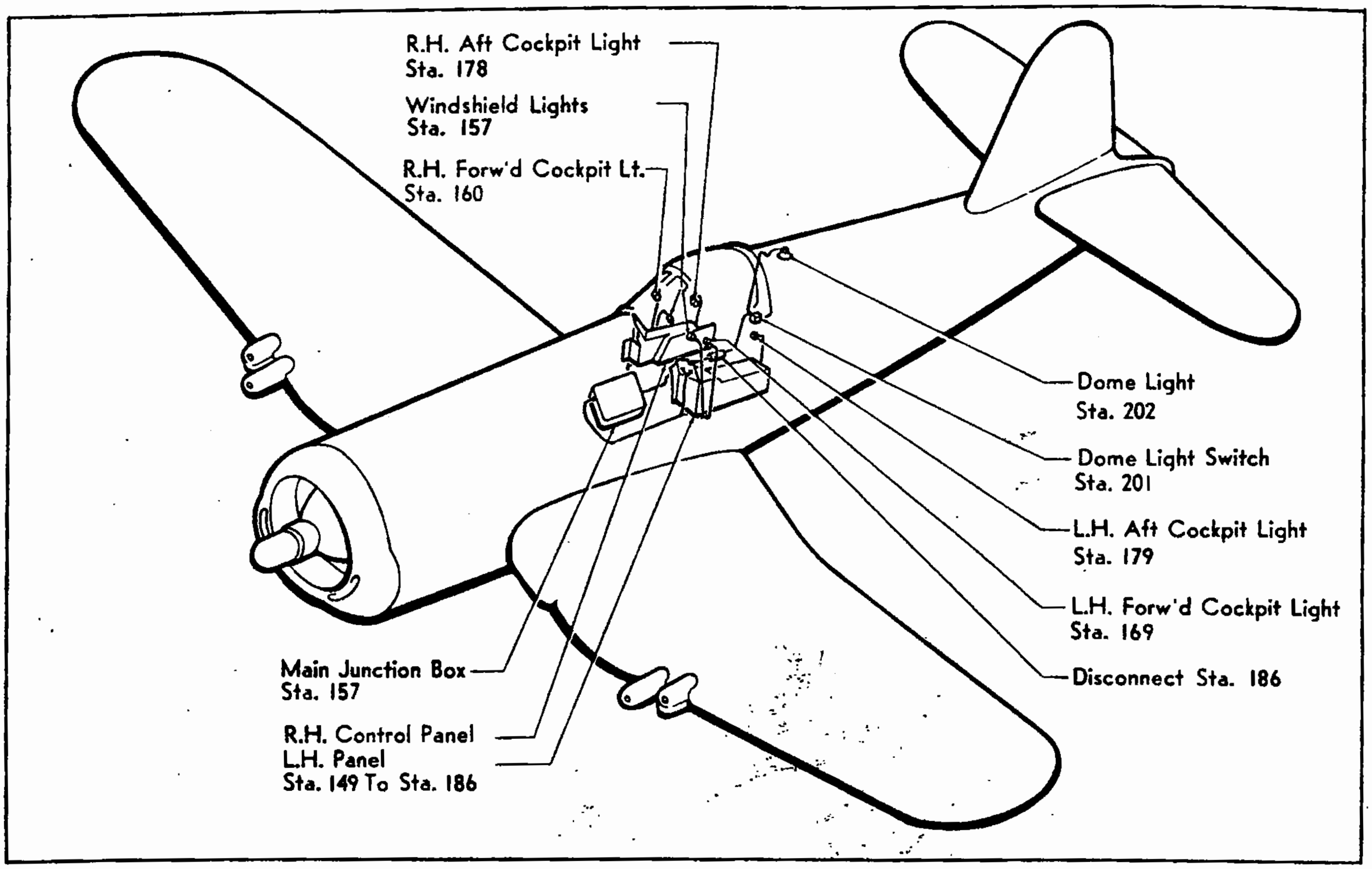
WIRE TABLE (Continued)

WIRE NO.	NAF 1070	END TYPE AN LUG	INS. SL. CVC	END TYPE AN LUG	INS. SL. CVC	LENGTH IN.
LJ6J18	AN18					4
LJ6K18	AN18					3
LJ6L18	AN18					4
LJ6M18	AN18					4
LJ7A18	AN18			659-2	860-16-3	13
LJ7B18	AN18					1½
NL1A18	AN18			659-2	860-16-3	12
NL2A18	AN18			659-2	860-16-3	4
PL1A18	AN18	659-2	860-16-3	659-2	860-16-3	14

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
7	AN753B1	Coupler
54	AN3106-28-12P	Plug
70	VS-44423 Chance Vought A-2870 Grimes Mfg Co.	Light Assembly Instruments
72	VS-48746 Chance Vought Spec. 12038-1 Phillips Control Co.	Relay
75	VS-59882-1 Chance Vought RW22G160 Ward Leonard Co.	Resistor, 16 ohm
76	VS-59882-3 Chance Vought RW22G8R0 Ward Leonard Co.	Resistor, 8 ohm
102	AN3102-28-12S	Receptacle
115	AN3140-327	Lamp
116	AN3155-50-200	Rheostat
120	AN3161-P5	Circuit-breaker
127	AN3226-1	Switch





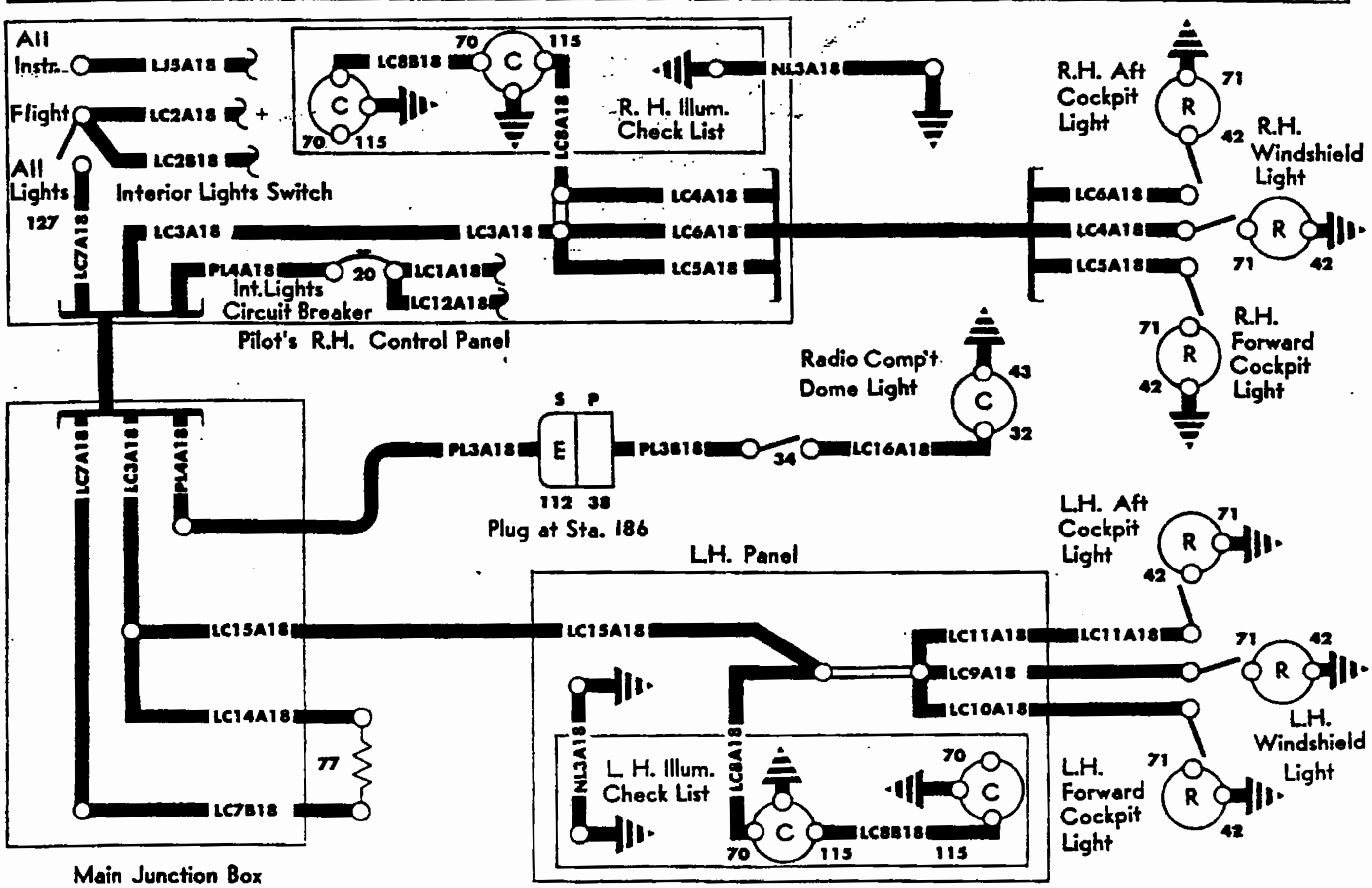


Figure 5–38. Interior Lights Circuits—Cockpit Lights and Radio Compartment Dome Light.

5—127. INTERIOR LIGHTS CIRCUITS — COCKPIT LIGHTS AND RADIO COMPARTMENT DOME LIGHT.

5—128. DESCRIPTION. *(See figure 5—38.)* The radio compartment dome light is wired through a two-position switch to the interior lights circuit breaker.

Note

On some airplanes prior to 121889 the dome light will get power from the plus bus bar. On 121889 and subsequent this light is protected with a circuit breaker.

This switch is located adjacent to the radio compartment access door; it must be manually turned "ON," and is automatically turned "OFF" by closing the door. Both the right and left check list lights, located on their respective control panels will be on when the interior lights switch is in the "ON" position. The four lights which illuminate the cockpit, and the two which illuminate the windshield have individual switches and the interior lights switch acts as a master switch for these lights. A dimming resistor located on the main junction box dims all of the lights enough to eliminate glare. The interior lights rheostat controls the brilliance of all lights except the radio compartment dome light.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
LC3A18	AN18	659-2	860-16-3	659-2	860-16-3	41
LC4A18	AN18			659-2	860-16-3	36
LC5A18	AN18			659-2	860-16-3	40
LC6A18	AN18			659-2	860-16-3	56
LC7A18	AN18	659-2	860-16-3	659-2	860-16-3	48
LC7B18	AN18	659-2	860-16-3	659-2	860-16-3	21
LC8A18	AN18	659-2	860-16-3		860-18-3	36
LC8B18	AN18					1½
LC9A18	AN18			659-2	860-16-3	54
LC10A18	AN18			659-2	860-16-3	29
LC11A18	AN18			659-2	860-16-3	42
LC14A18	AN18			659-2	860-16-3	24
LC15A18	AN18	659-2	860-16-3	659-2	860-16-3	130
LC16A18	AN18			659-2	860-16-3	59
NL3A18	AN18	659-2	860-16-3	659-2	860-16-3	20
PL3A18	AN18	659-2	860-16-3		860-18-3	40
PL3B18	AN18		860-18-3	659-2	860-16-3	26
PL4A18	AN18	659-2	860-16-3	659-2	860-16-3	45

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
32	Grimes Mfg. Co. B1775 VS-58811 Chance Vought	Dome Light
34	AN3021-2	Switch
38	AN3100-28-12P	Receptacle
42	AN3121-R313	Lamp
43	AN3124-SB307	Lamp
70	Grimes Mfg. Co. A-2870 VS-44423 Chance Vought	Light Assembly—Instruments
71	Grimes Mfg. Co. A-2200 VS-44424 Chance Vought	Light Assembly—Cockpit
77	Ward Leonard Co. RW22G120 VS-59882-4 Chance Vought	Resistor—12 ohms
112	AN3106-28-12S	Plug
115	AN3140-327	Lamp
120	AN3161-P5	Circuit-breaker
127	AN3226-1	Switch

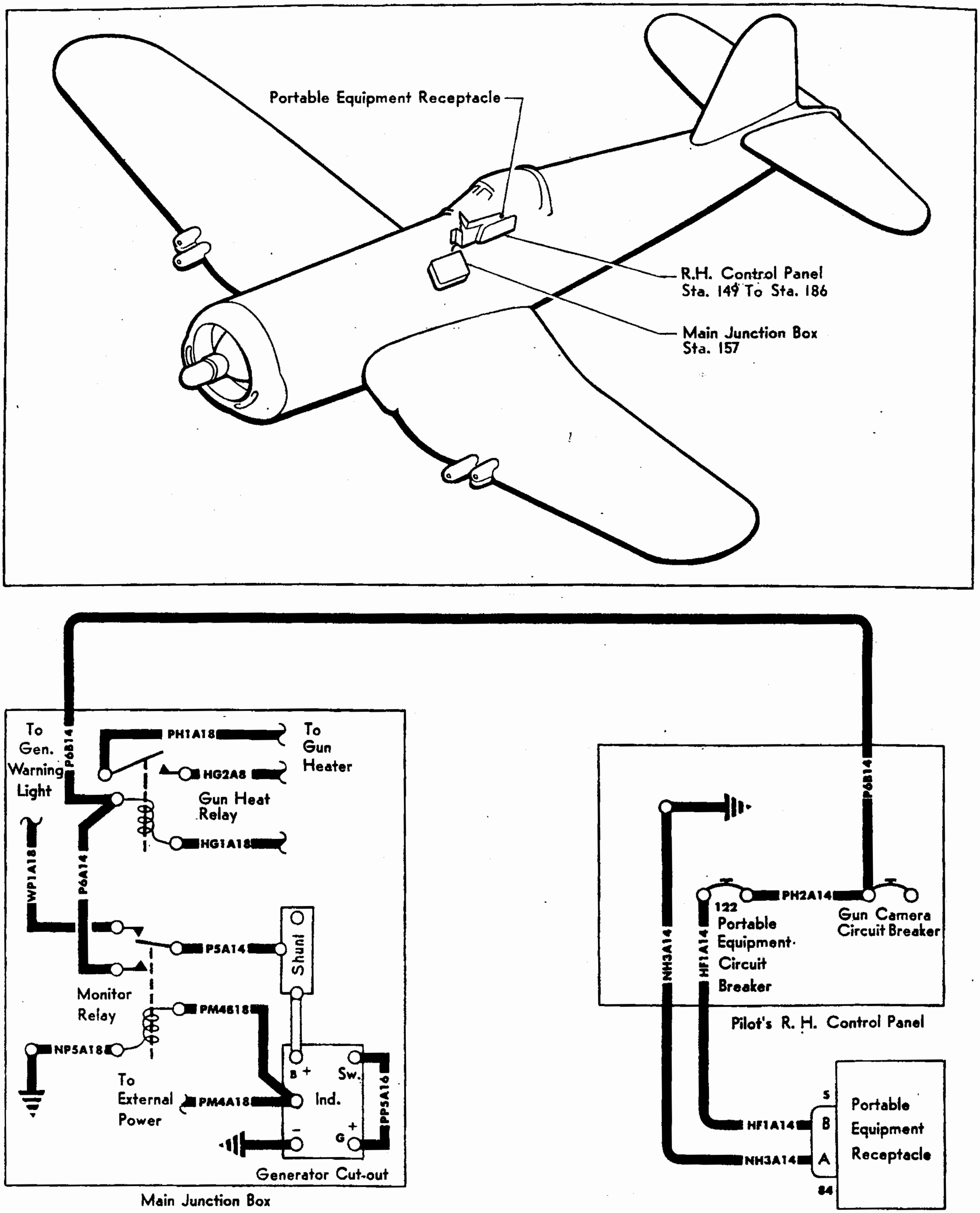


Figure 5–39. Heating Equipment Circuits—Portable Equipment Receptacle.

5-129. HEATING EQUIPMENT CIRCUITS—PORTABLE EQUIPMENT RECEPTACLE.

5-130. DESCRIPTION. (*See figure 5-39.*) The portable equipment receptacle is located aft and inboard of the radio control panel just forward of the pilot's locker. It is used when the pilot is wearing a heated flying suit. Power is taken from a connection on the gun heat relay which connects through the monitor relay to the plus bus. The receptacle is ready for use whenever the airplane generator is supplying power or an external power source is being used.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
HF1A14	AN14		860-14-3	659-4	860-14-3	34
NH3A14	AN14		860-14-3	659-4	860-14-3	25
NP5A18	AN18			659-2	860-16-3	5
P5A14	AN14	659-4	860-14-3			17
P6A14	AN14		860-12-3	659-4	860-14-3	23
P6B14	AN14	659-4	860-14-3	659-4	860-14-3	37½
PH2A14	AN14	659-4	860-14-3	659-4	860-14-3	15
PM4B18	AN18	659-2	860-16-3			18
PP5A16	AN16	659-4	860-14-3	659-4	860-14-3	4

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
84	NAF1077-3	Receptacle
122	AN3161-P15	Circuit-breaker

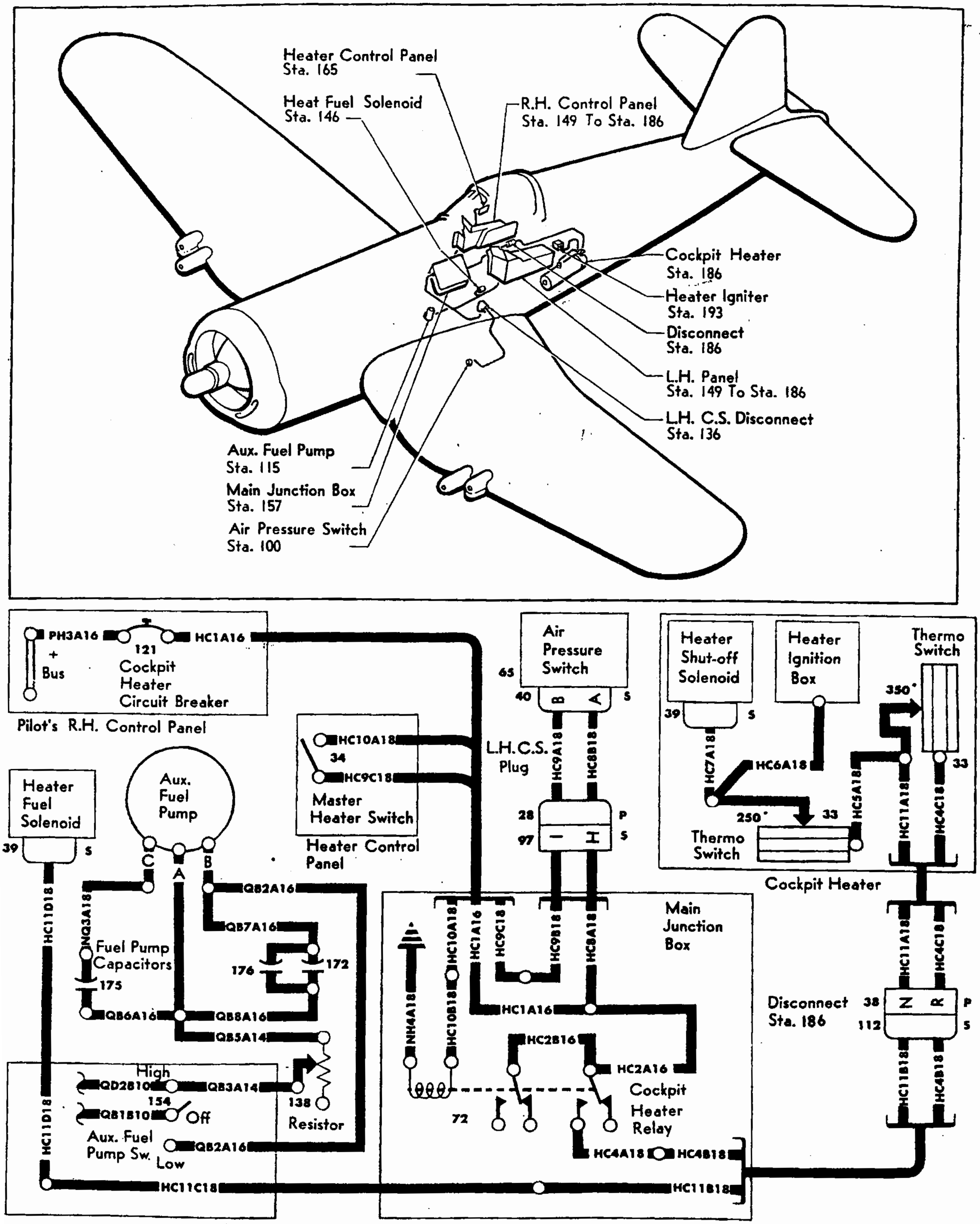


Figure 5–40. Heating Equipment Circuits—Cockpit Heater.

5—131. HEATING EQUIPMENT CIRCUITS — COCKPIT HEATER.

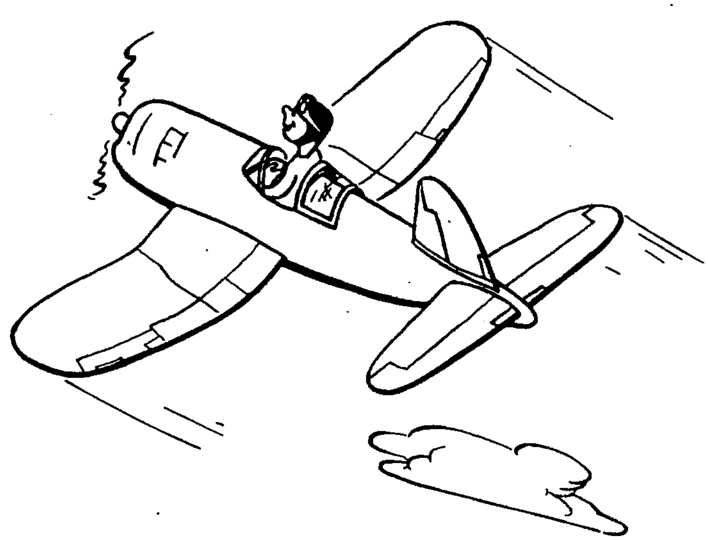
5—132. DESCRIPTION. *(See figure 5—40.)* Power for the cockpit heater comes through the heater circuit-breaker, located on the right hand console to the master heater switch. When the master heater switch is turned "ON," power flows to the air pressure switch, located behind the air intake duct in the right hand center section, and to the cockpit heater relay, located in the main junction box. At air speeds over 120 knots (with master heater switch in "ON" position) the air pressure switch closes, energizing the cockpit heater relay, which in turn energizes heater shut-off solenoid, heater fuel solenoid, the heater ignition box and the heater. For fuel supply to the cockpit heater the auxiliary fuel pump switch should be turned to "LOW." Should heater temperatures rise above 250° F, the 250° F thermal switch shuts off the heater cycling solenoid. If, for any reason, the heater continues to overheat, a second thermal switch becomes operative at 350° and cuts out the heater fuel solenoid, thus shutting off completely the supply of fuel to the heater. Three capacitors in the circuit eliminate radio noise caused by the fuel pump. Two of these are located on the right hand former at station 120½. The third capacitor is mounted on a stiffener on the right hand side just forward of station 120½.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
HC1A16	AN16	659-4	860-14-3	659-4	860-14-3	38
HC2A16	AN16		860-16-3	659-4	860-14-3	10
HC2B16	AN16					1½
HC3A16	AN16			659-4	860-14-3	13
HC3B16	AN16	659-4	860-14-3	659-4	860-14-3	130
HC4A18	AN18			659-2	860-16-3	9½
HC4B18	AN18	659-2	860-16-3		860-18-3	47
HC4C18	AN18	659-2	860-16-3		860-18-3	61
HC5A18	AN18	659-2	860-16-3	659-2	860-16-3	3
HC6A18	AN18	659-2	860-16-3	659-2	860-16-3	34
HC7A18	AN18		860-18-3	659-2	860-16-3	22
HC8A18	AN18	659-2	860-16-3		860-18-3	46
HC8B18	AN18		860-18-3		760-18-3	84
HC9A18	AN18		860-18-3		860-18-3	84
HC9B18	AN18		860-18-3	659-2	860-16-3	48
HC9C18	AN18	659-2	760-16-3	659-2	860-16-3	45
HC10A18	AN18	659-2	860-16-3	659-2	860-16-3	45
HC10B18	AN18	659-2	860-16-3			10
HC11A18	AN18	659-2	860-16-3		860-18-3	56
HC11B18	AN18		860-18-3	659-2	860-16-3	48
HC11C18	AN18	659-2	860-16-3	659-2	860-16-3	130
HC11D18	AN18	659-2	860-16-3		860-18-3	46
NH4A18	AN18	659-2	860-16-3			4
NQ3A16	AN16	659-27	860-14-3		860-16-3	9½
PH3A16	AN16	659-4	860-14-3	659-4	860-14-3	24
QB2A16	AN16			753-A2		130
QB3A14	AN14	659-4	860-12-3	659-4	860-12-3	40
QB5A14	AN14	659-4	860-12-3	753A	860-12-16	93
QB6A16	AN16	659-4	860-14-3		860-16-3	11
QB7A16	AN16	659-4	860-14-3		860-16-3	9½
QB8A16	AN16	659-4	860-14-3		860-16-3	11

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
28	AN3108-24-7P	Plug
33	VS-59194 Chance Vought	Thermo-switch
	Fenwal, Inc. S-1432	
34	AN3021-2	Switch
38	AN3100-28-12P	
39	AN3108-10S-2S	Receptacle
40	AN3108-12S-3S	Plug
65	VS-48616 Chance Vought	Plug
	P-501 Aerotec Co.	Switch Assembly
72	VS-48746 Chance Vought	
	Phillips Control Co. Spec. 12038-1	Relay
97	AN3100-24-7S	
112	AN3106-28-12S	Receptacle
121	AN3161-P10	Plug
138	VS-54411 Chance Vought	Circuit-breaker
	Ward Leonard Elec. Co. Type B Ribflex	Resistor—0.25 ohm, 110 watts
154	AN3021-1	
172	VS-54499-1 Chance Vought	Switch
	Cornell Dubilier MYR 6050	Capacitor
175	VS-54499-4 Chance Vought	
	Cornell Dubilier MYR 6200	Capacitor
176	VS-54498 Chance Vought	
	Cornell Dubilier 1D5D6	Capacitor



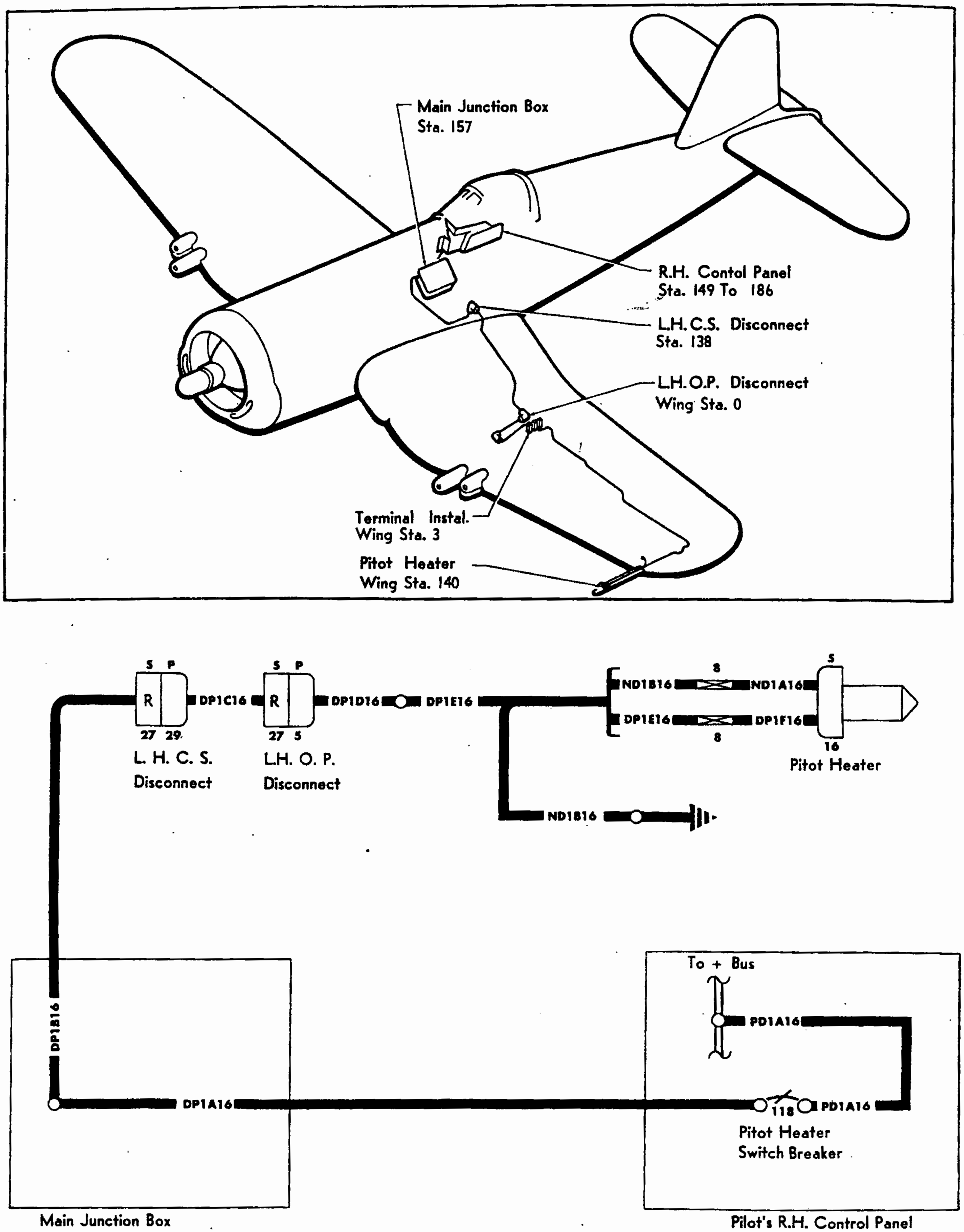


Figure 5—41. Heating Equipment Circuits—Pitot Heater.

5-133. HEATING EQUIPMENT CIRCUITS—PITOT HEATER.

5-134. DESCRIPTION. (*See figure 5-41.*) The pitot tube in the left outer panel requires a heater for proper operation under freezing weather conditions. A small resistance heater mounted within the tube, takes power from the plus bus through the pitot heater switch breaker, on the inclined portion of the right hand control panel. This switch breaker is the "ON-OFF" switch for the pitot heater circuit. Disconnects are provided in the cabling between the center section and outer panel to facilitate outer panel removal.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
DP1A16	AN16	659-4	860-14-3	659-4	860-14-3	49
DP1B16	AN16	659-4	860-14-3		860-16-3	47
DP1C16	AN16		860-16-3		860-16-3	102
DP1D16	AN16		860-16-3	659-4	860-14-3	55
DP1E16	AN16	659-4	860-14-3	753-A2		164
DP1F16	AN16	753-A2			860-16-3	54
ND1A16	AN16		860-16-3	753-A2		54
ND1B16	AN16	753-A2		659-4	860-14-3	160
PD1A16	AN16	659-4	860-14-3	659-4	860-14-3	8½

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
5	VS-59909 Chance Vought (made from AN3108-28-12P)	Plug
8	AN753B2	Coupler
16	AN3115-1	Plug
27	AN3100-28-12S	Receptacle
29	AN3108-28-12P	Plug
118	AN3160-10	Switch-breaker

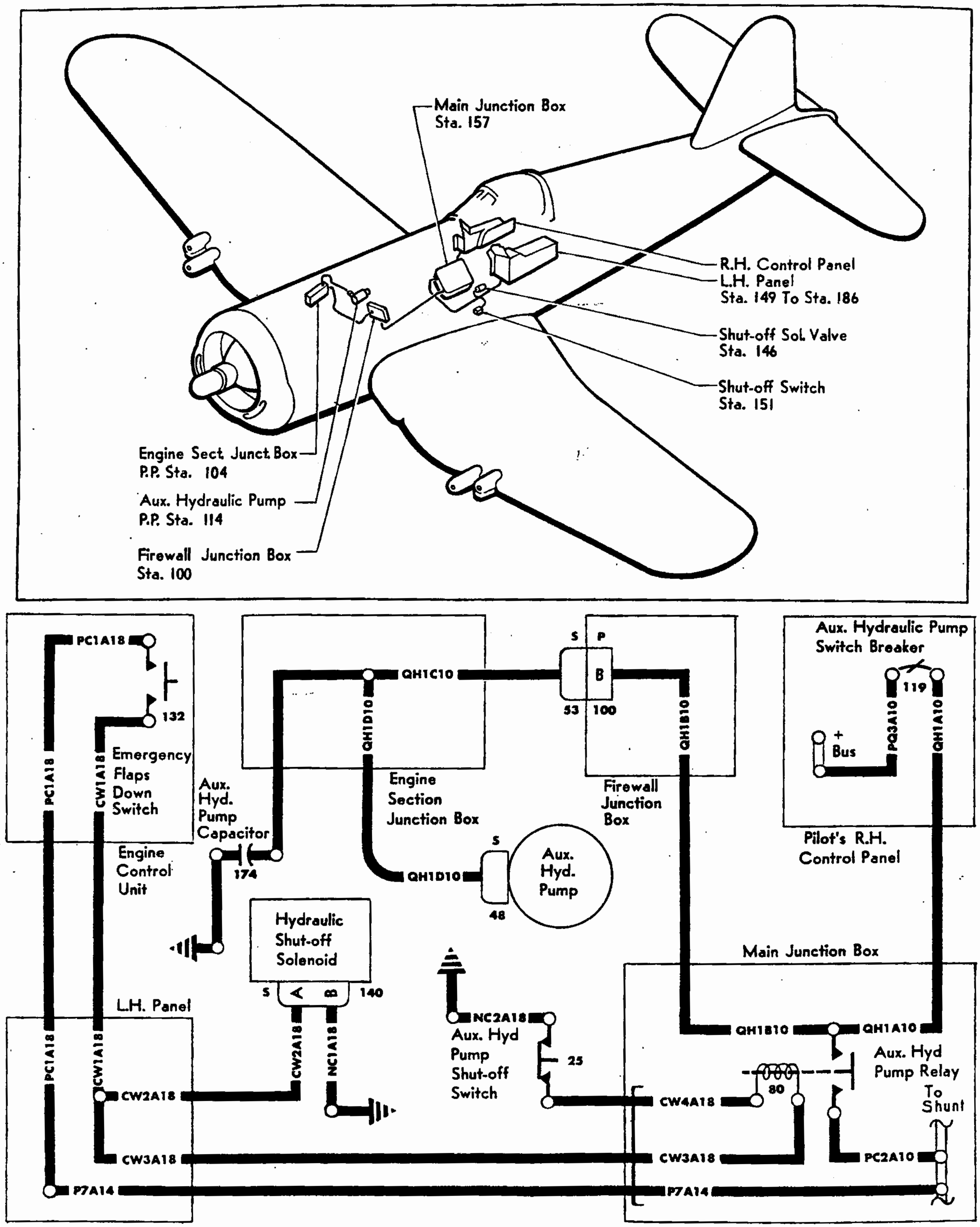


Figure 5–42. Special Equipment Circuits—Auxiliary Hydraulic Pump.

5—135. SPECIAL EQUIPMENT CIRCUITS — AUXILIARY HYDRAULIC PUMP.

5—136. DESCRIPTION. *(See figure 5—42.)* The electric motor which drives the auxiliary hydraulic pump is turned on by either of the two following methods.

a. When the wing flap control lever is placed in the "EMERGENCY DOWN" position, the "emergency flaps down" switch is actuated, closing the circuit to the hydraulic solenoid valve and energizing the auxiliary hydraulic pump relay located in the main junction box. The solenoid, which stops hydraulic flow to all systems except wing flaps, will remain energized as long as the control handle is in the "EMERGENCY DOWN" position. The relay will remain energized until the flaps reach full down position at which time the pump shut-off switch, which is in the relay circuit, is actuated by contact with the follow-up control rod arm. The relay will be deenergized and the pump will shut off.

b. When it is desirable to operate any hydraulic subsystem, the auxiliary hydraulic pump switch breaker on the right hand control panel may be used. This switch breaker supplies current directly to the electric motor regardless of other switch settings. Power for these circuits is taken from the plus bus and a shunt in the main junction box. A capacitor mounted on the cover of the engine section junction box eliminates radio noise caused by the auxiliary hydraulic pump.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
CW1A18	AN18	659-2	860-16-3			18
CW2A18	AN18	659-2	860-16-3		860-18-3	54
CW3A18	AN18	659-2	860-16-3	659-2	860-16-3	130
CW4A18	AN18	659-2	860-16-3	CVC-880-22	860-16-3	111
NC1A18	AN18		860-18-3	659-2	860-16-3	10
NC2A18	AN18	659-2	860-16-3	CVC-880-22	860-16-3	32
NQ5A18	AN18	659-2	860-16-3		860-18-3	14
P7A14	AN14	659-4	860-14-3	659-4	860-14-3	92
PC1A18	AN18	659-2	860-16-3	659-2	860-16-3	18
PC2A10	AN10	CVC-880-3	860-10-3	CVC-880-10	860-10-3	7
PQ3A10	AN10	659-2	860-10-3	659-5	860-10-3	9
QH1A10	AN10	659-5	860-10-3	659-5	860-10-3	40
QH1B10	AN10	659-5	860-10-3		860-10-3	110
QH1C10	AN10		860-10-3	659-5	860-10-3	58
QH1D10	AN10	659-5	860-10-3		860-10-3	43
QH1E18	AN18	659-2	860-16-3		860-18-3	15

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
25	AN3217-1 CR1070-D114C3 General Elec. Co.	Switch Assembly
48	AN3106-12-5S	Plug
53	AN3106-28-10P	Plug
80	NAF1204-1	Relay
100	AN3102-28-10S	Receptacle
119	AN3160-35	Switch-breaker
132	CR1070C103F3 General Elec. Co.	Switchette
140	AN3106-14S-9S	Plug
174	VS-54499-3 Chance Vought Cornell Dubilier MYR-6100	Capacitor

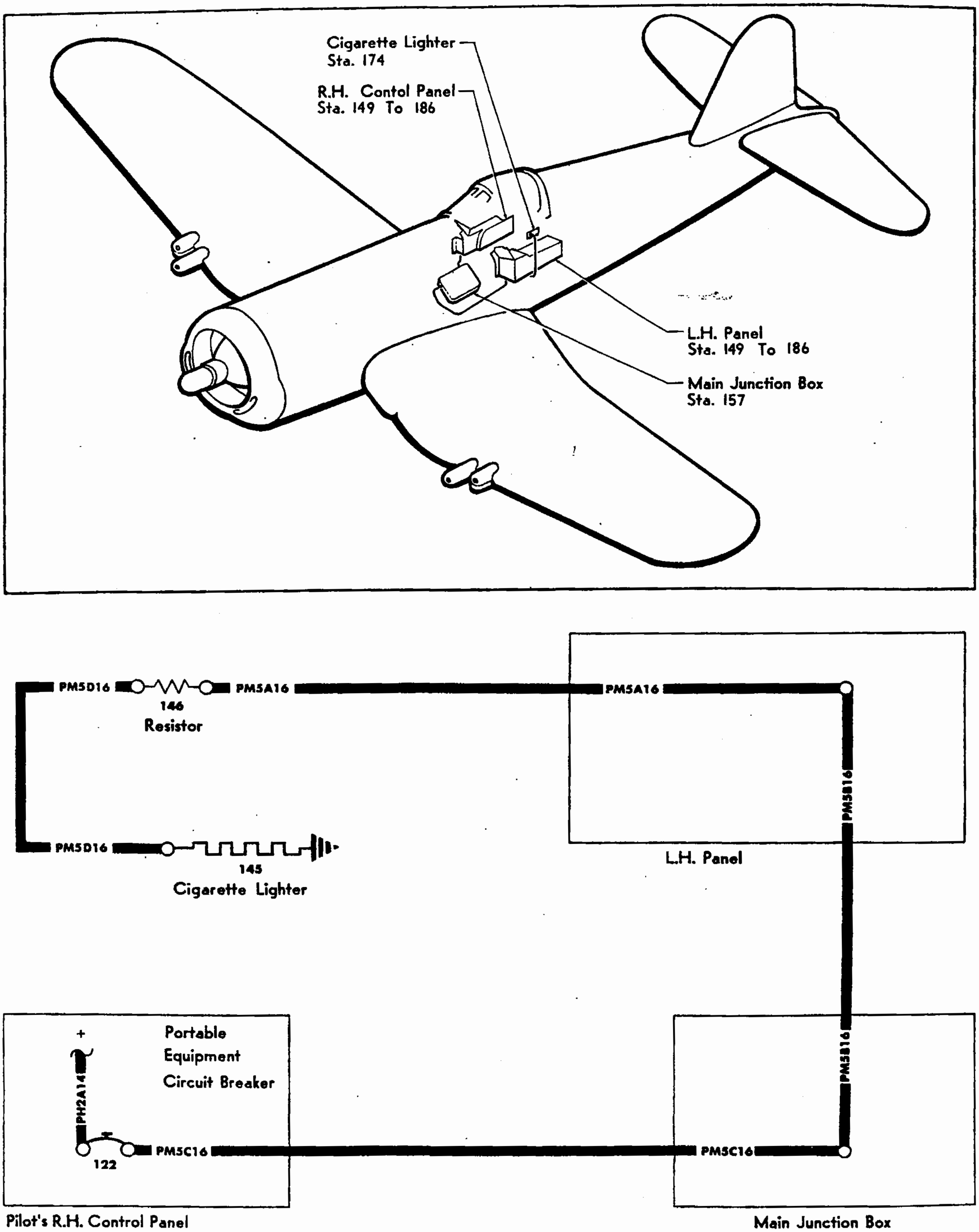


Figure 5–43. Special Equipment Circuits—Cigarette Lighter.

5-137. SPECIAL EQUIPMENT CIRCUITS—CIGARETTE LIGHTER.

5-138. DESCRIPTION. (*See figure 5-43.*) The cigarette lighter is located with an ash tray on the sheathing above the left hand control panel. The removable unit contains the heater element which, when pushed into its socket, will complete the heater circuit, heat to red hot and then snap out, breaking the circuit. When the heater unit snaps out, it is ready for use. The circuit takes power from the plus bus through the portable equipment circuit-breaker and a 1 ohm, 200 watt voltage dropping resistor.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
PH2A14	AN14	659-4	860-14-3	659-4	860-14-3	15
PM5A16	AN16	659-4	860-14-3	659-4	860-14-3	29
PM5B16	AN16	659-4	860-14-3	659-4	860-14-3	91
PM5C16	AN16	659-4	860-14-3	659-4	860-14-3	45
PM5D16	AN16	659-4	860-14-3	659-4	860-14-3	22

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	NOMENCLATURE
122	AN3161-P15	Circuit-breaker
145	VS-53886 Chance Vought E-2363 Casco Products Corp.	Cigarette Lighter
146	VS-53895 Chance Vought 0900-C Ohmite Mfg. Co.	Resistor 1 ohm—200 watts

5—139. ELECTRONIC SYSTEM.

5—140. GENERAL DESCRIPTION. The following radio and radar equipment is installed in the F4U-5 airplane:

a. RT-18/ARC-1 RADIO TRANSMITTER-RECEIVER. This equipment provides radio-telephone communication between aircraft and between aircraft and ground. It operates in a frequency range of 100 to 156 megacycles. Refer to paragraph 5—146 for a complete description of this equipment.

b. R-4A/ARR-2 RADIO RECEIVER. This equipment is used to receive both telegraph and voice signals in the 234 to 258 megacycle range. Refer to paragraph 5—162 for a complete description of this equipment.

c. R-23A/ARC-5 RADIO RECEIVER. This equipment is designed to receive voice, tone modulated, or continuous wave signals between .19 and .55 megacycles. Refer to paragraph 5—180 for a complete description of this equipment.

d. RT-22/APX-1 IFF TRANSPONDOR. The main purpose of this equipment is to identify the aircraft in which it is installed when challenged by appropriately equipped air, ship, or ground forces. It may also be used to transmit a distress-width pulse in the event of an emergency. Refer to paragraph 5—195 for a complete description of this equipment.

e. DY-2A/ARR-2 DYNAMOTORS. These units are installed on both the R-23A/ARC-5 and the R-4A/ARR-2A receivers (one to each receiver). The power output of this type dynamotor is 250 volts at 60 milliamperes.

f. DY-9/ARC-1 DYNAMOTOR. This unit is installed on the RT-18/ARC-1 transmitter-receiver and supplies 300 to 360 volts dc, using a 28 volt source.

g. A CX-922/AR coiled cord and a V-56/AR jack plug are used to connect the pilot's microphone and headset.

Note

For detailed information concerning each equipment, consult the handbook for the equipment or components involved, as listed in the current issue of the Naval Aeronautics Publications Index or Army Air Force Indexes of Technical Publications and Confidential Orders. Wiring information may be found on the cabling diagrams for each unit.

5—141. The electronic equipment is installed on Metalite mounting shelves just aft of bulkhead 186. Bolting or riveting through the Metalite shelves should be carefully done, as noted in paragraphs 4—1886 through 4—1896. The electronic equipment is accessible through the radio compartment access door on the right hand side of the airplane aft of station 186. A wire and free plug extending from the upper right hand section of bulkhead 186 is used to connect the pilot's boom type lip microphone and headsets. The microphone switch is located at the top of the throttle control on the engine control unit. The radio equipment has a cable disconnect at bulkhead 186 which facilitates equipment removal. Current for operating the electronic equipment comes from the 28 volt plus bus to the master panel switch and thence through the radio circuit-breakers to the individual dynamotors which supply high voltage to the electronics equipment. When the airplane battery is used to supply power for the electronics equipment, the battery switch must be turned on. The battery should not be used to operate the electronics equipment for prolonged checking or testing. With the battery switch "OFF," use an external power source which is adjustable to 28 volts.

5—142. RADIO CONTROL PANELS.

5—143. DESCRIPTION. *(See figure 5—44.)* The radio control panels on the right hand electrical and radio control shelf give complete remote control of the electronic system equipment with the exception of microphone operation. The radio console control panels for the communicating equipment are as follows:

a. Master control panel C-127A/ARC contains the master switch for all radio equipment (except the IFF radio equipment) and the volume control for the AN/ARC-1 VHF receiver.

b. VHF panel C-115/ARC-1 contains the channel selector for VHF transmitting and receiving.

c. Navigation panel C-116/ARR-2A controls the homing receiver.

d. Receiver panel C-125/ARC-5 controls the range receiver.

e. IFF panel C-119/APX-1 controls the identification transpondor and contains the power switch for this unit.

5—144. REMOVING. Access to the control panel is gained through the cockpit.

a. Remove the four screws which secure the individual panel to be removed.

b. Raise the panel and disconnect the cable and wiring from the bottom side. Remove panel.

5—145. INSTALLING. The installation of the control panel sections is the reverse of the removal procedure given in paragraph 5—144.

5—146. RT-18/ARC-1 RADIO TRANSMITTER-RECEIVER.

5—147. DESCRIPTION. *(See figure 5—45.)* This radio equipment provides two-way voice communication between aircraft or between aircraft and ground stations on any of nine prearranged main-channel communication frequencies or a guard-channel frequency. Incoming signals are received with the equipment except for those intervals when transmission is desired. The change from the receiving to the transmitting condition is accomplished simply by operating the microphone throttle switch. The main components of this equipment are the receiver-transmitter unit with mounting base, the remote control box, and the connecting cables. The VHF antenna is a mast located just forward of station 218 on the top of the fuselage. A coaxial cable connects the antenna to the RT-18/ARC-1 transmitter-receiver which is located in the radio compartment on the lower mounting shelf. The remote control panel is mounted on the electrical and radio control shelf in the cockpit and is connected by a cable to the transmitter-receiver. For cable information on this equipment, see figure 5—46.

5—148. OPERATION. The transmitter-receiver power switch (on the transmitter-receiver in the radio compartment) is, at installation, set to the "ON" position, and safety-wired there. Therefore, the set is ready for operation when the battery switch and master radio switch in the cockpit are closed.

Note

Allow 20 seconds warm-up after equipment is turned on before operating throttle switch.

a. Operate the power switch to the "ON" position, the "GUARD-MAIN" switch to the "BOTH" position, and rotate the "CHANNEL SELECTOR" switch to the desired main channel. The equipment will be ready for the reception of incoming signals on the guard channel and the selected main channel after the vacuum tubes reach operating temperature.

b. While operating on the main channel and monitoring the guard channel ("BOTH" position of switch), selectivity of signal may be increased by turning the switch to either the "GUARD" or "MAIN T/R" position, depending on the incoming signal.

c. Transmission of signals may be accomplished by simply depressing the microphone throttle switch.

5—149. The following text gives a general description of circuit operation. The transmitter section of the RT-18/ARC-1 consists essentially of an I-F oscillator, a mixer, a driver, a power amplifier and an audio amplifier. The mixer stage obtains an input from the main-channel harmonic amplifier which also supplies the heterodyne frequency for the radio receiver. Ten crystal units (nine main-channel and one guard-channel) are provided for controlling the fundamental frequency of the oscillator in the frequency generator circuit. The proper crystal unit is automatically selected and the eighteenth harmonic of its frequency is delivered by the heterodyne frequency generator to the mixer stage. This signal is modulated in the mixer stage by the I-F oscillator signal in order to obtain the desired carrier frequency. The output of the mixer stage is amplified by the driver stage in order to provide sufficient excitation for the power amplifier. Speech signals are amplified by the audio amplifier and applied to the screen circuit of the driver stage, as well as to the screen and plate circuits of the power amplifier to effect modulation of the carrier. A portion of the audio amplifier output is delivered to the radio receiver dual audio output stage to provide sidetone signals. The radio receiver main channel consists essentially of an R-F amplifier, a mixer wherein is provided a beat frequency between the heterodyne frequency generator and the amplified carrier signals, an I-F amplifier, a detector, a first audio amplifier stage, and a dual audio output stage. The guard-channel R-F assembly consists of an R-F amplifier, a mixer and a heterodyne frequency generator. The outputs of the guard-channel mixer stage and main-channel mixer stage are coupled to the common I-F amplifier. The output of the I-F amplifier is applied to the detector and

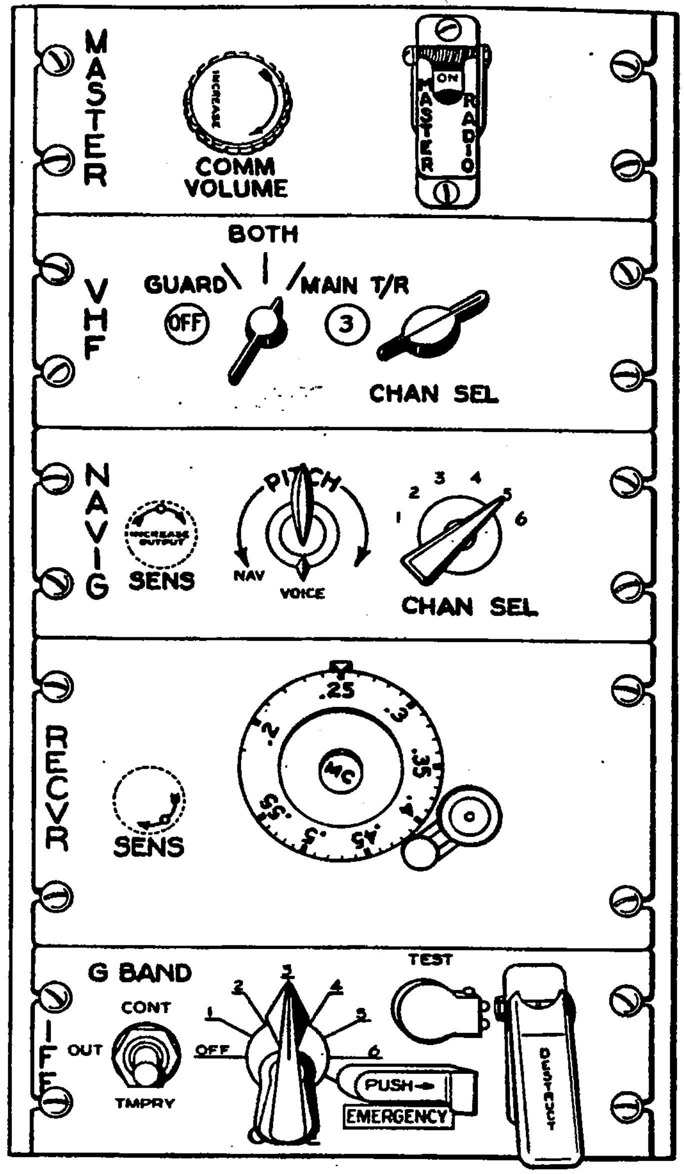


Figure 5—44. Radio Control Panel.

an automatic volume control circuit. The audio frequency output of the detector is amplified by the first audio amplifier to provide adequate input signals for proper operation of the dual audio output stage. The components of the AVC circuit consists of an AVC detector, a dc amplifier, and a squelch circuit. The output of the AVC circuit is applied to the control grids of the I-F amplifier and the two R-F amplifiers in the radio receiver. The squelch circuit is controlled by the AVC circuit and functions to suppress the output of the first audio amplifier during intervals when there is no incoming carrier signal.

Note

For complete alignment procedure for the RT-18/ARC-1 equipment, refer to Handbook of Maintenance Instruction for Model AN/ARC-1 Aircraft Radio Equipment (AN 08-30ARC1-3).

5—150. REMOVING. *(See figure 5—45.)* The RT-18/ARC-1 transmitter-receiver, located on the lower mounting shelf in the radio compartment, is secured in the mounting rack by two studs at the rear of the rack and by two wing nuts which engage two brackets on the front panel of the radio transmitter-receiver. Use the following procedure for removal.

a. Remove the antenna transmission line from the front face of the transmitter-receiver.

b. Loosen the two wing nuts until the lugs fall free of the prongs on the front panel.

c. Grasp the two handles of the transmitter-receiver and slide the unit out, along the mounting base, being careful not to damage the multi-pin plug at the back of the transmitter-receiver.

5—151. INSTALLING. Installing the RT-18/AC-1 transmitter-receiver is the reverse of the removal procedure given in paragraph 4—150.

5—152. MAINTENANCE.

WARNING

THE PLATE VOLTAGE USED IN THIS EQUIPMENT IS DANGEROUS TO LIFE. EXTREME CARE SHOULD BE TAKEN WHEN OPERATING THE SET WITHOUT ITS COVER.

Since maintenance of electronics equipment is limited to repairs which can be done when equipment is installed, routine servicing consists only of electrical and ground cable inspection, blown fuse replacement, installation inspection, and replacement of damaged or broken units. Refer to Handbook AN 08-30ARC1-3 for alignment and further maintenance procedures.

5—153. PRE-FLIGHT INSPECTION. The following inspection should be made before each flight to determine that equipment is operating satisfactorily.

a. Check the radio transmitter-receiver for proper insertion in the mounting base. The arrow on each side of the chassis cover must be within the marked area on the mounting base. Be sure the wing nuts are tight.

b. Check the clamping nuts on the power cables (both ends) and the antenna transmission line (both ends) and be sure they are tight.

c. Remove the radio transmitter-receiver front panel cover and check the crystal units for proper frequencies and location in the proper sockets.

d. Turn "ON" battery switch, master radio switch, and "GUARD-MAIN" switch on VHF control panel.

e. After the vacuum tubes have had an opportunity to reach operating temperature (approximately 20 seconds), operate the "SQUELCH" button on the front panel of the equipment. Electrical noise or a normal hiss of set should be heard in the head set.

f. With the "SQUELCH" button operated, operate the "CHANNEL SELECTOR" and "GUARD-BOTH-MAIN T/R" switches as required to check noise for each channel. Approximately the same degree of noise should be heard on each channel and an appreciably greater amount of noise should be heard with the "GUARD-MAIN" switch in the "BOTH" position.

g. If radio silence regulations permit, check for side-tone signals by operating the microphone button and talking into the microphone while listening to the radio receiver output.

h. When radio silence restrictions permit, establish two-way communication with another aircraft or a ground station, checking operation on each channel.

5—154. ANTENNA.

5—155. DESCRIPTION. *(See figure 5—45.)* The VHF antenna (AN-100BX) is a mast located just forward of station 218 on the top of the fuselage, and is connected to the RT-18/ARC-1 transmitter-receiver through a coaxial cable. It is a quarter-wave, base-fed type antenna which serves both the transmitter and receiver.

5—156. REMOVING. To remove the mast antenna, use the following procedure.

a. Unfasten the quick-disconnect fitting located between the antenna and the strain insulator.

b. Disconnect the antenna cable from the base of the mast.

c. Remove the six bolts which secure the ring and seal to the skin of the aircraft.

d. Loosen the clamp on the mast just beneath the skin of the airplane.

e. Remove the four bolts which secure the two clips to the bracket. The mast may now be pulled upward and removed.

5—157. INSTALLING. The installation of the VHF antenna is the reverse of the removal procedure given in paragraph 5—156.

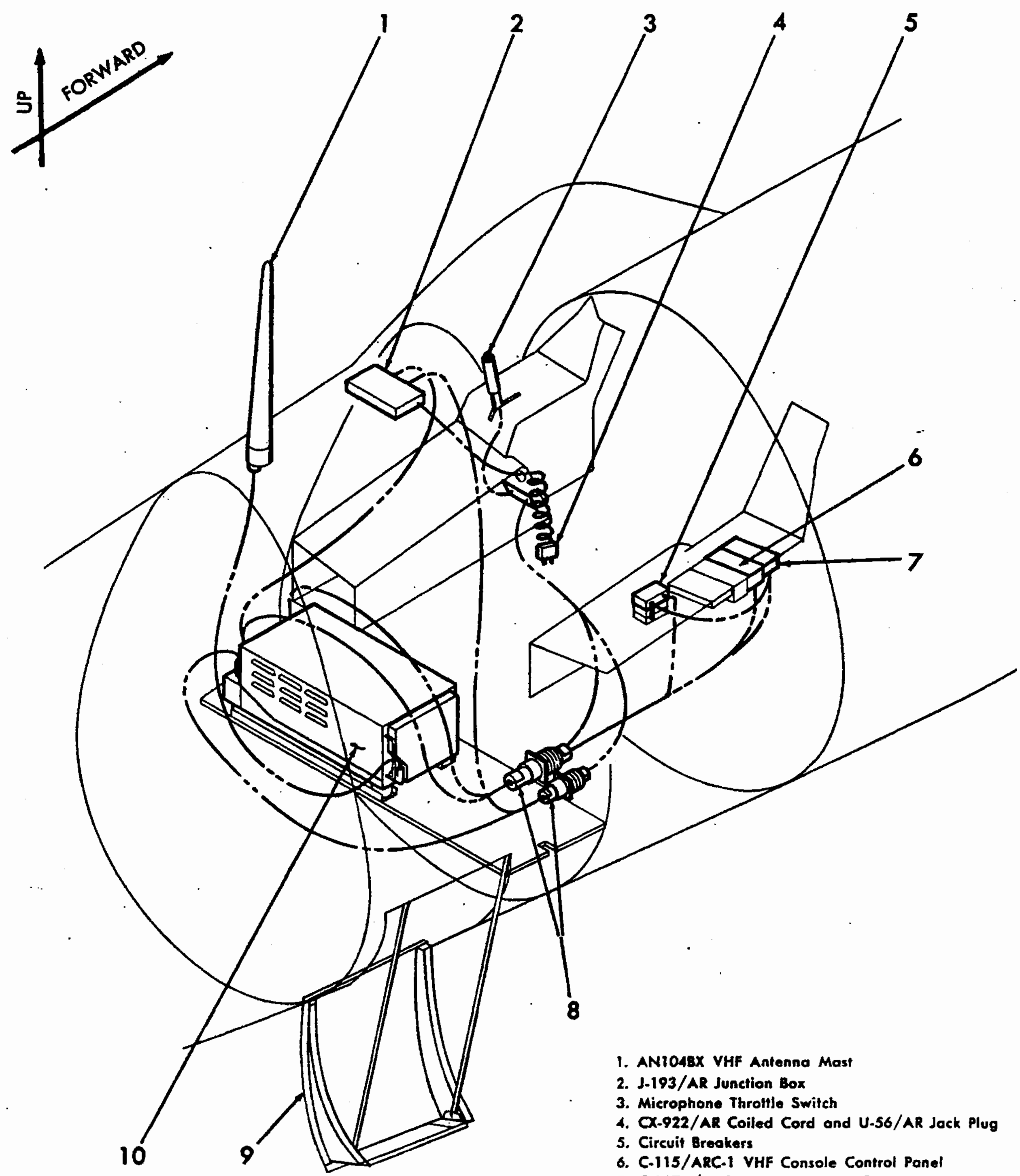
5—158. POWER SUPPLY.

5—159. DESCRIPTION. The high voltage power supply (300 to 360 volts) for the RT-18/ARC-1 consists of a dynamotor DY-9/ARC-1, which is mounted in the aft end of the transmitter-receiver unit. The low voltage input to the dynamotor (28 volts) also supplies the tube heaters with power. A voltage divider used with the dynamotor, supplies the different voltages necessary to operate the equipment.

5—160. REMOVING DYNAMOTOR. To remove the DY-9/ARC-1 dynamotor:

a. Loosen the four machine screws which secure the dynamotor to the chassis. Remove the dynamotor.

5—161. INSTALLING DYNAMOTOR. To install the DY-9/ARC-1 dynamotor, reverse the procedure given in paragraph 5—160.



1. AN104BX VHF Antenna Mast
2. J-193/AR Junction Box
3. Microphone Throttle Switch
4. CX-922/AR Coiled Cord and U-56/AR Jack Plug
5. Circuit Breakers
6. C-115/ARC-1 VHF Console Control Panel
7. C-127A/ARC Master Console Control Panel
8. Bulkhead 186 Cable Disconnects
9. Radio Compartment Access Door (ref.)
10. RT-18/ARC-1 Radio Receiver—Transmitter

*NOTE

The NAF-1124-17 microphone switch assembly is installed in a number of F4U-5 aircraft until the Aero 4B ranging throttle grip becomes available; when available, the Aero 4B grip will be installed retroactively in all F4U-5 aircraft.

Figure 5—45. RT-18/ARC-1 Radio Transmitter—Receiver Reference Diagram.

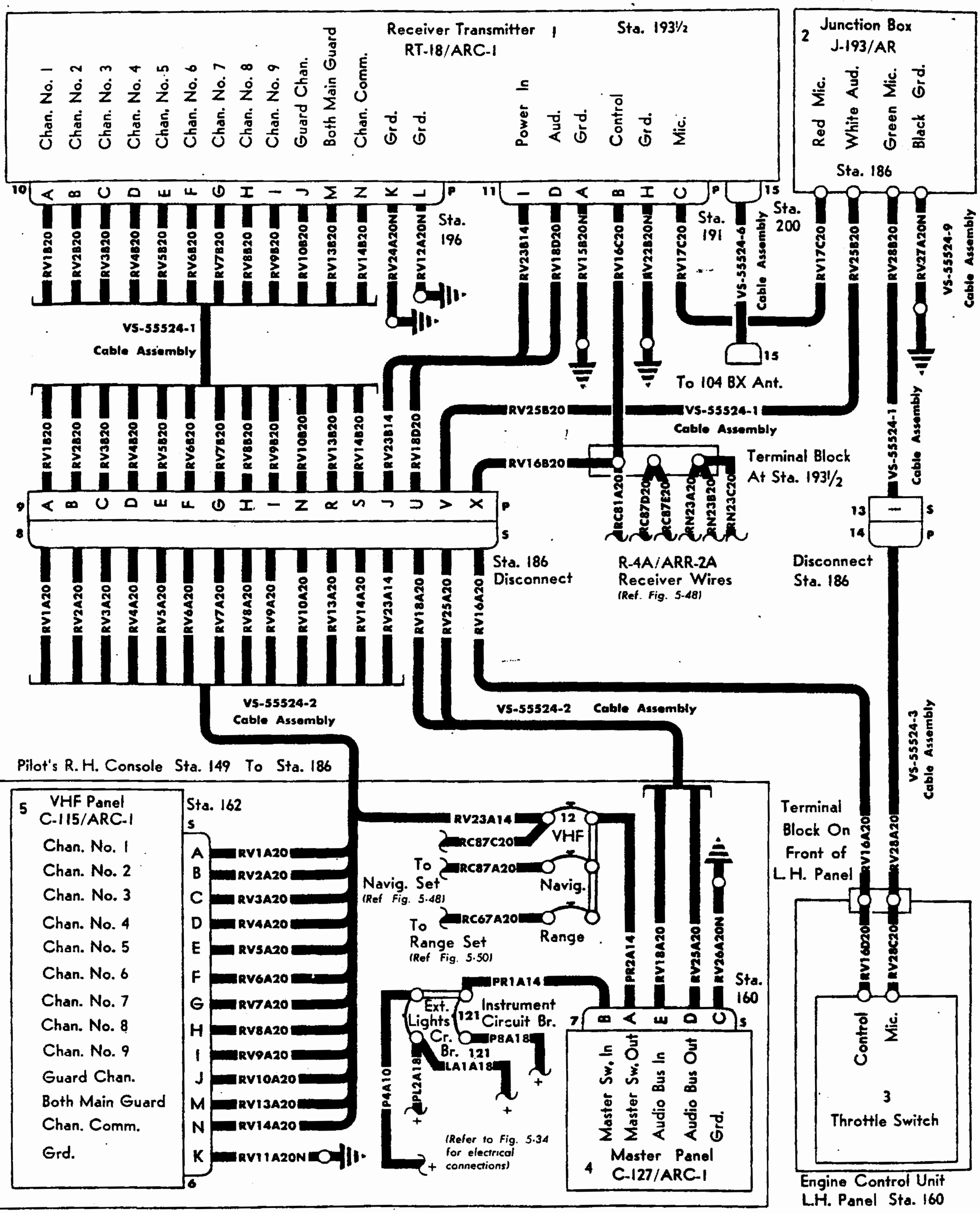


Figure 5–46. RT-18/ARC-1 Radio Transmitter—Receiver Cabling Diagram.

RT-18/ARC-1 WIRE TABLE *(See figures 5–45 and 5–46.)*

CABLE ASSEMBLY VS-55524-1

WIRE NO.	WIRE SIZE	WIRE LENGTH INCHES
RV1B20	NAF1070-AN20	36
RV2B20	NAF1070-AN20	36
RV3B20	NAF1070-AN20	36
RV4B20	NAF1070-AN20	36
RV5B20	NAF1070-AN20	36
RV6B20	NAF1070-AN20	36
RV7B20	NAF1070-AN20	36
RV8B20	NAF1070-AN20	36
RV9B20	NAF1070-AN20	36
RV10B20	NAF1070-AN20	36
RV13B20	NAF1070-AN20	36
RV14B20	NAF1070-AN20	36
RV23B14	NAF1070-AN14	44
RV24A20N	NAF1070-AN20	28
RV12A20N	NAF1070-AN20	28
RV18D20	NAF1070-AN20	44
RV25B20	NAF1070-AN20	80
RV16B20	NAF1070-AN20	48
RV15B20N	NAF1070-AN20	28
RV16D20	NAF1020-AN20	30
RV22B20N	NAF1070-AN20	28
RV28B20	Shield No. 20	82
RV28C20	NAF1070-AN20	30
RV17C20	NAF1070-AN20	88
RV16C20	NAF1070-AN20	28

CABLE ASSEMBLY VS-55524-2

WIRE NO.	WIRE SIZE	WIRE LENGTH INCHES
RV1A20	NAF1070-AN20	32
RV2A20	NAF1070-AN20	32
RV3A20	NAF1070-AN20	32
RV4A20	NAF1070-AN20	32
RV5A20	NAF1070-AN20	32
RV6A20	NAF1070-AN20	32
RV7A20	NAF1070-AN20	32
RV8A20	NAF1070-AN20	32
RV9A20	NAF1070-AN20	32
RV10A20	NAF1070-AN20	32
RV13A20	NAF1070-AN20	32
RV14A20	NAF1070-AN20	32
RV11A20N	NAF1070-AN20	32
PR1A14	NAF1070-AN14	34
PR2A14	NAF1070-AN14	34
RV23A14	NAF1070-AN14	28
RV18A20	NAF1070-AN20	40
RV25A20	NAF1070-AN20	40
RV26A20N	NAF1070-AN20	40
RV16A20	NAF1070-AN20	72

RT-18/ARC-1 WIRE TABLE (Continued)

(See figures 5–45 and 5–46.)

CABLE ASSEMBLY VS-55524-3

WIRE NO.	WIRE SIZE	WIRE LENGTH INCHES
RV28A20	Shield No. 20	72

CABLE ASSEMBLY VS-55524-6

WIRE NO.	WIRE SIZE	WIRE LENGTH INCHES
RG-8/U	—	112

CABLE ASSEMBLY VS-55524-9

WIRE NO.	WIRE SIZE	WIRE LENGTH INCHES
RV27A20N	NAF1070-AN20	24

RT-18/ARC-1 EQUIPMENT PARTS LIST

(See figure 5–46.)

ITEM NO.	PART	MANUFACTURER	PART OR DRAWING NUMBER
1	Receiver-Transmitter	Government Furnished	RT-18/ARC-1
2	Junction Box	Government Furnished	J-193/AR
3	Throttle Switch	Government Furnished	NAF1124-17
4	Master Panel	Government Furnished	C-127A/ARC-1
5	VHF Panel	Government Furnished	C-115/ARC-1
6	Plug	Government Furnished	AN3106-20-1S
7	Plug	Government Furnished	AN3106-20-14S
8	Plug	Government Furnished	AN3101-28-11S
9	Receptacle	Government Furnished	AN3100-28-11P
10	Receptacle	Government Furnished	AN3106-20-1P
11	Receptacle	Government Furnished	AN3106-20-16P
12	Circuit-Breaker	Government Furnished	AN3161-P20
13	Receptacle	Government Furnished	AN3100-20-27S
14	Plug	Government Furnished	AN3106-20-27P
15	Plug	Government Furnished	Navy 49190

5—162. R-4A/ARR-2 RECEIVER.

5—163. DESCRIPTION. *(See figures 5—47 and 5—48.)* The R-4A/ARR-2 receiver is a remote controlled superheterodyne receiver used for navigation operations. It brings in either voice or telegraph signals on any one of six modulated frequency channels. When used for navigation, a beat frequency oscillator produces an audible beat note, and when used for reception of voice modulation the beat note oscillator is cut out. The type of operation (NAV or VOICE) is selected by a rheostat on the remote control unit. This rheostat also controls the PITCH (beat note). Power is supplied by the plus bus through the navigation radio circuit-breaker to a seven-contact receptacle at the dynamotor end of the cover. The receiver uses remote control unit C-116/ARR-2A mounted on the radio control panel, and tuning control C-37/ARR-2A attached to the tuning end of the receiver. The antenna, located at station 203 beneath the fuselage, is further discussed in paragraph 5—171. The receiver is located on the right hand side of the upper radio shelf just inboard of the R-23A/ARC-5 deceiver and is accessible through the radio compartment access door. It is mounted on a removable rack which attaches to a permanent base. This receiver has its individual dynamotor. The dynamotor is mounted permanently on a base which fits over four shock mount studs on the receiver chassis.

5—164. OPERATION.

a. Power is supplied to the receiver when the master radio switch is turned on. With the control at "NAV", the beat note oscillator functions and a navigation signal is heard. The "VOICE" setting is not used for navigating. If "VOICE" is to be used, special instructions are given before take-off. Be sure this control is set as desired. This control also varies the pitch of the incoming signal.

b. The sensitivity control varies the gain of the receiver and is used as a volume control to limit the audio output to a level of comfort. Its use makes possible a variation of sensitivity over a considerable range.

c. The channel selector consists of a six position rotary switch, the turning of which actuates the tuning unit motor which stops precisely at the channel selected.

5—165. HOMING SIGNALS. When the R-4A/ARR-2A receiver is operating, it may be used to receive homing signals for the purpose of navigation.

a. The associated base transmitter uses a VHF carrier wave, in the range of 234 to 258 megacycles, transmitted from a rotating directional antenna. This radiation is a directional beam, approximately 45 degrees wide. Due to the directional beam type radiation, a receiver of like design remotely located will receive only those signals radiated in the particular direction of its location.

b. The VHF carrier wave transmitted is revolved by a change in antenna direction through the 360 degree azimuth scale at the rate of one revolution every 30 seconds. At it revolves through the pattern, there is broadcast a different International Morse Code Character for each 30 degrees of rotation, each character being transmitted twice in its 30 degree sector.

c. The sequence and strength of signals received in the aircraft permit the pilot to decode and estimate his location and bearing. In order to reach the home base, it is necessary to fly the reciprocal of this bearing.

5—166. ALIGNMENT OF THE RADIO RECEIVER.

Note

The oscillator used for pre-flight check should be tested at the shop and brought directly to the airplane. Channel alignment is done only at the shop.

a. Be certain that the test oscillator TS-24.ARR-2 (for external power supply, use TS-24A/ARR-2) has been set on all the assigned channels and in the correct order for receiving equipment.

b. Put up the oscillator antenna and place the oscillator ten feet from the receiver antenna. Switch the oscillator "ON" and turn the selector switch to one of the required channels. No tone modulation is required for the test.

c. Turn battery and master radio switches "ON."

d. Set the channel control on the receiver to the corresponding test oscillator channel.

e. Set receiver "NAV-VOICE" switch to "NAV" position, and connect headphones and output meter to the receiver output.

f. Advance the "SENS" control on the "NAVIG" panel until noise or signal of moderate level is heard.

g. Adjust "PITCH" control to a position which gives a pleasing tone.

h. Loosen the dial lock and adjust the dial on the front of the receiver for maximum signal output. No further adjustment of the dial is required. (If a signal is not received, check the wiring and the selector channel settings. Check the test oscillator with a frequency standard taken from the shop. If, after these checks, a signal cannot be heard, remove the receiver from the airplane and replace with a set which is aligned.

i. Adjust the antenna trimmer screw on the front of the receiver for maximum output. No further adjustment of the trimmer screw will be required.

j. Check all channels. Normally, the test oscillator channels follow in the same sequence as the corresponding channels on the receiver. Turn "CHANNEL" switch on the test oscillator to No. 1 and turn "CHANNEL" switch on the receiver to No. 1. Adjust "PITCH" control for the desired response. Check channels 2, 3, 4, 5, and 6 in the same manner. It may be necessary, in each instance, to readjust the "PITCH" control for best response. If proper pitch is not obtained, the oscillator, the receiver, or both may be out of alignment. The test oscillator should be checked against a frequency standard just before the test, when possible. Ordinarily, the oscillator will require checking once every hour. If the oscillator is found to be in alignment, and the receiver out of alignment on any desired channel, the receiver needs a complete channel realignment at the shop. It is not recommended that this be done at the airplane.

5—167. REMOVING. *(See figure 5—47.)* The radio compartment access door is between stations 186 and 218 on the right hand side of the fuselage. The removal of the R-4A/ARR-2 receiver unit is as follows:

a. Loosen the two attaching bracket thumbscrews on the lower part of the tuning end of the receiver. Disengage the retainers.

b. Disconnect the antenna couplings at the receiver tuning and antenna jacks.

c. Disconnect the remote control and tuning control cables at the tuning end. The receiver may now be pulled backward to disconnect the power plug. If the mounting rack is to be removed, both the R-4A/ARR-2 and R-23A/ARC-5 receivers must be removed. The same procedure applies to each except that when both receivers and the rack are removed, it is necessary to take the steps outlined and in addition, to remove two grounds which are attached from the mounting rack to the base. If the dynamotor unit only is to be removed, unfasten the dynamotor slide fasteners and lift the dynamotor mounting plate which will disengage the unit from its plug in the chassis. For removal of the control panel, see paragraph 5—144. The tuning control unit is removed from the receiver by removing four screws which attach it to a base plate and carefully withdrawing the spline shaft gear coupling.

5—168. INSTALLING. The R-4A/ARR-2 receiver is installed by placing the mounting rack on the permanent mounting base and reversing the procedure detailed in paragraph 5—167.

5—169. MAINTENANCE. Since maintenance of electronics equipment is limited to repairs which can be done when the equipment is installed, routine servicing consists only of electrical and ground cable inspection, blown fuse replacement, installation inspection, and the replacement of damaged or broken units. Refer to Handbook AN 16-30ARR2-2 for alignment and further maintenance procedures.

5—170. PRE-FLIGHT INSPECTION. In addition to the mechanical inspection, the equipment should be checked before flight as follows:

a. Turn battery and master radio switches "ON."

b. Set channel control in accordance with orders received before flight.

c. Set "NAV-VOICE" switch to "NAV."

d. Set the "SENS" control for reception at moderate volume. If too much noise or signal is received from other equipment, their controls may be turned off temporarily in order to identify navigation signals properly. After the desired signal comes in, turn these controls on again.

e. Adjust "PITCH" control as position giving clearest tone and pitch.

f. Readjust "SENS" control.

5—171. ANTENNA.

5—172. DESCRIPTION. *(See figure 5—47.)* The homing antenna, (AT-5/ARR-1) located at fuselage station 203, comes out from the underside of the airplane. It is connected by a 50 ohm concentric transmission line and cable to the R-4A/ARR-2 right angle antenna adapter. The antenna assembly wiring is easily disconnected at either end, and the assembly is attached by eight screws to the inside of the airplane.

5—173. REMOVING. To remove this antenna, disconnect the cable at the antenna coupling (at the tuning end of the receiver) and then disconnect the other end of the cable. The antenna mast is retained by 8 screws on the interior bottom of the fuselage. When the screws are taken out, the antenna can be pulled back into the bottom of the airplane.

5—174. INSTALLING. To install the antenna, push the mast through the hole in the bottom of the fuselage at station 203. Fasten the mast to the stiffener on the bottom fuselage and then make cable connections at the mast end and at the right angle antenna adapter at the receiver. Be careful that the cable and spline connections are in proper mesh position when making cable connections.

5—175. POWER SUPPLY.

5—176. DESCRIPTION. The dynamotor power supply (DY-2/ARR-2) provides approximately 250 volts at 60 milliamperes for the plate and screen grid potentials of the vacuum tubes in the R-4A/ARR-2 receiver. The load current from the dynamotor under actual operating conditions is approximately 40 milliamperes. The fuse required in the receiver rack must be capable of withstanding the starting current of the dynamotor, electric tuning control adapter motor and the heater current of the vacuum tubes.

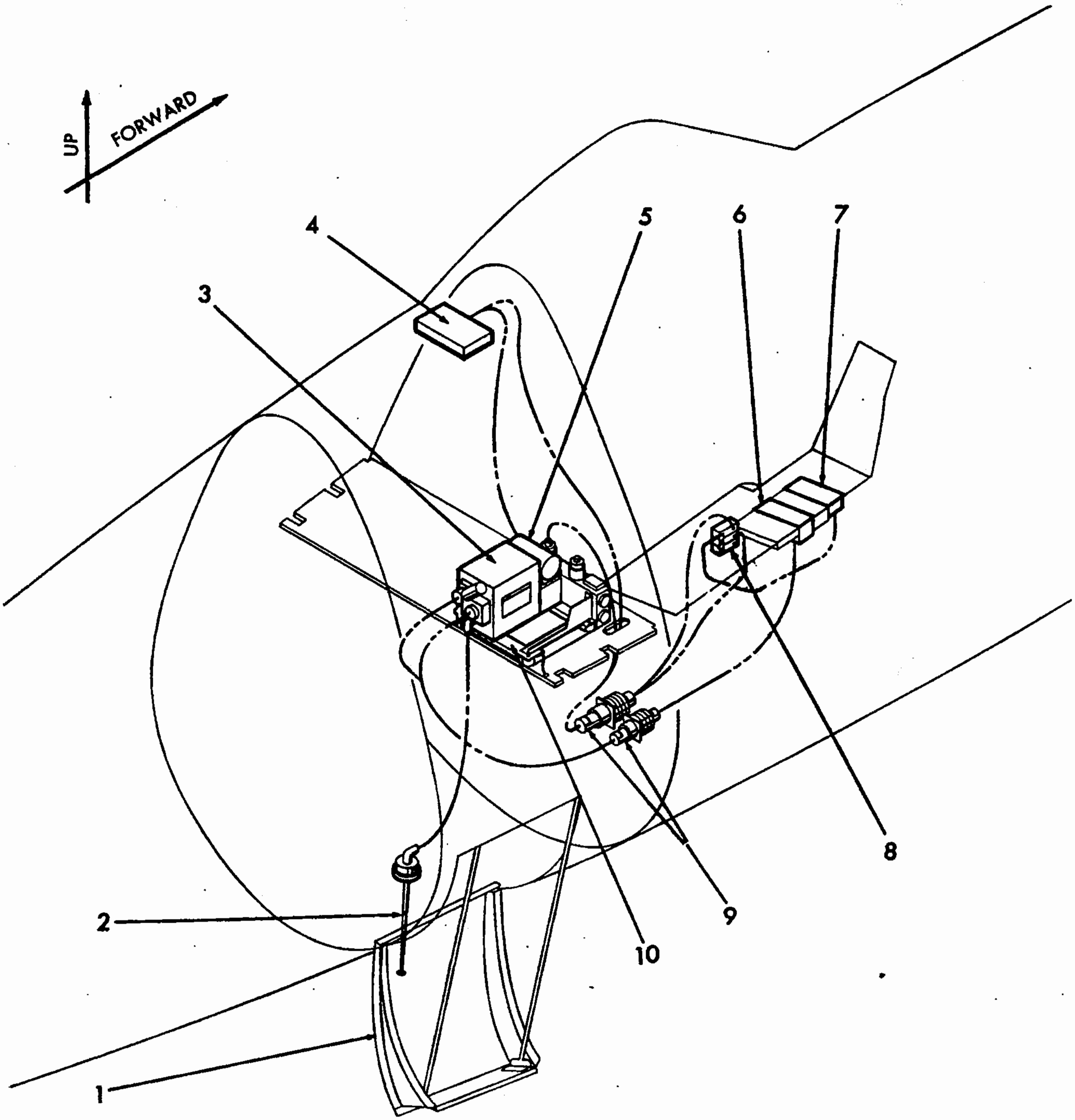
5—177. REMOVING.

a. Make sure power switches are off.

b. Unfasten the four slide fasteners and remove dynamotor.

5—178. REPAIRING. The dynamotor is lubricated at first installation of the bearings and normally this lasts from one to three thousand hours. Dynamotor noise due to dirt may be corrected, in an emergency, at the airplane, by removing the safety wire and screws from the dynamotor end covers, making a close visual inspection of the armature and stator assemblies and removing any dirt found there. Preinstallation inspection will reduce to a minimum the possibility of dynamotor failure.

5—179. INSTALLING. The dynamotor is placed over four shock mount studs at one end of the receiver chassis. All wiring goes through a single plug to the chassis. Guide studs arranged in triangular fashion make it impossible to install the dynamotor backwards.



1. Radio Compartment Access Door (ref.)
2. AT-5/ARR-1 Homing Antenna Mast
3. R-4A/ARR-2 Navigation Receiver
4. J-193/AR Junction Box
5. DY-2A/ARR-2 Dynamotor
6. C-116/ARR-2A Navigation Console Control Panel
7. C-127A/ARC Master Console Control Panel
8. Circuit Breakers
9. Bulkhead 186 Cable Disconnects
10. MT-63/ARC-5 Mounting Rack

Figure 5–47. R-4A/ARR-2A Receiver Reference Diagram.

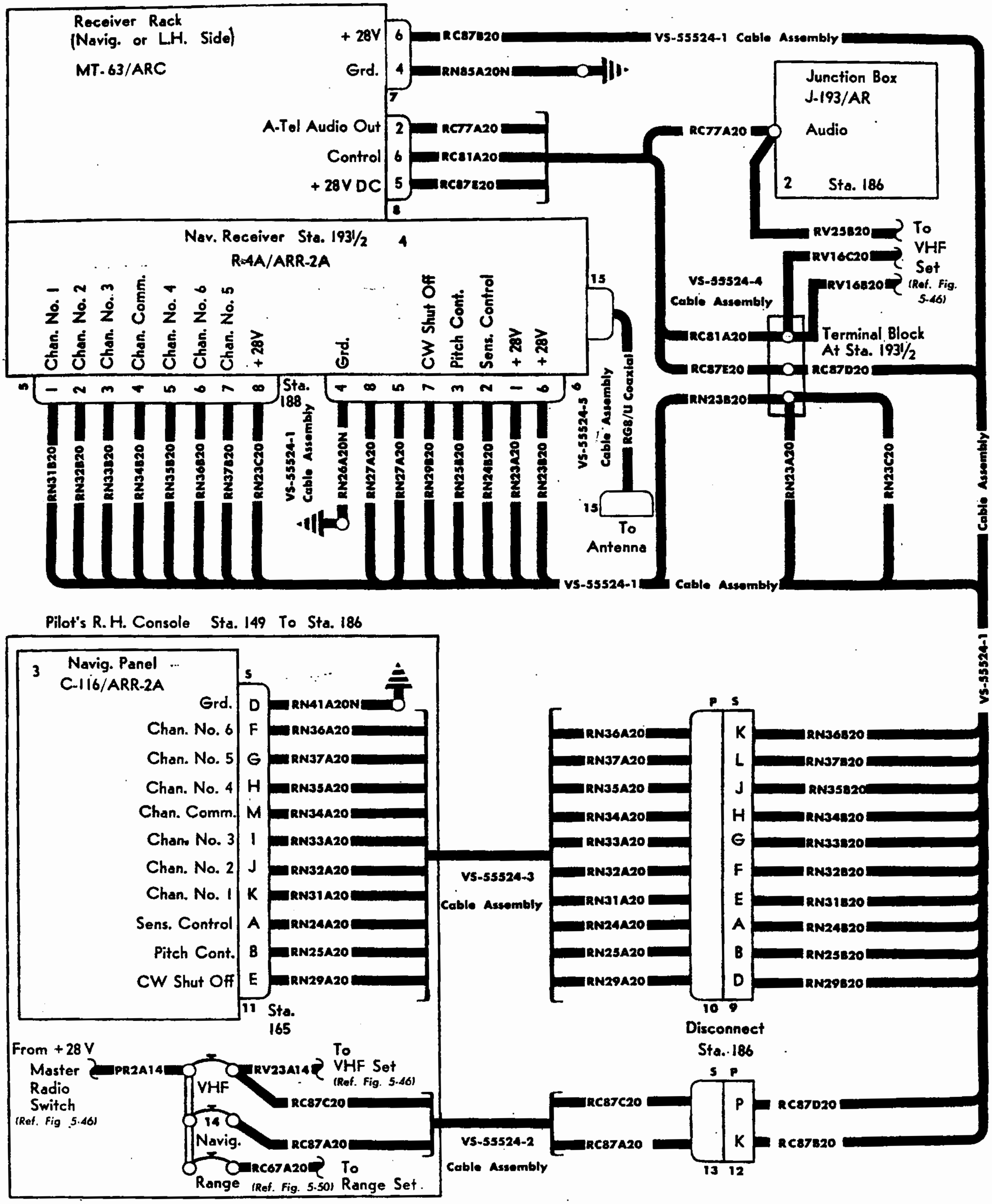


Figure 5—48. R-4A/ARR-2A Receiver Cabling Diagram.

R-4A/ARR-2A WIRE TABLE *(See figures 5–47 and 5–48.)*

CABLE ASSEMBLY VS-55524-1

WIRE NO.	WIRE SIZE	WIRE LENGTH INCHES
RN31B20	NAF1070-AN20	52
RN32B20	NAF1070-AN20	52
RN33B20	NAF1070-AN20	52
RN34B20	NAF1070-AN20	52
RN35B20	NAF1070-AN20	52
RN36B20	NAF1070-AN20	52
RN37B20	NAF1070-AN20	52
RN23C20	NAF1070-AN20	4
RN26A20N	NAF1070-AN20	28
RN27A20	NAF1070-AN20	5
RN29B20	Shield No. 20	48
RN25B20	Shield No. 20	48
RN24B20	NAF1070-AN20	48
RN23A20	NAF1070-AN20	28
RN23B20	NAF1070-AN20	28
RC87D20	NAF1070-AN20	36
RC87B20	NAF1070-AN20	32
RN85A20N	NAF1070-AN20	12

CABLE ASSEMBLY VS-55524-2

WIRE NO.	WIRE SIZE	WIRE LENGTH INCHES
RC87C20	NAF1070-AN20	32
RC87A20	NAF1070-AN20	28

CABLE ASSEMBLY VS-55524-3

WIRE NO.	WIRE SIZE	WIRE LENGTH INCHES
RN41A20N	NAF1070-AN20	32
RN36A20	NAF1070-AN20	32
RN37A20	NAF1070-AN20	32
RN35A20	NAF1070-AN20	32
RN34A20	NAF1070-AN20	32
RN33A20	NAF1070-AN20	32
RN32A20	NAF1070-AN20	32
RN31A20	NAF1070-AN20	32
RN24A20	NAF1070-AN20	32
RN25A20	Shield No. 20	32
RN29A20	Shield No. 20	32

R-4A/ARR-2A WIRE TABLE (Continued)

(See figures 5–47 and 5–48.)

CABLE ASSEMBLY VS-55524-4

WIRE NO.	WIRE SIZE	WIRE LENGTH INCHES
RC77A20	NAF1070-AN20	36
RC81A20	NAF1070-AN20	36
RC87E20	NAF1070-AN20	36

CABLE ASSEMBLY VS-55524-5

WIRE NO	WIRE SIZE	WIRE LENGTH INCHES
RG-8/U Coaxial	——	65

R-4A/ARR-2A EQUIPMENT PARTS LIST (See figure 5–48.)

ITEM NO.	PART	MANUFACTURER	PART No.
1	Receiver Rack	Government Furnished	MT-63/ARC
2	Junction Box	Government Furnished	J-193/AR
3	Navigation Panel	Government Furnished	C-116/ARR-2A
4	Navigation Receiver	Government Furnished	R-4A/ARR-2
5	Plug	Government Furnished	B-33069-2
6	Plug	Government Furnished	ARC-9125
7	Plug	Government Furnished	ARC-9125
8	Plug	Government Furnished	ARC-9123
9	Receptacle	Government Furnished	AN3100-20-27S
10	Plug	Government Furnished	AN3106-20-27P
11	Plug	Government Furnished	AN3100-20-27S
12	Receptacle	Government Furnished	AN3100-28-11P
13	Plug	Government Furnished	AN3106-28-11S
14	Circuit-Breaker	Government Furnished	AN3161-P5

5—180. R-23A/ARC-5 RECEIVER.

5—181. DESCRIPTION. *(See figures 5—49 and 5—50.)* The R-23A/ARC-5 is a superheterodyne receiver, operating with dynamotor power, from the airplane 28 volt system. The set is used for range signal reception. The current drain is 1.6 amperes at 28 volts input. The band covering .19 to .55 megacycles, is used for reception of modulated voice signals only. The R-23A/ARC-5 has an antenna filter choke mounted on the top side of the unit cover. This receiver uses MX-22/ARR-2 right angled tuning coupling and a mechanical linkage assembly which passes through bulkhead 186 at its lower right hand corner for remote control of its tuning range. For description of the antenna, see paragraph 5—187. The receiver is outboard of the navigation receiver on the right hand side of the upper radio shelf. It is easily accessible through the radio compartment access door.

5—182. OPERATION. With engine operating above generator cutout speed, and with battery switch "ON," operation of the R-23A/ARC-5 requires only that the master radio switch be turned "ON," the desired frequency selected, and the sensitivity control set to weakest possible usable signal while selecting the frequency. This will get the narrowest possible response, after which the sensitivity control may be advanced to a better audio level.

5—183. REMOVING. *(See figure 5—49.)* Access to the R-23A/ARC-5 receiver is gained through the radio compartment access door. To remove the receiver, proceed as follows:

a. Disconnect the antenna cable.

b. Loosen thumbscrew on tuning end of receiver.

c. Pull the receiver aft until the plug-in to the mounting base becomes disengaged.

Note

If both the range and the navigation receivers and the mounting rack are to be taken out, it is necessary to take off the two grounds from the mounting rack, take off the safety wire and push the slide fasteners free from the shock mount studs of the permanent mounting base.

5—184. INSTALLING. Installation of the receiver is the reverse of the procedure given in paragraph 5—183.

Note

Mount the rack, if necessary, and attach the ground. Solder one end to the slide fastener base and bolt the other end to the radio shelf.

5—185. MAINTENANCE. Since maintenance of electronics equipment is limited to repairs which can be done when the equipment is installed, routine servicing consists only of electrical and ground cable inspection, blown fuse replacement, installation inspection, and the replacement of damaged or broken units. Refer to Handbook NAVAER 08-5Q-95 for alignment and further maintenance procedures.

5—186. PRE-FLIGHT INSPECTION.

a. A visual check and working check of the control and dial, checking of receptacles, plugs, threads and wire connections should be made after installation.

b. With the master radio switch "ON," the receiver should be tried first with no signal (sensitivity control turned fully counterclockwise) to listen for dynamotor hum. Loose wiring or loose shielding may be detected by listening.

c. With the set turned on and tuned in on a signal, the noise level should be checked with the engine running. All receivers except the one under test should be turned off.

d. If the receiver does not function properly, the following items should be checked: switches in proper positions, headset connected into proper jack, plugs securely attached, battery voltage satisfactory, dynamotor operating properly, and the antenna input circuit properly aligned.

5—187. ANTENNA.

5—188. DESCRIPTION. *(See figure 5—49.)* The LF wire type antenna is attached to the antenna coupling on the tuning control end of the R-23/ARC-5 range receiver. The antenna goes from the coupling to the filter on top of the receiver, through an insulator spool on the upper right hand fuselage and from here it is wound around and soldered to the main LF antenna which extends from the VHF antenna mast to the fin.

5—189. REMOVING. To remove this antenna, proceed as follows:

a. Unsolder the lead into the antenna filter choke.

b. Remove the nuts and washers from the spool and remove the section of the antenna wire within the fuselage.

c. Unfasten the link just aft of the forward antenna insulator, pull the insulator post from the fuselage and unhook the aft end of the antenna from the fin.

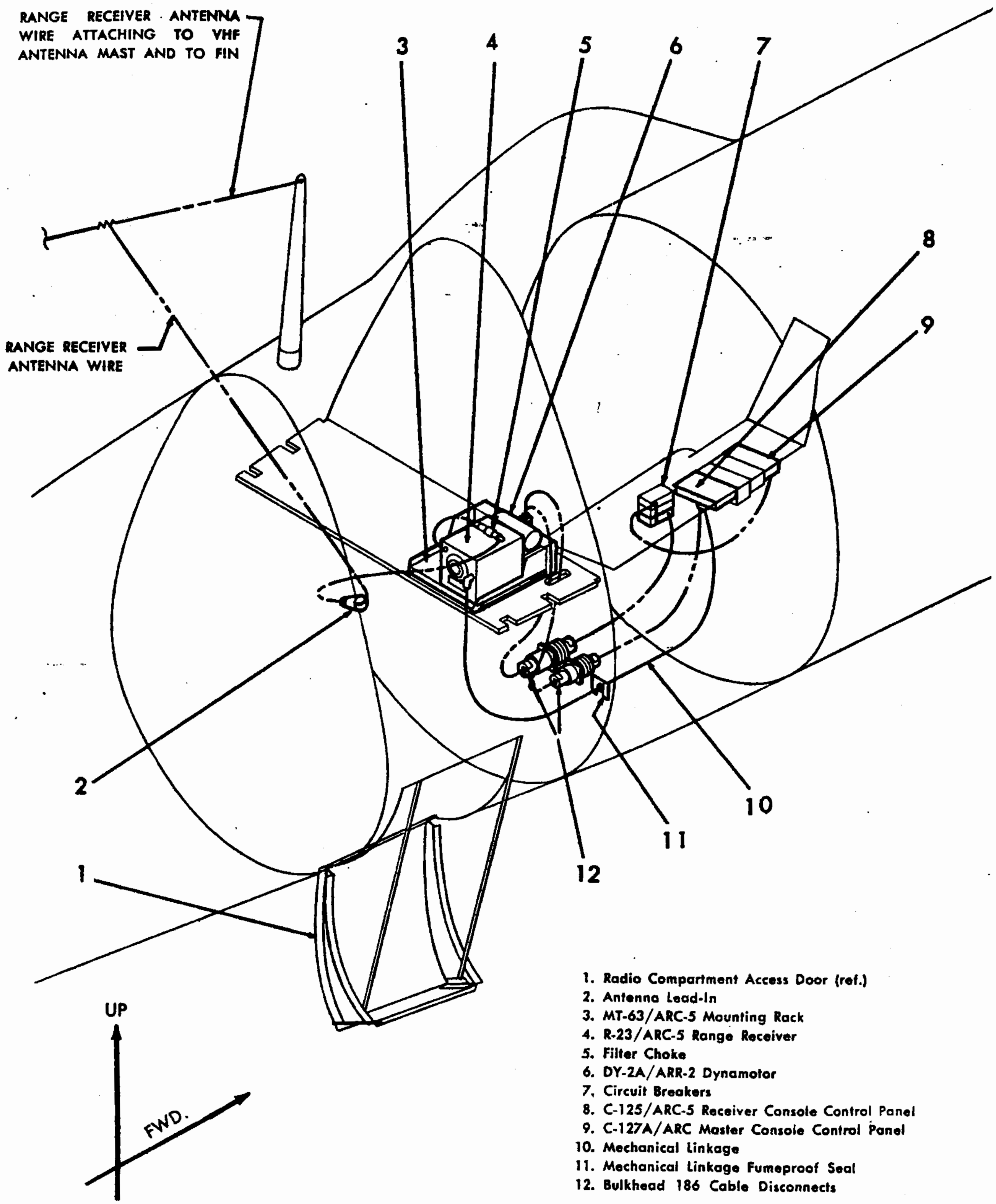
5—190. INSTALLING. Reverse removal procedure.

5—191. POWER SUPPLY.

5—192. DESCRIPTION. *(See figure 5—49.)* The dynamotor power supply DY-2A/ARR-2 is mounted on the forward end of the R-23A/ARC-5 receiver, delivering power through a plug on its mounting surface. It is retained by its power plug and by four snap slide fasteners. It is a continuous duty type, with a dc input rating of 1.1 amperes at 28 volts and a dc output rating of 60 milliamperes at 250 volts.

5—193. REMOVING. The dynamotor is removed by loosening the four snap slide fasteners and pulling the dynamotor directly upward to disengage it from its plug.

5—194. INSTALLING. To install the dynamotor, line up the three studs in their proper positions and press the unit down over its mounting studs. Close the snap slide fasteners and the installation is completed.



1. Radio Compartment Access Door (ref.)
2. Antenna Lead-In
3. MT-63/ARC-5 Mounting Rack
4. R-23/ARC-5 Range Receiver
5. Filter Choke
6. DY-2A/ARR-2 Dynamotor
7. Circuit Breakers
8. C-125/ARC-5 Receiver Console Control Panel
9. C-127A/ARC Master Console Control Panel
10. Mechanical Linkage
11. Mechanical Linkage Fumeproof Seal
12. Bulkhead 186 Cable Disconnects

Figure 5–49. R-23A/ARC-5 Receiver Reference Diagram.

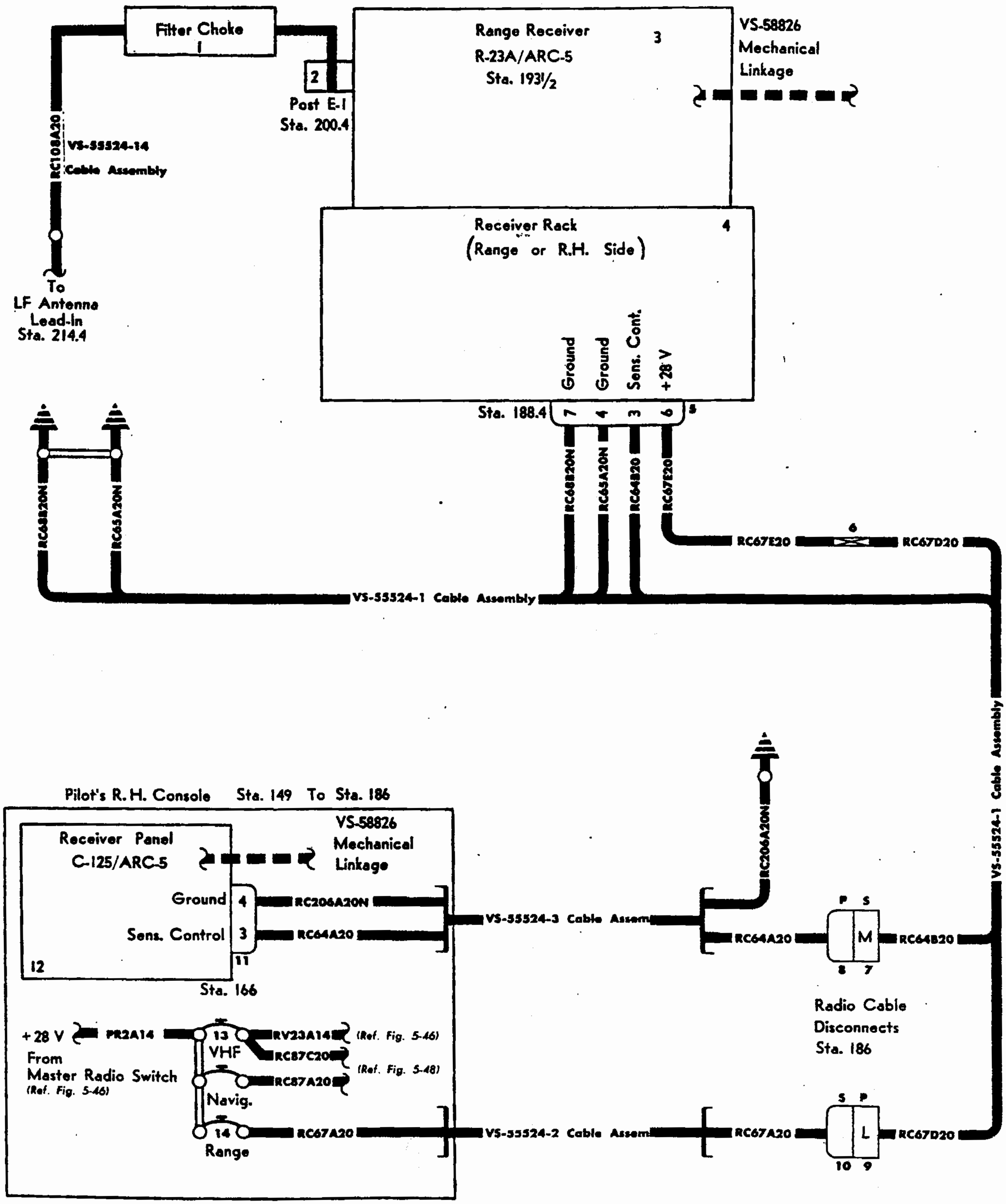


Figure 5–50. R-23A/ARC-5 Receiver Cabling Diagram.

R-23A/ARC-5 WIRE TABLE *(See figures 5—49 and 5—50.)*

CABLE ASSEMBLY VS-55524-1

WIRE NO.	WIRE SIZE	WIRE LENGTH INCHES
RC67D20	NAF1070-AN20	16
RC67E20	NAF1070-AN20	12
RC64B20	NAF1070-AN20	44
RC65A20N	NAF1070-AN20	16
RC68B20N	NAF1070-AN20	16

CABLE ASSEMBLY VS-55524-2

WIRE NO.	WIRE SIZE	WIRE LENGTH INCHES
RC67A20	NAF1070-AN20	28

CABLE ASSEMBLY VS-55524-3

WIRE NO.	WIRE SIZE	WIRE LENGTH INCHES
RC206A20N	NAF1070-AN20	28
RC64A20	NAF1070-AN20	28

CABLE ASSEMBLY VS-55524-5

WIRE NO.	WIRE SIZE	WIRE LENGTH INCHES
RG8/U	Coaxial Cable	65

CABLE ASSEMBLY VS-55524-14

WIRE NO.	WIRE SIZE	WIRE LENGTH INCHES
RC108A20	No. 14 Tinned Copper	24

R-23A/ARC-5 EQUIPMENT PARTS LIST

(See figure 5—50.)

ITEM NO.	PART	MANUFACTURER	PART NO.
1	Filter Choke	Government Furnished	VS-48384
2	Post	Government Furnished	ARC-4667
3	Range Receiver	Government Furnished	R-23A/ARC-5
4	Rack	Government Furnished	MT-63/ARC
5	Post	Government Furnished	ARC-6067
6	Plug	Government Furnished	ARC-9125
7	Quick-Disconnect	Government Furnished	AN753-A1-Tip AN753-B1-Coupler CVC-860-16-10
8	Receptacle	Government Furnished	AN3100-20-27S
9	Plug	Government Furnished	AN3106-20-27P
10	Receptacle	Government Furnished	AN3100-28-11P
11	Plug	Government Furnished	AN3106-28-11S
12	Plug	Government Furnished	ARC-9125
13	Receiver Panel	Government Furnished	C-125/ARC-5
14	Circuit-Breaker	Government Furnished	AN3161-P5

5-195. RT-22/APX-1 IFF TRANSPONDOR.

5-196. DESCRIPTION. (*See figures 5-51 and 5-52.*) The purpose of this equipment is to enable the airplane on which it is installed to identify itself as friendly when it is challenged by appropriately equipped air, ship, and ground forces. The basic units which make up the air and ground installation of the IFF system are the interrogator-responsor and the transpondor, which is carried by the craft to be identified. The F4U-5 airplane is equipped with the transpondor unit, an antenna which serves both receiver and transmitter, a control panel C-119/APX-1 and a destruct circuit. The transpondor is mounted on the left hand portion of the upper shelf in the radio compartment just aft of station 186. Access to this unit is gained through the radio compartment access door.

The receiver section of the transpondor operates on an automatic wide band frequency sweep and will cause the transmitter to reply to any number of incoming signals within the frequency range of the receiver. The control panel for this equipment is mounted on the electrical and radio control shelf at the right hand side of the cockpit. The six different switch positions adjust electronic circuits to transmit different coded replies to interrogation and the emergency position adjusts the electronic circuit to transmit an extremely wide pulse. The impact switch which will cause destruction of the transpondor in the event of a crash-landing is mounted on the bulkhead at station 218.

5-197. OPERATION. The RT-22/APX-1 transpondor may operate on the "A" band, "G" band or "EMERGENCY" switch position. The "A" band consists of six different coded replies which are selected by the setting of the knob on the control panel. The "G" band consists of a fixed frequency, non-coded reply, and is selected by the inboard control panel switch. The "EMERGENCY" position transmits only extremely wide SOS pulses and is selected by turning the six-position switch to the extreme clockwise position. Since these three variations of signal transmission utilize many common circuits, it is not possible to operate more than one circuit at a time. The "A" band operates normally. The tuned circuit of the "A" band is motor-swept from 157 to 187 megacycles during a sweep period of two and one-half seconds, following which there is a brief sweep retrace or "flyback" interval (approximately one-third of a second in duration) before a new sweep is begun. During the sweep itself, interrogation pulses can be received on any frequency in the "A" band range, and reply pulses will be automatically transmitted, pulse for pulse, on the same frequency. These "A" band replies are coded so that in addition to providing general identification responses, the replies may be used to communicate tactical information based on a predetermined code schedule. Coding is accomplished by means of selected combinations of narrow pulses, wide pulses, and blanks. Four sweeps or about eleven seconds are required to transmit a complete code combination. Six combinations are available, as determined by the setting of the selector switch on the control unit. The "A" band may also be used for emergency operation, in which it transmits very wide pulses, which the challenging craft will immediately recognize as an urgent appeal for help. "G" band operation is not used as a substitute for "A" band operation, but serves as an additional function, for special fighter director purposes. It is never used entirely alone but always in conjunction with the "A" band transpondor with which it shares time. Time sharing is accomplished by means of an electronic switching control which alternately switches the "A" band off and on, while simultaneously switching the "G" band on and off. The time-sharing rate is approximately five cycles per second and the operating periods are unequal for the two bands; in each cycle the "G" band is on and the "A" band is off for approximately one-twentieth of a second while the "A" band is on and the "G" band off for approximately three-twentieths of a second. Time sharing occurs when both the "G" and "A" bands are operating. Time sharing begins at once, but due to a holding circuit, the "G" band will continue operation for from ten to twenty seconds after the switch has been turned off.

5-198. REMOVING. (*See figure 5-51.*) Access to the RT-22/APX-1 transpondor is gained through the radio compartment access door. The unit is located on the left hand side of the upper radio mounting shelf.

a. Disconnect the four electrical cable plugs on the front panel of the unit as well as the antenna coupling which is on the left hand upper corner of the front panel.

b. Disconnect the forked-lug end of the bonding jumper from under the head of the screw on the lower left hand corner of the transpondor and retighten the screw so that there will be no danger of its loss.

c. Unscrew the two collars which secure the set to the mounting base until they are free to drop past the lugs.

d. Pull the unit an inch or so toward the front end of the mounting base to disengage the tapered hold-down plungers at the rear. Carefully draw the unit forward and remove it from the mounting base.

e. Remove the six destructors and store them in complete accordance with existing regulations dealing with IFF destructors.

5-199. INSTALLING. The installation of the RT-22/APX-1 is the reverse of the procedure given in paragraph 5-198.

5-200. MAINTENANCE. Since maintenance of electronics equipment is limited to repairs which can be done when the equipment is installed, routine servicing consists only of electrical and ground cable inspection, blown fuse replacement, installation inspection, and the replacement of damaged or broken units. Refer to Handbook CO-AN-08-20-11 for alignment and further maintenance procedures.

5-201. PRE-FLIGHT INSPECTION. To check the operation and test the operation of the various bands and their frequencies, use a BC-906-D frequency meter and a I-196-B signal generator. The frequency meter antenna should be parallel to and not over five feet from the RT-22/APX-1 Transpondor. The signal generator should be placed on the opposite side of the airplane antenna, in line with it and with the frequency meter antenna. In order to calibrate the signal-generator, move it until it is close to the frequency meter and be sure the RT-22/APX-1 Transpondor is inoperative. To set the signal generator and frequency meter to a designated frequency:

a. Throw the "OFF-ON" switches on both test units to the "ON" position and the sensitivity switch on the frequency meter to the "HI" position.

b. Set the frequency meter tuning dial to the designated frequency, referring to the calibration chart provided inside the top cover of the unit.

c. Rotate and adjust the signal generator tuning knob slowly until a maximum needle dip (minimum reading) is obtained on the frequency meter microammeter. Rock the tuning knob for exact resonance. After the designated frequency settings have been obtained, restore the units to their recommended pre-flight locations.

Note

Personnel should move about as little as possible during testing as body capacitance may distort meter readings.

5-202. The following tests shall be made before putting the set into actual operation.

a. Check the "GO" lower-frequency limit of the "A" band transpondor (158 megacycles).

b. Check the "NO-GO" lower-frequency limit of the "A" band transpondor (156 megacycles).

c. Check the "GO" upper-frequency limit of the "A" band transpondor (186 megacycles).

d. Check the "NO-GO" upper-frequency limit of the "A" band transpondor (188 megacycles).

e. Check the operation of the selector switch S-1401 (coded replies), but only if this test is permissible.

f. Check the emergency operation (very wide distress pulses) but only if this is permissible.

g. Set the "G" frequency.

h. Check the "A/G" time-sharing operation (approximately five cycles per second, "A" band on approximately 3/20 second, "G" band on 1/20 second), and the "G" holding period (10 to 20 seconds). See the following chart for a more detailed explanation of tests and note that in each test, the procedures are listed numerically in the order in which they should be completed.

PRE-FLIGHT TRANSPONDOR TESTS

CHECKS AND SETTINGS TO BE PERFORMED	FREQUENCY-METER BC-906-D	SIGNAL GENERATOR I-196-B	CONTROL UNIT C 119/APX	TRANSPONDOR UNIT
Check "A" Band "GO" Lower-Frequency Limit.	1. Set tuning dial to 158 megacycles. 4. Check for small needle dips occurring approx. every 2½ seconds (N N N N code).	2. Tune "I" band for greatest dip of meter in "grid-dip" frequency-meter.	3. S-1801, Pos. "1"	
Check "A" Band "NO-GO" Lower-Frequency Limit.	1. Rotate dial slightly clockwise (lowering frequency) until 2½ second dips cease. 2. Check frequency setting thus obtained (must be no lower than 156 megacycles).	(as set above)	(as set above)	
Check "A" Band "GO" Upper-Frequency Limit.	2. Set tuning dial to 186 megacycles. 5. Check for small needle dips (N N N N code) approximately every 2½ seconds.	3. Tune "I" band for maximum frequency-meter needle dip.	1. S-1801 OFF. 4. S-1801 Pos. "1".	

PRE-FLIGHT TRANSPONDOR TESTS (Continued)

CHECKS AND SETTINGS TO BE PERFORMED	FREQUENCY-METER BC-906-D	SIGNAL GENERATOR I-196-B	CONTROL UNIT C 119/APX	TRANSPONDOR UNIT
Check "A" Band "NO-GO" Upper-Frequency Limit.	1. Rotate dial slightly counterclockwise (raising frequency) until dips cease. 2. Check frequency setting thus obtained (must be no higher than 188 megacycles).	(as set above)	(as set above)	
Check "A" Band Mid-Frequency point.	2. Set tuning dial to 172 megacycles. 5. Check for dip every 2½ seconds as above.	3. Tune "I" band for maximum frequency-meter needle dip.	1. S-1801 OFF. 4. S-1801, Pos. "1".	
Check Selector Switch S-1401 (if permissible).*	2. Check dips for N N code. 4. Check dips for N N N code. 6. Check dips for N N W W code. 8. Check dips for N W code. 10. Check dips for N N W code.	(as set above)	1. S-1801, Pos. "2". 3. S-1801, Pos. "3". 5. S-1801, Pos. "4". 7. S-1801, Pos. "5". 9. S-1801, Pos. "6".	
Check EMERGENCY Operation (if permissible).*	3. Check for very large dips (distress pulses).	(as set above)	1. S-1801, Pos. "1". 2. S-1803 EMERG to ON 4. S-1803 OFF	
Set the Designated "G" Band Frequency (in range 194 to 212 megacycles).	2. Set tuning dial to designated operating "G"-band frequency. 6. Adjust for maximum needle-dips and reset (if necessary) to exact "G" frequency.	3. Tune "G" band for maximum needle-dip of meter in grid-dip frequency meter. Meter dips will pulsate due to time-sharing with "A" band.	1. S-1801, Pos. "1". 4. S-1802 "Cont."	5. Adjust "detent" mechanism 0-501 for maximum frequency-meter dips. 7. Readjust as above (if necessary) after 6.
Check A/G Time-Sharing and "G" Holding.	4. Check for rapid needle fluctuations (above five per sec.). 5. Check that these dips continue for 10 to 20 seconds after step 3; then cease. 7. Check that dips as above occur for 10 to 20 seconds after step 6; then cease.	(as set above)	1. S-1801, Pos. "1". 2. S-1803 "Cont." 3. S-1803 "Out". 6. S-1803 "Temp." for one second, then "Out."	

**Permissible only when tests are performed in an electrically shielded enclosure, or by specific authorization of the commanding officer.*

5-203. DESTRUCT CIRCUIT.

5-204. DESCRIPTION. (*See figure 5-51.*) The destruction of the RT-22/APX-1 Transpondor is accomplished either by manually operating the destruct switch from the cockpit or automatically by the release of the impact switch located adjacent to the Transpondor in the event of a crash-landing. The six destructors are located in jacks on the fore and aft face of the transpondor and extreme care should be taken to insure removal and storage of these destructors before any maintenance work is done on the equipment.

5–205. TESTING.

WARNING

The following paragraph deals with the testing of the destruct circuit and the precautionary measures which must be taken to prevent accidents. THE INSTRUCTIONS IN THIS PARAGRAPH MUST BE FOLLOWED EXACTLY.

The destructors shall not be installed in the transpondor until after the following complete destructor firing circuit test has been made. Voltage checks at the "D" plug (*see figure 5–52*) should include a low range check on a scale reading less than .1 volt as the destructors may explode with a very low voltage applied. Using the following procedure, test the operation of the destruct switch which is located on the control panel.

a. Check to make sure the destructors are removed from the jacks.

b. With the destruct switch in the "OFF" position, check for no voltage at the "D" plug.

c. Raise the guard on the destruct switch, breaking the safety wire, and throw the destruct switch to the "ON" position. Check for full applied voltage.

d. Return the destruct switch to its "OFF" position and secure the guard over the switch with safety wire.

e. Check for no voltage at "D" plug.

5–206. Using the following procedure, check for the proper operation of the impact switch.

a. Check to see that no destructors are installed in the transpondor. As an additional precaution, be sure that the "D" plug is removed from the transpondor.

b. Remove the plastic cover from the destruct switch and trip the pendulum until a sharp snap and the resulting loose swinging of the pendulum indicate that the switch has closed the destruct circuit.

c. Check for full applied voltage at the "D" plug.

d. Reset the impact switch by inserting a screw-driver into the cavity at the right hand side of the switch and turning the sunken screw fully clockwise.

e. Allow the spring-loaded screw to return until it catches. The pendulum should now be centered in the top opening of the case and firmly set.

f. Test the security of this setting by giving the side of the switch housing a sharp blow with the hand. The switch should remain untripped.

g. If the switch is tripped, reset it and repeat the sharp blow on the housing. If the switch fails to hold its setting under this test, remove and replace the switch.

h. If the new installation fails to hold the untripped position under test, check for poor mounting provisions and correct them immediately.

i. After finding the switch test satisfactory, replace and safety the plastic cover checking for tightness of cover fit.

5–207. ANTENNA.

5–208. DESCRIPTION. (*See figure 5–51.*) The AS-32/APX-1 antenna is located on the bottom of the fuselage just forward of station 253. It is connected through a coaxial cable to the antenna coupling unit on the upper left hand corner of the transpondor. It is a mast type and extends downward from the underside of the aircraft.

5–209. REMOVING. The antenna is secured to the bottom skin of the airplane just forward of station 253 by eight screws. Access is gained through the radio compartment access door.

a. Remove the cable connection to the antenna.

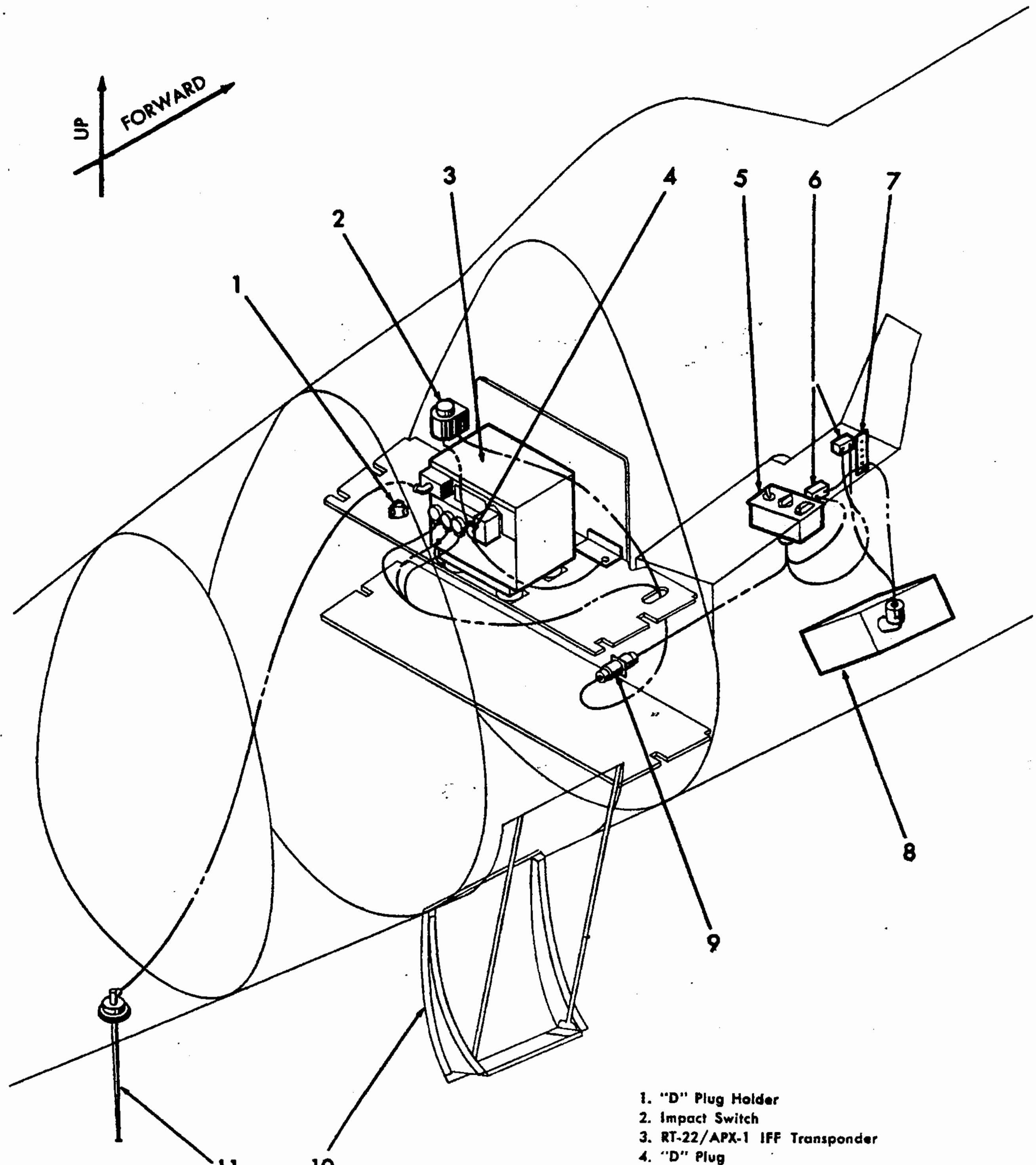
b. Remove the eight screws which secure the antenna.

c. Lift the antenna upward into the fuselage and remove.

5–210. INSTALLING. The installation of the AS-32/APX-1 antenna is the reverse of the removal procedure given in paragraph 5–209.

5–211. POWER SUPPLY.

5–212. DESCRIPTION. The RT-22/APX-1 transpondor derives its low voltage power from the airplane 28 volt source. A voltage regulator gives a steady 19 (plus or minus one) volt output which runs the A9062-2 dynamotor. The high voltage output of the dynamotor is 400 volts and 80 milliamperes. There is a 1/4 ampere fuse in the power line located on the front panel of the transpondor.



1. "D" Plug Holder
2. Impact Switch
3. RT-22/APX-1 IFF Transponder
4. "D" Plug
5. C-119/APX-1 IFF Console Control Panel
6. Circuit Breakers
7. Plus Bus Bar
8. Main Junction Box
9. Bulkhead 186 Cable Disconnects
10. Radio Compartment Access Door (ref.)
11. AS-32/APX-1 Antenna

Figure 5–51. RT-22/APX-1 IFF Transpondor Reference Diagram.

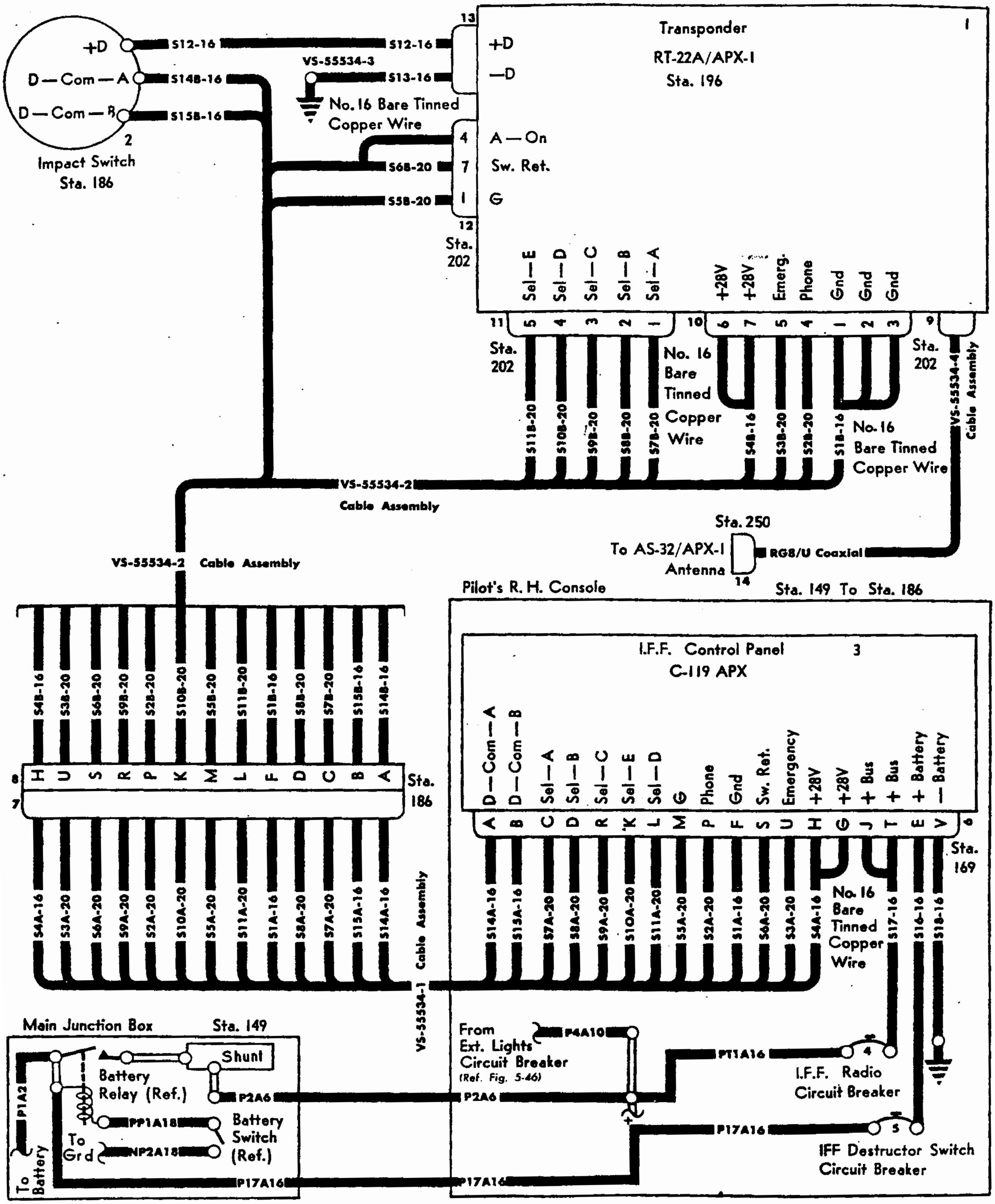


Figure 5-52. RT-22/APX-1 IFF Transpondor Cabling Diagram.

RT-22/APX-1 WIRE TABLE *(See figures 5–51 and 5–52.)*

CABLE ASSEMBLY VS-55534-1

WIRE NO.	WIRE SIZE	WIRE LENGTH INCHES
S1A-16	NAF1070-AN16	24
S2A-20	NAF1070-AN20	24
S3A-20	NAF1070-AN20	24
S4A-16	NAF1070-AN16	24
S5A-20	NAF1070-AN20	24
S6A-20	NAF1070-AN20	24
S7A-20	NAF1070-AN20	24
S8A-20	NAF1070-AN20	24
S9A-20	NAF1070-AN20	24
S10A-20	NAF1070-AN20	24
S11A-20	NAF1070-AN20	24
S14A-16	NAF1070-AN16	24
S15A-16	NAF1070-AN16	24

CABLE ASSEMBLY VS-55534-2

WIRE NO.	WIRE SIZE	WIRE LENGTH INCHES
S1B-16	NAF1070-AN16	48
S2B-20	NAF1070-AN20	48
S3B-20	NAF1070-AN20	48
S4B-16	NAF1070-AN16	48
S5B-20	NAF1070-AN20	48
S6B-20	NAF1070-AN20	48
S7B-20	NAF1070-AN20	48
S8B-20	NAF1070-AN20	48
S9B-20	NAF1070-AN20	48
S10B-20	NAF1070-AN20	48
S11B-20	NAF1070-AN20	48
S14B-16	NAF1070-AN16	134
S15B-16	NAF1070-AN16	134

CABLE ASSEMBLY VS-55534-3

WIRE NO.	WIRE SIZE	WIRE LENGTH INCHES
S12-16	CVC-812-4	—
S13-16	CVC-812-4	—

CABLE ASSEMBLY VS-55534-4

WIRE NO.	WIRE SIZE	WIRE LENGTH INCHES
RG8/U	Coaxial Cable	91

WIRING TO MAIN JUNCTION BOX

WIRE NO.	WIRE SIZE	WIRE LENGTH INCHES
P2A-6	NAF1070-AN6	40
PT1A-16	NAF1070-AN16	16
P17A-16	NAF1070-AN16	48
PP1A-18	NAF1070-AN18	47½

RT-22/APX-1 EQUIPMENT PARTS LIST

(See figure 5–52.)

ITEM NO.	PART	MANUFACTURER	PART OR DRAWING NUMBER
1	Transponder	Government Furnished	RT-22A/APX-1
2	Impact Switch	Walter Kidde & Co. No. 80800	Chance Vought VS-33536
3	IFF Panel	Government Furnished	C-119/APX
4	Circuit-Breaker	Government Furnished	AN3161-P5
5	Circuit-Breaker	Government Furnished	AN3161-P20
6	Plug	Government Furnished	AN3106-22-30S
7	Plug	Government Furnished	AN3106-22-14S
8	Receptacle	Government Furnished	AN3100-22-14P
9	Plug	Government Furnished	NAF47848-1
10	Plug	Government Furnished	NAF68925-1
11	Plug	Government Furnished	NAF68925-3
12	Plug	Government Furnished	NAF68925-2
13	Plug	Government Furnished	NAF68969-2
14	Plug	Government Furnished	Navy Type 49190

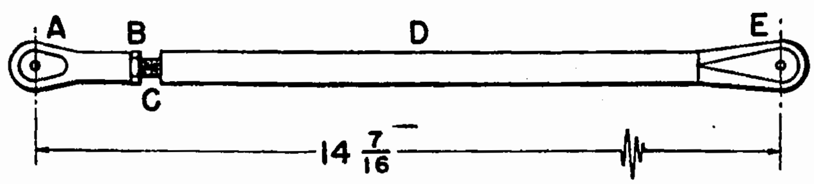
SECTION VI

CHARTS AND TABLES

6–1. SURFACE CONTROL ROD CHART.

6–2. DESCRIPTION. Figure 6–1 is to be used as a reference key in locating the control rods defined in paragraphs 6–3 through 6–6. The numbers to the left of the illustrated rods correspond to callouts on figure 6–1. All dimensions on control rod diagrams are normal.

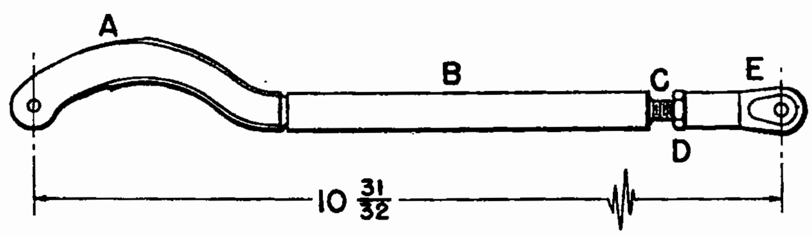
6–3. AILERON CONTROL RODS.



A. VS-24018 Terminal
B. AN316-4R Hex Nut
C. VS-37075 Rod End
D. VS-24016-1 Tube
E. VS-24017 Terminal

Ref. on fig. 6–1.

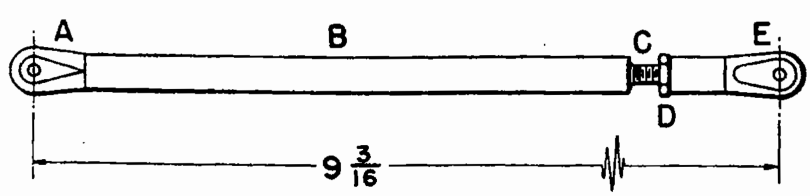
1. VS-24016 Control Rod Assem.—Aileron Balance Tab



A. VS-19809 Fork End
B. VS-19808-1 Tube
C. VS-11991 Rod End
D. AN316-4R Hex Nut
E. VS-11989 Clevis End

Ref. on fig. 6–1.

2. VS-19808 Rod Assem.—Aileron Trim Tab Control



A. VS-59991 Fork End
B. VS-58048-1 Tube
C. VS-11991 Rod End
D. AN316-4R Hex Nut
E. VS-59990 Fork End

Ref. on fig. 6–1.

3. VS-58048 Rod Assem.—Aileron Tab Actuator

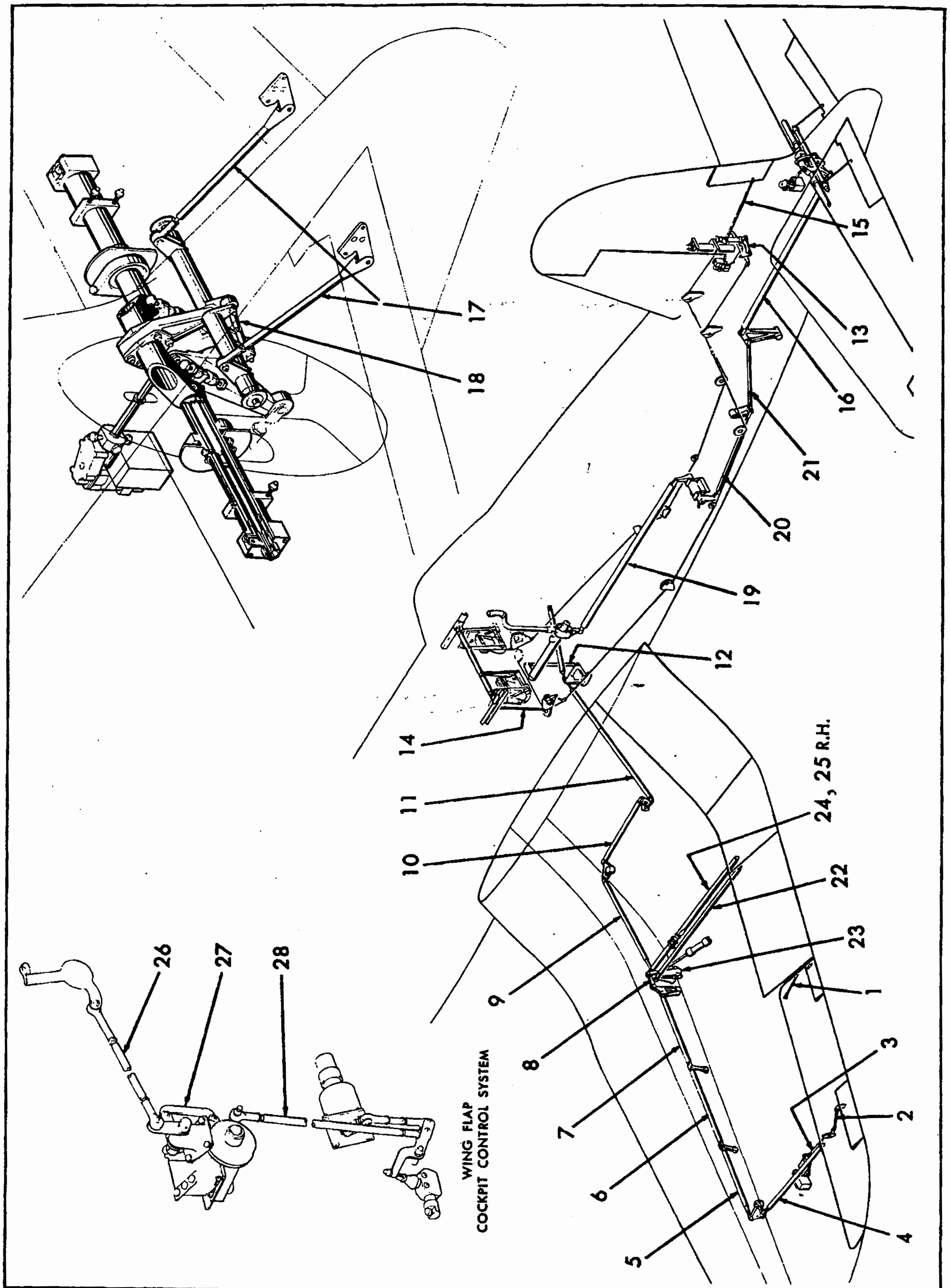
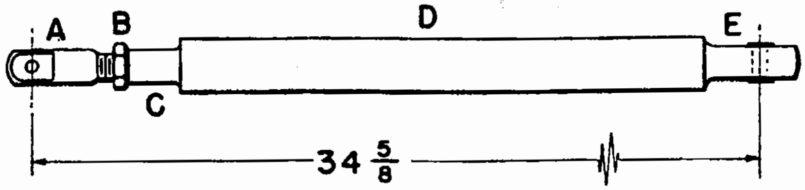


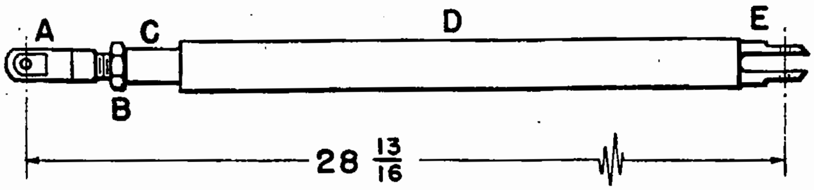
Figure 6–1. Surface Control Rod Reference Diagram.



A. CV-55449 Fork End
B. AN316-9R Check Nut
C. VS-10947 Rod End
D. VS-10944-1 Tube
E. VS-10949 Rod End

Ref. on fig. 6—1.

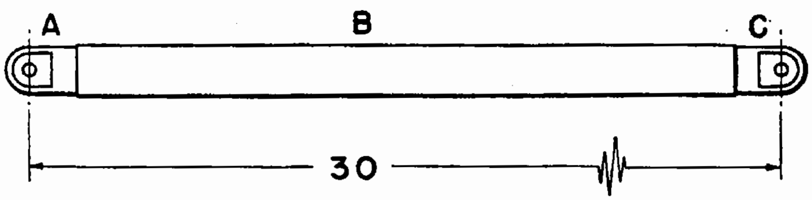
4. VS-10944 Pushrod Assem.—O.P. Sta. 107-Aileron Control



A. CV-41435 Fork End
B. AN316-9R Check Nut
C. VS-10946-2 Rod End
D. VS-10943-1 Tube
E. VS-10952 Fork End

Ref. on fig. 6—1.

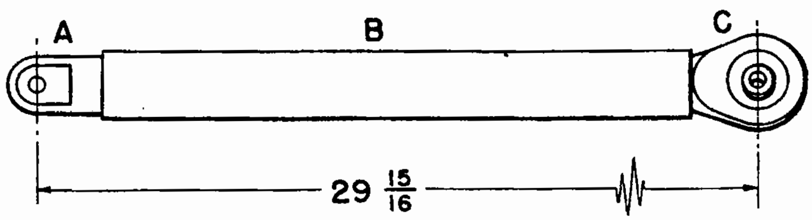
5. VS-10943 Pushrod Assem.—O.P. Sta. 68-107—Aileron Control



A. VS-10952 Fork End
B. VS-10942-1 Tube
C. VS-10952 Fork End

Ref. on fig. 6--1.

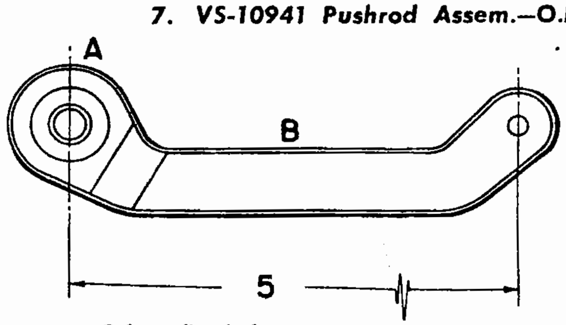
6. VS-10942 Pushrod Assem.—O.P. Sta. 38-68—Aileron Control



A. VS-10945 Fork End
B. VS-10941-1 Tube
C. VS-10948 Rod End

Ref. on fig. 6—1.

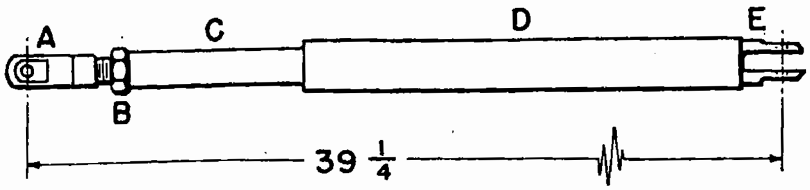
7. VS-10941 Pushrod Assem.—O.P. Sta. 0-38—Aileron Control



A. AN201-K6A Ball Bearing
B. VS-10486-2 Link (Machined)

Ref. on fig. 6—1.

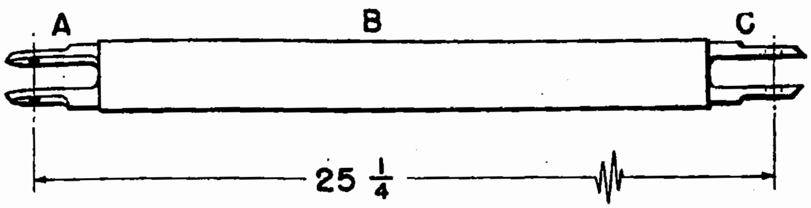
8. VS-10486 Link Assem.—O.P. Wing Hinge—Aileron Control



A. CV-41435 Fork End
B. AN316-9R Check Nut
C. VS-10946-1 Rod End
D. VS-10940-1 Tube
E. VS-10951 Fork End

Ref. on fig. 6–1.

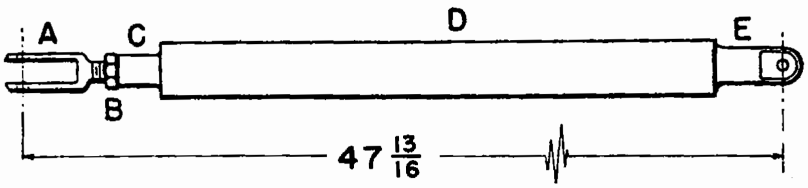
9. VS-10940 Pushrod Assem. No. 3—C. S. Aileron Control



A. VS-13419 Fork End
B. VS-10939-1 Tube
C. VS-13419 Fork End

Ref. on fig. 6–1.

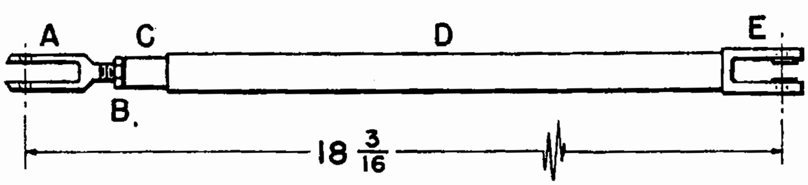
10. VS-10939 Pushrod Assem. No. 2—C. S. Aileron Control



A. CV-56418 Fork End
B. AN316-6R Check Nut
C. VS-13418 Rod End
D. VS-10938-1 Tube
E. VS-12480 Fork End

Ref. on fig. 6–1.

11. VS-10938 Pushrod Assem. No. 1—C. S. Aileron Control

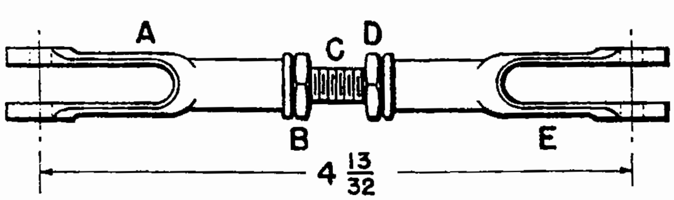


A. CV-56418 Fork End
B. AN316-6R Check Nut
C. VS-44143 Socket
D. VS-44141 Tube
E. VS-44142 Rod End Assy.

Ref. on fig. 6–1.

12. VS-44140 Rod Assem.—Fwd. Fuse Unit Sta. 134—Aileron Control

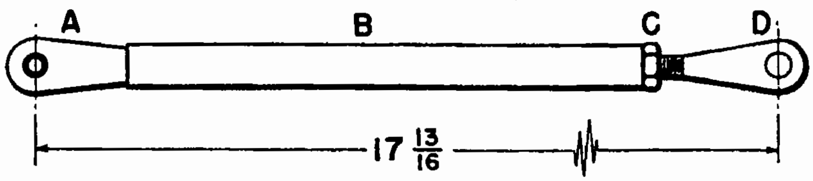
6–4. RUDDER CONTROL RODS.



A. AN486-3 Clevis
B. AN316-4R Nut
C. VS-58018 Stud
D. AN316-4R Nut
E. AN486-3 Clevis

Ref. on fig. 6–1.

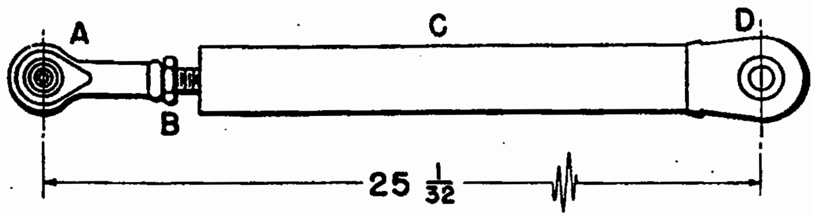
13. VS-58017 Link Assem.—Spring Tab—Jackshaft



A. VS-53941 Eye End Assem.
B. VS-54706 Rod
C. VS-44164 Socket
D. VS-44163 Rod End

Ref. on fig. 6—1.

14. VS-54705 Rod Assem.—Fwd. Fuse Unit—Adjustable Rudder Pedal

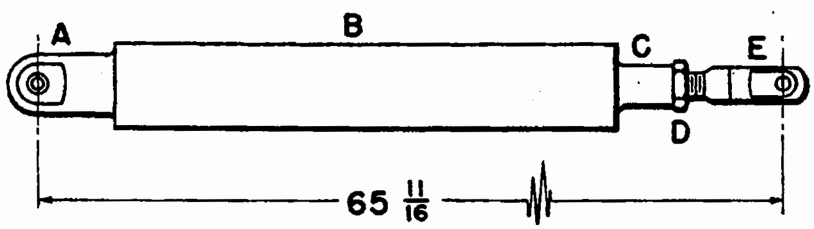


A. CVC-700-REB3N Rod End Bearing
B. AN316-4R Nut
C. VS-58020-1 Tube
D. VS-58021 Terminal

Ref. on fig. 6—1.

15. VS-58020 Rod Assem.—Spring Tab Push—Rudder

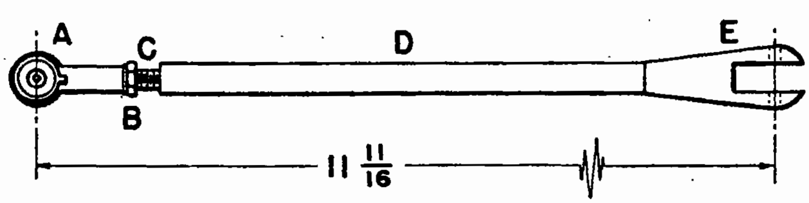
6–5. ELEVATOR CONTROL RODS.



A. VS-10478 Rod End
B. VS-10474-1 Tube
C. VS-10479 Socket
D. AN316-9R Hex Nut
E. VS-10482 Fork End

Ref. on fig. 6—1.

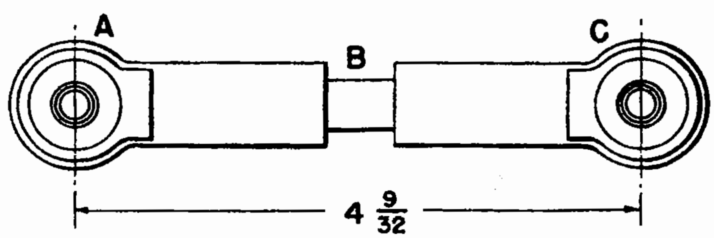
16. VS-10474 Rod Assem.—Fuse. Sta. 284¾—349—Elevator Control



A. CVC-700-REB3N Rod End Bearing
B. AN316-4R Hex Nut
C. VS-12175 Stud
D. VS-12173-1 Tube
E. VS-12174-1 Terminal

Ref. on fig. 6—1.

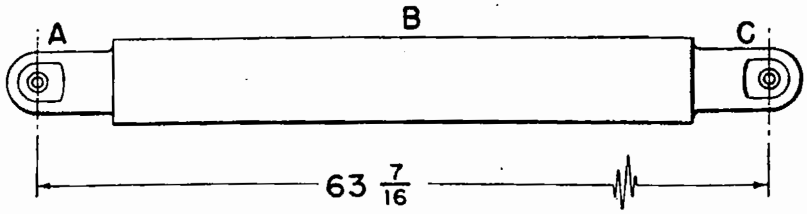
17. VS-12173 Push Tube Assem.—Tab Control—Elevator



A. CVC-698-RE4H6 Bearing
B. VS-58080-1 Rod
C. CVC-698-RE4H6 Bearing

Ref. on fig. 6—1.

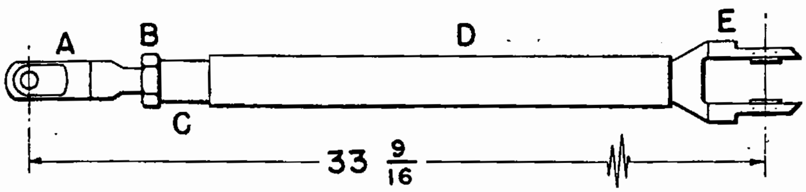
18. VS-58080 Link Assem.—Sta. 349.84 Tab Actuating—Elevator



A. VS-10478 Rod End Assy.
B. VS-58121-1 Tube
C. VS-10478 Rod End Assy.

Ref. on fig. 6–1.

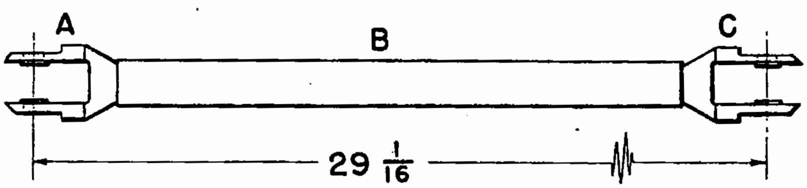
19. VS-58121 Rod Assembly—Fuse. Sta. 155⅜-220¼—Elevator Control



A. VS-10482 Fork End
B. AN316-9R Hex Nut
C. VS-47863-5 Socket
D. VS-58127-1 Tube
E. VS-47863-3 Fork End Assem.

Ref. on fig. 6–1.

20. VS-58127 Rod Assem.—Fuse. Sta. 220¼-253⅛—Elevator Control

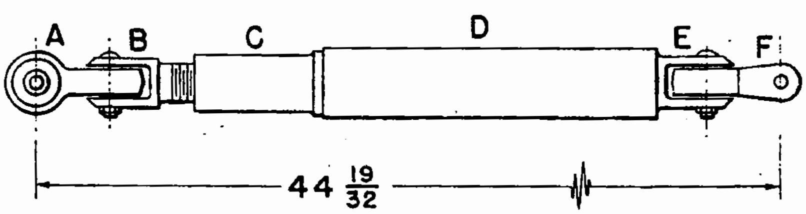


A. VS-47863-3 Fork End Assem.
B. VS-58136 Rod Assem.
C. VS-47863-3 Fork End Assem.

Ref. on fig. 6–1.

21. VS-58136 Rod Assem.—Fuse. Sta. 253⅛-284¾—Elevator Control

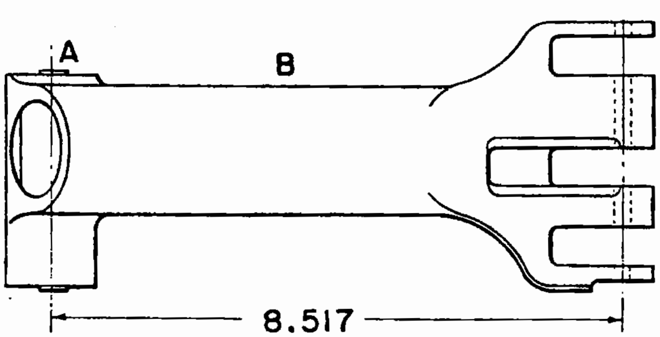
6–6. FLAP CONTROL RODS.



A. VS-10926 Universal
B. VS-10928 Swivel End
C. VS-10924 Rod End
D. VS-44720-1 Tube
E. VS-10925 Rod End
F. CV-56410 Universal

Ref. on fig. 6–1.

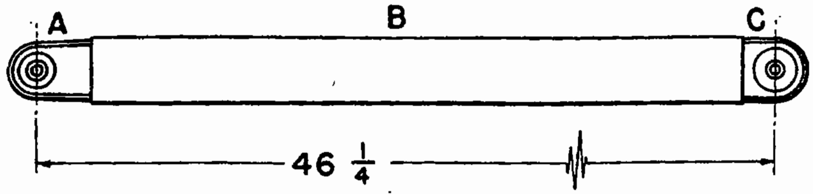
22. VS-10922 Rod Assem.—O.P. Flap Hyd. Operating



A. AN200-K4 Bearing
B. VS-10911-1 Forging (Machined)

Ref. on fig. 6–1.

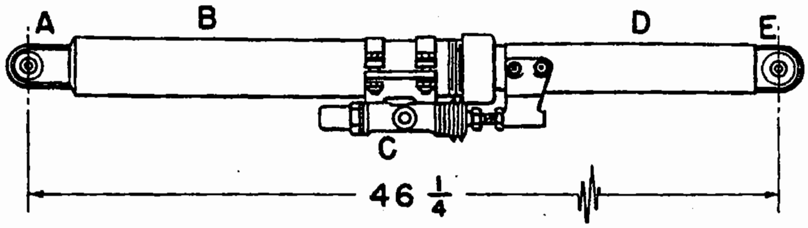
23. VS-10911 Lever—C. S. Flap Hyd. Operating



A. VS-10967 Terminal
B. VS-10966-1 Tube
C. VS-10937 Terminal

Ref. on fig. 6–1.

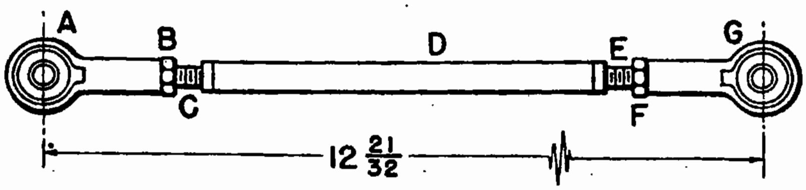
24. VS-10966 Rod Assem.—C. S. L.H. Flap Hyd. Operating



A. VS-10931 Terminal Assem.
B. VS-10930 Housing Assem.
C. VS-44913 By-Pass Valve
D. VS-10936 Tube Assem.
E. VS-10937 Terminal Assem.

Ref. on fig. 6–1.

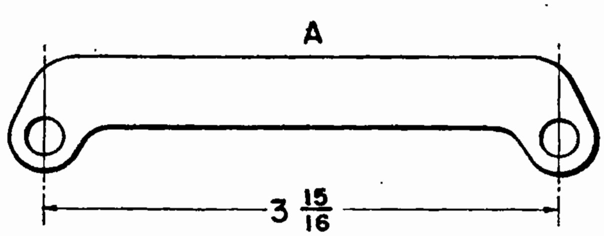
25. VS-44915 Rod Assem.—C. S. R.H. Flap Hyd. Operating



A. CVC-700-REB3N Rod End Bearing
B. AN316-4R Hex Nut
C. AN490-6P Rod End
D. VS-44728-16 Tube
E. AN490-6P Rod End
F. AN316-4R Hex Nut
G. CVC-700-REB3N Rod End Bearing

Ref. on fig. 6–1.

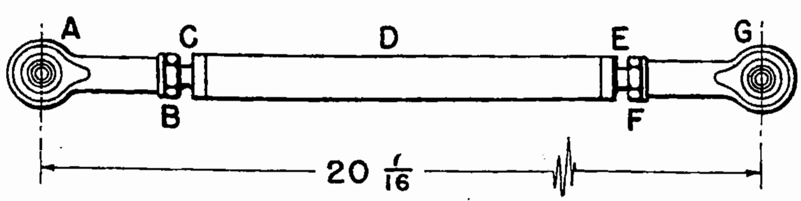
26. VS-44728-15 Rod Assem.—Front Fuse. Unit—Flap Operating



A. Made from 4130 Sheet Steel

Ref. on fig. 6–1

27. VS-54340 Link—Front Fuse. Unit Sta. 149 7/32—Flap Valve Operating



A. CVC-700-REB3N Rod End Bearing
B. AN316-4R Hex Nut
C. AN490-8P Rod End
D. VS-54345-1 Tube
E. AN490-8P Rod End
F. AN316-4R Hex Nut
G. CVC-700-REB3N Rod End Bearing

Ref. on fig. 6–1.

28. VS-54345 Rod Assem.—Front Fuse. Unit—Flap Control

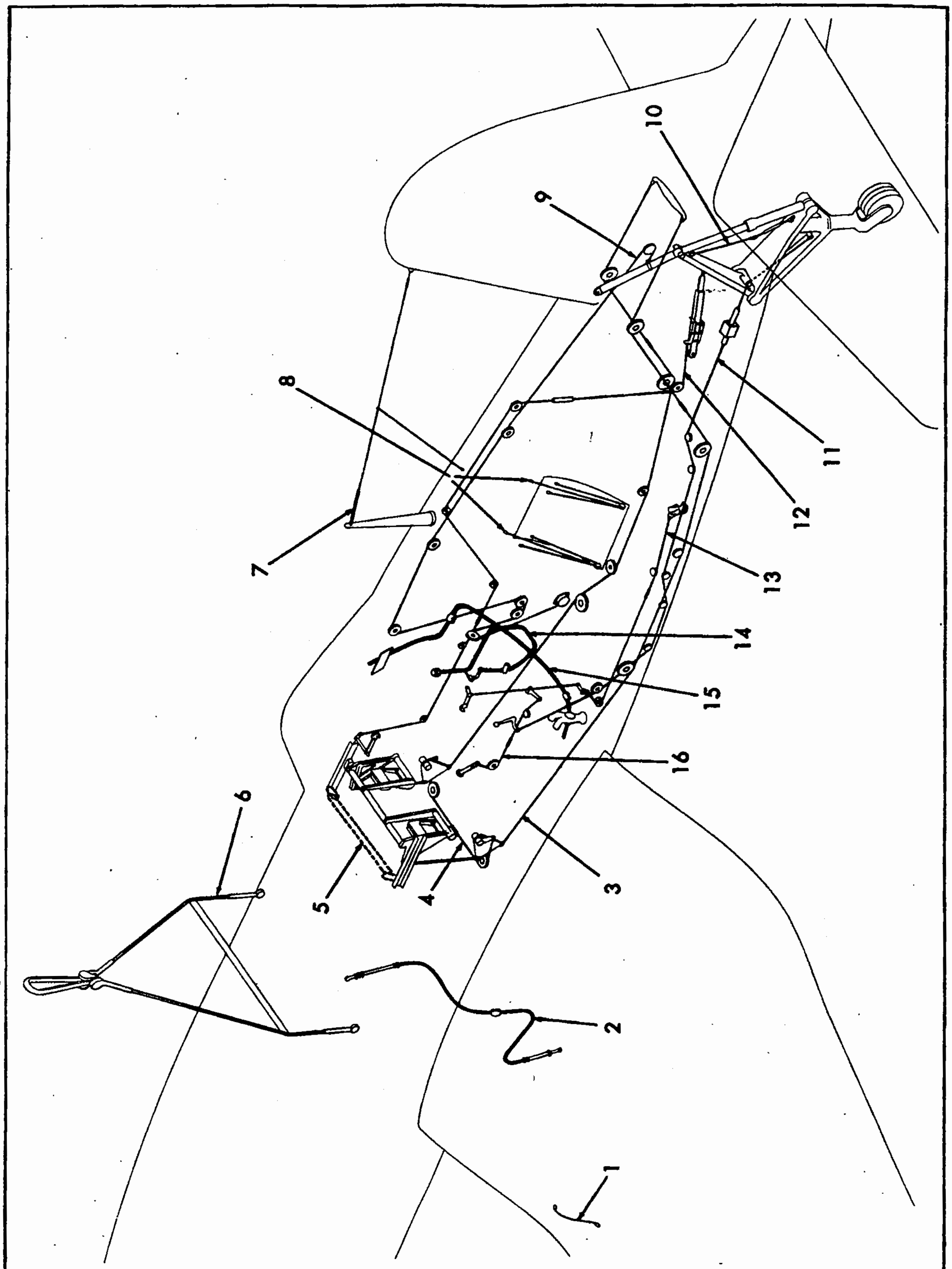
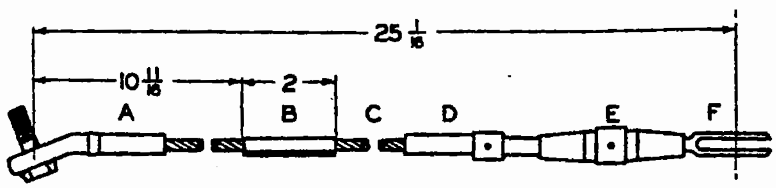


Figure 6–2. (Sheet 1 of 3 Sheets.) Flexible Cable and Chain Assemblies Reference Diagram.

6–6A. FLEXIBLE CABLE MANUFACTURING CHART.

6–6B. DESCRIPTION. Figure 6–2 (sheets 1, 2 and 3) is a master reference diagram to be used in locating the cables illustrated in paragraphs 6–6C through 6–6V. The numbers preceding the title beneath each cable illustration correspond to callouts on the three sheets of figure 6–2.

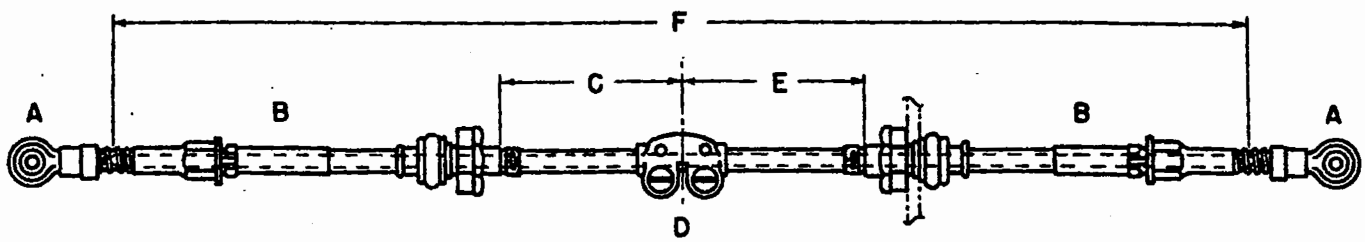
6–6C. LANDING GEAR LIFTING DEVICE CABLE.



			Dia.
A	VS-38449	Terminal	
B	VS-38451-1	Wrapper	
C	VS-38451-3	Cable	3/16
D	VS-38447	Terminal	
E	AN155-46S	Barrel	
F	VS-38446	Fork	

1. VS-38451 Cable Assem. — Landing Gear Lifting Device

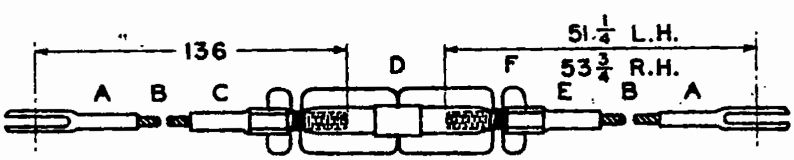
6–6D. OIL COOLER DOOR CONTROL INSTALLATION TELEFLEX CABLE.



			Length
A	CVC-1209-2	End (SD145A-2)	
B	CVC-1225-20	Teleflex Unit (SA159A-20)	
C	VS-57993-11	Conduit (SA116-1-186)	18.6
D	CVC-1203-1	Connector (SA115A-1)	
E	VS-57993-13	Conduit (SA116-1-307)	30.7
F	CVC-1201-2-660	Cable (SA118A-2-660)	66

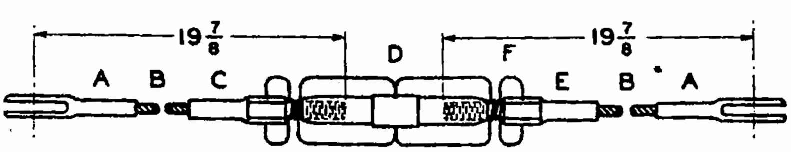
2. VS-59651 Teleflex Cable — Oil Cooler Door Automatic Control Installation

6–6E. RUDDER CONTROL CABLES AND PEDAL ADJUSTMENT CHAINS.



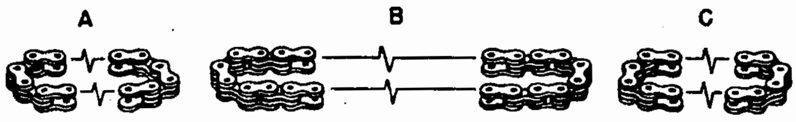
			Dia.
A	AN667-5	Terminal	
B	Spec. AN-RR-C-43	Cable	5/32
C	AN669-S5RH	Terminal	
D	AN155-32S	Barrel	
E	AN669-S5LH	Terminal	
F	Spec. AN-QQ-W-435	Safety Wire	.032 or .041

3. VS-55404 (Ref.) L.H. and R.H. Rudder Control Cables



			Dia.
A	AN667-4	Terminal	
B	Spec. AN-RR-C-43	Cable	1/8
C	AN669-S4LH	Terminal	
D	AN155-32S	Barrel	
E	AN669-S4RH	Terminal	
F	Spec. AN-QQ-W-435	Safety Wire	.032 or .041

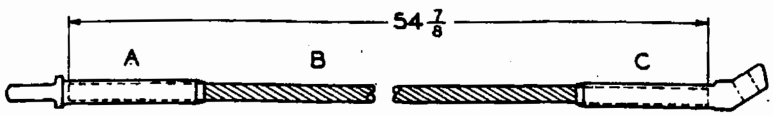
4. VS-55410 (Ref.) Cable — Rudder Pedal



			Length
A	CVC-1002-35	Chain	11.0
B	CVC-1002-147	Chain	46.3
C	CVC-1002-43	Chain	13.5

5. VS-55410 (Ref.) Chain — Pedal Adjustment

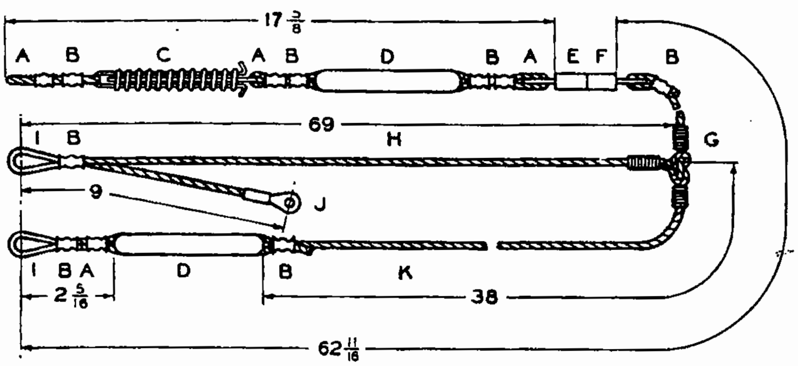
6–6F. HOIST SLING CABLES.



			Dia.
A	VS-78503	Terminal (2 req.)	
B	VS-78495-4	Cable (2 req.)	5/8
C	VS-44002-3	Terminal (2 req.)	

6. VS-78495-2 Cables — Hoist Sling

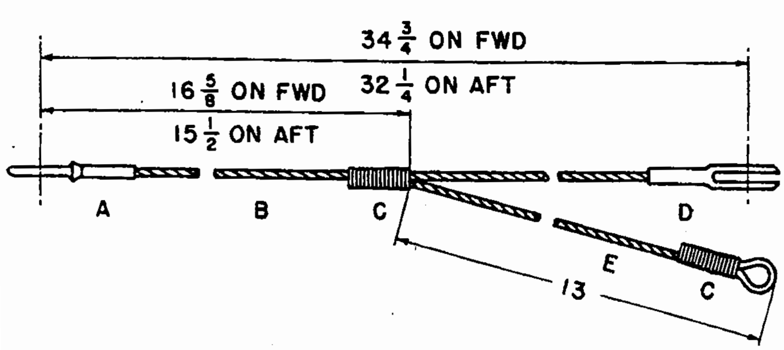
6–6G. AN/ARC-5 L.F. COMMUNICATIONS ANTENNA.



A	VS-55170-5	Loop Wire
B	CVC-629-1	Sleeve
C	NAF 1086-5	Spring
D	NAF 38787-2	Strain Insulator
E	VS-19159-1	Link
F	VS-19159-2	Link
G	VS-55170-6	Serving Wire
H	VS-55170-3	Antenna Wire
I	AN100C-3	Thimble
J	CVC-880-11	Terminal
K	VS-55170-4	Antenna Wire

7. VS-55170 Antenna Instal. — Radio System AN/ARC-5 L.F. Communications

6–6H. RADIO COMPARTMENT ACCESS DOOR CABLES.

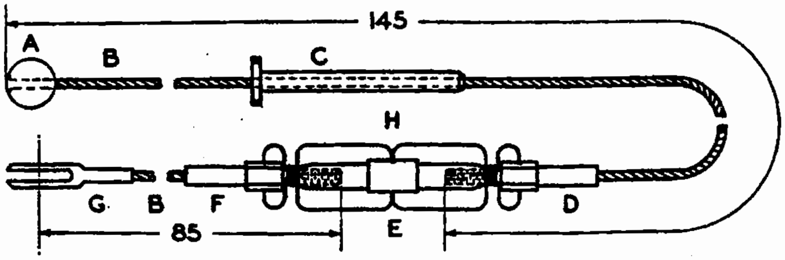


			Dia.
A	AN668-2	Terminal	
B	Spec. AN-RR-C-48	Cable	1/16
C	AN-W-22	Wire	1/32
D	AN667-2	Terminal	
E	Spec. AN-RR-C-48	Cable	1/32

Wrap cables with wire — sweat solder using 50-50 tin lead solder SPEC. QQ-S-571 Class A with resin core or with resin and alcohol flux.

8. VS-53351 Cable Assem. — Radio Compt. Access Door Support

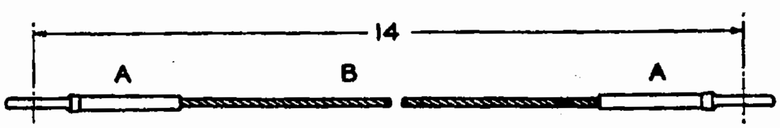
6—6J. PILOT'S RETRACTABLE STEP ACTUATING CABLE.



		Dia.
A	VS-57505-2 Plug	
B	Spec. AN-RR-C-43 Cable	1/16
C	VS-57450 Sleeve	
D	AN666-2RH Terminal	
E	AN155-8S Barrel	
F	AN666-2LH Terminal	
G	AN667-2 Terminal	
H	Spec. AN-QQ-W-435 Safety Wire	.032 or .041

9. VS-55802 Cable — Pilot's Retractable Step

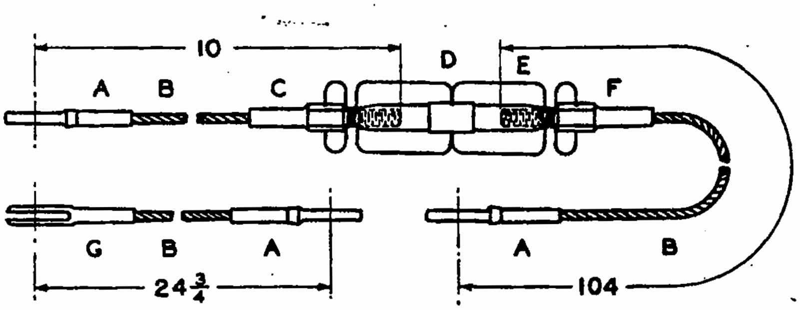
6—6K. TAIL GEAR SHOCK STRUT COMPRESSING CABLE.



		Dia.
A	AN668-10 Terminal	
B	Spec. AN-RR-C-43 Cable	5/16

10. VS-55226 (Ref.) Cable — Tail Gear Shock Strut Compressing

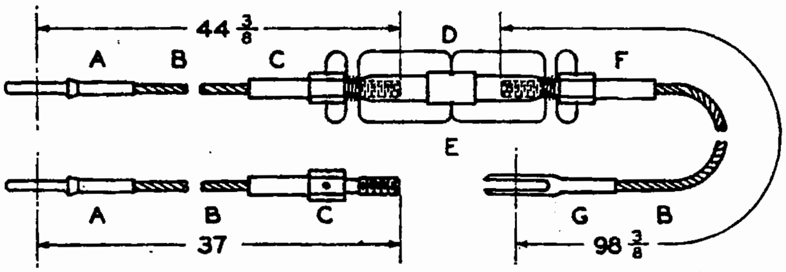
6—6L. TAIL WHEEL LOCK CABLE.



		Dia.
A	AN668-3 Terminal	
B	Spec. AN-RR-C-43 Cable	3/32
C	AN669-S3RH Terminal	
D	AN155-16S Barrel	
E	Spec. AN-QQ-W-435 Safety Wire	.032 or .041
F	AN669-S3LH Terminal	
G	AN667-3 Terminal	

11. VS-58884 Cable — Tail Wheel Lock

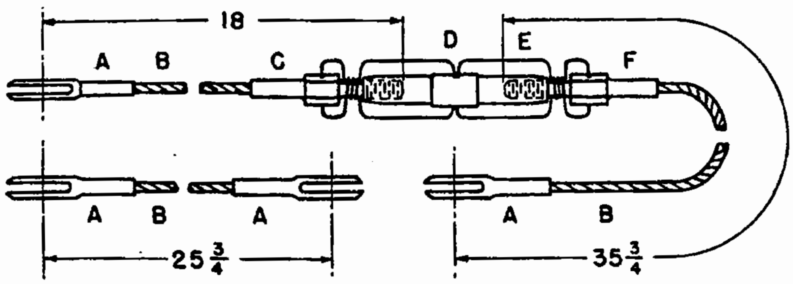
6—6M. ARRESTING HOOK CONTROL CABLE.



		Dia.
A	AN668-3 Terminal	
B	Spec. AN-RR-C-43 Cable	3/32
C	AN669-S3LH Terminal	
D	AN155-16S Barrel	
E	Spec. AN-QQ-W-435 Safety Wire	.032 or .041
F	AN669-S3RH Terminal	
G	AN667-3 Terminal	

12. VS-55493 Cable Control Instal. — Arresting Hook

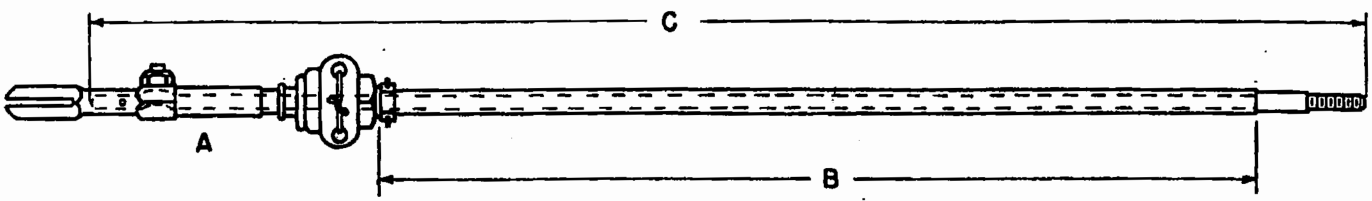
6—6N. TOW TARGET RELEASE CABLE.



		Dia.
A	AN667-2 Terminal	
B	Spec. AN-RR-C-43 Cable	1/16
C	AN669-S2LH Terminal	
D	AN155-8S Barrel	
E	Spec. AN-QQ-W-435 Safety Wire	.032 or .041
F	AN669-S2RH Terminal	

13. VS-58722 Cable — Tow Target Release

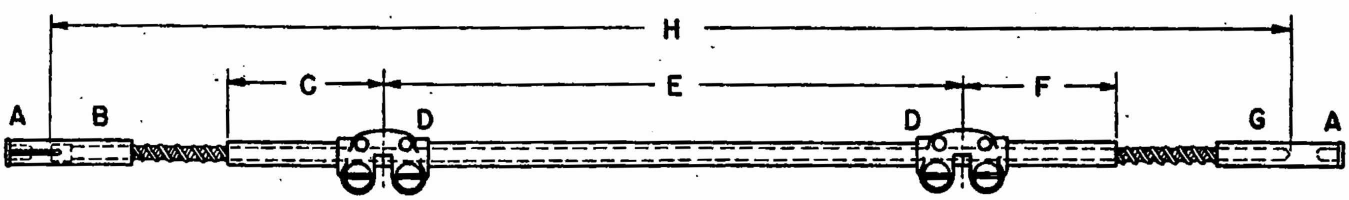
6—6P. PILOT'S SEAT CONTROL TELEFLEX CABLE.



		Length
A	VS-58761 Telescopic Unit (B5032)	
B	VS-54634-8 Conduit (SA116-1-439)	43.9
C	CVC-1207-502 Cable Assem. (B5069-502)	52.45

14. VS-59519 Teleflex Cable — Pilot's Seat Locking Pin Control

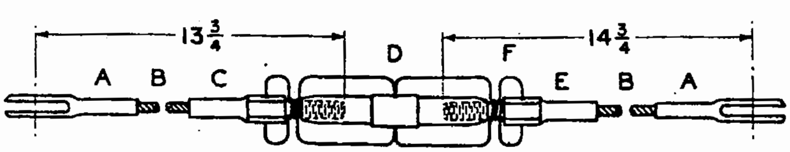
6—6Q. HEATING AND VENTILATING SYSTEM TELEFLEX CONTROL CABLE.



		Length			
A	CVC-1208-1 Plug		E	VS-54634-3 Conduit (SA116-1-318)	31.8
B	VS-54634-1 Conduit (SA116-1-35)	3.5	F	VS-54634-4 Conduit (SA116-1-60)	6
C	VS-54634-2 Conduit (SA116-1-272)	27.2	G	VS-54634-5 Conduit (SA116-1-35)	3.5
D	CVC-1203-1 Connector (SA115A-1)		H	VS-47972-7 Cable Assem.	71.3

15. VS-59180 Teleflex Cable — Heating and Ventilating

6—6R. SHOULDER HARNESS LOCK CONTROL CABLE.



		Dia.
A	AN667-2 Terminal	
B	Spec. AN-RR-C-43 Cable	1/16
C	AN669-S2LH Terminal	
D	AN155-8S Barrel	
E	AN669-S2RH Terminal	
F	Spec. AN-QQ-W-435 Safety Wire	.032 or .041

16. VS-55876 Cable — Pilot's Shoulder Harness Reel

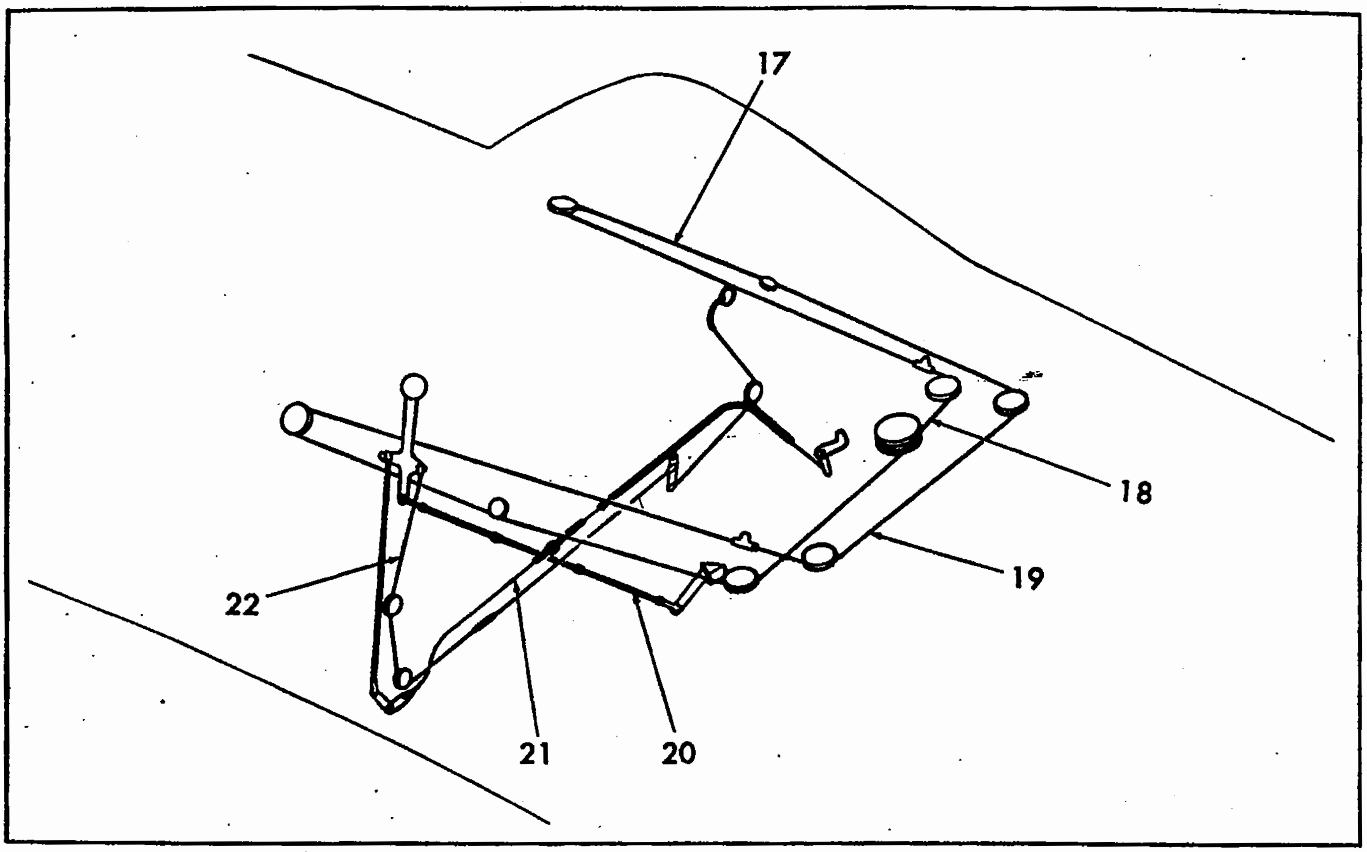
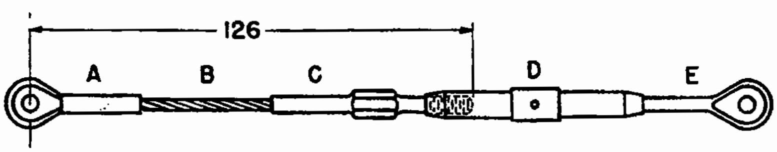


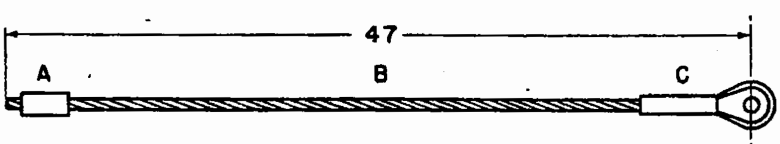
Figure 6–2. (Sheet 2 of 3 Sheets.) Flexible Cable Assemblies Reference Diagram.

6–6S. COCKPIT CABIN SLIDING SECTION CONTROL CABLES.



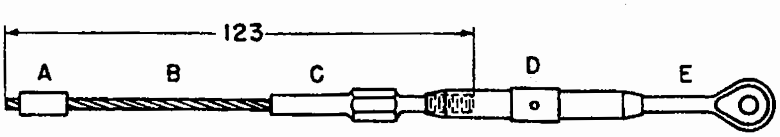
			Dia.
A	VS-57639	Terminal	
B	VS-55808-1	Cable	3/32
C	AN669-S3LH	Terminal	
D	AN155-16S	Barrel	
E	AN165-16S	Eye	

17. VS-55808 Cable Assem. — Sliding Section



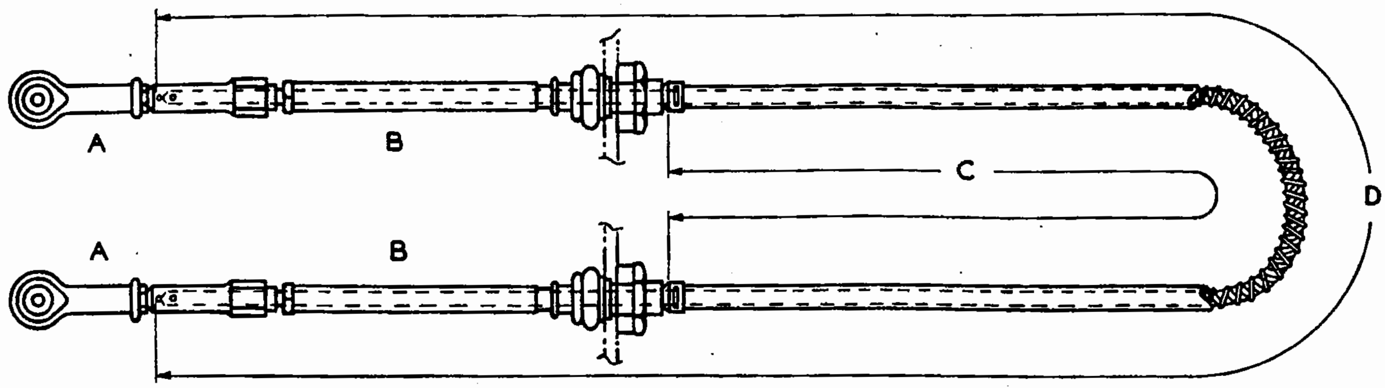
			Dia.
A	VS-57642	Stop	
B	VS-55855-1	Cable	3/32
C	VS-57639	Terminal	

18. VS-55855 Cable Assem. — Sliding Section



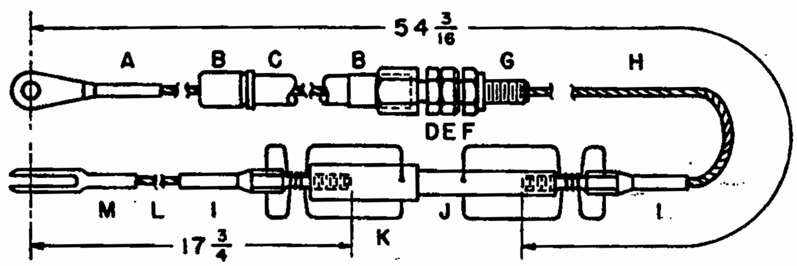
			Dia.
A	VS-57642	Stop	
B	VS-55862-1	Cable	3/32
C	AN669-S3LH	Terminal	
D	AN155-16S	Barrel	
E	AN165-16S	Eye	

19. VS-55862 Cable Assem. — Sliding Section



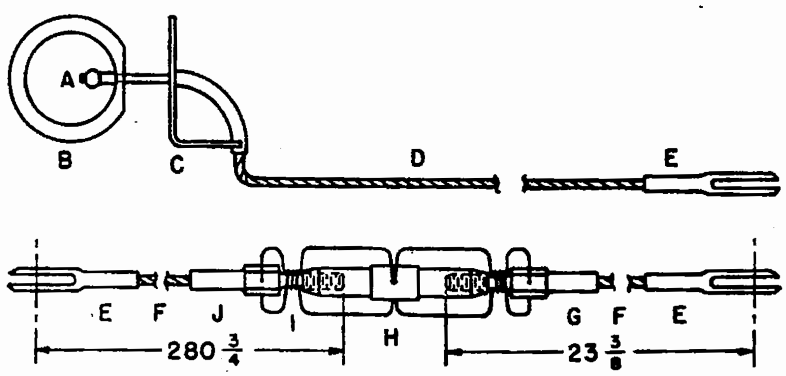
			Length
A	CVC-700-REB3N	Rod End	
B	CVC-1222-20	Telescopic Unit (SA159A-20)	
C	CVC-1202-1-112	Conduit (SA116-1-112)	11.2
D	CVC-1201-2-281	Cable (SA118A-2-281)	28.1

20. VS-55211 Teleflex Cable — Sliding Section



			Dia.
A	AN668-2	Eye Terminal	
B	AN8004-1	Cap	
C	AN8016-3-45¼	Casing	
D	AN316-4R	Check Nut	
E	AN345-416	Hex Nut	
F	AN364-428	Stop Nut	
G	AN8005-1	Stop	
H	VS-53307-1	Cable	1/16
I	AN669-S2RH	Terminal	
J	VS-53305	Turnbuckle	
K	Spec. AN-QQ-W-435	Safety Wire	.032 or .041
L	Spec. AN-RR-C-43	Cable	1/16
M	AN667-2	Terminal	

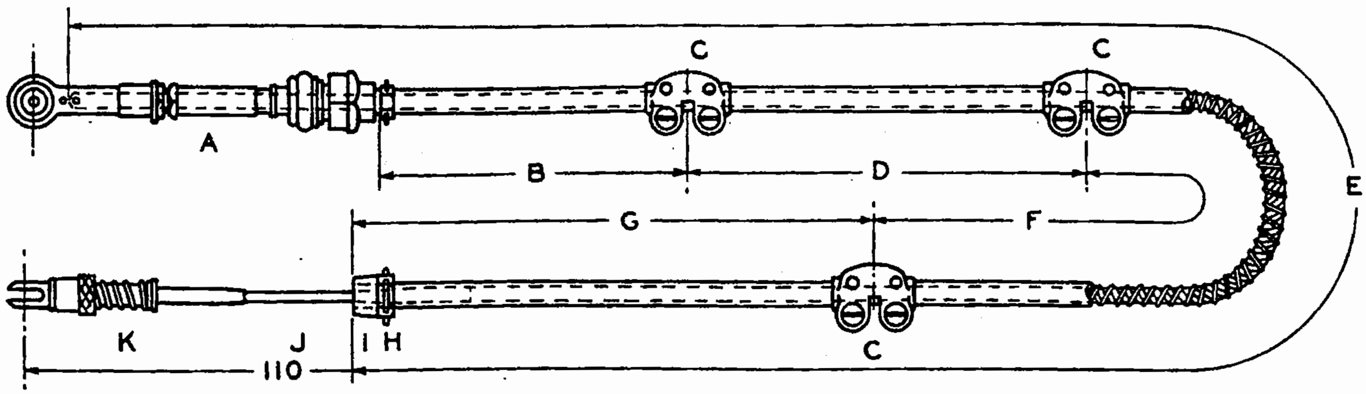
21. VS-55831 Cable Assem. — Safety Stop — Sliding Section



			Dia.
A	AN664-2	Terminal	
B	VS-57654	Ring	
C	VS-55866	Guide	
D	VS-55893-1	Cable	1/16
E	AN667-2	Terminal	
F	Spec. AN-RR-C-43	Cable	1/16
G	AN669-S2LH	Terminal	
H	AN155-8S	Barrel	
I	Spec. AN-QQ-W-435	Safety Wire	.032 or .041
J	AN669-S2RH	Terminal	

22. VS-55832 Cable Assem. — External Release — Sliding Section

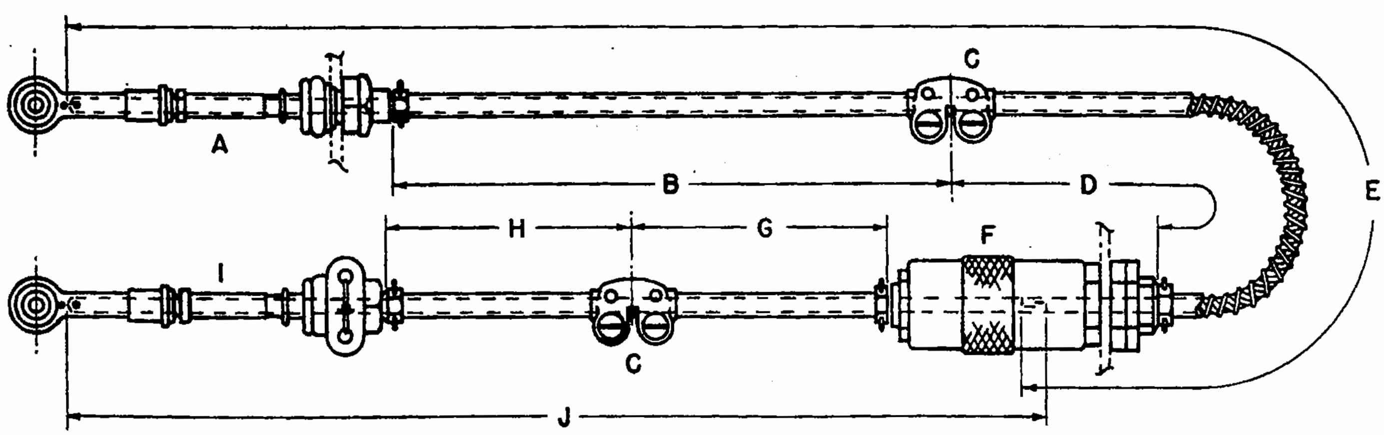
6–6T. WING HINGE PIN LOCK TELEFLEX CABLES.



			Length
A	CVC-1231-14	Swivel End (SA134A-14)	
B	VS-54346-3 (L.H.)	Conduit (SA116-1-269)	26.9
	VS-54346-4 (R.H.)	Conduit (SA116-1-255)	25.5
C	CVC-1203-1	Connector (SA115A-1)	
D	VS-54346-2 (L.H.)	Conduit (SA116-1-373)	37.3
	VS-54346-5 (R.H.)	Conduit (SA116-1-410)	41
E	VS-54346-1 (L.H.)	Conduit (SA116-1-659)	65.9
	VS-42128-7 (R.H.)	Conduit (SA116A-1-24$^{11}/_{16}$)	24$^{11}/_{16}$
F	CVC-1201-2-1800 (L.H.)	Cable (SA118A-2-1800)	180
	CVC-1201-2-1440 (R.H.)	Cable (SA118A-2-1440)	144
G	VS-42128-1 (L.H.)	Conduit (SA116A-1-40$^{3}/_{16}$)	40$^{3}/_{16}$
	VS-42128-8 (R.H.)	Conduit (SA116A-1-37$^{3}/_{16}$)	37$^{3}/_{16}$
H	CVC-1221-16	Swivel End (SA159A-16)	

23. VS-58133 Teleflex Cables — Wing Hinge Pin Lock

6–6U. ENGINE CONTROLS TELEFLEX CABLES.



			Length				Length
A	CVC-1221-25	Telescopic Unit (SA159A-25)		F	CVC-1205-1	Quick Disconnect (XA178A-1)	
B	VS-57993-3	Conduit (SA116-1-143)	14.3	G	VS-57993-15	Conduit (SA116-1-757)	75.7
C	CVC-1203-1	Connector (SA115A-1)		H	VS-57993-16	Conduit (SA116-1-448)	44.8
D	VS-57993-6	Conduit (SA116-1-484)	48.4	I	CVC-1231-24	Telescopic Unit (SA134A-24)	
E	CVC-1206-743	Cable (SA271A-74$^{5}/_{16}$)	74.3	J	CVC-1206-1297	Cable (SA271A-129$^{3}/_{4}$)	129.7

24. VS-55301 Teleflex Cable — Engine Controls — Propeller Governor

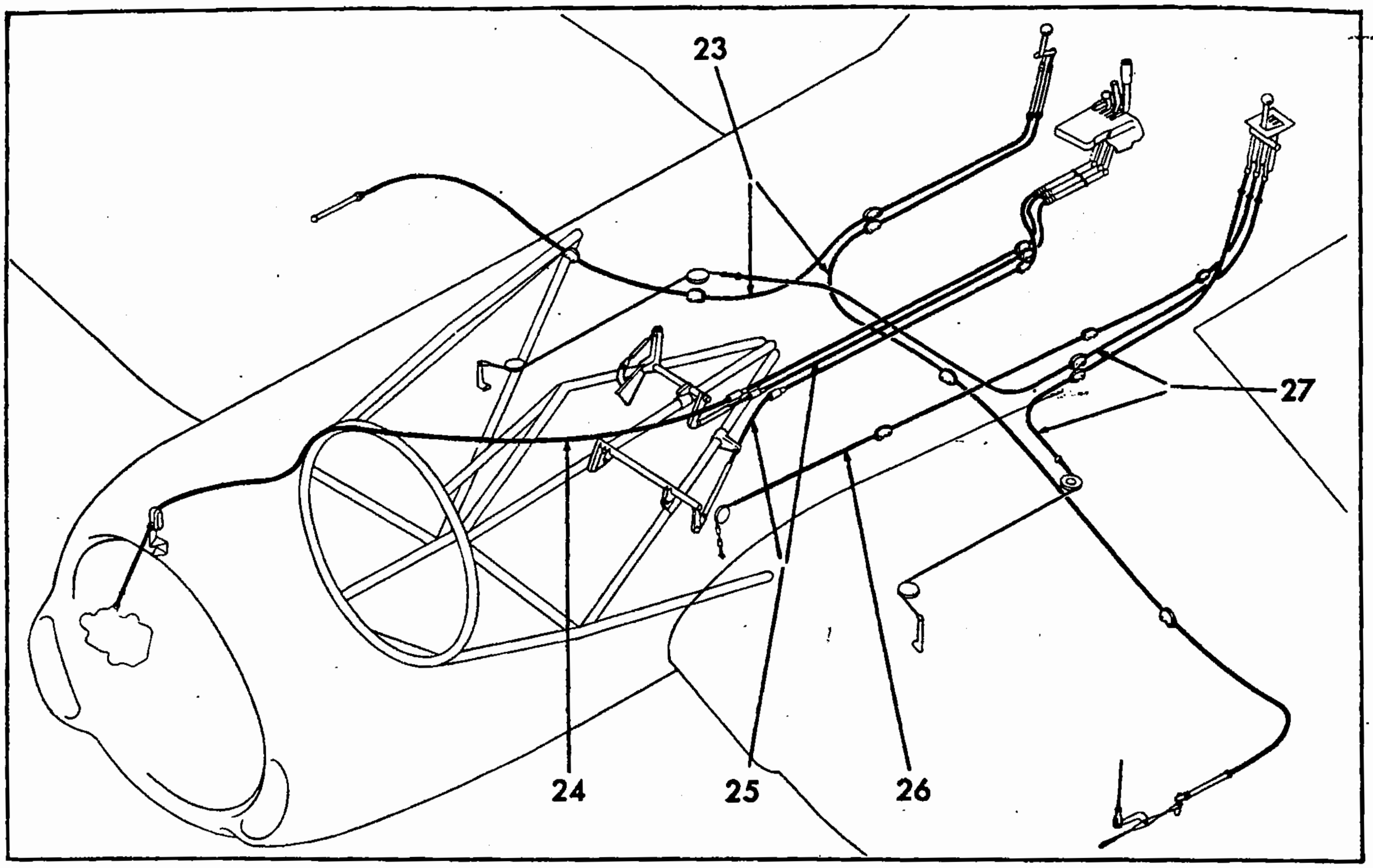
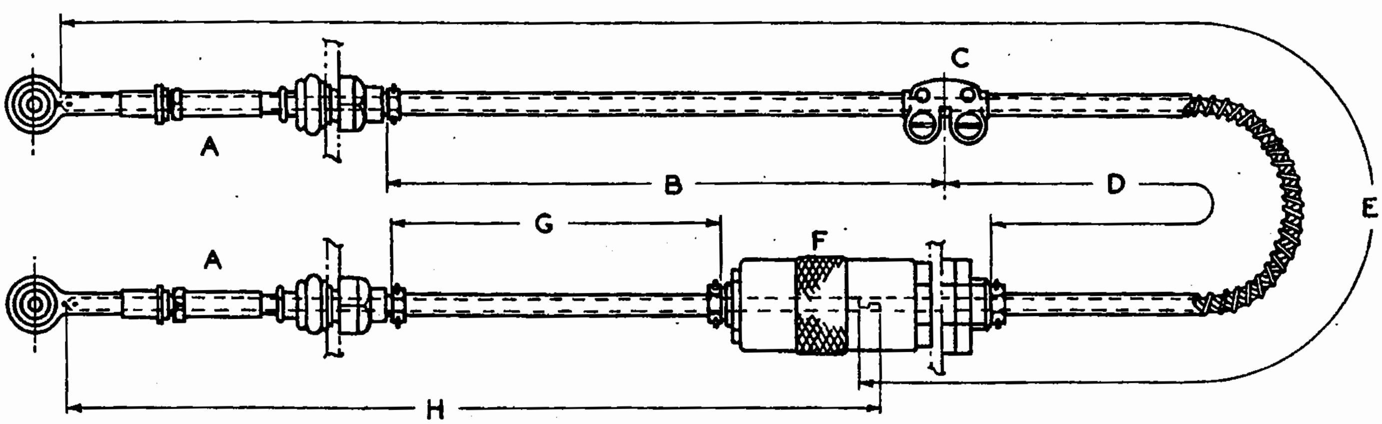


Figure 6—2. (Sheet 3 of 3 Sheets.) Flexible Cable Assemblies Reference Diagram.

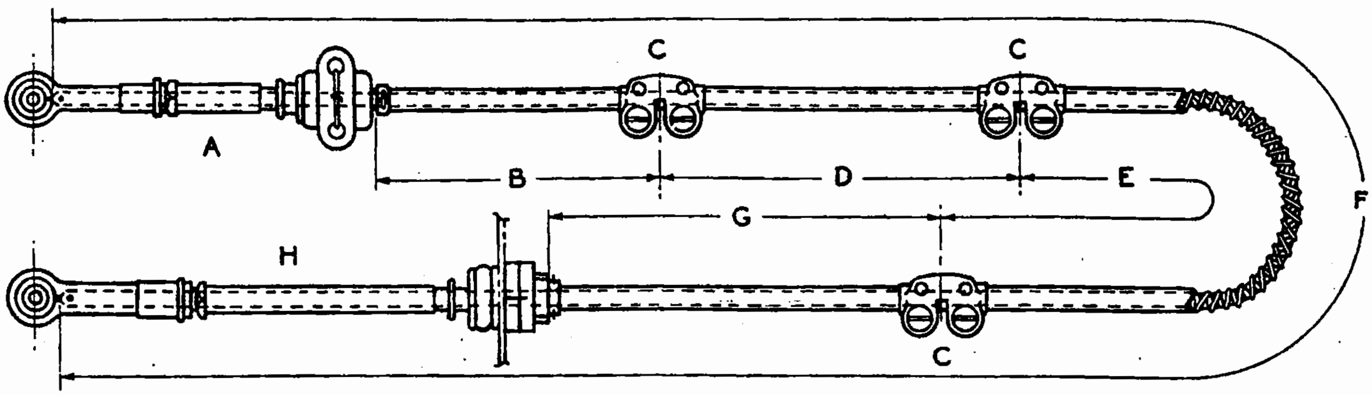


			Length
A	CVC-1221-25	Telescopic Unit (SA159A-25)	
B	VS-57993-1*	Conduit (SA116-1-150)	15
	VS-57993-2**	Conduit (SA116-1-137)	13.7
C	CVC-1203-1	Connector (SA115A-1)	
D	VS-57993-4*	Conduit (SA116-1-482)	48.2
	VS-57993-5**	Conduit (SA116-1-509)	50.9
E	CVC-1206-743*	Cable (SA271A-74$\frac{5}{16}$)	74.3
	CVC-1206-758**	Cable (SA271A-75$\frac{13}{16}$)	75.8
F	CVC-1205-1	Quick Disconnect (XA178A-1)	
G	VS-57993-14*	Conduit (SA116-1-6)	6
	VS-57993-17**	Conduit (SA116-1-175)	17.5
H	CVC-1206-171*	Cable (SA271A-17$\frac{1}{8}$)	17.1
	CVC-1206-123**	Cable (SA271A-12$\frac{5}{16}$)	12.3

*Mixture Control
**Throttle Control

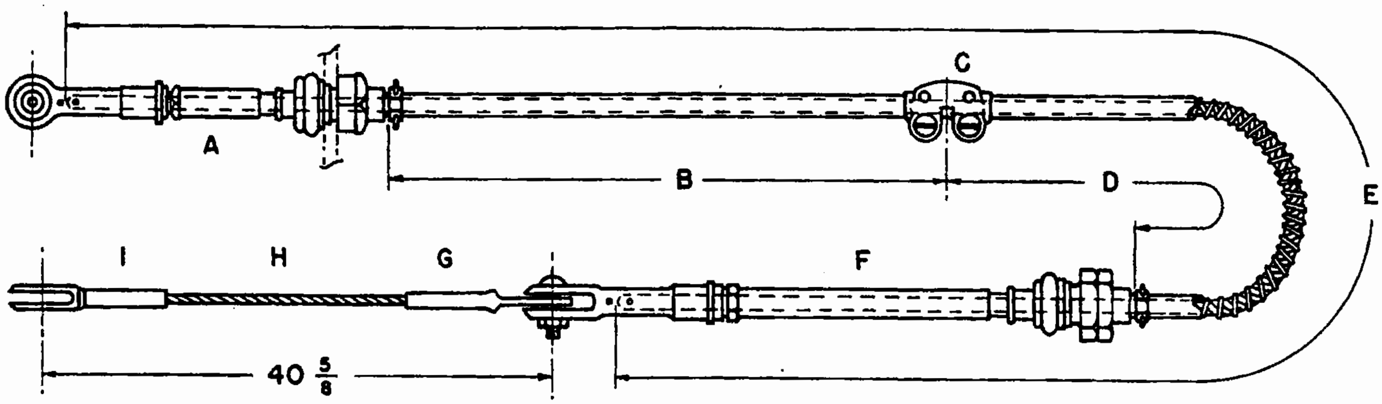
25. VS-55301 Teleflex Cables — Engine Controls — Mixture and Throttle Controls

6–6V. BOMB AND EXTERNAL FUEL TANK MANUAL RELEASE CABLES.



			Length
A	CVC-1221-15	Telescopic Unit (SA160A-15)	
B	VS-54008-3	Conduit (SA116-1-288)	28.8
C	CVC-1203-1	Connector (SA115A-1)	
D	VS-54008-8	Conduit (SA116-1-256)	25.6
E	VS-54015	Cable Assem. (B5849)	99 11/16
F	VS-54008-4	Conduit (SA116-1-225)	22.5
G	VS-54008-5	Conduit (SA116-1-159)	15.9
H	VS-54010	Clip (SD107A-2)	
I	VS-54011	Nipple (SD106A)	
J	Spec. AN-RR-C-43	Cable	1/16
K	VS-54014	Quick Disconnect (A5845)	

26. VS-55693-3 Teleflex Cable — Centerline Bomb and External Tank Manual Release



			Length
A	CVC-1221-17	Telescopic Unit (SA160A-17)	
B	VS-54008-10 (L.H.)	Conduit (SA116-1-412)	41.2
	VS-54008-9 (R.H.)	Conduit (SA116-1-428)	42.8
C	CVC-1203-1	Connector (SA115A-1)	
D	VS-54008-6 (L.H.)	Conduit (SA116-1-129)	12.9
	VS-54008-7 (R.H.)	Conduit (SA116-1-506)	50.6
E	CVC-1201-2-720 (L.H.)	Cable (SA118A-2-720)	72.0
	CVC-1201-2-1100 (R.H.)	Cable (SA118A-2-1100)	110.0
F	VS-54009	Control Assem. (SA163A-17)	
G	AN668-3	Terminal	
H	Spec. AN-RR-C-43 Cable 3/32		40 5/8
I	AN667-3	Terminal	

27. VS-55693 Teleflex Cable — L.H. and R.H. Bomb and External Tank Manual Release

6–7. TORQUE RECOMMENDATIONS.

6–8. GENERAL. The wrench torque recommendations in paragraphs 6–9 through 6–13 below contain the torque values to be used in tightening the bolts, nuts and fittings mentioned in the tables. All dural bolts and nuts should be tightened by using 1/2 the recommended torque values used for steel bolts and nuts. Specific torque values are listed separately in paragraph 6–14. In all cases where more than one nut or bolt is used in mounting an accessory in the airplane, be sure to tighten them evenly and to approximately the same torque value. Minimum torque limits should be used for installations, and maximum limits used for tolerances when using torque indicating devices.

6–9. WRENCH TORQUE VALUES. The information presented in the following table applies to medium fit, cadmium plated, non-lubricated, nut-bolt installations, heat-treated to 125,000 psi ultimate tensile strength. The values given are for castellated and self-locking steel nuts (female threaded member) tightened down onto steel bolts. In order to find the allowable wrench torque limits when the size and type of nut is known, use the accompanying tables as follows:

a. From column 2 or 3, determine the torque limits recommended for the nut.

b. If the desired initial tension stress is other than 40,000 psi, multiply the allowable torque limits by:

$$\frac{\text{limit tensile stress.}}{40{,}000}$$

c. If the heat treat is other than 125,000 psi, multiply the allowable torque limits by:

$$\frac{\text{actual heat treat.}}{125{,}000}$$

FINE THREAD SERIES
Steel Castellated Nuts
Torque Limits Recommended (pound-inches)*

Size (1)	*Tension Type (AN365-AN310) (2)*		*Shear Nut Type (AN365-AN320) (3)*	
	Min.	*Max.*	*Min.*	*Max.*
8-36	12	15	7	9
10-32	20	25	12	15
1/4-28	50	70	30	40
5/16-24	100	140	60	85
3/8-24	160	190	95	110
7/16-20	450	500	270	300
1/2-20	480	690	290	410
9/16-18	800	1000	480	600
5/8-18	1100	1300	660	780
3/4-16	2300	2500	1300	1500
7/8-14	2500	3000	1500	1800
1-14	3700	5500	2200	3300
1 1/8-12	5000	7000	3000	4200
1 1/4-12	9000	11000	5400	6600

COARSE THREAD SERIES
Steel Castellated Nuts
Torque Limits Recommended (pound-inches)*

Size (1)	*Tension Type (AN365-AN310) (2)*		*Shear Nut Type (AN365-AN320) (3)*	
	Min.	*Max.*	*Min.*	*Max.*
8-32	12	15	7	9
10-24	20	25	12	15
1/4-20	40	50	25	30
5/16-18	80	90	48	55
3/8-16	160	185	95	100
7/16-14	235	235	140	155
1/2-13	400	480	240	290
9/16-12	500	700	300	420
5/8-11	700	900	420	540
3/4-10	1150	1600	700	950
7/8-9	2200	3000	1300	1800
1-8	3700	5000	2200	3000
1 1/8-8	5500	6500	3300	3900
1 1/4-8	6500	8000	3900	4800

*For dural bolts and nuts, use one-half of listed torque.

6–10. METALITE TORQUE VALUES.

6–11. GENERAL.

a. The following torque values are recommended for installing bolts through Metalite with balsa core and aluminum spacers:

3/16 inch bolt — 20-25 pound-inches
1/4 inch bolt — 30-35 pound-inches
5/16 inch bolt — 30-35 pound-inches

b. The following torque values are recommended for installing bolts through Metalite with a mahogany insert:

3/16 inch bolt — 15-20 pound-inches
1/4 inch bolt — 25-30 pound-inches
5/16 inch bolt — 25-30 pound-inches

6–12. HYDRAULIC FITTING WRENCH TORQUE VALUES.

6–13. GENERAL. The procedure for installation of universal fittings is as follows:

a. Assemble nut AN924 on fitting AN832, AN833, AN834, or AN837, as applicable. Run the nut all the way back on the fitting to clear the gasket groove.

b. Place gasket AN902 in the gasket groove and screw the fitting into the boss until the gasket contacts the boss.

c. Unscrew the fitting not more than 360° to the approximate position desired.

d. Tighten the lock nut lightly.

e. Assemble the hydraulic line to the fitting.

f. Tighten the lock nut against the boss.

WRENCH TORQUE VALUES — HYDRAULIC FITTINGS

ALLOWABLE ASSEMBLY WRENCH TORQUE (POUND-INCHES)

ALUMINUM ALLOY TUBING

Tubing O.D Inches	*Minimum*	*Maximum*
3/16	—	—
1/4	40	65
3/8	75	125
1/2	150	250
1	500	700

6–14. SPECIFIC TORQUE VALUES.

6–15. The following table gives wrench torque values for bolts, nuts and studs that require an exact setting:

TORQUE VALUES	DESCRIPTION
150 ±5 lb.-ft.	Engine mount assembly — top bolts (VS-78686) to firewall fitting.
100 (+5,-0) lb.-ft.	Engine mount assembly — lower bolts (VS-10616) to firewall fitting.
20 (+5,-0) lb.-ft.	Through engine mount fittings (VS-56607) and forward lugs on engine mount ring.
50 (+25,-0) lb.-ft.	Through engine mount fitting (VS-56607) and aft lug on ring.
85 ±15 lb.-ft.	At ring, through engine housing mounting lug.
25 lb.-ft.	Fiber lock nuts securing gun adapter tube.
100-125 lb.-ft.	Bolt attaching center pylon section to wing.
150-175 lb.-ft.	Large upper bolt attaching landing gear drag link shaft fitting to main beam.
50-60 lb.-ft.	Three small bolts attaching landing gear drag link shaft fitting to main beam.
1500 lb.-ft.	Propeller retaining nut on propeller shaft.
250 lb.-ft.	Propeller dome retaining nut.
30-50 lb.-ft.	Propeller dome breather hole nut.
100 lb.-ft.	Propeller shaft extension.
175-225 lb.-in.	Bolts attaching carburetor to engine case.
300-360 lb.-in.	To tighten spark plugs with PWA No. 3168 wrench.
25 lb.-in.	Clamps — hose.
50-60 lb.-in.	Clamps on hose connections between ducts on air induction system.
25 lb.-in.	Accessory and stud connections to fuel cell.
150-175 lb.-in.	Nuts connecting exhaust collectors to cylinders.
800-1000 lb.-in.	Four bolts NAS-59A-25 attaching stabilizer assembly to bulkhead 346 5/32.
100-140 lb.-in.	Six bolts AN5-14A attaching stabilizer assembly to bulkhead 346 5/32.
15 lb.-in. (approx.)	Six air duct boot clamp bolts.

6—16. COMPOUNDS AND EQUIVALENTS.

Greases and Dry Lubricants.

DESCRIPTION	AN SPECIFICATION	VENDOR
Low Temperature Lubricant	AN-G-25	
Aluminum Soap Grease	AN-G-4 Grade B	
High Temperature Lubricant	AN-G-5	
Lubricating Graphite	AN-G-6	
Low Temperature Extreme Pressure Grease	AN-G-10	
General Purpose Aircraft Lubricating Grease	AN-G-15	
Oil — Slushing Aircraft Engine	AN-O-8, Grade 1065	

Fuel, Oil and Fluids.

DESCRIPTION	AN SPECIFICATION	VENDOR
Fuel	AN-F-48, Grade 115/145	
Oil — Lubricating Aircraft Engine	AN-O-8, Grade 1100/1120	
Oil — Hydraulic (petroleum base)	AN-O-366 (red fluid)	
Oil — General Purpose Low Temperature	AN-O-6	
Oil — Lubricating and Preservative	O.S.-1361, AXS-777	
Water Injection Fluid (equal parts of ethyl and methyl alcohol and 50% water)	AN-A-24	

Corrosion Preventive.

DESCRIPTION	AN SPECIFICATION	VENDOR
Exterior Surface Corrosion Preventive	AN-C-52 Type 1 (Paralketone)	
Aircraft Engine Compound Corrosion Preventive	AN-VV-C-576	

Anti-Seize and Sealing Compounds.

DESCRIPTION	AN SPECIFICATION	VENDOR
Adhesive Neoprene Cement	EC-613	Minnesota Mining & Mfg. Co.
Windshield Sealer	Aluminastic	Parr Paint Co.
Non-Hygroscopic Adhesive Tape	AN-T-12	
Caulking Compound — Fumeproofing	EC-612 Cement	Minnesota Mining & Mfg. Co.
Caulking Compound — Fumeproofing	EC-504 Cement	Minnesota Mining & Mfg. Co.
Waterproofing — Dow Corning Dielectric Compound	AN-C-128	

Straight Thread Lubricants.

DESCRIPTION	AN SPECIFICATION	VENDOR
Hydraulic System	AN-P-51 (Petrolatum)	
	AN-VV-O-366b (red fluid)	
Oil System	Seal-Lube	Parker Appliance Co.
	Tite-Seal	Radiator Specialty Co.
	AN-P-51 (Petrolatum)	
Fuel System	Seal-Lube	Parker Appliance Co.
	Tite-Seal	Radiator Specialty Co.
Electrical System	Alcoa Thread Lube	Aluminum Co. of America

Straight Thread Lubricants *(Continued)*

DESCRIPTION	AN SPECIFICATION	VENDOR
Water Injection System	AN-P-51 (Petrolatum)	
Oxygen System	AN-C-86 (Rectorseal)	
Vacuum Lines	AN-P-51 (Petrolatum)	
Airspeed System	AN-P-51 (Petrolatum)	
Air Pressure	AN-P-51 (Petrolatum)	
Tie Rods — Clevis Fittings, etc.	Alcoa Thread Lube	Aluminum Co. of America
	Seal-Lube	Parker Appliance Co.

Tapered Thread Lubricants

DESCRIPTION	AN SPECIFICATION	VENDOR
Oil System	Seal-Lube	Parker Appliance Co.
	Tite-Seal	Radiator Specialty Co.
Fuel System	Seal-Lube	Parker Appliance Co.
	Tite-Seal	Radiator Specialty Co.
	AN-C-53	
Water Injection System	Seal-Lube	Parker Appliance Co.
	Tite-Seal	Radiator Specialty Co.
	AN-C-53	
Oxygen System	AN-C-86	
Vacuum Lines	Seal-Lube	Parker Appliance Co.
	Tite-Seal	Radiator Specialty Co.
	AN-C-53	
Spark Plugs	AN-VV-C-566 (Mica-base Compound)	
Airspeed	Seal-Lube	Parker Appliance Co.
	AN-C-53	
Air Pressure	Seal-Lube	Parker Appliance Co.
	AN-C-53	
Tie Rods, Clevis Fittings, etc.	Alcoa Thread Lube	Aluminum Co. of America
	Seal-Lube	Parker Appliance Co.

6–17. LIST OF ATTACHING PARTS.

6–18. GENERAL. The following list of part numbers is included to facilitate identification of those parts (bolts, nuts, screws, etc.) which attach frequently removed assemblies known as "exchange items." While this list will prove useful to the mechanic replacing the tail gear, for example, no attempt has been made to give complete part number information, only major attaching points have been considered. Reference should therefore be made to the Illustrated Maintenance Parts List (NAVAER 01-45HD-504) for more complete part number information.

6–19. LANDING GEAR (VS-55275)

a. Drag Link To Slipper Fittings
AN26-40 Bolts (4 req.)
CVC1099-56 Nut (4 req.)
AN960-616 Washer (4 req.)

b. Main Hydraulic Actuating Cylinder to Shock Strut
VS-58637 Bolt (2 req.)
CVC754-752-S-25 Washer (2 req.)
CVC328-18ST Spacer (2 req.)
AN380C3-3 Cotter Pin (2 req.)
AN960-616 Washer (2 req.)
AN310-6 Nut (2 req.)

c. Knuckle Fitting Pivot Pin
CV-18299

d. Bolt Securing Shock Strut to Drag Links
VS-10884 Bolt
VS-10889 Nut
AN380C4-10 Cotter Pin

e. Bolts Securing Lock Links to Knuckle Fittings
AN26-25 Bolt (2 req.)
AN320-6 Nut (2 req.)
AN380C-3-3 Cotter Pin (2 req.)

6–20. LANDING GEAR DOORS (VS-13593 left, VS-13593 right)

6–21. OUTBOARD DOOR (VS-10775)

a. Forward Hinge Attachment
AN5-16 Bolt

b. Aft Hinge Attachment
AN4-13 Bolt
AN310-4 Nut
AN380-2C-2 Cotter Pin
AN960-D416 Washer
CVC752-416 Washer

c. Hydraulic Actuating Cylinder Attachment (to door)
AN4-16 Bolt
AN960-D416 Washer (2 req.)
AN320-4 Nut
AN380-2C-3 Cotter Pin
NAS75-4-020 Bushing
AN960-616 Washer (2 req.)

6–22. INBOARD DOOR (VS-10781)

a. Forward Hinge Attachment
AN5-16 Bolt
AN310-5 Nut
AN380-2C-2 Cotter Pin
AN960-D516 Washer
CVC-752-516 Washer

b. Aft Hinge Attachment
AN24-20 Bolt
AN320-4 Nut
CVC-752-416 Washer
AN380-3C-2 Pin

c. Hydraulic Actuating Cylinder Attachment (to door)
AN4-16 Bolt (2 req.)
AN960-D416 Washer (2 req.)
AN320-4 Nut
AN380-2C-3 Cotter Pin
AN960-616 Washer (2 req.)
NAS75-4-020 Bushing

6–23. TAIL GEAR (VS-55210)

a. Compression Strut (Upper Attachment)
VS-47564 Bolt
AN320-8 Nut
AN960-D916 Washer

b. Arresting Gear Dashpot (Forward Attachment)
VS-11881 Grease Bolt
AN320-4 Nut
AN960-416 Washer
AN960-516 Washer

c. Tail Gear Hydraulic Actuating Cylinder (Forward Attachment)
AN25-20 Bolt
AN320-5 Nut
AN-D516 Washer
AN380-2C-3 Cotter Pin

d. Tail Wheel Housing Assembly To Fuselage
VS-11879 Grease Bolt
AN960-D1016 Washer
CVC-752-1216 Washer

e. Arresting Hook Locking Strut (Forward Attachment)
VS-11881 Grease Bolt
AN960-D516 Washer
AN960-D416 Washer
AN320-4 Nut
AN380-C2-3 Cotter Pin

f. Arresting Hook Cam Link (Attachment to Bulkhead)
AN24-12 Bolt
AN320-4 Nut
AN380-C2-3 Cotter Pin

6–24. TAIL WHEEL DOORS (VS-55292)

a. Door Actuating Universal
VS-44117-1 Universal
VS-42291 Setscrew

b. Forward and Aft Door Attaching Links
CVC-133-3-14 Bolt
AN960-D10 Washer
AN320-3 Nut
AN380-C2-2 Pin
CVC-752-10 Washer

6–25. FLAPS (VS-55700-11-2)

6–26. CENTER SECTION OUTBOARD FLAP (VS-10068L/R)

a. Outboard Hinge Attachment Bolt
CVC-133-5-18 Bolt
CVC-752-516 Washer
AN960-D516 Washer
AN320-5 Nut

b. Outboard C.S. Flap Door Actuating Rod (at flap)
AN3-13 Bolt
AN310-3 Nut
AN960-10 Washer
AN960-10L Washer

c. Outboard C.S. Flap Interconnecting Turnbuckle Link
AN3-5A Bolt
AN365-1032 Nut
AN960-D10 Washer

d. Outboard C.S. Flap Inboard Hinge Support Attachment
VS-14417 Bolt

6–27. CENTER SECTION INBOARD FLAP (VS-40069L/R)

a. Inboard C.S. Flap Outboard Hinge
VS-14417 Bolt

b. Inboard C.S. Flap Door Actuating Rod
AN3-13 Bolt
AN310-3 Nut
AN960-10L Washer
AN960-10 Washer

c. Inboard C.S. Flap Inboard Hinge Attachment
AN8-21 Bolt R.H.
VS-15142 Bolt L.H.

6–28. OUTER PANEL FLAP (VS-38776L/R)

a. Inboard Hinge Attachment
AN24-20 Bolt
AN320-4 Nut
AN960-416 Washer

b. Inboard Pushrod Attachment
AN25-17 Bolt
AN320-5 Nut
AN960-D516 Washer
CVC-752-516 Washer

c. Outboard Hinge Attachment
AN4-14 Bolt
AN310-4 Nut
AN960-D416 Washer

d. Flap Downlocks Mechanism Pushrod Flap Attachment
AN4-14 Bolt
AN960-D416 Washer
AN310-4 Nut
AN380-C2-4 Cotter Pin

6–29. AILERON (VS-24009L/R)

a. Outboard Hinge Attachment
CVC-133-4-15 Bolt
CVC-752-416 Washer
AN320-4 Nut
AN380-C2-2 Cotter Pin

b. Center Hinge Attachment
CVC-133-4-16 Bolt
AN960-D416 Washer
AN320-4 Nut
AN380-C2-2 Cotter Pin

c. Inboard Hinge Attachment
CVC-133-4-15 Bolt
CVC-752-416 Washer
AN320-4 Nut
AN380-C2-2 Cotter Pin

d. Trim Tab Pushrod to Idler (Left Hand Only)
CVC-133-3-9 Bolt
AN320-3 Nut
CVC-752-D10 Washer

6–30. OUTER PANEL WING HINGE (VS-55700-1) (VS-.55700-2)

a. Front Hinge Pin Assembly
VS-13795

b. Upper Rear Hinge Bolt Assembly
VS-13796 Bolt Assembly
VS-13797 Nut

c. Main Wing Hinge Pin Bolt
VS-17001 Bolt
AN320-8 Nut
AN960-816 Washer

6–31. ELEVATOR (VS-55109L/R)

a. Elevator Torque Tube to Jackshaft Art Support
AN4-14A Bolt (4 req.)
AN960-D416 Washer (8 req.)
AN365-428 Self-Locking Nut (4 req.)

b. Torque Tube Collar to Horn Assembly
AN4-7A Bolt (4 req.)
AN960-D416L Washer (4 req.)
AN365-428 Self-Locking Nut (4 req.)

c. Tab Jackshaft Ends

Left Hand	*Right Hand*
VS-13120 Screw	VS-13120 Screw
VS-13121 Nut	VS-13121 Nut
AN380-C2-2 Pin	AN380-C2-2 Pin

d. Elevator Inboard Hinge Attachment
NAS55-35 Bolt
AN320-5 Nut
AN960-D516 Washer
AN320-C2-2 Cotter Pin

e. Elevator Center Hinge Attachment
NAS54-30 Bolt
AN320-4 Nut
AN960-D416 Washer
AN380-C2-2 Cotter Pin

f. Elevator Outboard Hinge
NAS542-6 Bolt
AN320-4 Nut
AN960-D416 Washer
AN380-C2-2 Cotter Pin

6–32. RUDDER (VS-55107)

a. Rudder Base
AN5-27 Bolt (4 req.)
AN310-5 Nut (4 req.)
AN960-D516 Washer (4 req.)
AN380-C2-2 Cotter Pin (4 req.)

b. Upper Hinge Bolt
NAS54-32 Bolt
AN520-4 Nut
VS-12151-1 Spacer
AN960-D416 Washer
AN380-C2-2 Cotter Pin

6–33. FIN (VS-55105)

a. Fin Fitting Attachment Bolts
AN310-10 Nut (2 req.)
VS-58527 Bolt (2 req.)
AN960-D146 Washer (2 req.)

6–34. STABILIZER (VS-55106)

a. Main Attachment Fittings Taper Pins
VS-59477 Bushing (4 req.)
VS-41274 Pin (4 req.)
AN975-5 Taper Pin Washer (4 req.)
CVC-754 564 S24 Washer
AN310-5 Cotter Nut (4 req.)
AN380-C2-2 Cotter Pin (4 req.)

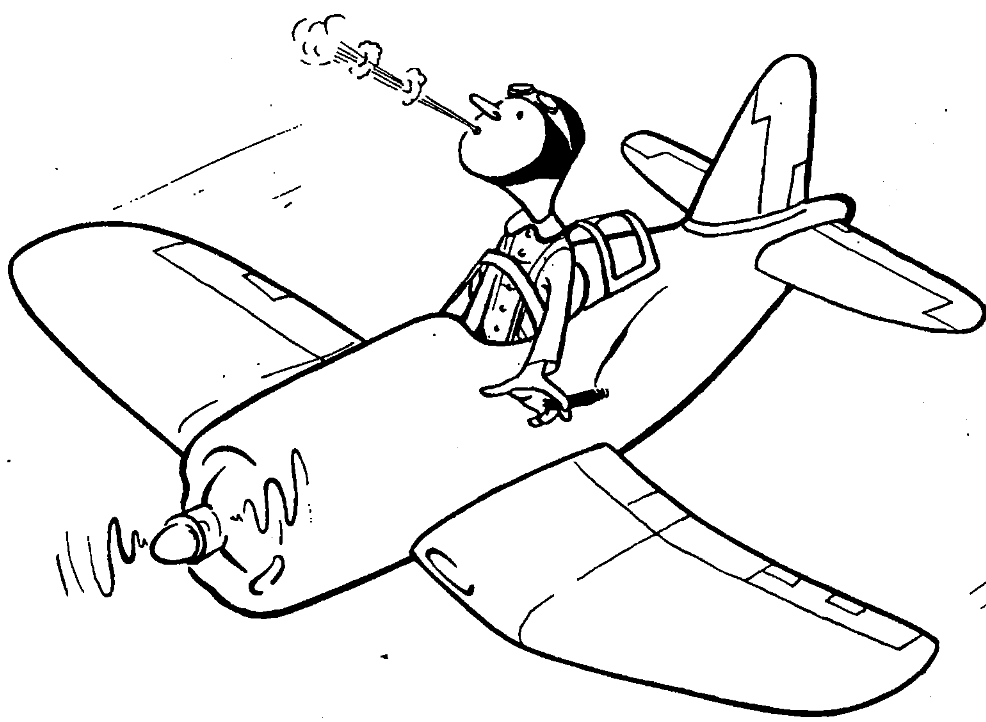
b. Stabilizer Forward Attaching Bolt
VS-11139

6–35. NOSE COWL ATTACHING BOLTS (VS-55645)
AN4-13A Bolt (18 req.)
AN365-524 Nut (18 req.)
AN960-516 Washer (36 req.)

6–36. ENGINE MOUNT ATTACHING BOLTS (VS-55640)

a. Lower VS-10616 Bolt (2 req.)

b. Upper VS-78686 Bolt (2 req.)



SECTION VII

MAINTENANCE INSPECTION

7–1. INTRODUCTION.

7–2. The following maintenance inspection information is presented in tabular form so that the mechanic can quickly locate the periodic inspections applicable to each system or section of the airplane. Maintenance inspection information may be found under seven general headings: I. POWER PLANT, II. AIRFRAMES, III. COMMUNICATIONS, IV. ELECTRICAL, V. HYDRAULIC, VI. ORDNANCE, and VII. AIRPLANE EQUIPMENT.

Note

Inspection periods established for AAF and Navy Service organizations are not identical. For that reason, inspection periods specified in this section in terms of hours consists of two figures; i. e., "25-30 Hour Inspection." The first figure indicates the AAF period and the second figure indicates the comparable Navy period. Inasmuch as the Navy inspection periods do not exceed 120 hours, all inspections of longer duration shall be considered as the 2nd, 3rd, 4th, etc. 120 hour inspection. All inspections listed under the headings "PRE-FLIGHT" and "DAILY" are Army. Navy daily inspections will include those listed as "PRE-FLIGHT" and DAILY."

7–3. SYMBOLS.

7–4. The symbols used in the following maintenance inspection tables are defined below:

a. "I"—Inspection (visual only). This means external visual check, only to the extent practical and without any disassembly. It will include opening only those inspection doors and cover plates necessary for access to the item being checked.

b. "C"—Functional check of the item. This check applies primarily to equipment whose satisfactory condition can be determined by actually operating it, either in place on the aircraft or by suitable test equipment.

c. "R"—Remove and recondition or replace. When new or reconditioned spares are available, they will be used as necessary to expedite return of the aircraft to flight. The removed items are to be checked and reconditioned for future use at the earliest moment.

d. "O"—Overhaul (on the aircraft). This operation applies primarily to parts which require periodic reconditioning, but which cannot be readily removed from the aircraft.

Note

For additional inspection or trouble shooting information, it is recommended that the mechanic refer to applicable text in Sections IV and V. Lubricate the required components of the airplane in accordance with the Lubrication Chart, figure 3–14.

I—Inspect (visual only).
C—Check (functional).
R—Remove, recondition or replace.
O—Overhaul on airplane.

Item No.	NATURE OF INSPECTION	PREFLIGHT	DAILY	25–30 HOUR	50–60 HOUR	75–90 HOUR	100–120 HOUR	OTHER
	I. POWER PLANT.							
A.	ENGINE COWLING AND COOLING FLAPS.							
1.	NOSE COWL.							
	a. Inspect for fit and security.	I		I	I	I	I	
	b. Inspect air scoops for foreign material.	I		I	I	I	I	

Item No.	I—Inspect (visual only). C—Check (functional). R—Remove, recondition or replace. O—Overhaul on airplane. NATURE OF INSPECTION	PREFLIGHT	DAILY	25–30 HOUR	50–60 HOUR	75–90 HOUR	100–120 HOUR	OTHER
A.	ENGINE COWLING AND COOLING FLAPS (Con't.).							
2.	ENGINE COWL PANELS.							
	a. Inspect for fit and security.	I		I	I	I	I	
	b. Inspect condition of seals.			I	I	I	I	
3.	COWL FLAPS AND COWL FLAP SUPPORT RING.							
	a. Inspect for fit and security.	I		I	I	I	I	
	b. Lubricate hinges and quick-disconnects.	(See figure 3-14.)						
	c. Check manual operation of cowl flaps.	C		C	C	C	C	
	d. Inspect motor, controller drive shafts and electrical connections for security.	I		I	I	I	I	
4.	ACCESSORY COMPARTMENT PANELS.							
	a. Inspect for fit and security.	I		I	I	I	I	
5.	INTERCOOLER FLAP.							
	a. Inspect for fit and security.	I		I	I	I	I	
	b. Lubricate hinges.	(See figure 3-14.)						
	c. Check manual operation of intercooler flap.	C		C	C	C	C	
	d. Inspect cowling beam for security.	I		I	I	I	I	
	e. Inspect intercooler flap pressure switch and its electrical connections for security.						I	
	f. Break pressure air line at switch and blow through through to check for obstructions.						I	
B.	POWER PLANT—GENERAL.							
1.	ENGINE MOUNT.							
	a. Inspect the engine mount for cracks, distortions, and security of bolts.			I	I	I	I	
	b. Check torque of engine mount bolts.						C	
	c. Check engine hold-down nuts for tightness.			C	C	C	C	
2.	ACCESSORIES.							
	a. Inspect exhaust stacks and collector ring for cracks and security. Inspect security of attaching bolts.			I	I	I	I	
	b. Check all accessories for security of mounting and signs of oil seepage from mounting pads.				IC	IC	IC	
3.	DRAIN LINES.							
	a. Check all drain lines for security and signs of stoppage.				IC	IC	IC	
C.	ENGINE. **Note** For engine maintenance inspection refer to Pratt and Whitney Engine Service Instructions Handbook (AN 02-10GE-2).							

I—Inspect (visual only).
C—Check (functional).
R—Remove, recondition or replace.
O—Overhaul on airplane.

Item No.	NATURE OF INSPECTION	PRE FLIGHT	DAILY	25-30 HOUR	50-60 HOUR	75-90 HOUR	100-120 HOUR	OTHER
D.	AIR INDUCTION SYSTEM.							
1.	GENERAL MAINTENANCE.							
	a. Inspect security of all ducts, clamps, hose connections, seals and supports.			I	I	I	I	
	b. Inspect ducts for foreign materials.			I	I	I	I	
	c. Check operation of take-off doors. Reach through take-off doors and check ducts for foreign materials.	C		C	C	C	C	
	d. Inspect security of hydraulic reservoir pressurizing line fitting in right intercooler air entrance duct.			I	I	I	I	
	e. Inspect security of external auxiliary fuel tank pressurizing line pipe fitting in left intercooler exit duct.			I	I	I	I	
	f. Inspect security of generator blast tube to left auxiliary stage entrance duct.			I	I	I	I	
2.	INTERCOOLERS.							
	a. Inspect for security.			I	I	I	I	
	b. Examine intercooler for clogged and broken cores.						I	
E.	WATER INJECTION SYSTEM.							
1.	GENERAL.							
	a. Inspect all electrical and water lines for security.			I	I	I	I	
	b. Inspect strainer, motor, pump and tanks for security.			I	I	I	I	
	c. Inspect filler neck screen.				I	I	I	
	d. Fill tanks (unless system is preserved).	C						
F.	ENGINE CONTROLS.							
1.	GENERAL.							
	a. Inspect control unit, cables, conduits and connectors for security.			I	I	I	I	
	b. Check security of Teleflex control installations.	C		C	C	C	C	
	c. Check each control for freedom of movement.	C		C	C	C	C	
	d. Check throttle, mixture and propeller governor controls for 1/8 inch spring-back.	C		C	C	C	C	
	e. Check to see that throttle control engages water injection microswitch.	C		C	C	C	C	
	f. Check to see that propeller governor control contacts intercooler and cowl flap microswitch.	C		C	C	C	C	
G.	PROPELLER AND ACCESSORIES.							
1.	PROPELLER.							

Note

For further propeller maintenance inspection information, refer to Hamilton Standard Propeller Service Manual No. 140 (AN 03-20CC-1).

I—Inspect (visual only).
C—Check (functional).
R—Remove, recondition or replace.
O—Overhaul on airplane.

Item No.	NATURE OF INSPECTION	PREFLIGHT	DAILY	25-30 HOUR	50-60 HOUR	75-90 HOUR	100-120 HOUR	OTHER
G.	PROPELLER AND ACCESSORIES (Con't.).							
	a. With engine running at reduced throttle (1300 rpm), operate governor control three or four times through its entire range to expel air which might have been trapped in the system.	C		C	C	C	C	
	b. Inspect all blades and hub for bends, nicks, cracks, raised edges, etc. (see paragraph 4-627).	I		I	I	I	I	
	c. If aircraft is operated near salt water, wash blades with clean (fresh) water, and dry thoroughly; then apply a thin film of clean engine oil.	C		C	C	C		
	d. Examine exterior of hub for evidence of damage.	I		I	I	I		
	e. Visually inspect for oil leakage at dome breather hole, dome retaining nut, barrel blade bores, barrel halves parting line, and at the rear cone.	I		I	I	I	I	
	Note If the propeller has been recently installed, residual oil may show up. This should not be misinterpreted as propeller leakage.							
	f. Check propeller blades and hub for protective film of engine oil.	C		C	C	C	C	
2.	PROPELLER GOVERNOR.							
	Note For further propeller governor maintenance inspection information, refer to Hamilton Standard Propeller Service Manual No. 140 (AN 03-20CC-1), and Hamilton Standard Propeller Service Bulletin 108 (Navy Bulletin 48).							
	a. Inspect for external leakage.	I		I	I	I	I	
	b. Inspect governor control and control system for security of mounting.	I		I	I	I	I	
	c. Check operation of governor.	C		C	C	C	C	
	d. Check security of hub, and lever and ring assembly mounted on governor.			IC	IC	IC	IC	
H.	STARTING SYSTEM.							
1.	STARTER.							
	a. Check security of starter to engine.			C	C	C	C	
	b. Inspect security of electrical cables.			I	I	I	I	
	c. Inspect starter for cracked housing or flanges.			I	I	I	I	
	d. Inspect starter for cleanliness or evidence of oil, especially around band covering brushes.			I	I	I	I	

I—Inspect (visual only).
C—Check (functional).
R—Remove, recondition or replace.
O—Overhaul on airplane.

Item No.	NATURE OF INSPECTION	PREFLIGHT	DAILY	25–30 HOUR	50–60 HOUR	75–90 HOUR	100–120 HOUR	OTHER
H.	STARTING SYSTEM (Con't.).							
	e. Check operation of starter.	C		C	C	C	C	
	f. On installation, check clearance between starter and engine jaw. Clearance should be .055 inches minimum.							C
2.	INDUCTION VIBRATOR.							
	a. Inspect for security of induction vibrator to mount on engine.			I	I	I	I	
	b. Inspect for security of electrical leads from engine section junction box to induction vibrator.			I	I	I	I	
3.	SPARK PLUGS.							
	a. Inspect spark plugs for looseness. Tightening torque should be 330-360 pound-inches.			IC	IC	IC	IC	
	b. Inspect spark plug leads for defects and tightness.			I	I	I	I	
	c. Inspect ignition harness for cleanliness and security of mounting.			I	I	I	I	
	d. Inspect cables and spark plug elbows for burned or damaged insulation.			I	I	I	I	
	e. Inspect magneto and distributors for security.			I	I	I	I	
	f. Check magneto and distributor pressurizing line for tightness.			I	I	I	I	
	Note Check spark plugs and helicoil inserts; refer to Pratt and Whitney Engine Service Instruction Handbook (AN 02-10-GE-2).							
I.	OIL SYSTEM.							
A.	GENERAL.							
	a. Inspect oil tank, coolers, and lines for security.			I	I	I	I	
	b. Remove, clean and reinstall main oil strainer.			R	R	R	R	
	c. Drain and refill the oil tank. Oil should be changed sooner if it contains excessive sludge, or if metallic chips are found in strainers.				R	R	R	
	d. Check to see that all drain plugs and cocks are tight and lock-wired.			C	C	C	C	
	e. Check manual operation of oil cooler doors.	C		C	C	C	C	
J.	FUEL SYSTEM.							
1.	MAIN FUEL CELL.							
	a. Inspect fuselage, engine section and all visible fuel lines for evidences of leakage.	I	I	I	I	I	I	
	b. Inspect filler cap for security.	I		I	I	I	I	
	c. Fill main fuel cell.	I	I	I	I	I	I	

I—Inspect (visual only).
C—Check (functional).
R—Remove, recondition or replace.
O—Overhaul on airplane.

Item No.	NATURE OF INSPECTION	PRE FLIGHT	DAILY	25-30 HOUR	50-60 HOUR	75-90 HOUR	100-120 HOUR	OTHER
J.	FUEL SYSTEM (Con't.).							
2.	EXTERNAL AUXILIARY FUEL TANKS.							
	a. Inspect tanks and caps for leakage.	I						
	b. Inspect tank mounting and connecting lines for security.	I						
3.	GENERAL.							
	a. With main cell filled, check fuel quantity gage for "FULL" reading.	C	C	C	C	C	C	
	b. Check fuel reserve warning light (push to test).	C						
	c. Check fuel selector valve for operation and leakage.	C		C	C	C	C	
	d. Check operation of fuel transfer system.	C		C	C	C	C	
	e. Check fuel transfer warning light;(push to test with transfer switch "ON").	C						
	f. Check operation of auxiliary fuel pump; (check full pressure.)	C		C	C	C	C	
	g. Remove, clean and reinstall main fuel strainer.		R					
	h. Check operation of engine-driven fuel pump; (check fuel pressure).	C		C	C	C	C	
	i. Check engine-driven fuel pump vent line for security.			I	I	I	I	
	II. AIRFRAMES.							
A.	WING.							
1.	EXTERNAL SURFACES.							
	a. Inspect all external surfaces for damage to the skin and structure, loose rivets or dents.	I		I	I	I	I	
2.	FLAPS.							
	a. Inspect the flaps for damage. Check security and operation to full "down" position.	IC		IC	IC	IC	IC	
3.	AILERONS.							
	a. Inspect ailerons and tabs for damage; check for security and operation.	IC		IC	IC	IC	IC	
4.	ACCESS PANELS.							
	a. Inspect all doors and removable panels for security.	I		I	I	I	I	
5.	WING TIPS.							
	a. Inspect wing tips for damage; inspect for security.	I		I	I	I	I	
6.	LIGHTS.							
	a. For night operation, inspect running lights for operation and plexiglas covers for breaks and security.	I		I	I	I	I	

I—Inspect (visual only). C—Check (functional). R—Remove, recondition or replace. O—Overhaul on airplane.		PRE FLIGHT	DAILY	25-30 HOUR	50-60 HOUR	75-90 HOUR	100-120 HOUR	OTHER
Item No.	NATURE OF INSPECTION							
A.	WING (Con't.).							
7.	WING HINGE.							
	a. Inspect wing hinge fittings for security.			I	I	I	I	
8.	PITOT TUBE.							
	a. Check that pitot tube cover is removed.	C						
	b. Inspect pitot tube to be sure passages are open.			I	I	I	I	
B.	EMPENNAGE.							
1.	GENERAL INSPECTION.							
	a. Inspect all external surfaces for damage, loose rivets and dents.			I	I	I	I	
2.	STABILIZER.							
	a. Inspect stabilizer for security.	I		I	I	I	I	
3.	ELEVATORS AND TABS.							
	a. Inspect elevators and tabs for security.	I		I	I	I	I	
4.	FIN.							
	a. Inspect the fin for security.	I		I	I	I	I	
5.	RUDDER AND TAB.							
	a. Inspect rudder and rudder tab for security.	I		I	I	I	I	
C.	SURFACE CONTROLS.							
1.	CONTROL STICK.							
	a. Check freedom of rotation of control stick.	C		C	C	C	C	
	b. Check maximum forward and lateral movement of stick. Lateral movement is 9⅛ inches to either side of neutral; longitudinal movement is 8 inches fore and 8.5 inches aft of neutral.			C	C	C	C	
	c. Check security of surface actuating rods to control stick.			IC	IC	IC	IC	
	d. Check security of elevator torque tubes.			IC	IC	IC	IC	
	e. Hold control stick rigidly and check play in control surfaces. Motion of surfaces in excess of $1/16$ inch indicates excessive play in the control surfaces.			C	C	C	C	
2.	AILERON CONTROL SYSTEM.							
	a. Move pilot's stick laterally; inspect for evidence of binding or looseness in ailerons, or control stick.	C		C	C	C	C	
	b. Inspect aileron control system for security of installation.			I	I	I	I	
	c. Check aileron displacement. MAX. UP 19° MAX. DOWN 14° (Plus or minus 1°)			C	C	C	C	

I—Inspect (visual only).
C—Check (functional).
R—Remove, recondition or replace.
O—Overhaul on airplane,

Item No.	NATURE OF INSPECTION	PREFLIGHT	DAILY	25–30 HOUR	50–60 HOUR	75–90 HOUR	100–120 HOUR	OTHER
C.	SURFACE CONTROLS (Con't.).							
	d. Check aileron trim tab displacement. MAX. UP 15° (+4°−1°) MAX. DOWN 15°			C	C	C	C	
	e. Check rigging with travel checking board whenever aileron is replaced.						C	
3.	AILERON TRIM TAB.							
	a. Check aileron trim tab settings with tab displacement shown on indicator.			C	C	C	C	
	b. Check operation and security of trim tab actuating mechanism.	C		C	C	C	C	
	c. Check length of tab actuator rod in extended and retracted positions, at time of installation. Retracted Length 6⅞ in. approx. Extended Length 8⅜ in. approx.							C
	d. Check rigging with travel checking board whenever aileron trim tab is replaced.						C	
4.	ELEVATOR CONTROL SYSTEM.							
	a. Check elevator control system for security and operation.			IC	IC	IC	IC	
	b. Check full throws of elevators: Normal travel without spring deflection: Up 23.5°, Down 21° (Plus or minus 1°) Maximum travel with full deflection of spring tab: Up 18.5°, Down 14.5° (Plus or minus 1°)			C	C	C	C	
	c. Check for excessive play in elevator control system by securing stick with control lock and attempting to move the elevators. Motion of the elevators in excess of 1/16 inch indicates excessive play.			C	C	C	C	
	d. Check rigging with travel checking board whenever elevators are replaced.							C
5.	ELEVATOR SPRING-TRIM TABS.							
	a. Check spring-trim tab displacement: Spring Deflection: MAX. UP 20° (±1°), MAX. DOWN 15° (± 1°) Trim Deflection: MAX. UP 5° (+4°−1°), MAX. DOWN 15° (+4°−0°) (Plus or minus 1°)			C	C	C	C	
	b. Check rigging with travel checking board whenever elevator tabs are replaced.						C	
	c. Inspect security of linear actuator.			I	I	I	I	
	d. Check operation of actuator.	C		C	C	C	C	
	e. Check length of linear actuator rod in neutral, retracted, and extended positions:			IC	IC	IC	IC	

I—Inspect (visual only).
C—Check (functional).
R—Remove, recondition or replace.
O—Overhaul on airplane.

Item No.	NATURE OF INSPECTION	PREFLIGHT	DAILY	25–30 HOUR	50–60 HOUR	75–90 HOUR	100–120 HOUR	OTHER
C.	SURFACE CONTROLS (con't.).							
	Neutral $7\frac{27}{32}$ inch approx.							
	Retracted $6\frac{7}{8}$ inch approx.							
	Extended $8\frac{3}{16}$ inch approx.							
6.	RUDDER CONTROL SYSTEM.							
	a. Check security of rudder, pedals, and adjusting mechanism.	C		C	C	C	C	
	b. Check rudder controls for freedom of movement.	C		C	C	C	C	
	c. Check fore and aft adjusting mechanism.			C	C	C	C	
	d. Check rudder deflections.			C	C	C	C	
	MAX. RIGHT / MAX. LEFT							
	Normal: 25° / 25°							
	Plus Spring Tab: 21.75° / 21.75°							
	(Plus or minus 1°)							
	e. Check rigging with travel checking board whenever rudder is replaced.							C
	f. Inspect cables, especially near pulleys and terminals, inspect bearings and pulleys.			I	I	I	I	
	g. Check that cables have tension of 50 pounds, plus or minus 10 pounds.			C	C	C	C	
7.	RUDDER SPRING-TRIM TAB.							
	a. Check operation of spring-trim tab.	C		C	C	C	C	
	b. Check tab deflections:							
	MAX. RIGHT / MAX. LEFT							
	Spring Deflection: 3°45′ / 3°45′ (±1°)							
	Trim Deflection: 10° / 10° (+4°−1°)							
	c. Check lengths of tab actuator rod:			C	C	C	C	
	Retracted $6\frac{15}{16}$ inches approx.							
	Neutral $7\frac{5}{16}$ inches approx.							
	Extended $7\frac{11}{16}$ inches approx.							
	d. Check rigging with travel checking board whenever rudder trim-spring tab is replaced.							C
8.	WING FLAP CONTROL SYSTEM.							
	a. Check security of the flap control system.	C		C	C	C	C	
	b. Check flap operation.	C		C	C	C	C	
	c. Check flap settings with setting shown on indicator. Flap positions range from the "full up" position, to 50 degrees "full down", (within 7 degrees, except for full up position).			IC	IC	IC	IC	
	WARNING REMOVE SURFACE CONTROL LOCK BEFORE FLIGHT.							

I—Inspect (visual only).
C—Check (functional).
R—Remove, recondition or replace.
O—Overhaul on airplane.

Item No.	NATURE OF INSPECTION	PREFLIGHT	DAILY	25-30 HOUR	50-60 HOUR	75-90 HOUR	100-120 HOUR	OTHER
D.	FUSELAGE.							
1.	EXTERNAL.							
	a. Inspect the entire fuselage for cracks, dents, holes, buckling, loose or missing rivets.			I	I	I	I	
	b. Inspect all fasteners on access doors and removable panels for security.			I	I	I	I	
	c. Inspect the cockpit steps for security; check function.			IC	IC	IC	IC	
2.	INTERNAL.							
	a. Inspect all accessible structure thoroughly for cracks, bent supports, and corrosion.			I	I	I	I	
	b. Inspect all of the fuselage internal structural members and bulkheads for cracks, loose rivets, screws or bolts, elongated bolt holes, and corrosion.						I	
	FUMEPROOFING.							
3.	a. Inspect all fumeproofed areas for bad seals.			I	I	I	I	
	b. Inspect the carbon monoxide protective cover in the inboard interbeam rib for security and possible damage.			I	I	I	I	
	COCKPIT.							
4.	a. Inspect the canopy, windshield, and bullet-resistant glass for cleanliness and damage.	I		I	I	I	I	
	b. Check the canopy for proper fit, operation, and lubrication. Inspect the seal between the windshield and cabin to determine that it has not been cut, broken, or badly worn.	IC		IC	IC	IC	IC	
	c. Inspect the cockpit for loose articles and cleanliness.	I		I	I	I	I	
	d. For night flying, check the lighting system for operation.	C		C	C	C	C	
E.	MAIN LANDING GEAR.							
1.	GENERAL MAINTENANCE.							
	a. Inspect the main landing gear drag links and fittings for bends, cracks, displacement; inspect for security.			I	I	I	I	
	b. With the airplane raised, test the landing gear, downlock, and landing gear doors for proper function, using an auxiliary source of hydraulic pressure.			C	C	C	C	
	c. Inspect bolts subject to rotation for proper lubrication.			I	I	I	I	
	d. Inspect clearance of tire against greased skid in wheel well.	(See figure 3-14)		I	I	I	I	

I—Inspect (visual only).
C—Check (functional).
R—Remove, recondition or replace.
O—Overhaul on airplane.

Item No.	NATURE OF INSPECTION	PRE FLIGHT	DAILY	25–30 HOUR	50–60 HOUR	75–90 HOUR	100–120 HOUR	OTHER
E.	MAIN LANDING GEAR (Con't.).							
2.	SHOCK STRUT.							
	a. Inspect the main landing gear shock strut for proper lubrication and security of bolts, safety wire, screws, fittings, etc.	I		I	I	I	I	
	b. Check the main landing gear shock strut for proper inflation in accordance with the decalcomania on the strut. If necessary, inflate strut, rock airplane, and recheck.	IC		IC	IC	IC	IC	
	c. Inspect for air leakage at the air valve.	IC		IC	IC	IC	IC	
	d. Inspect exposed portion of piston rod (must have light film of oil) for corrosion, pitting, or scarring. Inspect before each flight when in dusty areas.	I		I	I	I	I	
3.	KNUCKLE FITTING.							
	a. Inspect indicator protruding from top of lubricator. on fitting, refer to paragraph 4-315.	I		I	I	I	I	
4.	LANDING GEAR DOORS.							
	a. Inspect the landing gear doors and movable fairing for cracks, deformation, or distortion.			I	I	I	I	
F.	TAIL GEAR AND ARRESTING HOOK.							
1.	GENERAL MAINTENANCE.							
	a. Inspect the tail gear and fittings for bends, cracks, displacement; inspect for security.			I	I	I	I	
	b. Inspect the arresting hook and retracting linkage for cracks and distortion (aboard aircraft carriers).	I		I	I	I	I	
	c. Hoist the airplane and check tail gear, arresting hook, and tail wheel doors for proper function, using an auxiliary source of hydraulic pressure.			C	C	C	C	
	d. Remove all grease bolts and examine them for wear. If they are defective, replace them. Grease bolts with an AN-G-10 grease before reinstalling. Inspect all other bolts in the tail gear and arresting hook subject to rotation.	(See Figure 3-14.)						R
2.	SHOCK STRUT.							
	a. Inspect the tail gear shock strut for proper inflation and oil level in accordance with the decalcomania on the strut. If necessary, service strut.			IC	IC	IC	IC	
3.	ARRESTING HOOK.							
	a. Inspect the arresting hook mechanism for function, condition and lubrication (when aboard aircraft carrier).	I		I	I	I	I	
	b. Inspect dashpot for leakage, damage, and security (when aboard aircraft carrier).	I		I	I	I	I	

I—Inspect (visual only).
C—Check (functional).
R—Remove, recondition or replace.
O—Overhaul on airplane.

Item No.	NATURE OF INSPECTION	PREFLIGHT	DAILY	25–30 HOUR	50–60 HOUR	75–90 HOUR	100–120 HOUR	OTHER
G.	WHEELS, TIRES AND BRAKES.							
1.	TIRES.							
	a. Inspect the tires for breaks, blisters or other visual damages.	I	I	I	I	I	I	
	b. Check for proper inflation (117 psi for land and carrier operation).	C		C	C	C	C	
2.	WHEELS.							
	a. Inspect wheels for cracks, and condition of protective coating.	I		I	I	I	I	
	b. Remove wheels, check the condition of the bearings, inspect wheel internally and lubricate as necessary.	(See Figure 3-14.)					I	
3.	BRAKES.							
	a. Rotate wheels and check for binding and dragging; if necessary, check brake clearance.			C	C	C	C	
	b. Inspect the brake assembly (with the wheel off) for its general condition.						I	
	c. Check brake for proper operation.	C		C	C	C	C	
	d. Inspect brake hydraulic lines for chafing.			I	I	I	I	
	e. Inspect brake hydraulic system for leaks.			I	I	I	I	
	f. Check reservoir of master cylinder for proper fluid level.			I	I	I	I	
H.	INSTRUMENTS.							
1.	GENERAL MAINTENANCE.							
	a. Inspect all instruments for security of mounting, tubing and electrical connections.			I	I	I	I	
	b. Inspect glass dial coverings for cracks, breaks, or loose pointers.	I		I	I	I	I	
	c. With engine running, check all instruments for readings. See that all are working.	C		C	C	C	C	
	d. Inspect all tubing (vacuum system, airspeed system, engine gage unit and manifold pressure gage tubing) for leaks or obstructions.			I	I	I	I	
	III. COMMUNICATIONS.							
A.	RADIO EQUIPMENT.							
1.	GENERAL.							
	a. Check each radio equipment for proper operation.	C		C	C	C	C	
	b. Inspect all radios, cables, plugs and receptacles for security; inspect for corrosion.			I	I	I	I	
	c. Inspect all antennae for security (stations 203, 218, and 240).			I	I	I	I	

I—Inspect (visual only).
C—Check (functional).
R—Remove, recondition or replace.
O—Overhaul on airplane.

Item No.	NATURE OF INSPECTION	PRE FLIGHT	DAILY	25–30 HOUR	50–60 HOUR	75–90 HOUR	100–120 HOUR	OTHER
B.	RADAR EQUIPMENT.							
1.	GENERAL.							
	a. Check radar equipment for proper operation.	C		C	C	C	C	
	b. Inspect all radar cables, plugs and receptacles for security; inspect for corrosion.			I	I	I	I	
	c. Inspect radar antenna (station 253).			I	I	I	I	
	IV. ELECTRICAL.							
A.	SYSTEM MAINTENANCE.							
1.	GENERAL.							
	a. Inspect all cables and wires for security and condition.			I	I	I	I	
	b. Inspect the circuit-breakers for indications of shorts in the electrical system. Reset open circuit-breakers after trouble has been remedied.	C		C	C	C	C	
	c. Check operation of all electrical controls and switches from the cockpit, making sure all switches are returned to "OFF" when check is completed.	C		C	C	C	C	
	d. During engine warm-up, check for short circuits and loose connections by operating the radio receivers and listening for interference.	C		C	C	C	C	
2.	GENERATOR.							
	a. Inspect mounting studs, generator external surfaces, and electrical connections to generator.	C		C	C	C	C	
	b. Check for free passage of air by removing the air inlet cover; check brushes. Brushes worn to $\frac{9}{16}$ inches should be replaced.				CR	CR	CR	
	c. Remove generator from airplane, clean, and replace worn parts.						R	
3.	VOLTAGE REGULATOR.							
	a. Check voltage regulator for security of mounting, wire connections, and proper voltage regulation. Adjust carbon pile to 27.5 volts steady output when necessary.	C		C	C	C	C	C
	b. Remove voltage regulator from airplane, clean, and replace worn parts.				R	R	R	
4.	REVERSE CURRENT RELAY.							
	a. Check for security of mounting and tight wire connections.	C		C	C	C	C	
5.	BATTERY SYSTEM.							
	a. Check specific gravity of battery with hydrometer. The reading must lie between 1.200 and 1.275.			C	C	C	C	

I—Inspect (visual)
C—Check (functional)
R—Remove, recondition or replace
O—Overhaul on airplane

Item No.	NATURE OF INSPECTION	PREFLIGHT	DAILY	25–30 HOUR	50–60 HOUR	75–90 HOUR	100–120 HOUR	OTHER
A.	SYSTEM MAINTENANCE (Con't).							
	b. Check fluid level in battery for 1/4 inch above the separators.	C		C	C	C	C	
	c. Inspect battery cables and installation for security.	I		I	I	I	I	
	V. HYDRAULICS.							
A.	MAIN AND SUB-SYSTEMS.							
1.	RESERVOIR.							
	a. Inspect reservoir sight gage for full level indication.	I		I	I	I	I	
	b. Replace filter.			R	R	R	R	
2.	HYDRAULIC GAGE.							
	a. With engine running, inspect gage for a steady 1500 (plus or minus 100) psi reading.	I		I	I	I	I	
3.	EXTERNAL LEAKAGE.							
	a. Inspect interior low points of airplane for oil pools. Check for oil pools on ground under airplane. Check exterior of valves, cylinders, etc. for signs of leakage.	I		I	I	I	I	
4.	TUBING, FITTINGS AND CASTINGS.							
	a. Inspect for cleanliness, chafing of tubing, damage and leakage.	I		I	I	I	I	
5.	CONTROL ADJUSTMENT.							
	a. Check the adjustment of each control lever to each selector valve. Check linkages and adjustable end fittings for security and proper locking.			C	C	C	C	
6.	LUBRICATION.							
	a. Oil felt wipers of the hydraulic actuating cylinders every 30 hours with hydraulic oil, Spec. AN-O-366. More frequent lubrication of felt wipers may be necessary in dry climates.							
B.	EMERGENCY SYSTEMS.							
1.	GENERAL.							
	a. Check emergency operation of landing gear, wing flaps and cockpit canopy.			C	C	C	C	
	b. Inspect for proper filling of air bottles; see paragraph 3–76.	I		I	I	I	I	
	c. Inspect Schrader valve and all tubing for air leakage.	I		I	I	I	I	
	VI. ORDNANCE.							
A.	GUNNERY SYSTEM.							
1.	20MM GUNS.							
	a. Check guns for general condition and security of mounting.	C		C	C	C	C	
	b. Check gun electric leads, hydraulic lines for loose connections, and for wear due to vibration or chafing.	C		C	C	C	C	

I—Inspect (visual only).
C—Check (functional).
R—Remove, recondition or replace.
O—Overhaul on airplane.

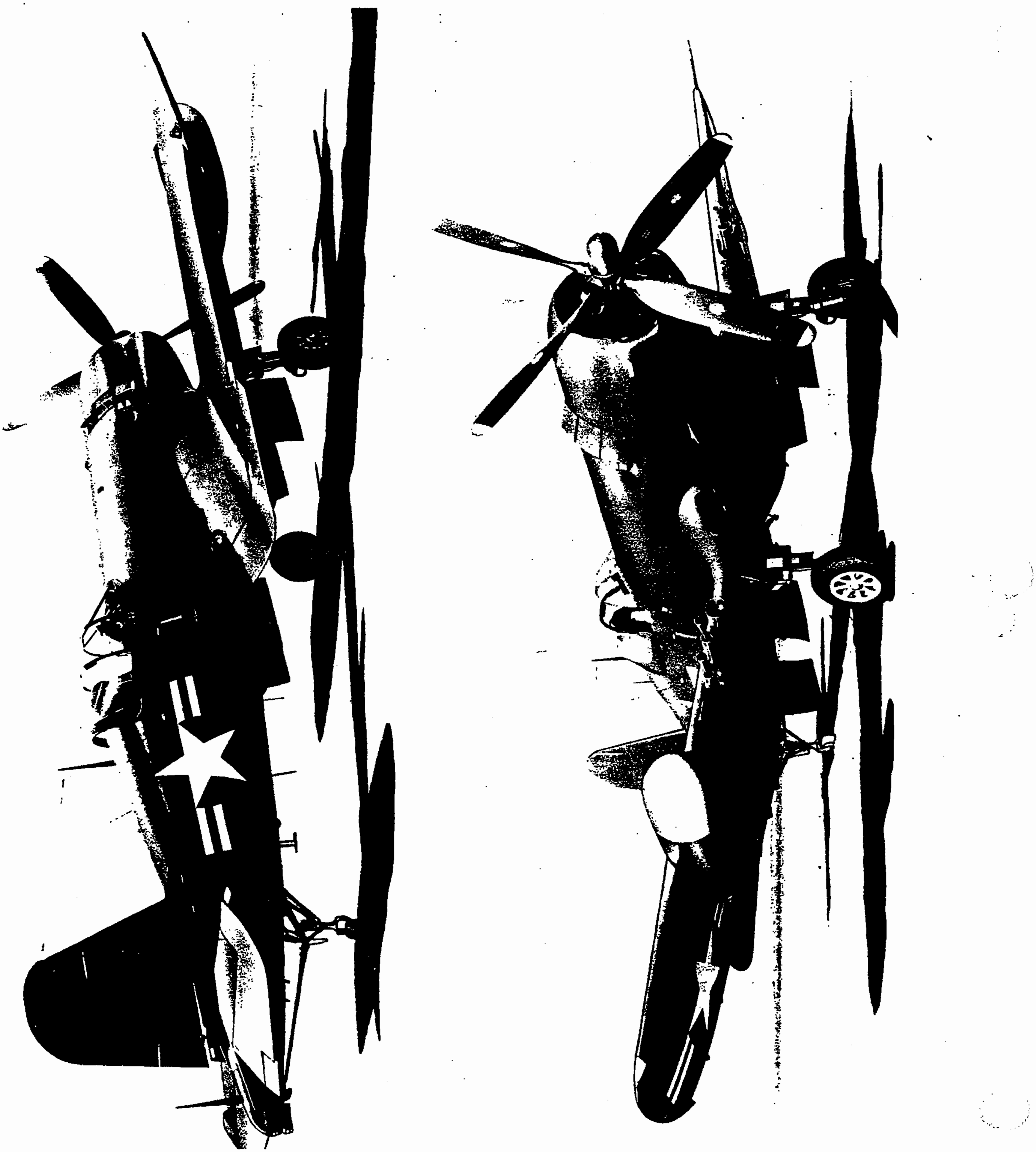
Item No.	NATURE OF INSPECTION	PRE FLIGHT	DAILY	25-30 HOUR	50-60 HOUR	75-90 HOUR	100-120 HOUR	OTHER
A.	GUNNERY SYSTEM (Con't.).							
	c. Inspect guns for proper oiling and cleanliness.	I		I	I	I	I	
	d. Check hydraulic charging and electric "dry" firing of guns; check for sticking trigger switch.	C		C	C	C	C	
	e. Check for proper operation of gun safety switch.	C		C	C	C	C	
	f. Check to see that guns are inoperative when master armament switch is "OFF" and when arresting hook handle is down.	C		C	C	C	C	
	g. Check for proper ejection of belt links and ammunition using dummy round belt.	IC						
	h. Check for proper loading (prior to gunnery hop), security of accessories to guns and structure, and make certain that all gunnery switches are in the "OFF" position.	IC						
2.	GUN HEATER.							
	a. Check proper function of gun heater.	C		C	C	C	C	
3.	GUNSIGHT.							
	a. Check for general condition, cleanliness, and security of mounting.	IC		IC	IC	IC	IC	
	b. Inspect for burned out bulbs and for spare bulbs in stowage clips.	IC		IC	IC	IC	IC	IC
	c. Check gunsight for proper electrical operation.	C		C	C	C	C	
	d. Check to see that range grip rotates range drum from minimum (6) to maximum (24) range smoothly.	C		C	C	C	C	
	e. Check for proper operation of masking lever.	C		C	C	C	C	
	f. Check for freedom of movement of the span setting handle.	C		C	C	C	C	
	g. Check gunsight for image parallax.	C		C	C	C	C	
	h. Inspect silica gel for correct (bright blue) color.	C		C	C	C	C	
4.	GUN CAMERA.							
	a. Check for security of mounting and general condition.	IC		IC	IC	IC	IC	
	b. Check for operation of motor, shutter, etc. when trigger, bomb and rocket switches are depressed.	C		C	C	C	C	
	c. Check to see that magazine is properly loaded and that film speed and film footage knobs are set correctly.	IC						
B.	BOMBING AND ROCKET SYSTEMS.							
1.	BOMB PYLONS.							
	a. Check for general condition and security of mounting.	IC		IC	IC	IC	IC	
	b. Check for loose fairing, loose electrical and cable connections.	IC		IC	IC	IC	IC	

I—Inspect (visual only).
C—Check (functional).
R—Remove, recondition or replace.
O—Overhaul on airplane.

Item No.	NATURE OF INSPECTION	PRE FLIGHT	DAILY	25-30 HOUR	50-60 HOUR	75-90 HOUR	100-120 HOUR	OTHER
B.	BOMBING AND ROCKET SYSTEMS (Con't.).							
	c. Check to see that special plug is installed in fuel line if external auxiliary fuel tank is not installed.	I		I	I	I	I	
	d. Check for proper electrical operation of bomb racks (arming, release, and selection).	C		C	C	C	C	
	e. Check to see that bombracks are electrically inoperative when master armament switch is "OFF" and when arresting hook handle is down.	C		C	C	C	C	
	f. Check operation of bombrack manual latching pin.	C		C	C	C	C	
	g. Check to make certain that bomb suspension hooks do not open when anti-release safety pin or lock and relatch pin are installed in bombrack.	C		C	C	C	C	
	h. Check for proper operation of emergency bomb release system.	C		C	C	C	C	
	i. Check for proper loading of bombs (arming wires in place, sway braces tightened, etc.) prior to bombing mission and make certain that master armament switch is in the "OFF" position.	IC						
	j. Check to make certain that anti-release safety pins, lock and relatch pins, and fuse safety wires are removed prior to take-off.	IC						
2.	ROCKET LAUNCHERS.							
	a. Check for general condition and security of mounting.	IC		IC	IC	IC	IC	
	b. Check for proper electrical operation of launchers and rocket firing circuit (use rocket circuit test plug, Model 1).	C		C	C	C	C	
	c. Check for proper loading of rocket (pigtail connected, rocket properly latched in launcher, arming wire in place, etc.) and make certain that master armament switch is in "OFF" position.	IC						
	VII. AIRPLANE EQUIPMENT.							
A.	OXYGEN SYSTEM.							
1.	GENERAL.							
	a. Oxygen equipment shall be given a bench check at least once each month.							R
	b. Before each flight, when oxygen is required, open the cylinder valve and check the state of charge of the cylinder. (Pressure gage should show 1800 psi.) With the cylinder valve still open, check the operation of the regulator and oxygen flow indicator.	C		C	C	C	C	
	c. Operate system and inspect for leakage.			C	C	C	C	
	d. Check air valve for freedom of movement.	C		C	C	C	C	
	e. Inspect security of oxygen cylinder.	I		I	I	I	I	

I—Inspect (visual only).
C—Check (functional).
R—Remove, recondition or replace.
O—Overhaul on airplane.

Item No.	NATURE OF INSPECTION	PREFLIGHT	DAILY	25-30 HOUR	50-60 HOUR	75-90 HOUR	100-120 HOUR	OTHER
B.	FUSELAGE EQUIPMENT.							
1.	SEAT.							
	a. Check seat for full travel. See that it moves freely in its tracks.			C	C	C	C	
2.	SAFETY BELT AND SHOULDER HARNESS.							
	a. Inspect safety belt and shoulder harness for cleanliness, freedom from grease, and fraying or cuts in belt; buckle should work smoothly under tension.	IC		IC	IC	IC	IC	
3.	INERTIA REEL.							
	a. Inertia reel should play out when unlocked, and hold its position when locked.	C		C	C	C	C	
4.	MISCELLANEOUS.							
	a. Inspect relief tube, chartboard, mirrors, headrest, arm rests, map case, and check-off lists for condition and security.	I		I	I	I	I	
	b. Check pilot's catapult handgrip before catapult operations.							C
	c. Inspect pilot's locker and baggage compartment for condition and security.							I
	d. Check tow target mechanism (if installed) before each use.							C
	e. Check ash tray, cigarette lighter and portable equipment receptacle for proper operation.							C
C.	HEATING AND VENTILATING SYSTEM.							
1.	GENERAL. Pull heater at major engine overhaul period (500 hours approximately). Check the following:							O
	a. Primary power source.							
	b. Heater ignition box.							
	c. High tension leads.							
	d. Spark plugs.							
	e. Thermal switch.							
	f. Air pressure switch.							
	g. Fuel supply to heater (including wiring to auxiliary fuel pump).							
	h. Fuel pressure regulator filter.							
	i. Heater fuel cycling solenoid and fuel shut-off solenoid.							
	j. See that there are no obstructions in ram air line.							



APPENDIX I

NIGHT FIGHTER EQUIPMENT

A-1. F4U-5N NIGHT FIGHTER.

A-2. DESCRIPTION. The F4U-5N airplane is a completely equipped single seat night fighter which can easily be distinguished from the F4U-5 day fighter by the radar nacelle on the right wing and the trihedral prism retro-reflectors on each wing tip and the tail cone. This airplane incorporates the following systems and miscellaneous units which are not installed in the F4U-5 day fighter; (1) P-1 Auto Pilot, (2) AN/APS-19 Radar Set, (3) AN/ARC-28 Communication (VHF) Equipment, (4) AN/APX-2 IFF Identification Equipment, (5) AN/APN-1 Radio Altimeter, (6) Windshield Degreaser, (7) Mk20 Gunsight, (8) Night Fighter Gunnery Training Camera Lights and Trihedral Prism Retro-Reflectors, (9) T-20 Flash Hiders mounted on the gun muzzles, and (10) Exhaust Collector Flame Dampeners. In addition, the ranging throttle grip used on the F4U-5 airplane is replaced by a conventional throttle grip and microphone switch. *(See figure A-1.)*

A-3. P-1 AUTOMATIC PILOT SYSTEM.

A-4. DESCRIPTION. The P-1 automatic pilot is a system of automatic controls which will hold the aircraft on any selected heading, bring it back without overswing when momentary displacements occur, and simultaneously keep the airplane stabilized in pitch and bank. While under automatic control, the aircraft can also be made to climb, dive, and execute perfectly banked turns. The automatic pilot is engaged and disengaged from the surface controls electrically, by means of a clutch switch. It can also be disconnected by a cable system in an emergency. The auto pilot is controlled by a number of autosyn transmitters located in the compass, bank and turn, and gyro horizon indicators. When the auto pilot is engaged with the controls, it maintains the airplane in the same heading and flight attitude it was on prior to engagement. This is made possible by the instruments which register any changes whatever in direction, pitch, bank and trim due to air currents, etc. As the instruments register the changes they also turn the auto pilot autosyn transmitter rotors located in the instrument housings. The transmitters send out signals which are proportionate in voltage to the amount of change in the airplane's position. These signals are amplified and sent to the auto pilot servo motors which move the control surfaces to positions which will cause the airplane to regain its original heading, flight track and attitude. Power for the auto pilot is supplied by an inverter which serves the auto pilot system. The inverter produces three-phase, 400-cycle, 115-volt ac current. Twenty-eight volt dc current is used only for the relays in the system and for the heater filaments in the vacuum tubes of the amplifier units. All units in the auto pilot system are readily accessible through the lower cockpit access door, radio compartment access door and the cockpit.

A-5. TROUBLE SHOOTING. If any part of the auto pilot system fails to operate, check for improper connections and for broken or damaged parts. For wiring diagram information see figure A-9. Malfunctions in the auto pilot system should be remedied by experienced and qualified personnel. For an operational test of the auto pilot system see paragraph A-75. Extensive testing and trouble shooting of the auto pilot system must be handled by specialists. See AN 05-45DA-1, Operation and Service Instructions for Automatic Pilots.

A-6. AUTO PILOT SWITCH CONTROLS.

A-7. DESCRIPTION. *(See figure A-2 and figure A-3.)* The auto pilot control switches are located on the right hand control panel in the cockpit with the exception of the gyro horizon caging switch on the gyro horizon instrument which breaks the auto pilot clutch switch holding circuit. For wiring diagram information on the switches see figure A-9. The switches are described in the following steps:

a. P-1 INVERTER CIRCUIT BREAKER. This switch is located on the circuit breaker panel and is normally closed. It completes the 28-volt dc power circuit to the auto pilot inverter.

b. AUTO PILOT CIRCUIT BREAKER. This circuit breaker closes a 28-volt dc circuit to the caging relays and to the filaments in the vacuum tubes of the servo amplifier and flux gate transmitter amplifier. If the compass system fails to operate, check to make certain this switch is "on." When "out" this switch breaks the holding circuit to the clutch switch preventing the clutch switch from being pushed "ON."

c. CAGING SWITCH. This switch is operated by the knob on the gyro horizon indicator. When the knob mechanically cages the indicator gyro, it closes the caging switch which, in turn, closes a circuit to the caging relays. The caging relay operates the flux gate caging motor which cages the compass gyro. The caging switch also breaks the holding circuit to the clutch switch when the gyros are caged.

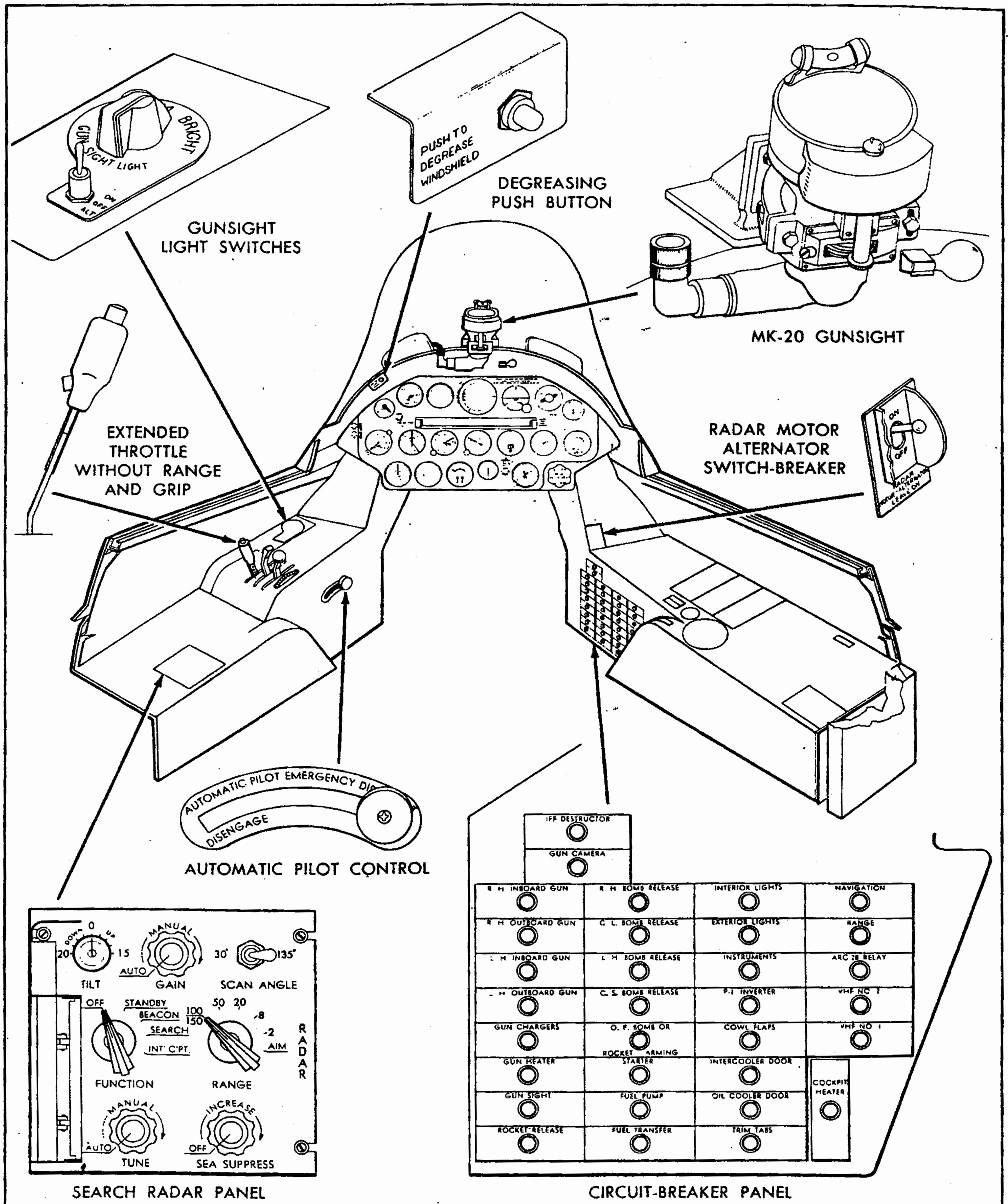
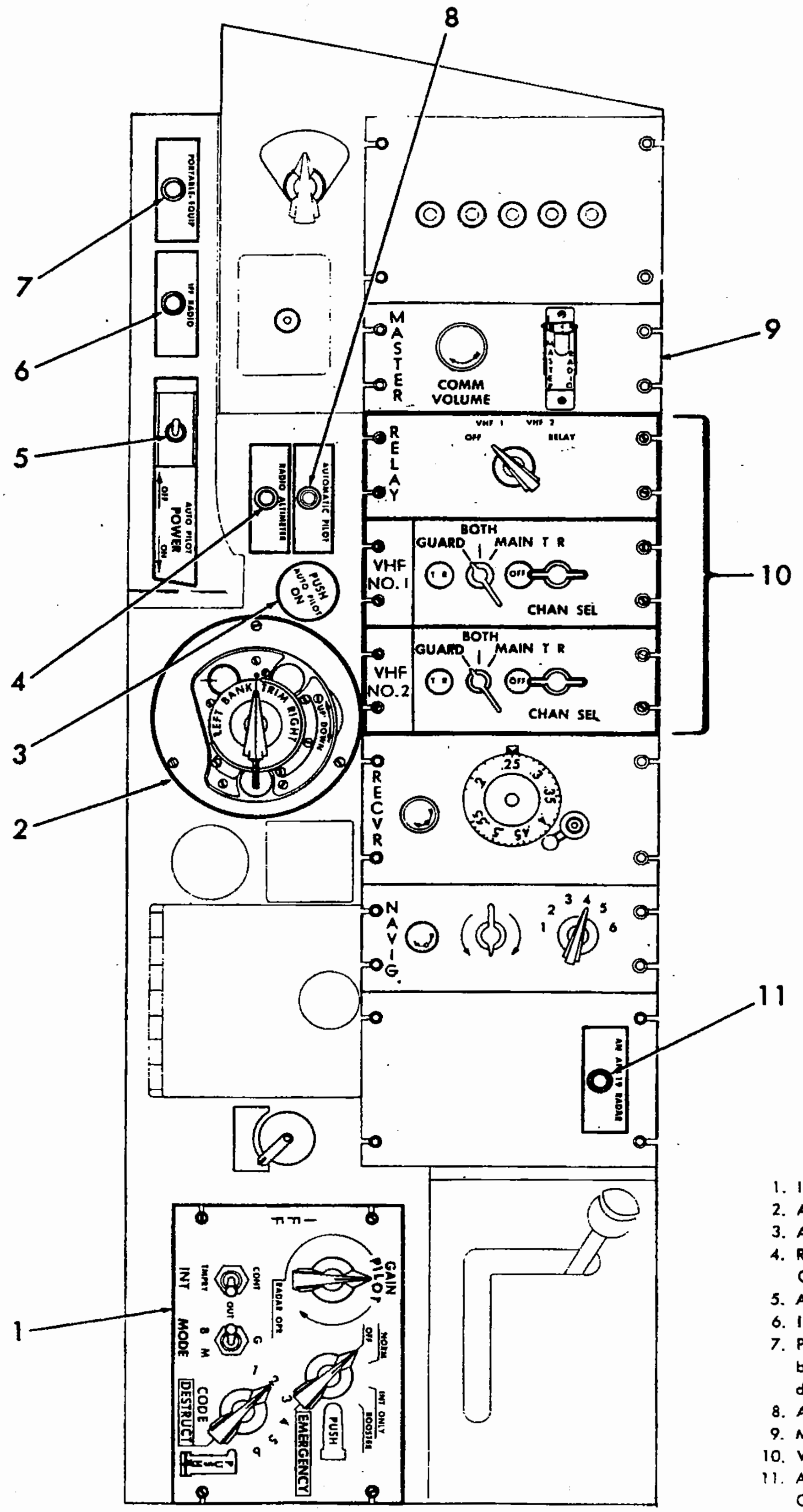
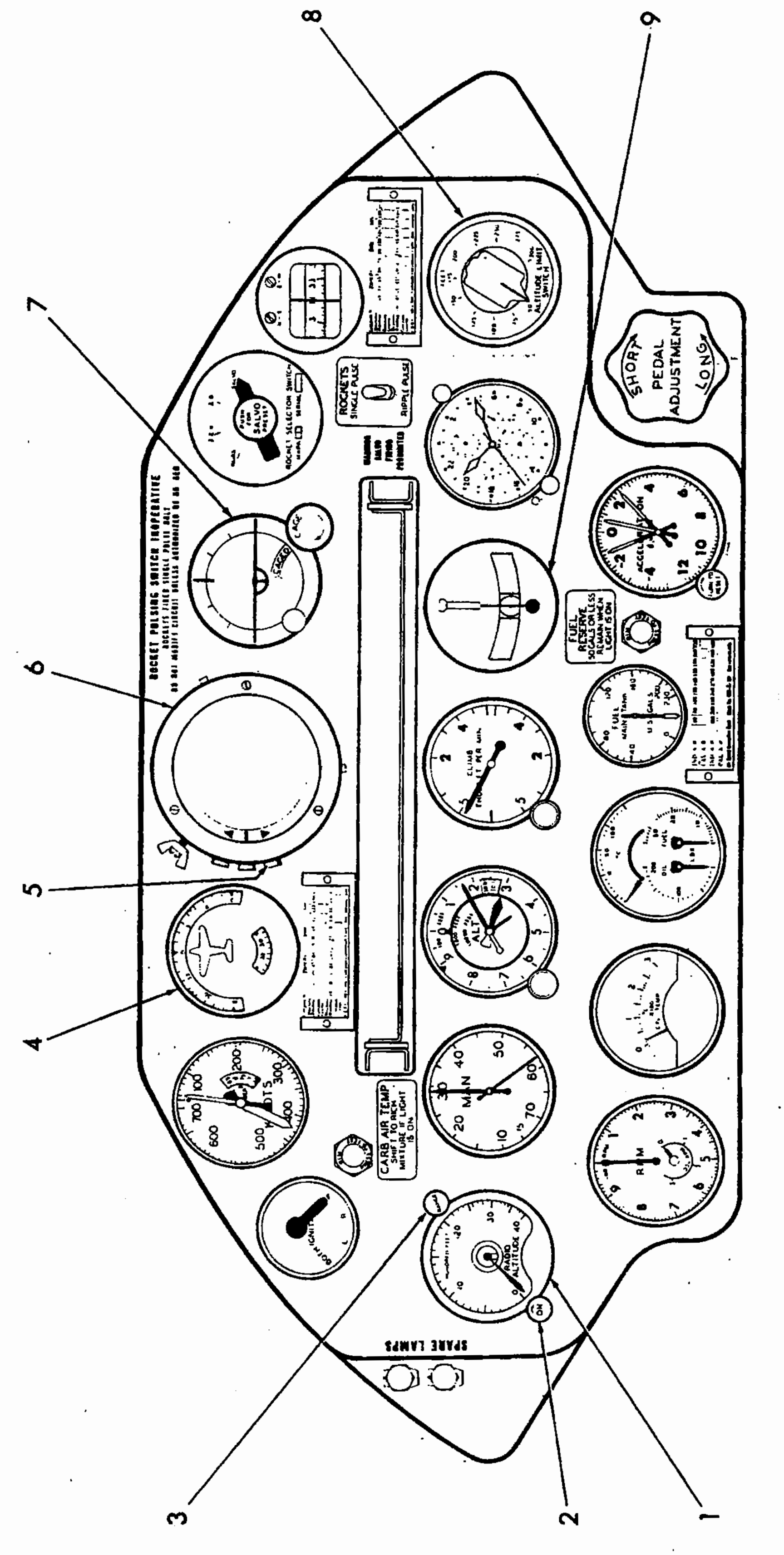


Figure A-1. Cockpit — View Looking Forward.



1. IFF Control Panel
2. Auto Pilot Controller
3. Auto Pilot Clutch Switch
4. Radio Altimeter Circuit - breaker
5. Auto Pilot Power Switch
6. IFF Circuit-breaker
7. Portable Equipment Circuit-breaker (must be closed for degreaser operation)
8. Auto Pilot Circuit-breaker
9. Master Radio Control Panel
10. VHF Control Panels
11. AN APS-19 Radar Circuit - breaker

Figure A-2. Right Hand Console.



1. Radio Altitude Indicator
2. Power Switch
3. Range Switch
4. Master Direction Indicator (Controls Rudder Channel-Auto Pilot)
5. Radio Altitude Limit Indicator Light (red)
6. Radar Indicator
7. Gyro Horizon Indicator (Vertical Gyro Control-Auto Pilot)
8. Radio Altitude Limit Switch
9. Bank and Turn Indicator (Rate Gyro Control-Auto Pilot)

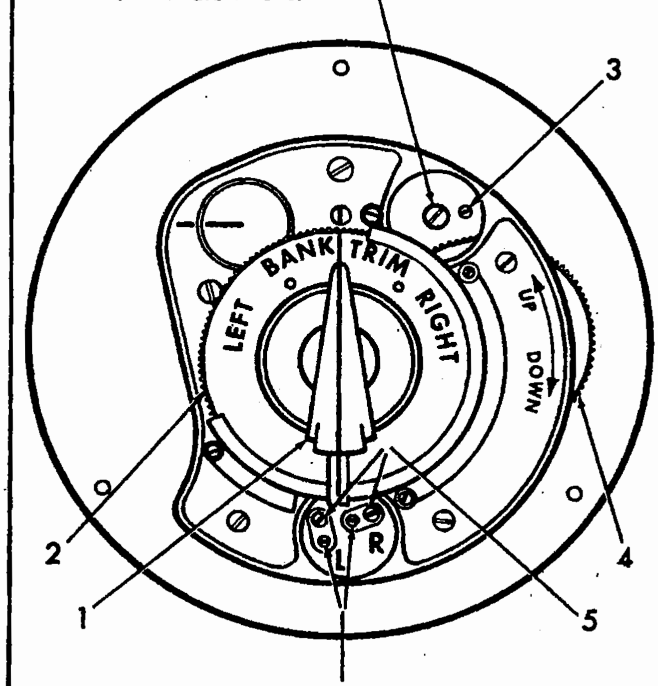
Figure A-3. F4U-5N Instrument Panel.

d. AUTO PILOT POWER SWITCH. The power switch is an "ON-OFF" switch which operates the power relay in the power junction box. When the power switch is "ON" it closes the power relay which, in turn, closes the 400-cycle, 115-volt ac circuit from the auto pilot inverter to the servo amplifier and the 28-volt dc circuit to the filaments in the servo amplifier. The power switch also operates one of the caging relays which closes the holding circuit to the clutch switch. With this arrangement the clutch switch cannot be placed in the "ON" position until the power switch is "ON." Note that the power switch must be on 30 seconds prior to engaging clutch switch. This is to permit the servo amplifier to warm up. If the clutch switch is engaged immediately after the power switch is placed in the "ON" position, controls will creep and possibly control stick movement will be violent.

e. CLUTCH SWITCH. This is a push-button switch, which when depressed, closes its own holding circuit to keep it in the "ON" position. The holding circuit will be broken and the switch will "pop" out if the gyros are caged or if the power switch or auto pilot circuit breaker is "OFF." The clutch switch closes a 28-volt dc circuit to the clutch solenoids in the aileron, rudder and elevator servos. The clutch solenoids operate clutches which in turn move the servo motors with power-drive shafts which operate the control surfaces.

f. CONTROLLER. *(See figure A-4.)* The controller is employed to maneuver the airplane, change the heading (direction of flight) or fly in a set course other than a straight heading (circle) with the auto pilot. The controller consists essentially of a turn control, bank-trim control, pitch-trim control and three transmitting autosyns which send signals to the rudder, aileron and elevator channels in the servo amplifier. It also incorporates a differential clutch which permits the three autosyn rotors to be turned simultaneously or individually. The turn control (knob on the top of controller) turns all three autosyn rotors simultaneously through the differential clutch to make a coordinated turn of the airplane with the auto pilot. The rate-trim autosyn sends its signal to the rudder channel in the servo amplifier, the pitch-trim autosyn to the elevator channel, and the bank-trim autosyn to the aileron channel. The pitch-trim control and bank-trim control individually turn the rotors of the pitch-trim and bank-trim autosyns independently of the turn control. This arrangement makes it possible to climb or dive the airplane with the auto pilot. When the turn control is in the detent (neutral) the three autosyn rotors are in neutral, thus, the controller does not effect operation of the auto pilot and signals from the trasmitting autosyns in the gyro horizon, bank and turn, and master direction (compass) indicators cause the auto pilot to keep the airplane on a straight heading and specific attitude. When the turn control is removed from the neutral position it breaks a circuit which causes a solenoid clutch to de-energize and disengage the transmitting autosyn in the master indicator from the induction motor. This enables the rate-trim autosyn to send its own signal to the rudder channel as its rotor is moved by the turn control, without fighting the compass signal from the master direction autosyn which would tend to pull the airplane back on a previous heading. The controller is provided with three adjustments which must be made whenever a new controller is installed *(see figure A-4)*. After the ground adjustment, further adjustments must be made while the airplane is in flight.

TURN ADJUSTING SCREW COUNTERCLOCKWISE TO INCREASE, OR CLOCKWISE TO DECREASE AMOUNT OF RUDDER IN PROPORTION TO AILERON MOVEMENT. MAKE THIS ADJUSTMENT BEFORE ADJUSTING FOR THE ELEVATORS.



TURN ADJUSTING SCREWS CLOCKWISE TO INCREASE, OR COUNTERCLOCKWISE TO DECREASE AMOUNT OF ELEVATOR MOVEMENT IN PROPORTION TO RUDDER AND AILERON. ADJUST SEPARATELY FOR RIGHT AND LEFT TURN.

1. Trim Control
2. Bank Trim Control
3. Rudder Locking Screw
4. Pitch-trim Control
5. Elevator Locking Screws

Figure A-4. Auto Pilot Controller.

g. EMERGENCY DISCONNECT HANDLE. This handle is located on the vertical face of the engine control unit. It actuates a cable system which manually disconnects the auto pilot servos from the control surfaces should the auto pilot fail to do so electrically. To disengage the servos, pull the handle aft to the "DISENGAGE" position.

Note

After the emergency disconnect handle has been used, the auto pilot system will remain disengaged until the servo units are manually reset on the ground (see paragraph A-56).

A-8. OPERATION OF AUTO PILOT CONTROLS. To operate the auto pilot system see figure A-2 and figure A-3 and proceed as follows:

a. Make certain that 28-volt dc power supply is available either with an external source or from the airplane's generator. Do not use the batteries in the airplane.

b. Check to see that P-1 inverter circuit breaker and auto pilot circuit breakers are "on."

c. Turn auto pilot power switch "ON" and wait from 30 seconds to one minute.

d. Turn caging knob on master direction indicator to cage gyros. Leave in caged position until indicator dial rocks back and forth and moves within 30 degrees of airplane's heading.

e. Uncage gyro and allow compass dial to settle on correct heading. This will take as long as 15 minutes on an east or west heading, and approximately five minutes on a north or south heading if airplane is in a three-point position.

f. Set controller so that turn control, pitch-trim and bank-trim controls are in neutral.

g. Neutralize all control surfaces with control stick. Surface controls and auto pilot are now aligned for engagement.

h. Depress clutch button. Auto pilot is now engaged with controls. Any subsequent change in position of the airplane will cause auto pilot to move controls to correct for change. Controller may be operated to move surface controls as desired with auto pilot.

i. To disengage the auto pilot, yet permit it to remain in operation, pull the clutch switch "OFF." To disengage the auto pilot and discontinue operation, throw the power switch "OFF."

j. To disengage the auto pilot in an emergency, pull the emergency disconnect handle to the "DISENGAGE" position.

A-9. P-1 INVERTER POWER SUPPLY.

A-10. DESCRIPTION. *(See figure A-9.)* The auto pilot inverter (R88-I-7467, Eclipse Pioneer, Part No. 12133) is located at approximately station 165 on the left hand side of the airplane just below the rudder servo unit. Access to the inverter may be gained through the lower cockpit access door. The inverter is a motor generator which converts the airplane's normal power supply of 28-volt dc into three-phase, 400-cycle, 115-volt ac power. The 115-volt ac power supplied by the inverter is sent to the gyro flux gate amplifier and the servo amplifier after it has passed through the power junction box. The inverter also supplies the power for the gyros in the auto pilot system. In this case, however, the 115 volts ac is stepped down to 26 volts ac by means of a three phase step-down transformer in the power junction box. For wiring diagram information on the inverter see figure A-9.

A-11. REMOVING. Make certain that the battery switch is "OFF" and proceed as follows:

a. Work through lower cockpit access door and remove the electric lead to the inverter.

b. Remove four bolts and washers which secure the inverter to the mounting bracket. The outboard bolts (left) must be removed with a socket wrench employing an extension.

A-12. MAINTENANCE. Since maintenance of this unit is limited to repairs which can be done when the equipment is installed, routine servicing consists only of electrical and ground cable inspection, installation inspection, and the replacement of damaged or broken parts.

A-13. INSTALLING. To install the inverter, reverse the removal procedure.

A-14. POWER JUNCTION BOX.

A-15. DESCRIPTION. The power junction box (R88-B-856-100) is located at approximately station 195 on the lower radio shelf next to the IFF transpondor. It is accessible through the radio compartment access door. This unit is the central distribution point for the three-phase, 400-cycle, 115-volt current and the 28-volt dc current to the auto pilot units. The three-phase, 115-volt, 400-cycle current is brought into the power junction box and distributed to receptacles supplying both the gyro flux gate amplifier and the servo amplifier. Three electrolytic condensers are provided for power factor correction. A three-phase transformer in the junction box is operated off the ac line. Its secondary windings supply three-phase, 400-cycle, 26-volt current for operation of the gyro motors. The 28-volt dc current is used to operate the power relay in the junction box. It is also distributed to receptacles supplying heater current for vacuum tubes in both amplifiers, the solenoid in the clutch switch, and the solenoids in the three servos as well as one in the master direction indicator. The power relay opens and closes the circuit carrying 400-cycle current at 115 volts to the servo amplifier. It also simultaneously opens and closes the circuit carrying 28-volt dc current to the tube heaters in the servo amplifier and to all the clutch solenoids in the servos. It does not, however, control the power supply to the gyro motors and the gyro amplifier. The relay thus permits power to the automatic pilot to be shut off without affecting the operation of the gyro compass. For wiring diagram information on this unit see figure A-9.

A-16. REMOVING. Make certain that battery switch is "OFF" and proceed as follow:

a. Disconnect the four electric leads to the power junction box.

b. Remove the four screws and locknuts which secure the power junction box to its mounting bracket on the lower radio shelf.

A-17. MAINTENANCE. Since maintenance of this unit is limited to repairs which can be done when the equipment is installed, routine servicing consists only of electrical and ground cable inspection, installation inspection and the replacement of damaged or broken units. Refer to AN 05-45DA-1, Operation and Service Instructions for Automatic Pilots for further maintenance procedures.

A-18. INSTALLING. To install the power junction box, reverse the removal procedure.

A-19. GYRO FLUX GATE TRANSMITTER.

A-20. DESCRIPTION. *(See figure A-9.)* The gyro flux gate transmitter (R88-T-1910) (used also in the F4U-5 airplane) is located at approximately station 265, above and aft of the gyro flux gate amplifier. This unit is accessible through the radio access door. The transmitter contains the compass element, called the flux gate, and the vertical seeking gyro by means of which the flux gate is stabilized on the horizontal plane. The gyro is caged by means of an electric motor incorporated in the transmitter housing. The flux gate provides the reference to the earth's magnetic field and sends a signal to the coupling autosyn in the master direction indicator which represents the heading of the airplane. The signals sent by the transmitter to the master direction indicator are relayed to the auto pilot through its rudder channel. The auto pilot in turn, by means of these signals, keeps the airplane on the correct heading. For wiring diagram information see figure A-9. For further information on this unit see paragraph 4-1385.

A-21. REMOVING. With the battery switch in the "OFF" position proceed to remove the compass transmitter as follows:

a. Disconnect the electric lead from the receptacle on the transmitter.

b. Remove the three nuts and washers which secure the transmitter to its mounting bracket and remove the transmitter from the airplane.

A-22. INSTALLING. To install the transmitter, reverse the removal procedure.

A-23. GYRO FLUX GATE AMPLIFIER.

A-24. DESCRIPTION. *(See figure A-5 and figure A-9.)* The gyro flux gate amplifier (R88-A-525) or single channel amplifier is located at approximately station 240 on the left hand side just aft of the servo amplifier. This unit is also used in the F4U-5. For a complete description of this unit (see paragraph 4-1380). This amplifier contains a 487½ cycle oscillator which supplies excitation for the compass element in the gyro flux gate transmitter. It also amplifies the output signals from the coupling autosyn in the master direction indicator and sends these signals to the variable phase of the two-phase induction motor in the indicator. A second oscillator in the amplifier of 975 cycles supplies current to the fixed phase of the induction motor. The induction motor drives the compass dial, the transmitting magnesyn (used only when ship has more than one compass indicator) and

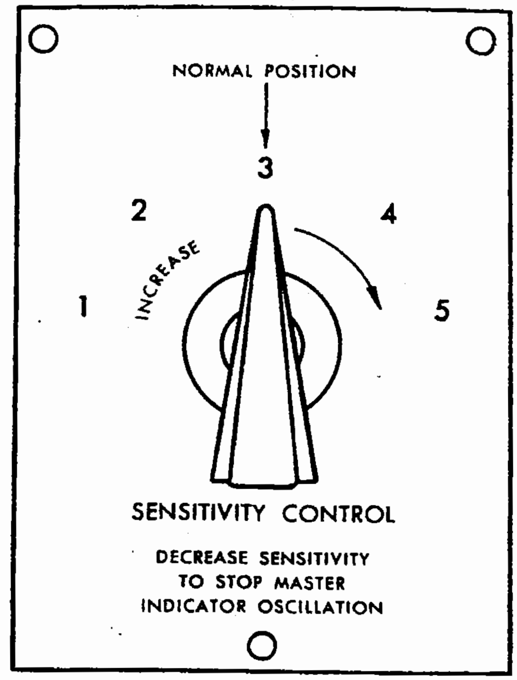


Figure A-5. Correct Setting for Sensitivity Control in Gyro Flux Gate Amplifier

the auto pilot transmitting autosyn. The transmitting autosyn sends compass direction signals to the rudder channel in the auto pilot servo amplifier. See figure A-9 for wiring diagram information on the flux gate amplifier.

A-25. REMOVING. Make certain that the battery switch is "OFF" and proceed as follows:

a. Remove the four electric leads to the amplifier.

b. Remove the four attaching bolts and locknuts which secure the amplifier shock mount to the shelf. The amplifier and shock mount are integral and are removed as one unit.

A-26. INSTALLING. To install the amplifier, reverse the removal procedure.

A-27. MASTER DIRECTION INDICATOR.

A-28. DESCRIPTION. The master direction indicator (R88-I-1681) is located on the instrument panel. This unit is also used on the F4U-5. For a complete description of the indicator and all adjustments see paragraphs 4-1394 through 4-1404. In the F4U-5N airplane this unit directly effects the operation of the auto pilot system in the following manner. The coupling autosyn in the indicator receives direction signals from the gyro flux gate transmitter and sends them out to the gyro flux gate amplifier. The signals return amplified to run an induction motor in the indicator. The induction motor drives the dial on the face of the indicator and also the rotor of a transmitting autosyn which sends compass signals to the rudder channel of the servo amplifier. The servo amplifier, in turn, operates the rudder servo motor which actuates the rudder control cables. As the transmitting autosyn in the F4U-5 airplane serves no purpose, it is disengaged from the rest of the indicator mechanism by means of an electrically operated clutch. For wiring diagram information on the master direction indicator see figure A-9.

A-29. REMOVING. Follow procedure given in paragraph 4-1276.

A-30. INSTALLING. Reverse removal procedure.

A-31. GYRO HORIZON INDICATOR.

A-32. DESCRIPTION. The gyro horizon indicator (R88-I-1325) or vertical gyro control is located on the instrument panel. This unit consists essentially of an electrically-driven gyro mounted in a rotatable yoke which provides it with 100 degrees of freedom in bank, 85 degrees in dive, and 60 degrees in climb; an erection system; an indicating face; a horizon bar; an adjustable reference marker; a caging switch; an auto pilot bank autosyn transmitter and a pitch autosyn transmitter. The rotors of the bank and pitch autosyns are turned by the gimbals of the gyro. As the airplane pitches or banks, the gimbals turn the autosyn transmitter rotors causing signals to be sent to pitch-trim and bank-trim autosyns in the controller. From here the pitch-trim signal is sent to the elevator channel in the servo amplifier, while the bank-trim signal is sent to the aileron channel. The servo amplifier, amplifies these signals to run the servo motors which move the control surfaces and correct for pitch or bank. This arrangement makes it possible for the auto pilot to maintain the airplane at a specific altitude and in the attitude desired by the pilot. The gyro horizon indicator also incorporates a caging mechanism. The caging mechanism is manually operated by means of a knob at the lower right hand side of the instrument. A red signal flag is raised when the gyro is in the caged position. The knob mechanically cages the gyro in the indicator and simultaneously operates a switch which closes a circuit which operates the caging relays in the hermetically-sealed caging relay box. The relay in turn, closes a circuit which operates the caging motor in the flux gate transmitter and breaks the holding circuit to the clutch switch. Thus, when the horizon gyro is caged, the flux gate gyro will be automtically caged also.

A-33. REMOVING. To remove the gyro horizon indicator, see paragraph 4-1276.

A-34. INSTALLING. Reverse the removal provedure.

A-35. BANK AND TURN INDICATOR.

A-36. DESCRIPTION. (*See figure A-3.*) The bank and turn indicator (R88-I-3150) or rate gyro control is located on the instrument panel. This unit consists of a ball-type inclinometer, an electrically-driven gyro, a rate-of-turn indicator, and the rate autosyn transmitter whose purpose is to provide a signal to the rudder channel in the servo amplifier. This signal is proportional to the aircraft's rate of turn. The signal makes it possible for the auto pilot not only to bring the aircraft back on a parallel heading, but on the same flight track which the ship was on prior to being thrown off. The autosyn rotor is mounted on the shaft which supports the gyro housing. The shaft turns with the gyro which precesses proportionately to the rate of turn. The movement of the rotor of the autosyn, since it is mounted on the shaft, is therefore proportional to the airplane's rate of turn. The signal transmitted from the autosyn is superimposed on the rate-trim autosyn in the controller on the left hand control panel of the cockpit. This signal goes through the rate potentiometer in the amplifier adapter and then to the rudder channel in the servo amplifier to bring the airplane back into its original flight track. For wiring diagram information see figure A-9.

A-37. REMOVING. To remove the bank and turn indicator, see paragraph 4-1276.

A-38. INSTALLING. To install the turn and bank indicator, reverse the removal procedure.

A-39. NO. 1 SERVO AMPLIFIER.

A-40. DESCRIPTION. (*See figure A-9.*) The servo amplifier (R88-A-496) or multiple channel amplifier is located at approximately station 225 on the left hand radio shelf just forward of the gyro flux gate amplifier. It is accessible through the radio compartment access door. This unit consists essentially of ten vacuum tubes and three magnetic amplifiers for three identical channels: rudder, aileron and elevator. Basically, the servo amplifier controls the power to the servo motor for the rudder, ailerons and elevator. Each channel consists of a two stage balanced amplifier containing three tubes and a magnetic amplifier. The tenth tube is the power supply for the channels. The amplifier also serves as a junction point for cables to other units in the auto pilot system. For wiring diagram information on this unit see figure A-9.

A-41. REMOVING. Make certain battery switch is "OFF" and proceed as follows:

a. Remove four electric leads to amplifier.

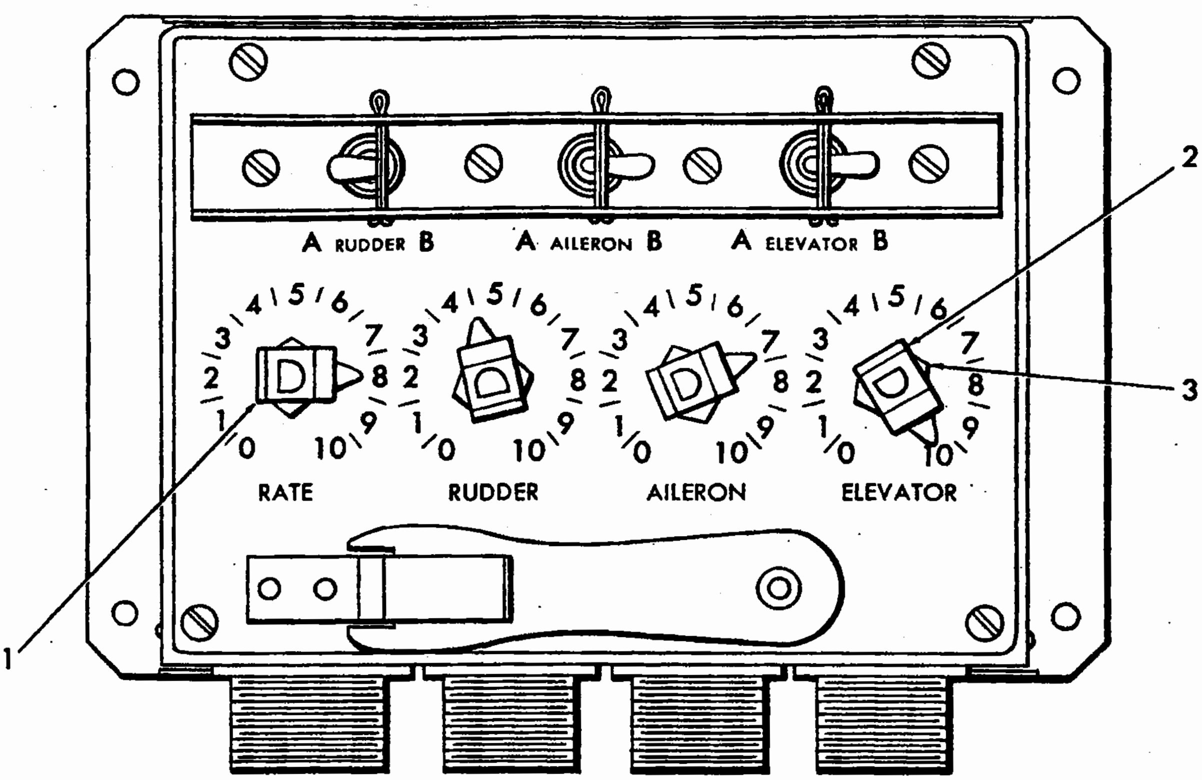
b. Remove four screws and locknuts which secure amplifier shock mount to left hand shelf. Amplifier and shock mount are integral and are removed as one unit.

A-42. MAINTENANCE. Since maintenance of this unit is limited to repairs which can be done when the equipment is installed, routine servicing consists only of electrical and ground cable inspection and the replacement of damaged or broken units. Refer to AN 05-45DA-1, Operation and Service Instructions for Automatic Pilots.

A-43. INSTALLING. To install servo amplifier, reverse the removal procedure.

A-44. AMPLIFIER ADAPTER.

A-45. DESCRIPTION. (*See figures A-6 and A-9.*) The amplifier adapter (R88-A-200) is located at approximately station 215 on the left hand side of the airplane just aft and below the controller junction box. This unit is accessible through the radio compartment access door. The amplifier consists essentially of four adjustable



1. Rate Signal Adjusting Knob
2. Follow-up Signal Adjusting Knobs (three)
3. Lock Nuts (four)

Figure A-6. Correct Setting for Amplifier Adapter.

follow-up potentiometers and three four-pole double-throw reversing switches. The amplifier incorporates all adjustments necessary for adapting the automatic pilot to the characteristics of the aircraft in which the system is installed. The four potentiometers control the proportion of rate signal to direction signal, and the follow-up ratios of the rudder, aileron, and elevator servos. The three reversing switches determine the direction of rotation of the rudder, aileron, and elevator servo units to suit installation. The potentiometers and reversing switches are set permanently in the correct positions for the F4U-5N as shown in figure A-6. The amplifier adapter also serves as a junction point for cables to the servo units and the servo amplifier. For wiring diagram information on this unit see figure A-9.

A-46. REMOVING. Make certain battery switch is "OFF" and proceed as follows:

a. Disconnect four electric leads to amplifier adapter.

b. Remove four screws and locknuts which secure amplifier adapter to its mounting bracket.

A-47. MAINTENANCE. Since maintenance of this unit is limited to repair which can be done when the equipment is installed, routine servicing consists only of electrical and ground cable inspection, installation inspection, and the replacement of broken or damaged units. Refer to AN 05-45DA-1, Operation and Service Instructions for Automatic Pilots for further maintenance procedures.

A-48. INSTALLING. To install the amplifier adapter reverse the removal procedure.

A-49. CONTROLLER JUNCTION BOX.

A-50. DESCRIPTION. The controller junction box is located at approximately station 205, and is secured to the underside of the left hand radio shelf. This unit simply serves the purpose of a cable terminal box and also externally mounts the hermetically-sealed caging relay box. The controller junction box is a good point to check all voltages in the auto pilot system without breaking circuits. For wiring diagram information on this unit see figure A-9.

A-51. REMOVING. Make certain battery switch is "OFF" and proceed as follows:

a. Remove the radio transmitter-receiver located just above the controller junction box in order to gain access to the controller junction box mounting bolts. To remove the transmitter-receiver, see paragraph A-213.

b. Remove the controller junction box cover by releasing six fasteners to gain access to the nuts securing the junction box mounting bolts.

c. Remove the three electrical leads to the junction box.

d. Remove the four mounting bolts and nuts which secure the junction box to the underside of the left hand radio shelf.

e. In order to detach the caging relay from the junction box it is only necessary to disconnect the caging relay electrical lead at the point where it is secured to the controller junction box receptacle and remove two mounting screws.

A-52. INSTALLING. To install the controller junction box, reverse the removal procedure.

A-53. AILERON SERVO INSTALLATION.

A-54. DESCRIPTION. *(See figures A-7 and A-8.)* The aileron servo installation consists of a No. 1 Servo (R88-S-150), a No. 1 Servo Disconnect (R88-D-334) and an arm and push rod assembly connected to the servo disconnect, which actuates the aileron bellcrank *(see figure 4-20)*. This installation is located approximately station 140, under the cockpit floor and just to the left of the aileron bellcrank. Access to the servo may be gained through the lower cockpit access door. The servo unit is essentially a two-phase induction motor and drive shaft controlled by the aileron channel in the servo amplifier. The servo disconnect is mounted on the servo motor drive shaft and turns with the shaft. The shaft turns clockwise or counterclockwise depending on whether the aileron demands left aileron down or right aileron down. As the servo disconnect turns, it actuates the arm and push rod assembly connected to the aileron bellcrank *(see figure A-7)*. The servo motor consists of a two-phase stator and squirrel cage rotor supported in ball bearings. One phase of the induction motor is constantly excited at a frequency of 400 cycles, 115 volts. Signals sent from the bank-trim autosyn are amplified to provide power for the second, or variable phase of the motor. Excitation of the variable phase, also at a frequency of 400 cycles, varies from 0 to 110 volts. A damper rotor, mounted on a common shaft with the induction motor, prevents hunting or oscillation about a null point. A follow-up autosyn is linked by a gear train to the induction motor. The signals from the follow-up autosyn are superimposed on the signals from the bank-trim autosyn in order to immediately check movement of the ailerons as soon as an appropriate auto pilot correction has been made. The servo also incorporates a solenoid operated clutch mechanism which engages or disengages the servo induction motor from the servo power shaft. The clutch is held in when the solenoid is energized; thrown out by a spring when the power to the solenoid is cut. This arrangement permits the auto pilot to be electrically disengaged from the control surfaces with, however, the servo motors still in operation. The clutch solenoid is controlled by the auto pilot clutch switch in the cockpit *(see figure A-2 and paragraph A-7)*. For wiring diagram information on the aileron servo motor see figure A-9.

A-55. AILERON SERVO DISCONNECT.

A-56. DESCRIPTION. The aileron servo disconnect is mounted on the servo motor drive shaft and provides a means of mechanically disconnecting the auto pilot from the aileron controls in case of emergency. See figure A-8 and paragraph A-72 for information on the auto pilot emergency disconnect cable system. The disconnect consists essentially of a bearing and hub assembly. The hub assembly is internally splined to fit the external spline of the servo motor drive shaft. The bearing assembly is free to idle on the hub assembly when the unit is in the disconnect position, but the two assemblies are locked together when the units are engaged by two drive pins. The drive pins are pulled out by a cable, thus disconnecting the hub and bearing assembly when the emergency disconnect handle in the cockpit is actuated *(see figure A-8, item 11)*. The idler bearing mounts the arm which actuates the push rod connected to the aileron bellcrank *(see figure A-7)*. With this arrangement, the auto pilot servo motor may be turning the hub assembly of the servo disconnect while the disconnected idler bearing with the aileron bellcrank pushrod remains stationary. In this case, the pilot can manually operate the controls with the idler bearing riding with them and causing a minimum of friction. When the servo disconnect unit has been disengaged by operation of the emergency cable system, it becomes necessary to re-engage the unit manually *(see figure A-8)* by pushing outwards on one of the latches (15) on the face of the servo disconnect, then rotating the disconnect idler bearing until the drive pins partially fall into place with an audible "click" and engage the idler bearing assembly with the internally splined hub. The second latch (15) must now be pushed outwards to completely seat the drive pins. When the pins are seated they will be flush with the face of the servo disconnect and insure positive engagement of the idler bearing with the internally splined hub. For information on the emergency disconnect cable system see figure A-8 and paragraph A-72. The servo disconnect is also provided with a manually operated spline type clamping jaw *(see figure A-8, item 14)* which is spring-loaded in the closed position. The entire servo disconnect assembly can be pulled off the servo motor drive shaft merely by squeezing the jaws open and freeing the disconnect from the servo drive shaft spline. Normally, the jaws engage with a groove around the circumference of the spline.

A-57. REMOVING AILERON SERVO MOTOR. Make certain that battery switch is "OFF," *(see figure A-7)* and proceed as follows:

a. Disconnect electrical lead (4) to servo motor.

b. Break safety-wire and remove six bolts which secure servo motor to its mounting bracket.

c. Depress jaws *(see figure A-8, item 14)* on servo disconnect and at same time pull servo motor aft till its spline shaft is disengaged from internal spline in servo disconnect.

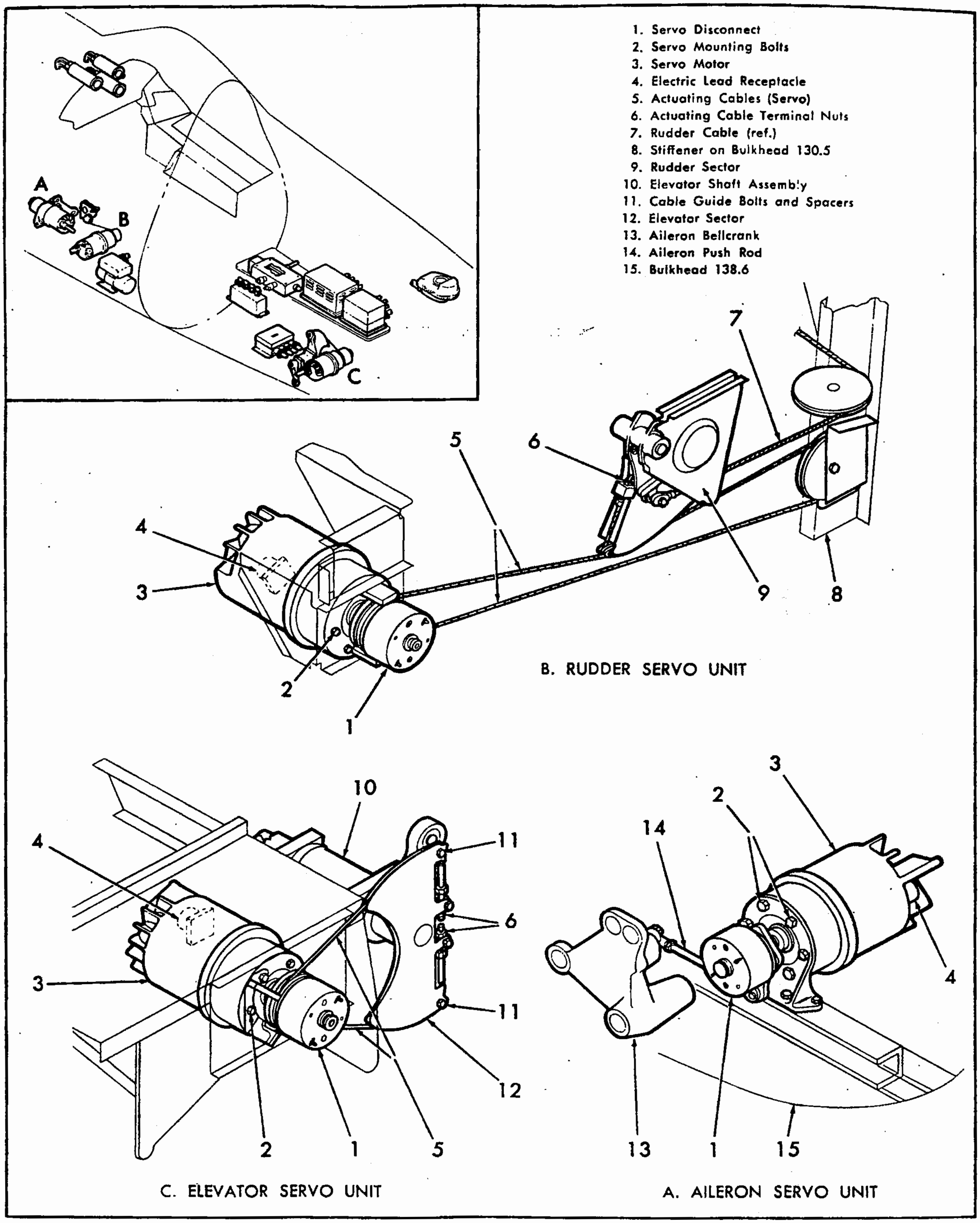


Figure A-7. Auto Pilot Servo Installation.

A-58. REMOVING AILERON SERVO DISCONNECT. Due to limited clearance it is necessary first to remove the servo motor before removing the servo disconnect. Observe the servo motor removing procedure in paragraph A-57. To remove the servo disconnect (after removal of servo motor has been accomplished) *(see figure A-8)* proceed as follows:

a. Disconnect servo disconnect pushrod at point where it attaches to aileron bellcrank.

b. Disconnect emergency cable slack spring (8) located above and forward of servo disconnect.

c. Trace servo disconnect cable leading out of servo disconnect. Cable is about four feet in length. It travels upward from servo disconnect through two fairlead pulleys, then to an idler pulley (4) on the left hand side. From the idler pulley the cable travels to the right hand side of the airplane through two more pulleys, a cable fairlead (2) and finally to a second idler pulley (4) which is the cable terminal point. This idler pulley is located just above the pilot's distribution box. Disconnect the cable terminal end from the right hand idler pulley (4). Remove the four fairlead pulleys and the left hand idler pulley (4). Loosen the bolts securing the two sections of the cable fairlead (2). Disengage the cable from the guide block and pulley brackets. Remove the servo disconnect with cable from the airplane.

A-59. MAINTENANCE. Since maintenance of the servo installation is limited to repairs which can be done when equipment is installed, routine servicing consists only of electrical and ground cable inspection, installation inspection, and the replacement of damaged or broken units. Refers to AN 05-45DA-1, Operation and Service Instructions for Automatic Pilots.

A-60. INSTALLING SERVO MOTOR AND SERVO DISCONNECT. To install servo motor and servo disconnect reverse the removal procedure. Make certain that slack spring is attached, and that there is slack on the cable between the spring and where it passes into servo disconnect. Remember to position the servo disconnect prior to bolting the servo motor to the bracket.

WARNING

Make certain that the servo disconnect arm (actuates pushrod) is projecting downwards on installation of servo disconnect. If arm were to project upward, reverse operation of ailerons would result.

A-61. RUDDER SERVO INSTALLATION.

A-62. DESCRIPTION. (*See figure A-7.*) The rudder servo installation consists of a No. 1 Servo (R88-S-150), a No. 1 Servo Disconnect (R88-D-334) incorporating a pulley and actuating cable assembly and the rudder sector which actuates the rudder pedals. The rudder sector is secured to an arm on the left hand rudder pedal. This installation is located at approximately station 160, below the cockpit floor on the left hand side and just above the auto pilot inverter. Access to the rudder servo units may be gained through the lower cockpit access door. The rudder servo installation is similar to that of the elevator servo, see paragraph A-67. For a complete description on the servo motor and servo disconnect see paragraph A-54. For wiring diagram information see figure A-9.

A-63. REMOVING RUDDER SERVO MOTOR. Make certain battery switch is "OFF," *(see figure A-7)* and proceed as follows:

a. Loosen up two actuating cables (5) by loosening cable terminal nuts (6) on rudder sector. The outboard cable terminal nut is accessible through a lightening hole in the rudder pedal arm assembly.

b. Squeeze servo disconnect jaws *(see figure A-8, item 14)* out and slide servo disconnect off servo motor spline.

c. Disconnect electric lead (4) to servo motor.

d. Break safety-wire and remove six bolts (2) which secure rudder servo motor to mounting bracket.

A-64. REMOVING RUDDER SERVO DISCONNECT. To remove the rudder servo disconnect separately from the airplane see figure A-8 and proceed as follows:

Note

It is assumed that the rudder servo disconnect is still engaged with the servo motor spline.

a. Unhook servo disconnect cable slack spring (8).

b. Detach servo emergency disconnect cable at terminal end from turnbuckle (3) located above and just aft of lower cockpit access opening.

c. Remove fairlead pulley located between turnbuckle (3) and servo disconnect (12).

d. Free emergency disconnect cable from fairlead pulley bracket.

e. *(Refer to figure A-7.)* Disconnect two servo actuating cables (5) from rudder pedal sector assembly. Remove cable guide bolts and spacers at each end of sector and remove cable terminal nuts (6) which secure cables to sector.

f. Squeeze open disengaging jaws *(see figure A-8, item 14)* of servo disconnect and slide servo disconnect off servo motor spline. Servo disconnect is removed with rudder actuating cables and emergency disconnect cable as one unit.

A-65. INSTALLING. To install rudder servo installation, reverse the removal procedure. Note that while installing cables, clutch switch must be off. Actuating cables should be adjusted to 45 ± 5 pounds tension. This is done by tightening or loosening the cable terminal nuts.

A-66. ELEVATOR SERVO INSTALLATION.

A-67. DESCRIPTION. *(See figure A-7.)* The elevator servo installation consists of a No. 1 Servo (R88-S-150), a No. 1 Servo Disconnect (R88-D-334) incorporating a pulley and actuating cable assembly and the elevator sector which actuates the elevator shaft assembly. This installation is located at approximately station 230 on the centerline of the ship. The servo motor is mounted on the right hand vertical face of the altimeter transmitter-receiver shelf. Access to the elevator servo installation may be gained through the radio compartment access door. For a complete description of the servo motor and servo disconnect units see aileron servo installation paragraph A-54, figure A-7 and figure A-8. The elevator servo installation differs from the aileron in that the aileron servo disconnect has an arm and pushrod connected to the aileron bellcrank, whereas the elevator servo disconnect has a pulley and actuating cable assembly connected to a sector which in turn is bolted to the elevator shaft *(see figure 4-23 and figure A-7)*. The actuating cables are adjusted for 45 ± 5 pounds tension by tightening or loosening the cable terminal nuts on the elevator sector *(see figure A-7, item 6)*. For wiring diagram information on the elevator servo see figure A-9.

A-68. REMOVING ELEVATOR SERVO MOTOR. Make certain that battery switch is "OFF," see figure A-7, and proceed as follows:

a. Work through radio compartment access door and disconnect electrical lead (4) to servo motor. The electric lead receptacle is located on left hand end of servo, aft of and just below amplifier adapter.

b. Loosen servo actuating cables (5) by loosening cable terminal units (6) which secure cables to elevator sector (12).

c. Disconnect slack spring *(see figure A-8, item 8)* from servo disconnect cable by unhooking spring from flange secured by servo motor mounting bolts.

d. Squeeze the servo disconnect disengaging jaws *(see figure A-8, item 14)* and slide disconnect off servo motor spline.

e. Break safety-wire and remove six bolts (2) which secure servo motor to right hand vertical face of support which mounts altimeter transmitter-receiver. Make certain when removing bolts to note the correct position of the slack spring anchor flange and actuating cable guides (11) secured by mounting bolts.

f. Reach under transmitter-receiver support and pull servo motor out from underneath and remove unit from the airplane.

A-69. REMOVING ELEVATOR SERVO DISCONNECT. The servo disconnect can be removed without removing servo motor by proceeding as follows:

Note

It is assumed that servo disconnect is still engaged with servo motor spline.

a. Detach disconnect slack spring *(see figure A-8, item 8)* from anchor flange.

b. Detach disconnect cable at terminal end making certain not to misplace slack spring and slack spring anchor tab.

c. Remove four cable guide bolts and spacers *(see figure A-7, item 11)* from elevator sector.

d. Loosen cable terminal nuts *(see figure A-7, item 6)* and free servo actuating cables from elevator sector.

e. Squeeze disengaging jaws *(see figure A-8, item 14)* out and slide servo disconnect off servo motor spline. Servo disconnect and actuating cables are removed as one unit.

f. Elevator sector may now be removed by removing three bolts which secure elevator sector shaft to elevator shaft assembly.

A-70. INSTALLING. To install the elevator servo installation reverse the removal procedure. Note that the clutch switch in the cockpit should be out and that the cable tension should be 45 ± 5 pounds. Adjust cable tension by tightening or loosening cable terminal nuts on elevator sector.

A-71. AUTO PILOT EMERGENCY DISCONNECT CABLE SYSTEM.

A-72. DESCRIPTION. *(See figure A-8.)* The auto pilot emergency disconnect system is employed to disconnect the auto pilot system from the rudder, aileron and elevator controls should the auto pilot fail to do so electrically. The emergency disconnect system consists essentially of a control handle in the cockpit which actuates a series of cables leading to the three servo disconnect units. When the control handle is placed in the "DISENGAGE" position, the cables actuate a mechanism in each one of the servo disconnects which disengages the servo disconnect idler bearing from the servo motor spline. The rudder and elevator servo cables and aileron servo pushrod which actuate the control surfaces through the auto pilot are secured to the servo idler bearings. Therefore, when the idler bearings are disengaged from the servo motors, the servo cables and pushrod are also disengaged and ride with a minimum of friction when the pilot manually operates the controls. It is important to remember that once the control handle has been placed in the "DISENGAGE" position, it cannot re-engage the servo disconnects. These units must be individually reset when the airplane is on the ground. For information on manually engaging a servo disconnect see paragraph A-56. In order to avoid the possibility of inadvertently disengaging the servo disconnects due to excessive cable tension, a slack spring is installed at each one of the servo units. These springs should be periodically checked for correct installation. Access to the emergency cables may be gained through the lower cockpit access door and radio compartment access door. A single cable leads from the cockpit control handle to an idler pulley below the cockpit floor on the left hand side. This idler pulley accommodates a second single cable, one end of which leads into the aileron servo disconnect and the other end which leads to a second idler pulley located on the right hand side just above the pilot's distribution box. This second idler pulley accommodates a third single cable, one end of which leads to a turnbuckle just above and aft of the

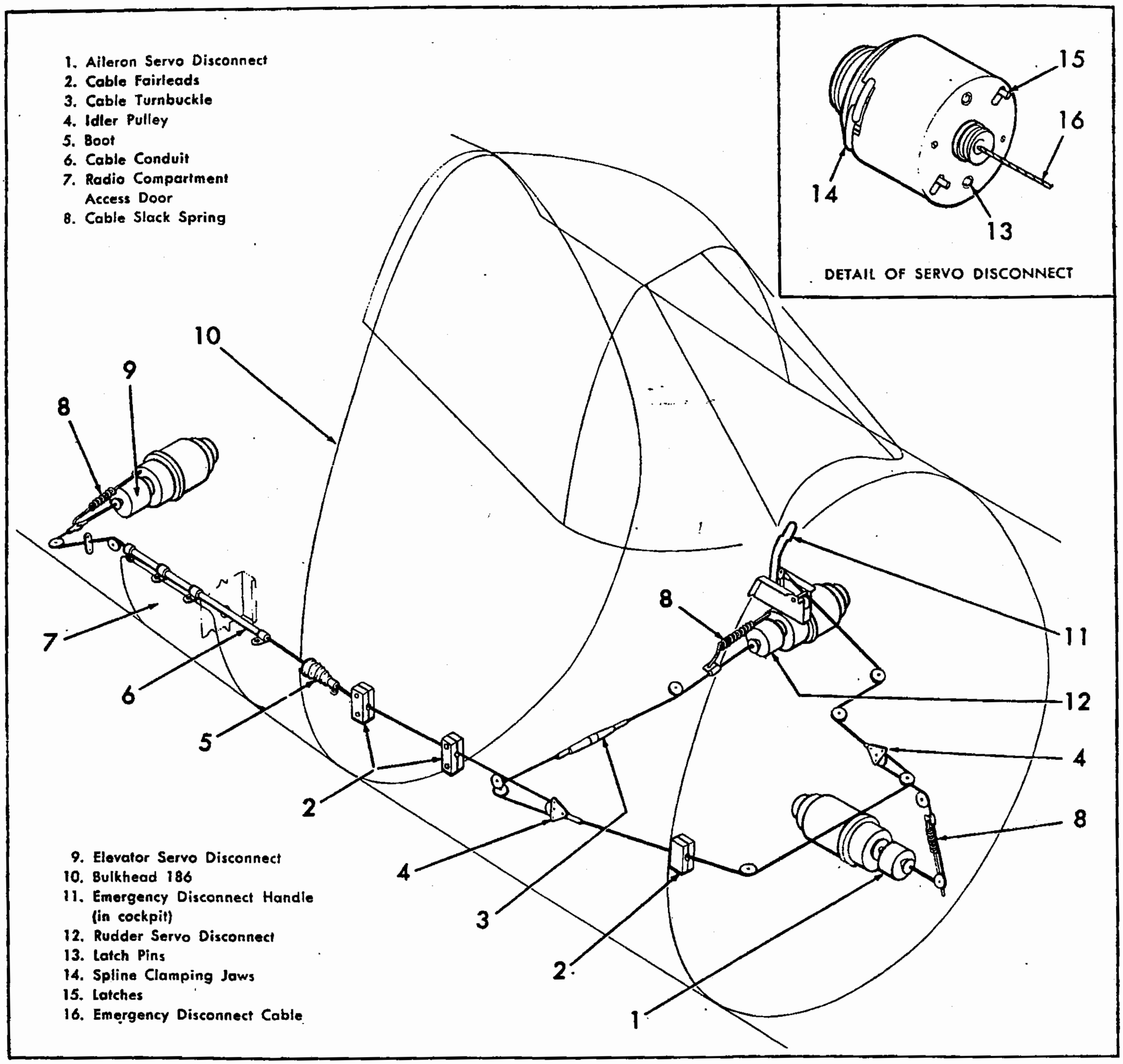


Figure A-8. Auto Pilot Emergency Disconnect Cable System.

lower cockpit access opening. The turnbuckle is connected to a short cable leading directly into the rudder servo. The other end of the third cable leads to the elevator servo, and connects to a short cable which leads into the servo unit.

A-73. REMOVING EMERGENCY CABLE SYSTEM. To remove the cable installation, see figure A-8 and proceed as follows:

a. Remove the aileron, rudder and elevator servo disconnect cables as described in paragraph A-58, paragraph A-64, and paragraph A-69.

b. Remove slotted cover on vertical face of control unit in cockpit to gain access to cable terminal connected to auto pilot emergency disconnect handle.

c. Detach cable terminal from handle (11).

d. Remove cable guide and spacer (not steel pulley) which is accessible through control unit cover.

e. Work through lower cockpit access door and remove two fairlead pulleys on left hand side. This frees the first single cable which leads from the control handle (11) to the first idler pulley (4). The idler pulley was freed of the second single cable when the aileron servo disconnect cable (second single cable) was removed.

f. Working on the right hand side remove the guide bolt and spacer from the double pulley bracket which guides the third single cable from the second idler pulley (4) to the turnbuckle (3) leading to the rudder servo cable and to the elevator servo cable in the aft section. Remove the second idler pulley making certain not to misplace idler bracket or pulley.

g. Separate cable fairlead (2) located just forward of bulkhead 186 on the right hand side.

h. Working through radio compartment access door, remove four clamps which secure protective cover for cable to top frame of radio compartment access door.

i. In radio compartment, pull third single cable through opening in bulkhead 186 and remove cable from airplane.

A-74. INSTALLING. To install cables reverse removal procedure. Make certain all cable springs are properly connected, and that servo disconnects are engaged to servo motor spline with cockpit control handle forward.

A-75. PREFLIGHT OPERATIONAL TEST OF AUTOMATIC PILOT. In addition to the visual inspection, the auto pilot should be checked before flight as follows:

a. With all cables properly connected to the units of the automatic pilot, connect an auxiliary power supply to the aircraft. Make certain that P-1 inverter circuit breaker and auto pilot circuit breaker are "on."

b. With external power available, the following units should begin functioning: automatic pilot inverter, gyro flux gate amplifier and the three gyros (flux gate transmitter, gyro horizon, and bank and trim gyro).

c. Turn caging knob on master direction indicator to cage gyros. Leave in caged position until indictor dial rocks back and forth and moves within 30 degrees of airplane's heading.

d. Uncage gyros and jar instrument panel to make certain gyro is uncaged. Allow compass dial to settle on correct heading. This will take up to 15 minutes on an east or west heading, and about five minutes on a north or south heading if airplane is in a three-point position.

e. Check freedom of all control surfaces.

f. Turn auto pilot power switch "ON." Wait for 30 seconds to one minute for servo amplifier to warm up.

g. Set controller so that turn control, pitch-trim and bank-trim controls are in neutral.

h. Neutralize all control surfaces with control stick. Surface controls and auto pilot are now aligned for engagement.

i. Depress clutch button. Auto pilot should now be engaged with controls. To check, overpower auto pilot by manually operating control stick and rudder pedals. Auto pilot should cause definite drag, particularly strong on rudder pedals. If any control drags, then lets go, then drags, etc., it is an indication that a servo disconnect idler bearing and hub are not properly engaged. To remedy this see paragraph A-56.

j. Pull clutch switch "OFF." All controls should go free. Make certain all controls are free by moving stick and rudder pedals around.

k. Return controls to neutral and depress clutch switch again. Make certain again that auto pilot is engaged by checking for drag. Check for disengagement of auto pilot from controls when the caging knob is turned to "CAGE," when power switch is turned "OFF," and when auto pilot circuit breaker is pulled "off." Repeat the same procedure used for the clutch switch. Clutch switch should also "pop" out when any of the three switches above are positioned as directed.

l. With auto pilot re-engaged to the neutralized controls after check above, operate controller as follows:

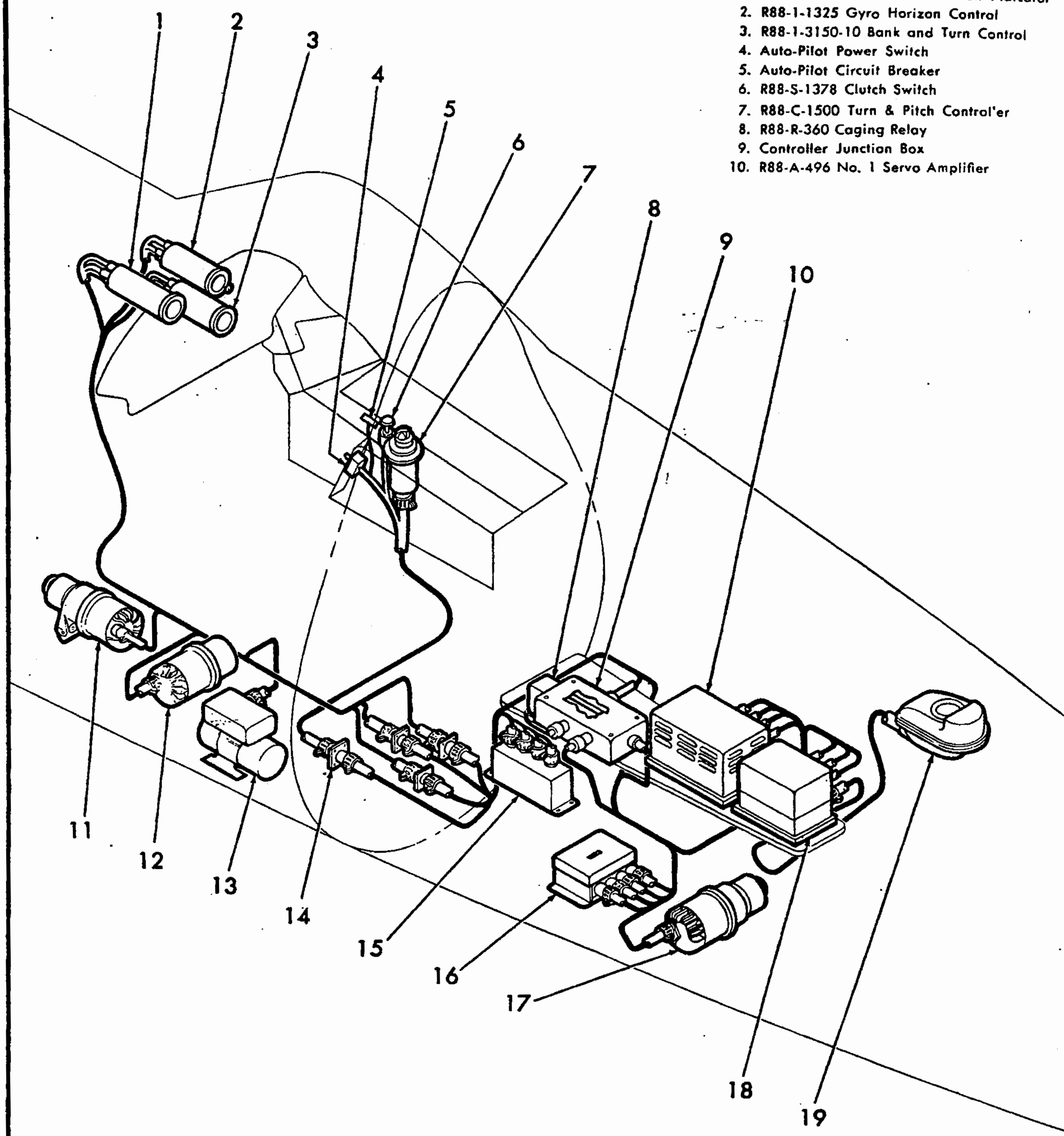
CONTROL BEING OPERATED	TURNING DIRECTION OF CONTROL	CORRECT MOVEMENT OF SURFACE CONTROLS
TURN CONTROL (knob on top of controller)	To Right	Right Aileron — "UP" Rudder — "RIGHT" Elevators — "UP"
	To Left	Left Aileron — "UP" Rudder —' 'LEFT" Elevators — "UP"
PITCH-TRIM CONTROL (small wheel, right hand side of controller)	To Right Towards "DOWN" To Left Towards "UP"	Elevators — 'DOWN" Elevators — "UP"
BANK-TRIM CONTROL (large wheel under knob)	To Left To Right	Left Aileron — "UP" Right Aileron — "UP"

Note

After checking each control on the controller return it to neutral before checking the next control. The control surfaces should move proportionately with the movement of the controls on the controller.

m. Overpower auto pilot to check for drag, and at the same time pull emergency disconnect handle to "DISENGAGE." All controls should go free. Turn off auto pilot. Reset all servo disconnects manually as described in paragraph A-56, and check out auto pilot system again to make cetrain that it properly engages with control surfaces.

1. R88-1-1861-10 Master Direction Indicator
2. R88-1-1325 Gyro Horizon Control
3. R88-1-3150-10 Bank and Turn Control
4. Auto-Pilot Power Switch
5. Auto-Pilot Circuit Breaker
6. R88-S-1378 Clutch Switch
7. R88-C-1500 Turn & Pitch Control'er
8. R88-R-360 Caging Relay
9. Controller Junction Box
10. R88-A-496 No. 1 Servo Amplifier



11. R88-S-150 Rudder Servo Unit
12. R88-S-150 Aileron Servo Unit
13. R17-1-7467 Inverter
14. Disconnects at Sta. 186
15. R88-B-856-100 Power Junction Box
16. R88-A-200 Amplifier Adapter
17. R88-S-150 Elevator Servo Unit
18. R88-A-525 Gyro Flux Gate Amplifier
19. R88-T-1910 Remote Compass Transmitter

Figure A–9. (Sheet 1 of 3 Sheets) Auto Pilot Circuit.

ELECTRICAL POWER SUPPLY TO AUTO PILOT WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
P2A6	AN6	659-30	860-6-3	659-30	860-6-3	30
P4A10	AN10	659-5	860-10-3	659-5	860-10-3	12
P13A6	AN6	659-30	860-6-3	659-30	860-6-3	30
P15A12	AN12	659-5	860-10-3	659-5	860-10-3	24
PC3A16	AN16	659-4	860-14-3	659-4	860-14-3	36
PV4A12	AN12	659-5	860-10-3	659-5	860-10-3	30

MASTER ELECTRICAL PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFGRS. NAME AND NO.	NOMENCLATURE
121	AN3161-P10	Circuit Breaker
123	AN3161-P20	Circuit Breaker

P-1 AUTO PILOT WIRE TABLE
CABLE ASSEMBLY VS-60044-1

WIRE NO.	LENGTH INCHES
CA34C20	24
CA35C20	24
CA60A20	87
CA61A20	87
CA62A20	87
CA63A20	87
CA64A20	87
CA65A20	87
CA66A20	87
CA67A20	87
CA68A20	87
CA69A20	87
CA70A20	49
CA71A20	49
CA72A20	49
CA73A20	49
CA74A20	49
CA75A20	49
CA76A20	49
CA77A20	49
CA78A20	49
CA79A20	49

CABLE ASSEMBLY VS-60044-2

WIRE NO.	LENGTH INCHES
CA1A20	109
CA2A20	109
CA3A20	109
CA4A20	109
CA5A20	109
CA6A20	109
CA7A20	109
CA8A20	109
CA9A20	109
CA10A20	109
CA11A20	109
CA12A20	109
CA13A20	109
CA14A20	109
CA15A20	109
CA16A20	111
CA17A20	111
CA18A20	111
CA19A20	111
CA20A20	111
CA21A20	117
CA22A20	117
CA23A20	117
CA80A20	109

CABLE ASSEMBLY VS-60044-3

WIRE NO.	LENGTH INCHES
CA37A20	63
CA38A20	63
CA39A20	63
CA40A20	63
CA41A20	63
CA42A20	63
CA43A20	63
CA44A20	63
CA45A20	63
CA46A20	63
CA47A20	63
CA48A20	63
CA49A20	63
CA50A20	63
CA51A20	63
CA52A20	63
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CA55A20	68
CA56A20	68
CA57A20	68
CA58A20	66
CA59A20	67

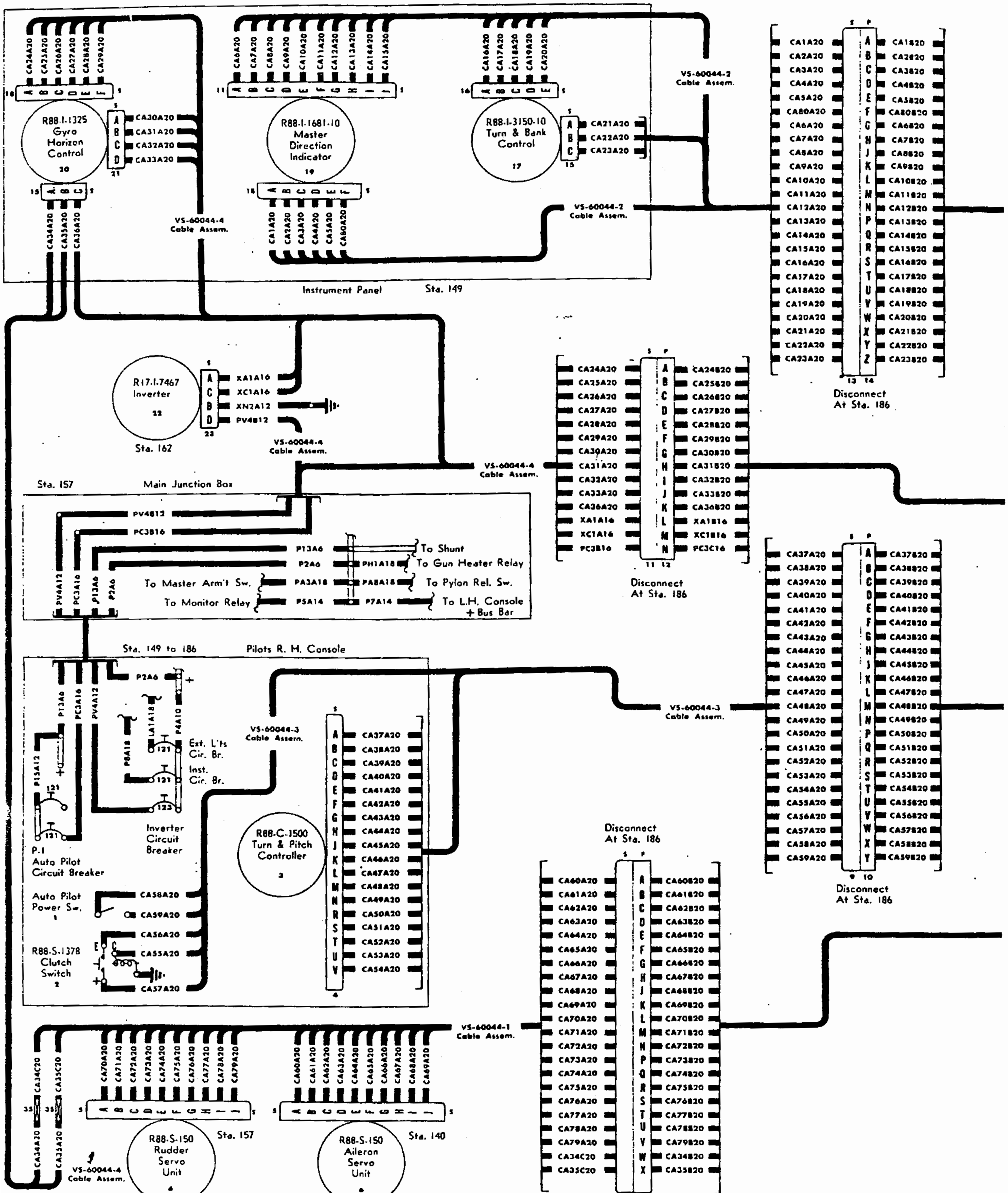


Figure A—9. (Sheet 2 of 3 Sheets) Auto Pilot Circuit.

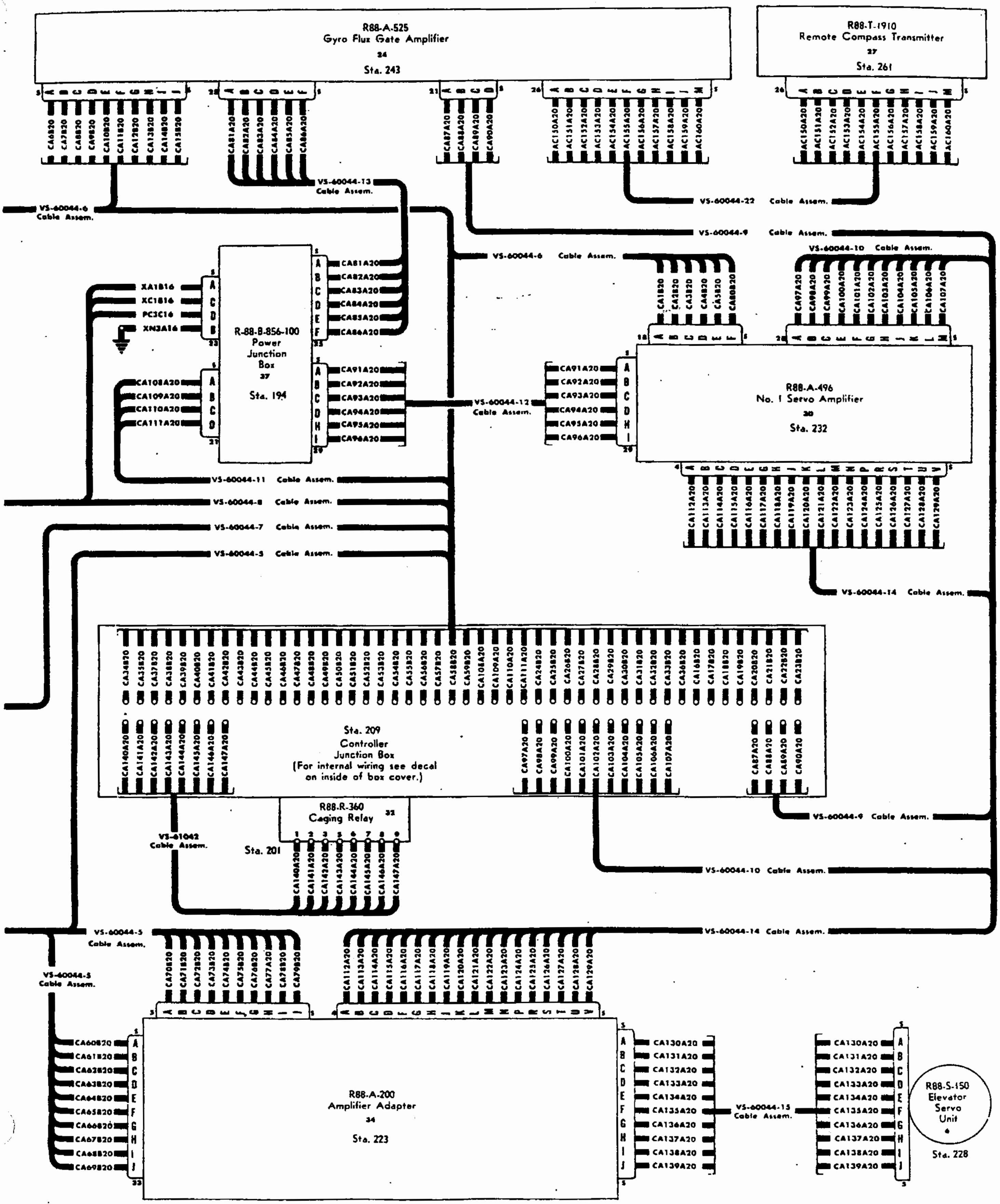


Figure A—9. (Sheet 3 of 3 Sheets) Auto Pilot Circuit.

P—1 AUTO PILOT WIRE TABLE (Continued)

CABLE ASSEMBLY VS-60044-4

WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES
CA24A20	131	CA30A20	130	CA36A20	129
CA25A20	131	CA31A20	130	PC3B16	125
CA26A20	131	CA32A20	130	PV4B12	32
CA27A20	131	CA33A20	130	XA1A16	58
CA28A20	131	CA34A20	84	XC1A16	58
CA29A20	131	CA35A20	84	XN2A12	12

CABLE ASSEMBLY VS-60044-5

WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES
CA34B20	78	CA66B20	78	CA73B20	78
CA35B20	78	CA67B20	78	CA74B20	78
CA60B20	78	CA68B20	78	CA75B20	78
CA61B20	78	CA69B20	78	CA76B20	78
CA62B20	78	CA70B20	78	CA77B20	78
CA63B20	78	CA71B20	78	CA78B20	78
CA64B20	78	CA72B20	78	CA79B20	78
CA65B20	78				

CABLE ASSEMBLY VS-60044-6

WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES
CA1B20	90	CA9B20	101	CA17B20	72
CA2B20	90	CA10B20	101	CA18B20	72
CA3B20	90	CA11B20	101	CA19B20	72
CA4B20	90	CA12B20	101	CA20B20	72
CA5B20	90	CA13B20	101	CA21B20	72
CA6B20	101	CA14B20	101	CA22B20	72
CA7B20	101	CA15B20	101	CA23B20	72
CA8B20	101	CA16B20	72	CA80B20	90

CABLE ASSEMBLY VS-60044-7

WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES
CA37B20	72	CA45B20	72	CA53B20	72
CA38B20	72	CA46B20	72	CA54B20	72
CA39B20	72	CA47B20	72	CA55B20	72
CA40B20	72	CA48B20	72	CA56B20	72
CA41B20	72	CA49B20	72	CA57B20	72
CA42B20	72	CA50B20	72	CA58B20	72
CA43B20	72	CA51B20	72	CA59B20	72
CA44B20	72	CA52B20	72		

CABLE ASSEMBLY VS-60044-8

WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES
CA24B20	72	CA29B20	72	CA36B20	72
CA25B20	72	CA30B20	72	PC3C16	39
CA26B20	72	CA31B20	72	XA1B16	39
CA27B20	72	CA32B20	72	XC1B16	39
CA28B20	72	CA33B20	72	XN3A16	18

P—1 AUTO PILOT WIRE TABLE (Continued)

CABLE ASSEMBLY VS-60044-9

WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES
CA87A20	66	CA89A20	66
CA88A20	66	CA90A20	66

CABLE ASSEMBLY VS-60044-10

WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES
CA97A20	72	CA101A20	69	CA105A20	69
CA98A20	72	CA102A20	69	CA106A20	72
CA99A20	72	CA103A20	69	CA107A20	72
CA100A20	72	CA104A20	72		

CABLE ASSEMBLY VS-60044-11

WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES
CA108A20	48	CA110A20	48
CA109A20	48	CA111A20	48

CABLE ASSEMBLY VS-60044-12

WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES
CA91A20	69	CA93A20	69	CA95A20	69
CA92A20	69	CA94A20	69	CA96A20	69

CABLE ASSEMBLY VS-60044-13

WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES
CA81A20	72	CA83A20	72	CA85A20	72
CA82A20	72	CA84A20	72	CA86A20	72

CABLE ASSEMBLY VS-60044-14

WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES
CA112A20	29	CA118A20	29	CA124A20	29
CA113A20	29	CA119A20	29	CA125A20	29
CA114A20	29	CA120A20	29	CA126A20	29
CA115A20	29	CA121A20	29	CA127A20	29
CA116A20	29	CA122A20	29	CA128A20	29
CA117A20	29	CA123A20	29	CA129A20	29

CABLE ASSEMBLY VS-60044-15

WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES
CA130A20	15	CA134A20	15	CA137A20	15
CA131A20	15	CA135A20	15	CA138A20	15
CA132A20	15	CA136A20	15	CA139A20	15
CA133A20	15				

CABLE ASSEMBLY VS-60044-22

WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES
AC150A20	50	AC154A20	50	AC158A20	50
AC151A20	50	AC155A20	50	AC159A20	50
AC152A20	50	AC156A20	50	AC160A20	50
AC153A20	50	AC157A20	50		

AUTO PILOT PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFGRS. NAME AND NO.	NOMENCLATURE
1	AN3022-2B	Switch
2	R88-S-1378 (GFE)	Switch
3	R88-C-1500 (GFE)	Controller
4	AN3106-22-14S	Plug
5	AN3106-18S-1S	Plug
6	R88-S-150	No. 1 Servo Unit
7	AN3106-24-28S (Pos."W")	Plug
8	AN3100-24-28P (Pos. "W")	Receptacle
9	AN3106-24-28S (Pos. "X")	Plug
10	AN3100-24-28P (Pos. "X")	Receptacle
11	AN3106-20-27S	Plug
12	AN3100-20-27P	Receptacle
13	AN3106-24-28S	Plug
14	AN3100-24-28P	Receptacle
15	AN3106-14S-1S	Plug
16	AN3106-14S-5S	Plug
17	R88-I-3150 (GFE)	Bank and Turn Control
18	AN3106-14S-6S	Plug
19	R88-I-1680 (GFE)	Master Direction Indicator
20	R88-I-1325 (GFE)	Gyro-Horizon Control
21	AN3106-14S-2S	Plug
22	R17-I-7467 (GFE)	Inverter
23	AN3106-20-4S	Plug
24	R88-A-525 (GFE)	Single Channel Amplifier
25	AN3106-18-12S	Plug
26	AN3106-20-1S	Plug
27	R88-T-1910 (GFE)	Compass Transmitter
28	AN3106-20-11S	Plug
29	AN3106-20-16S	Plug
30	R88-A-496 (GFE)	Multiple Channel Amplifier
31	R88-B-856 (GFE)	Power Junction Box
32	R88-R-360 (GFE)	Caging Relay
33	AN3106-18S-1S (Pos. "2")	Plug
34	R88-A-200 (GFE)	Amplifier Adapter
35	AN753-B1	Coupler

A-76. EXHAUST COLLECTOR FLAME DAMPENERS AND SHIELD ASSEMBLIES.

A-77. DESCRIPTION. *(See figure A-10.)* The F4U-5N airplane is equipped with six flame dampeners mounted on the engine exhaust collectors. The purpose of these units is to minimize the visible exhaust flame from the engine at night. Each assembly consists of the flame dampener and a shield which hides the flame dampener. The flame dampener is a "U"-shaped duct extension attached to the end of each exhaust collector which disperses the exhaust flame over the area of its inner surfaces in a manner which dissipates the flame before it reaches the outside air. The shield is necessary because the flame dampener becomes cherry red due to heat induction. The flame dampener is secured to the exhaust collector by means of a split clamp and bolt. The split clamp is grooved and fits over the "V"-shaped shoulder formed by the matched joining ends of both the flame dampener and exhaust collector. The shield is slip-fitted over the flame dampener and drawn tightly to the dampener by means of a bolt at the aft end. The shield is also secured to exhaust collector by means of a half clamp which is hooked and then bolted to the integral half clamp on the shield.

A-78. REMOVING. To remove the flame dampener and shield assembly proceed as follows:

a. Remove the bolt and nut from the half clamp which secures the shield to the exhaust collector.

b. Remove the bolt and nut on the aft end of the shield which draws the shield tightly over the flame dampener.

c. Slide the shield off the flame dampener.

d. Remove the bolt and nut from the split clamp which secures the flame dampener to the exhaust collector.

A-79. INSTALLING. To install the flame dampener, reverse the removal procedure.

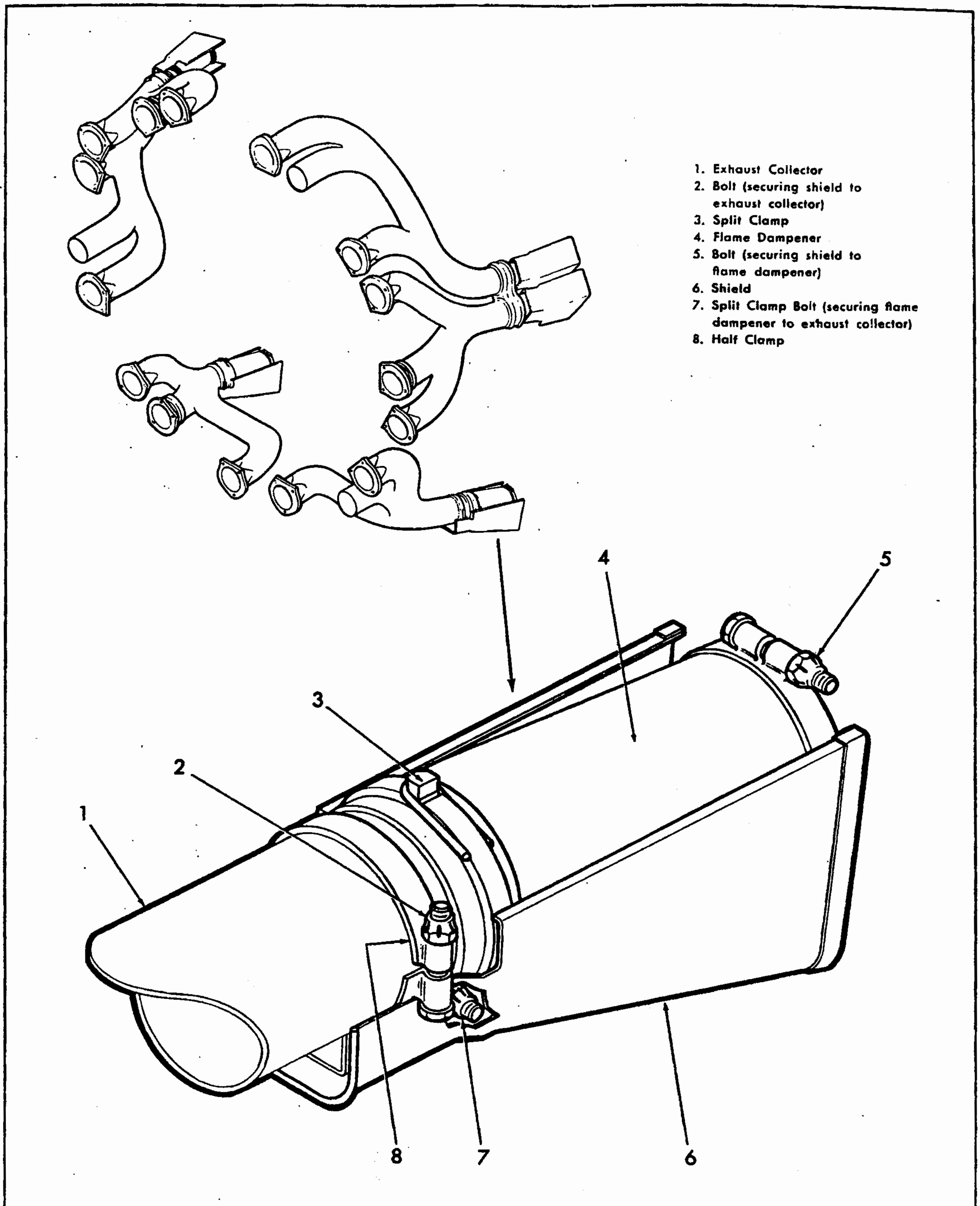


Figure A—10. Exhaust Collector Flame Dampeners.

A-80. WINDSHIELD DEGREASER SYSTEM.

A-81. DESCRIPTION. (*See figure A-11.*) The windshield degreaser system is employed to clean the outside surfaces of the bullet-resistant center windshield and the left side windshield at night. The system consists essentially of a .9 gallon reservoir containing a volatile thinner fluid (Federal Specification TT-T-291), an Adel Series "K" Metering Pump (Adel Part No. 8818-1), an AN6101-1 micronic filter, an AN6207-4 check valve and tubing to conduct the fluid to the atomizers on the windshield. The degreaser system is electrically operated by a push-button switch on the left hand side of the instrument cowl. The portable equipment circuit breaker on the circuit breaker panel must be closed for this switch to operate. All major units in the degreaser system are located just outboard of the right hand rudder pedal. Access to these units may be gained by reaching under the instrument panel.

A-82. TROUBLE SHOOTING. Should the degreaser system fail to operate, check first to make certain that the degreaser tank is filled with fluid. With 28-volt dc electrical power available, operate the degreaser pump by depressing the degreaser switch on the left hand side of the instrument cowl. If the pump does not operate, check to make certain that the portable equipment circuit breaker is "on." Check all cable connections for tightness. For wiring diagram information see figure A-13. Check degreaser pump brushes for wear. Replace pump if it does not operate with new brushes. If the pump operates properly but fluid delivery fails, check the degreaser tubing for tightness of connections and for freedom from foreign matter. Check the degreaser system filter for a clogged condition. Make certain that the vent plug on the degreaser tank is clear and free of foreign matter.

A-83. DEGREASER FLUID RESERVOIR.

A-84. DESCRIPTION. (*See figure A-11.*) The degreaser reservoir is a .9 gallon tank located just outboard of the right hand rudder pedal and mounted on the cockpit floor. The tank is bolted to the floor at two places on the outboard side. It is also bolted at one place to the bulkhead at station 143½. Prior to each night flight, the tank should be filled with degreaser fluid, Federal Specification TT-T-291. The tank filler cap is located on the inboard side and is accessible under the instrument panel. A ball check vent valve on the top of the tank prevents the occurrence of lower than atmospheric pressure in the tank when the fluid is being drawn out by the degreaser pump. The ball check in the vent valve prohibits fluid overflow when the airplane is in inverted flight. The pump outlet on the tank is integral with a standpipe which insures that all fluid in the tank is available.

A-85. REMOVING. (*See figures A-11 and A-12.*) To remove the degreaser tank, proceed as follows:

a. Disconnect tubing leading from tank to the AN6101-1 filter.

b. Remove the two bolts and nuts which secure the outboard flange of the tank to the floor. Although the outboard skin of the airplane is adjacent to the outboard side of the tank enough room remains for the use of a socket wrench with an extension. The nuts securing the mounting bolts are accessible through the lower cockpit access door.

c. Remove the bolt and nut which secure the tank to the bulkhead at station 143½.

A-86. INSTALLING. To install the degreaser tank, reverse the removal procedure.

A-87. DEGREASER FLUID METERING PUMP.

A-88. DESCRIPTION. (*See figure A-11.*) The degreaser pump is an Adel Series "K" metering pump (Adel Part No. 8818-1) having a 2.5 g.p.h. capacity. This pump is a gear type, direct drive model. It is located just forward of the degreaser tank and is secured to the bulkhead at station 138.6. The pump motor operates on 24 volts dc and is the continuous duty, explosion proof type. Power for the degreaser pump motor comes from the battery side of the gun heater relay in the main junction box. From here the circuit leads to the portable equipment circuit breaker, then to the degreaser push-button switch on the instrument cowl, and then finally to the pump motor. Motor torque is transmitted directly to the pumping cartridge, which includes three small gears machined to close tolerances. The central drive gear revolves two idler gears in opposite directions, creating simultaneously a suction to draw fluid into the pump from the tank, and a pressure to force it out to the windshield. The pump motor brushes are easily removed and should be replaced when excessively worn.

A-89. REMOVING. (*See figures A-11 and A-12.*) To remove the degreaser pump, make certain battery switch is "OFF" and proceed as follows:

a. Disconnect electrical lead to pump.

b. Disconnect two tubing connections on pump.

c. Remove four bolts and nuts which secure pump mounting bracket to the bulkhead at station 138.6.

d. Remove the four screws which secure the bracket to the pump.

A-90. INSTALLING. To install degreaser pump, reverse the removal procedure.

A-91. DEGREASER SYSTEM FILTER.

A-92. DESCRIPTION. (*See figure A-11.*) The degreaser system incorporates an AN6101-1 micronic filter located just above the degreaser tank in the fluid line between the tank and the degreaser pump. This filter insures that no foreign matter will pass into the pump unit. The filter is mounted to the bulkhead at station 143.6 and secured in place by two bolts. The filter element should be removed periodically for cleaning or replacement.

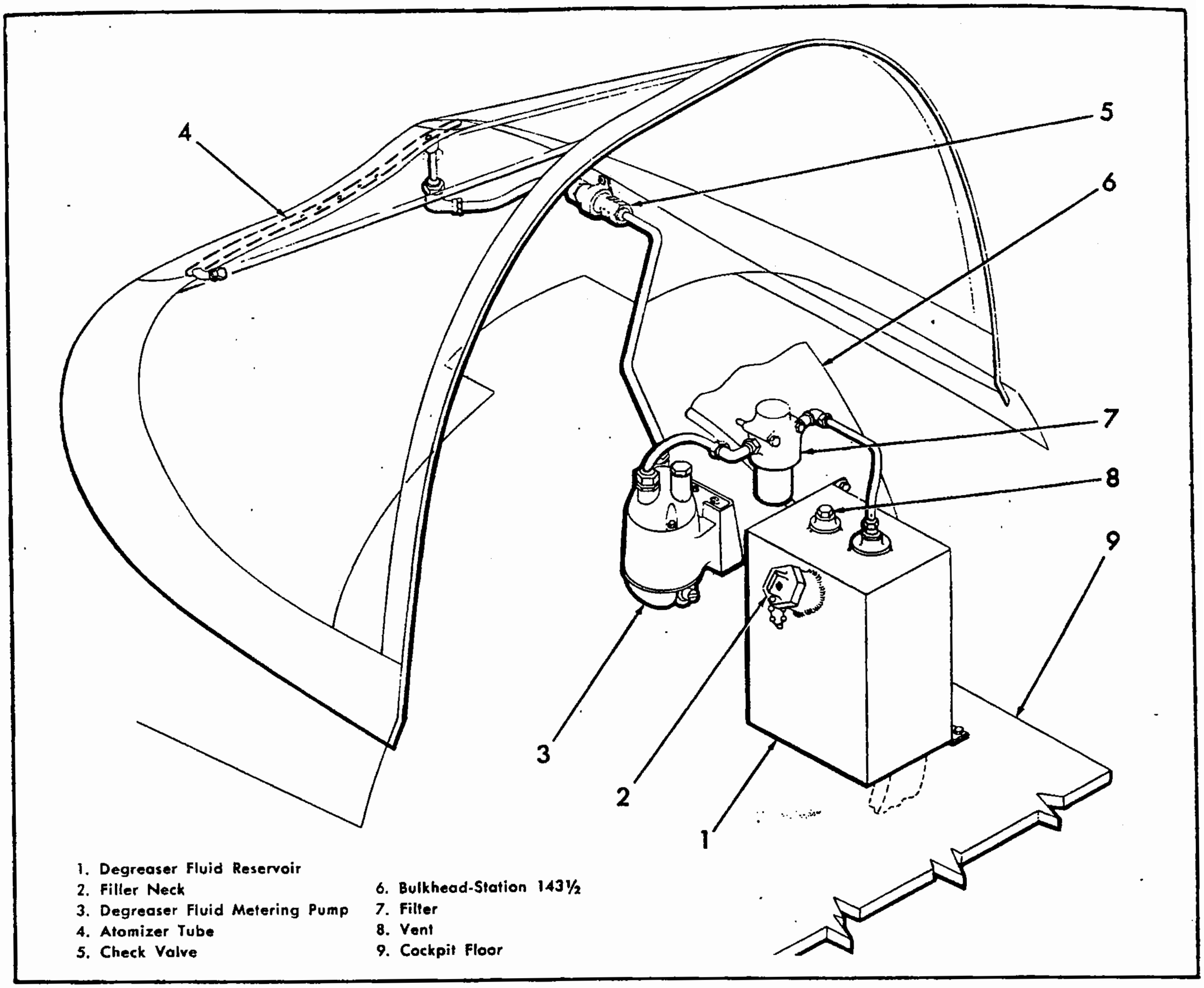


Figure A—11. Windshield Degreaser System.

A-93. REMOVING. (*See figure A-11.*) To remove the filter proceed as follows:

a. Disconnect two tubing connections on filter.

b. Remove the two bolts, nuts and spacers which secure the filter unit to the bulkhead at station 143.6.

A-94. DISASSEMBLY. To disassemble the filter unit in order to clean or replace the filter element, proceed as follows:

a. Break the safety-wire which safeties the filter element cap to the filter body.

b. Unscrew the cap.

c. Remove the filter element.

A-95. INSTALLING. To install the filter, reverse the removal procedure.

A-96. DEGREASER SYSTEM CHECK VALVE.

A-97. DESCRIPTION. The degreaser system incorporates an AN6207-4 check valve located at station 141.5 above the pump. This unit is accessible through the right hand instrument panel access door. It permits flow of fluid in one direction only, from the pump to the windshield, and insures that there will be a sufficient pressure build-up to permit efficient atomizing of the fluid on the windshield.

A-98. REMOVING. To remove the check valve proceed as follows:

a. Disconnect the tubing at both ends of the valve.

b. Remove the clip screw which secures the check valve to the side of the airplane.

A-99. INSTALLING. To install the check valve, reverse the removal procedure.

A-100. TUBING CHART. Figure A-12 should be used as a reference key in conjunction with the following table.

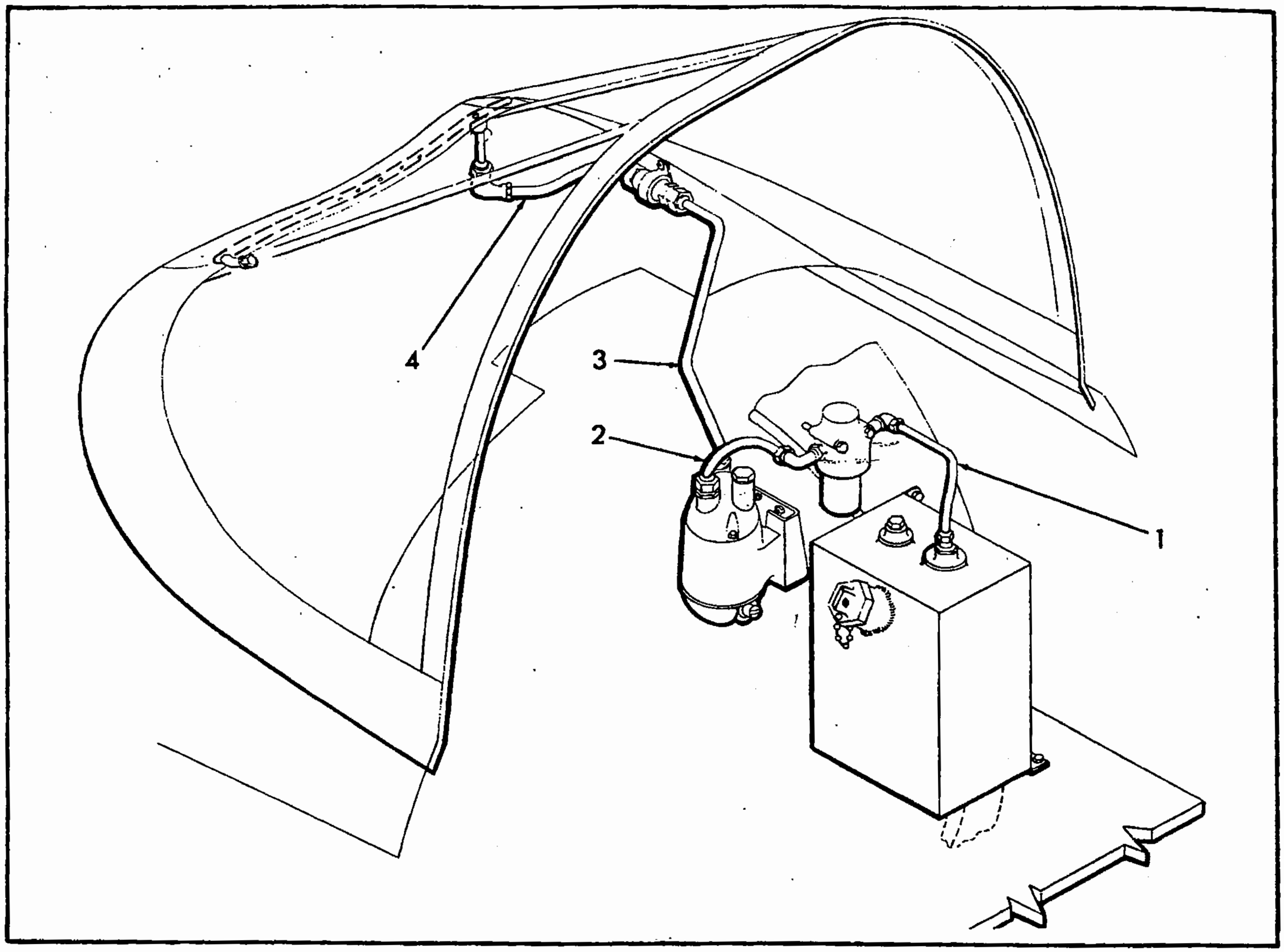


Figure A—12. Windshield Degreaser System Tubing Diagram.

PART NO.	REF. ON FIGURE	O.D. INCHES	WALL INCHES	LENGTH INCHES	MATERIAL	FITTINGS
VS-61506-1	1	1/4	.035	6	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN6227-7 Packing (2 req.) AN815-4D Union AN924-4D Nut AN833-4D Elbow
VS-61506-3	2	1/4	.035	8 7/8	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN6227-8 Packing (2 req.) AN815-4D Union AN924-4D Nut AN833-4D Elbow
VS-61506-5	3	1/4	.035	20	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN6227-7 Packing AN815-4D Union
VS-61506-7	4	1/4	.035	3 3/4	Spec. WW-T-787	AN818-4D Nut (2 req.) AN819-4Z Sleeve (2 req.) AN822-4D Elbow
VS-61517	5	3/16	.035	18 1/4	Spec. WW-T-787	AN818-3D Nut AN819-3 Sleeve

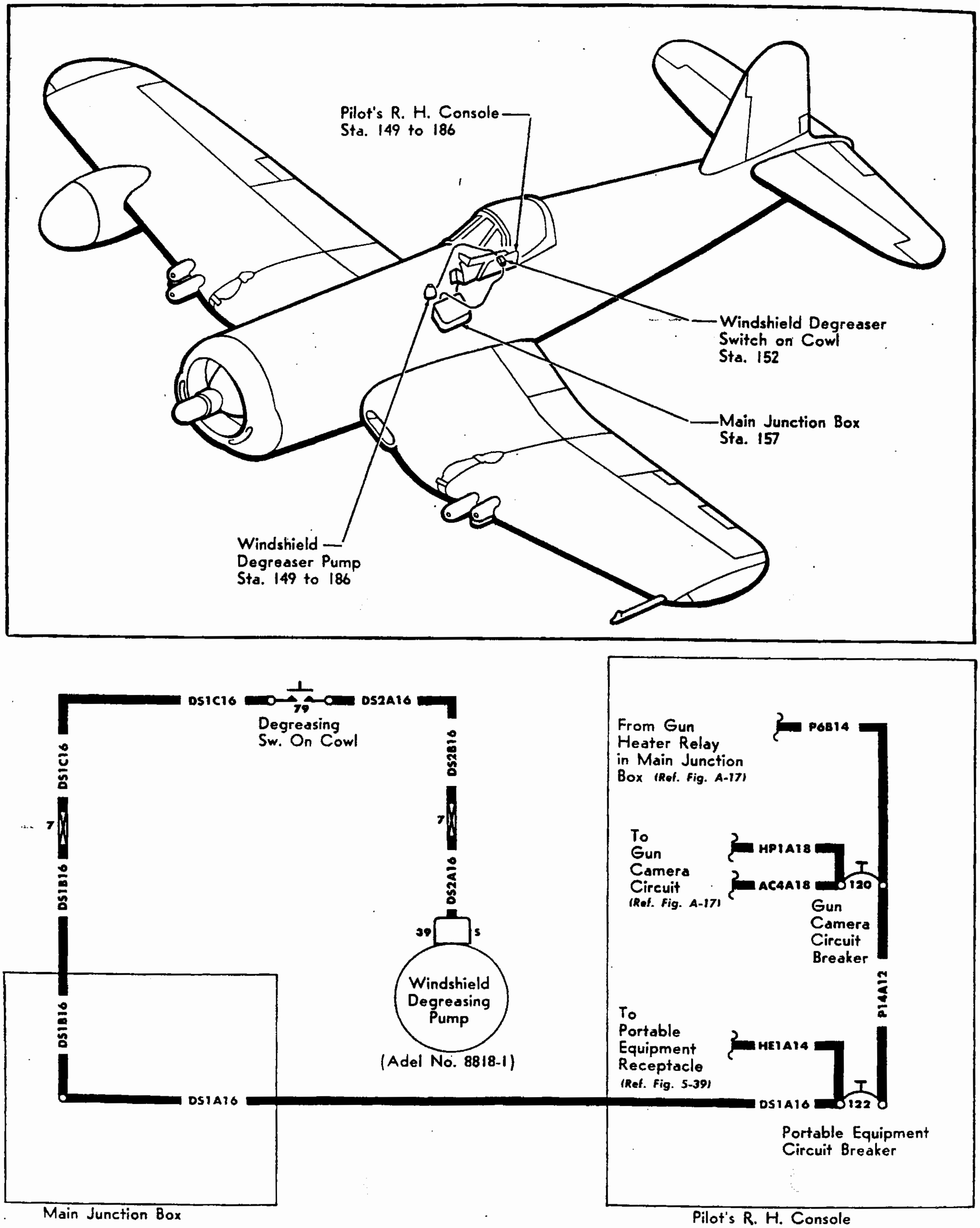


Figure A—13. Windshield Degreaser Circuit.

WINDSHIELD DEGREASER CIRCUIT

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
DS1A16	AN16	659-4	860-14-3	659-4	860-14-3	40
DS1B16	AN16	659-4	860-14-3	753-A2		28
DS1C16	AN16	753-A2				87
DS2A16	AN16		860-16-3	753-A2		40
DS2B16	AN16		860-16-3	753-A2		10
P14A12	AN12	659-5	860-10-3	659-5	860-10-3	12

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFGRS. NAME AND NO.	NOMENCLATURE
79	VS-47951 Chance Vought ACRO Electric No. 3N05-5P	Switch
120	AN3161-P5	Circuit Breaker
122	AN3161-P15	Circuit Breaker

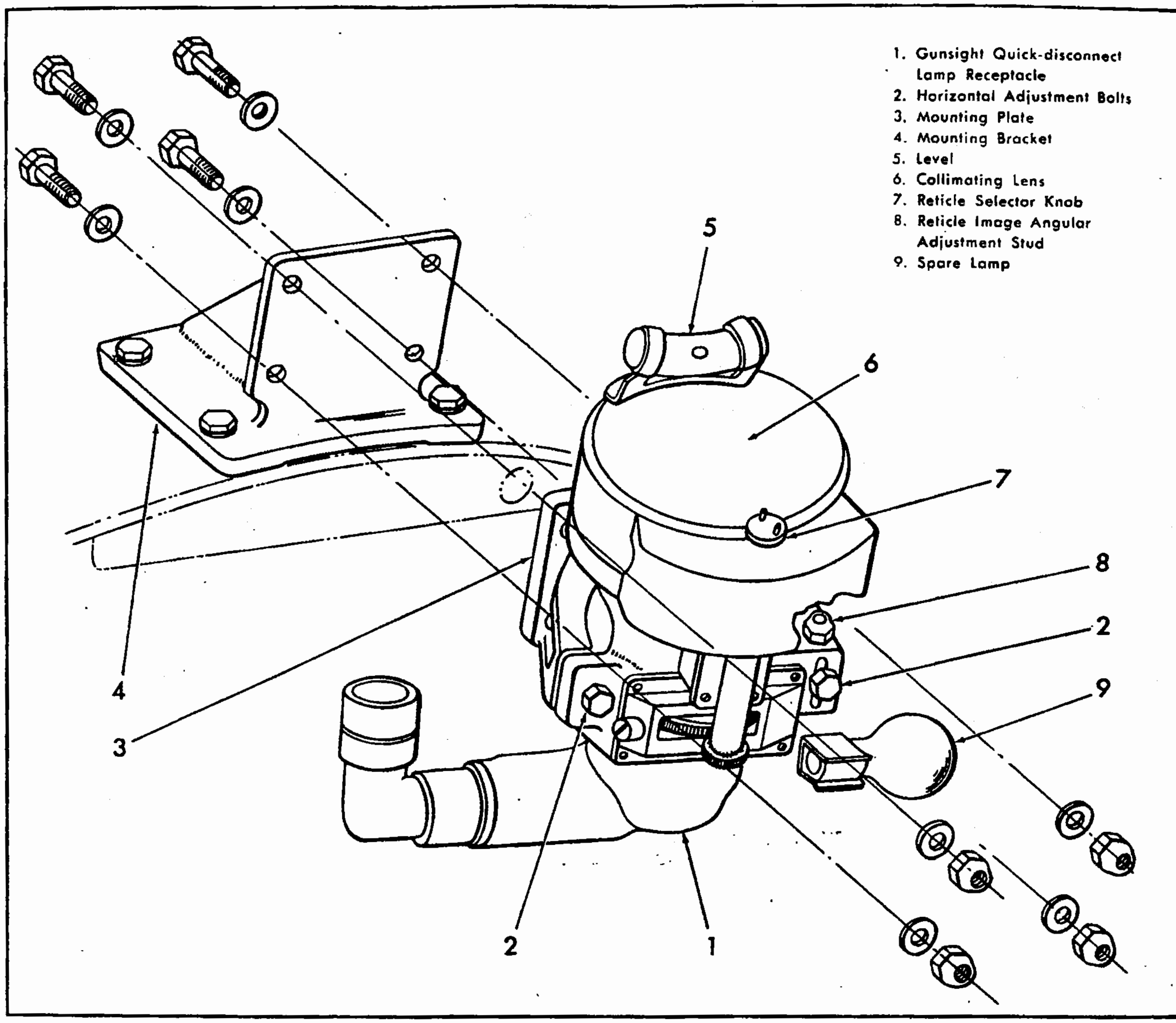


Figure A–14. Mk 20 Gunsight Installation.

A-101. MK 20 GUNSIGHT INSTALLATION.

A-102. DESCRIPTION. *(See figure A-14.)* The Mk 20 gunsight located at the front of the cockpit is supported on a mount which is bolted to the instrument cowling. The gunsight consists essentially of a rotatable reticle disc, a reticle selector knob, a series of lenses, a quick-disconnect reticle lamp housing and four gun boresight adjustment bolts. The reticle disc incorporates three reticle patterns, each of a different type. Any one of the reticle patterns may be individually selected for use by turning the reticle selector knob. The selector knob is integral with a shaft which rotates a small gear on its lower end. This gear is meshed with the teeth on the perimeter of the reticle disc which rotates about its center axis. The reticle lamp projects a beam of light through the particular reticle pattern which is positioned in the path of the beam. The lamp in effect creates a distinct light image (identical to the reticle pattern) in the form of a center dot surrounded by two circular segments (one of the three reticle patterns). The light image passes out through the gunsight collimating lens to the windshield which reflects the image into the pilot's eye. The reticle lamp is provided with two filaments each wired to a separate electric lead connected to the double-pole, double-throw gunsight switch which has the positions "ON," "OFF." and "ALT." Should the "ON" position filament burn out, the switch may be placed on "ALT" which will complete the circuit to the alternate filament. A spare gunsight lamp is held in a clip located just below and to the right of the gunsight. To facilitate replacement of a gunsight lamp in flight, the gunsight is provided with the quick-disconnect reticle lamp housing which snaps into the bottom of the gunsight. This housing contains the lamp and the electric leads to the gunsight switch. To disconnect the lamp housing, it is only necessary to free it from a support clip and then depress the snap fasteners which lock it to the gunsight.

Note

After a spare lamp has been removed from the spare lamp clip, it must be replaced immediately with a Mazda No. 890 lamp or equal (Av Ord Stock No. 2-L-400L).

A-103. OPERATION. To operate the gunsight, the master armament switch must be "ON". The master armament relay closes a circuit leading from the plus bus in the main junction box to the gunsight circuit breaker located on the main circuit breaker panel. From here a wire leads to the gunsight dimmer (rheostat) and then to the gunsight switch. From the gunsight switch two wires lead to the double filament gunsight lamp. The gunsight dimmer permits the pilot to adjust the light intensity of the reticle image. The gunsight switch completes the circuit to either one of the two filaments in the gunsight lamp as explained above. For wiring diagram information see figure A-15.

A-104. REMOVING. To remove the gunsight, proceed as follows:

a. Detach the quick-disconnect lamp housing from the support clip above the instrument panel. Rotate the housing outwards to clear it from the clip and then depress the snap fasteners which lock the housing to the bottom of the gunsight.

b. Remove the four bolts and nuts which secure the gunsight to the mount.

A-105. CLEANING. The gunsight collimating lens and the windshield must be kept clean at all times. Do not use harsh cleaners or rub too hard on the lens (white soap and water may be used).

A—106. ADJUSTING. *(See figure A-14.)* Four adjusting bolts on the gunsight permit vertical, horizontal and angular alignment of the sight for boresighting purposes. The adjustment bolt in the rear permits raising or lowering of the sight line. The two bolts (2) horizontally aligned to each other on the aft face of the gunsight permit horizontal adjustment of the sight line. The threaded stud with the nut on each end (8) located on the right hand side of the gunsight permits angular adjustment of the reticle image. When boresighting the gunsight, use all adjustments together by trial and error. Each adjustment bolt is more or less interrelated with the others in that it affects to some extent the adjustment settings of the others. For boresighting information see paragraph 4-1827.

A-107. INSTALLING. To install the gunsight reverse the removal procedure.

Mk 20 GUNSIGHT CIRCUIT WIRE TABLE

WIRE NO.	NAF 1070	END TYPE		END TYPE		LENGTH IN.
		AN LUG	INS. SL. CVC	AN LUG	INS. SL. CVC	
AS32A18	AN18	659-2	860-16-3	659-2	860-16-3	45
AS32B18	AN18	659-2	860-16-3	659-2	860-16-3	150
AS33A18	AN18	659-2	860-16-3	659-2	860-16-3	10
AS34A18	AN18		860-18-3	659-2	860-16-3	80
AS35A18	AN18		860-18-3	659-2	860-16-3	80
NA1A18	AN18	659-2	860-16-3	659-2	860-16-3	9
NA24A18	AN18	659-2	860-16-3		860-18-3	25
PA2A14	AN14	659-4	860-14-3	659-4	860-14-3	6
PA3A18	AN18	659-2	860-16-3		860-18-3	12
PA3B18	AN18	659-2	860-16-3		860-18-3	63
PA4A18	AN18	659-2	860-16-3		860-18-3	63
PA4B18	AN18	659-2	860-16-3		860-18-3	12
PA7A16	AN16	659-4	860-14-3	659-4	860-14-3	30

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFGRS. NAME AND NO.	NOMENCLATURE	ITEM NO.	TYPE OR DWG. NO. OR MFGRS. NAME AND NO.	NOMENCLATURE
57	AN3108-14S-1S	Plug	117	AN3160-5	Switch-breaker
80	NAF1204-1	Relay	121	AN3161-P10	Circuit Breaker
99	AN3102-24-7S	Receptacle	153	AN3155-50-150	Rheostat
110	AN3106-24-7P	Plug	154	AN3021-1	Switch

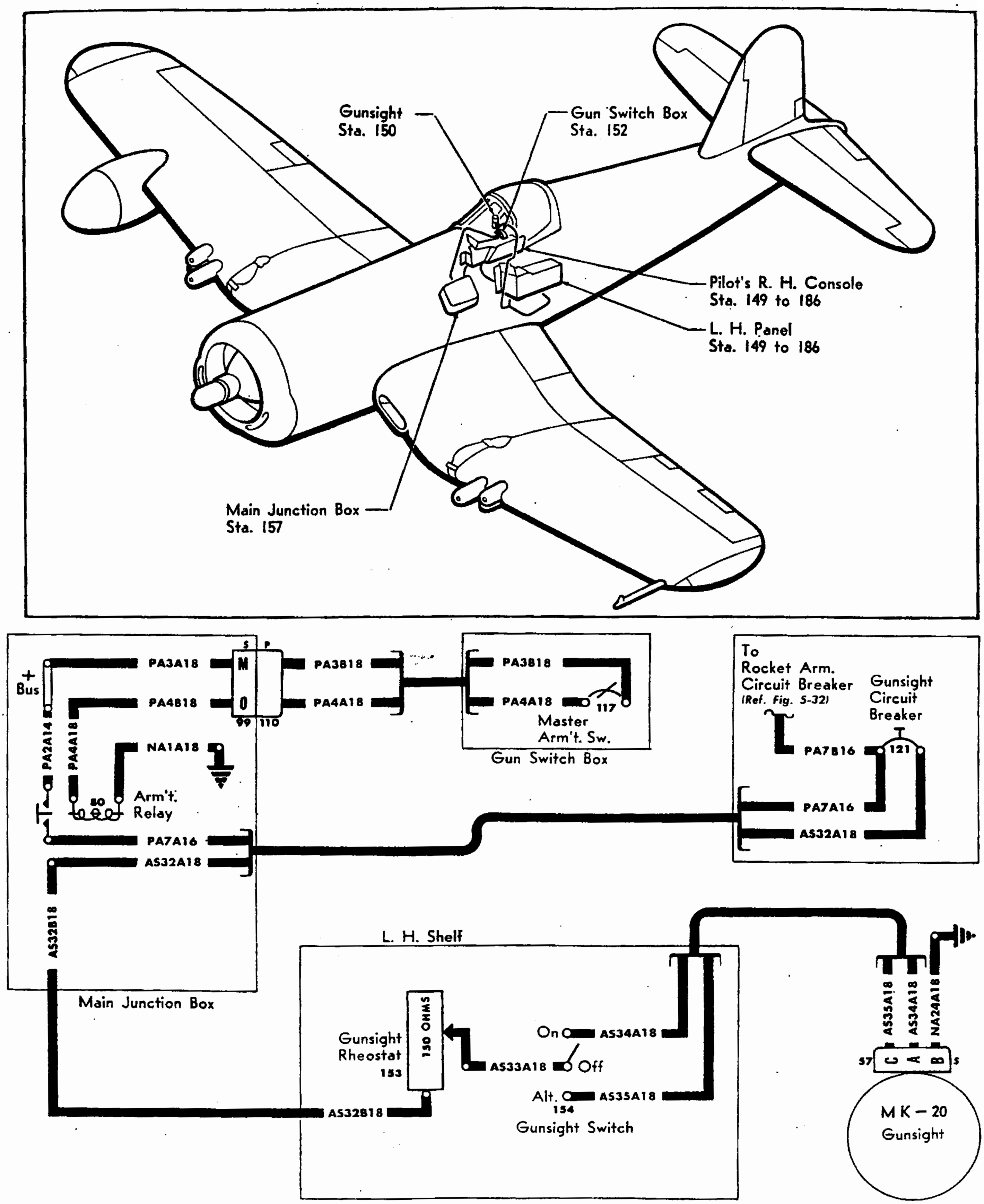


Figure A—15. Mk 20 Gunsight Circuit.

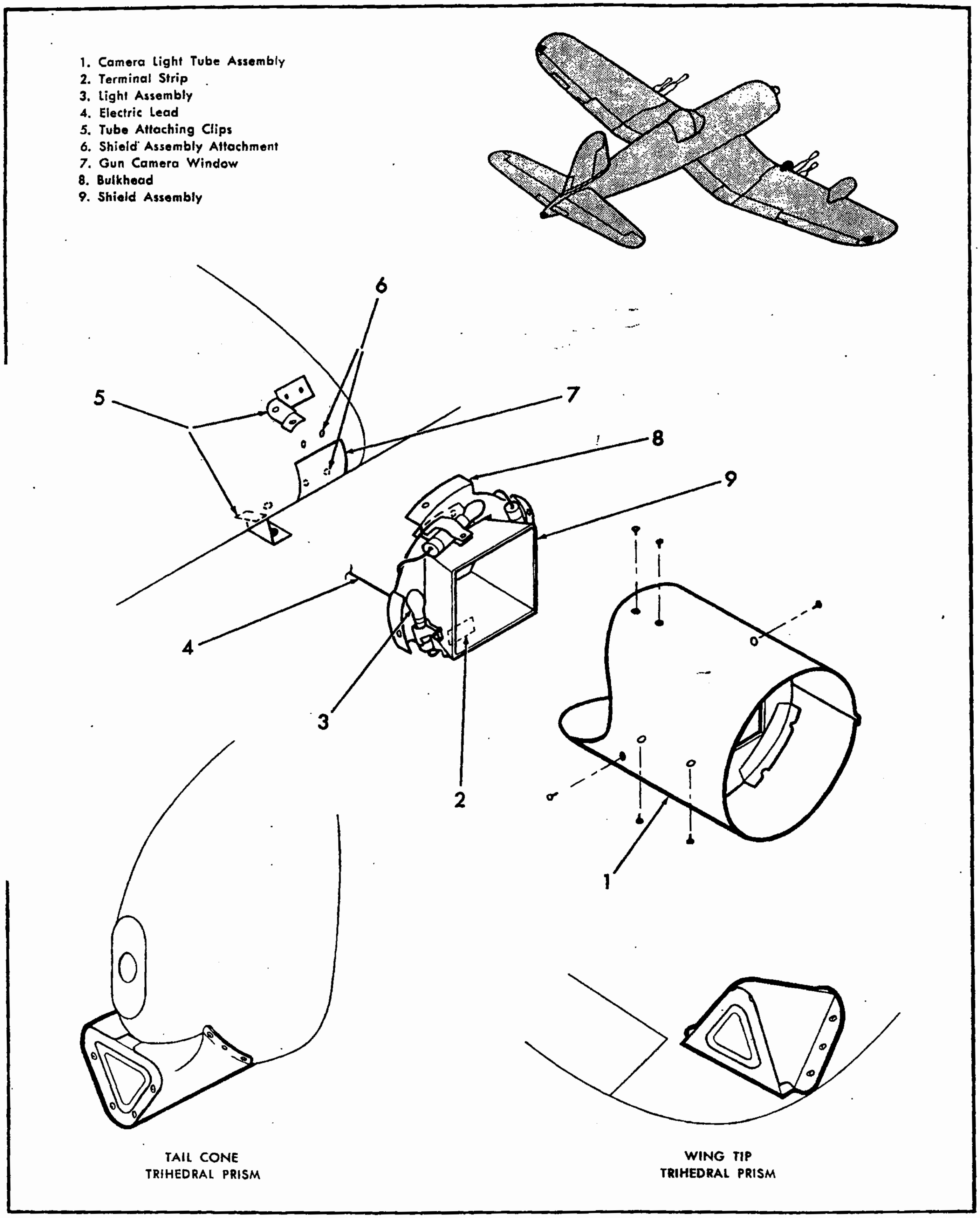


Figure A—16. Gunnery Lights and Trihedral Prism Retro — Reflectors Installation

A-108. GUN CAMERA LIGHTS AND REFLECTOR INSTALLATION.

A-109. DESCRIPTION. *(See figure A-16.)* The gun camera lights and reflector installation consists of three trihedral prism retro-reflectors and four lights mounted around the gun camera opening. A prism reflector is bolted to each wing tip and on the extreme tail end of the airplane. The purpose of this equipment in training is to indicate on the gun camera film the pilot's aim after he has made a firing run (with lights) on the tail of another airplane at night. The lights around the gun camera of the attacking airplane cause the reflectors on the airplane being attacked to reflect back this same light onto the gun camera film in the attacking airplane. The manner in which the light is reflected onto the gun camera film indicates the aim of the attacking airplane. The firing run is recorded photographically by the simultaneous operation of the lights and the gun camera when the trigger switch is depressed. The lights are so arranged that a barrel, acting as a lens hood protects the gun camera lens from receiving any directly transmitted light. The lights are protected by a plexiglass disc with a center opening for the gun camera. The hood is secured to the leading edge of the wing by three screws. The light assembly in the hood is secured by four screws. All screws are accessible around the outer surface of the hood. The gunnery light circuit is taken off the gun camera circuit which is operated by the trigger switch. A single wire leads from the gun camera circuit to a terminal strip in the light assembly. Four wires lead from the terminal strip to the lights. For wiring diagram information see figure A-17. For further information on the gun camera lights and reflector installation see instructions for photographic equipment in Night Fighter Gunnery Training, NAVAER 10-1-528.

Note

When using this equipment, the gun camera should be set for 16 frames per second at the widest lens opening. Film to be used is super XX (speed group 100) Standard Stock No. 18-F32010.

A-110. REMOVING. To remove the gunnery lights and prism reflectors proceed as follows:

a. Remove the three screws which secure the gunnery light hood to the leading edge of the wing.

b. Detach the electric lead which passes out of the wing and connects to the gunnery lights terminal strip. The hood and light assembly are now free of the airplane.

c. Remove the light assembly from the hood by removing four screws.

d. Remove the tail and wing tip prism reflectors by removing the six screws which secure each reflector to the airplane.

A-111. CLEANING. It is essential to maintain clean glass on the retro-reflectors and clean plexiglass on the gunnery light mount. Normal use of these units without cleaning can cause at least 15 percent loss in transmitted light.

A-112. INSTALLING. To install the gunnery light and prism reflector installation, reverse the removal procedure.

GUNNERY LIGHTS CIRCUIT WIRE TABLE

WIRE NO.	NAF 1070	END TYPE		END TYPE		LENGTH IN.
		AN LUG	INS. SL. CVC	AN LUG	INS. SL. CVC	
AB1A18	AN18		860-18-3	659-2	860-16-3	56
AB1B18	AN18		860-18-3	659-2	860-16-3	17
AC1A18	AN18			659-2	860-16-3	8½
AC2A18	AN18			659-2	860-16-3	15
AC3A18	AN18			659-2	860-16-3	20
AC4A18	AN18	659-2	860-16-3	659-2	860-16-3	44
AC4B18	AN18	659-2	860-16-3			20
AC4C18	AN18	659-2	860-16-3			12
AC4D18	AN18					3
AC4E18	AN18	659-2	860-16-3			18
AC5A18	AN18	659-2	860-16-3			15
AC5B18	AN18					3
AC5C18	AN18			659-2	860-16-3	9
AC5D18	AN18	659-2	860-16-3		860-18-3	95
AC5E18	AN18		860-18-3	659-2	860-16-3	42

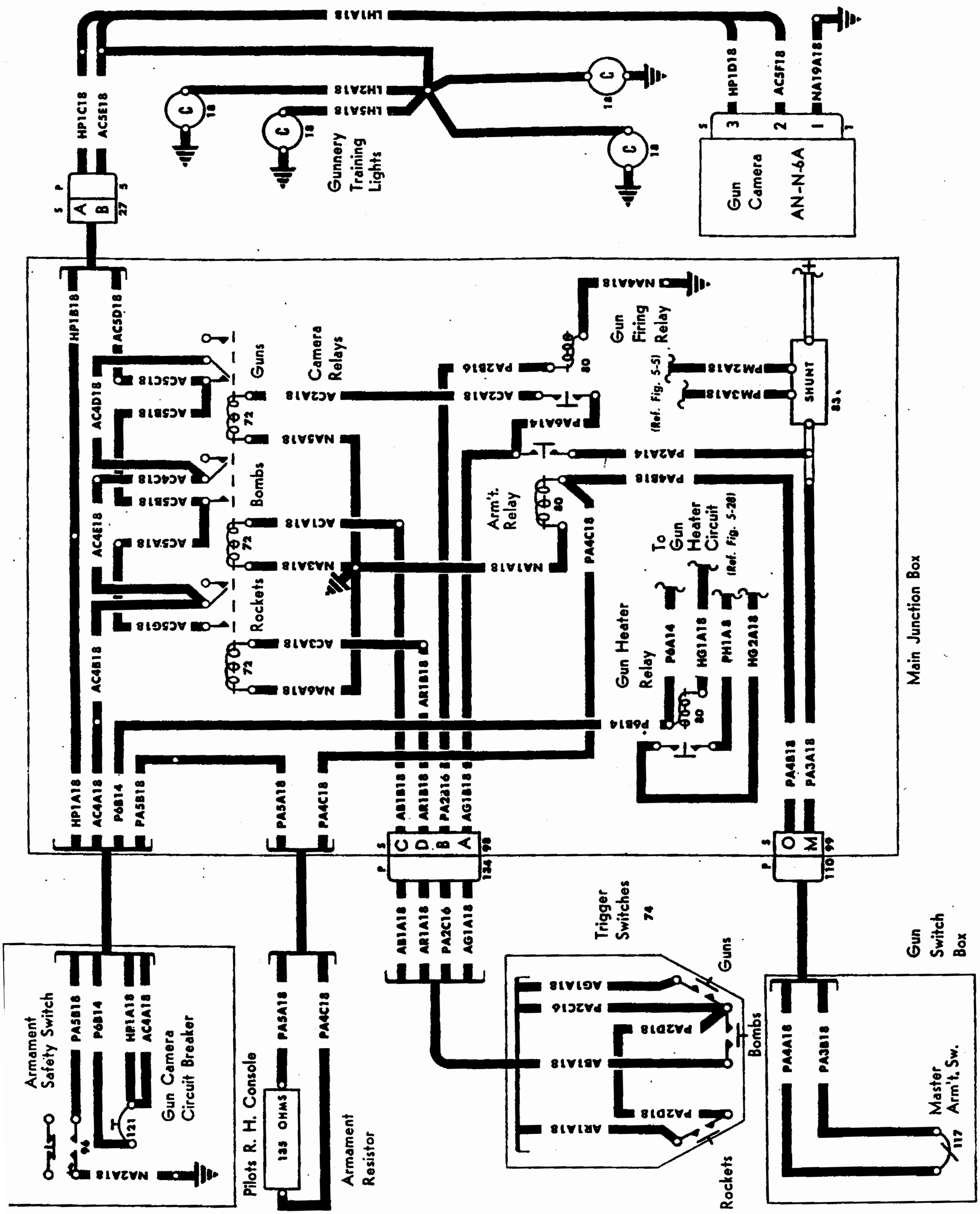


Figure A—17. (Sheet 1 of 2 Sheets) Gunnery Lights Circuit.

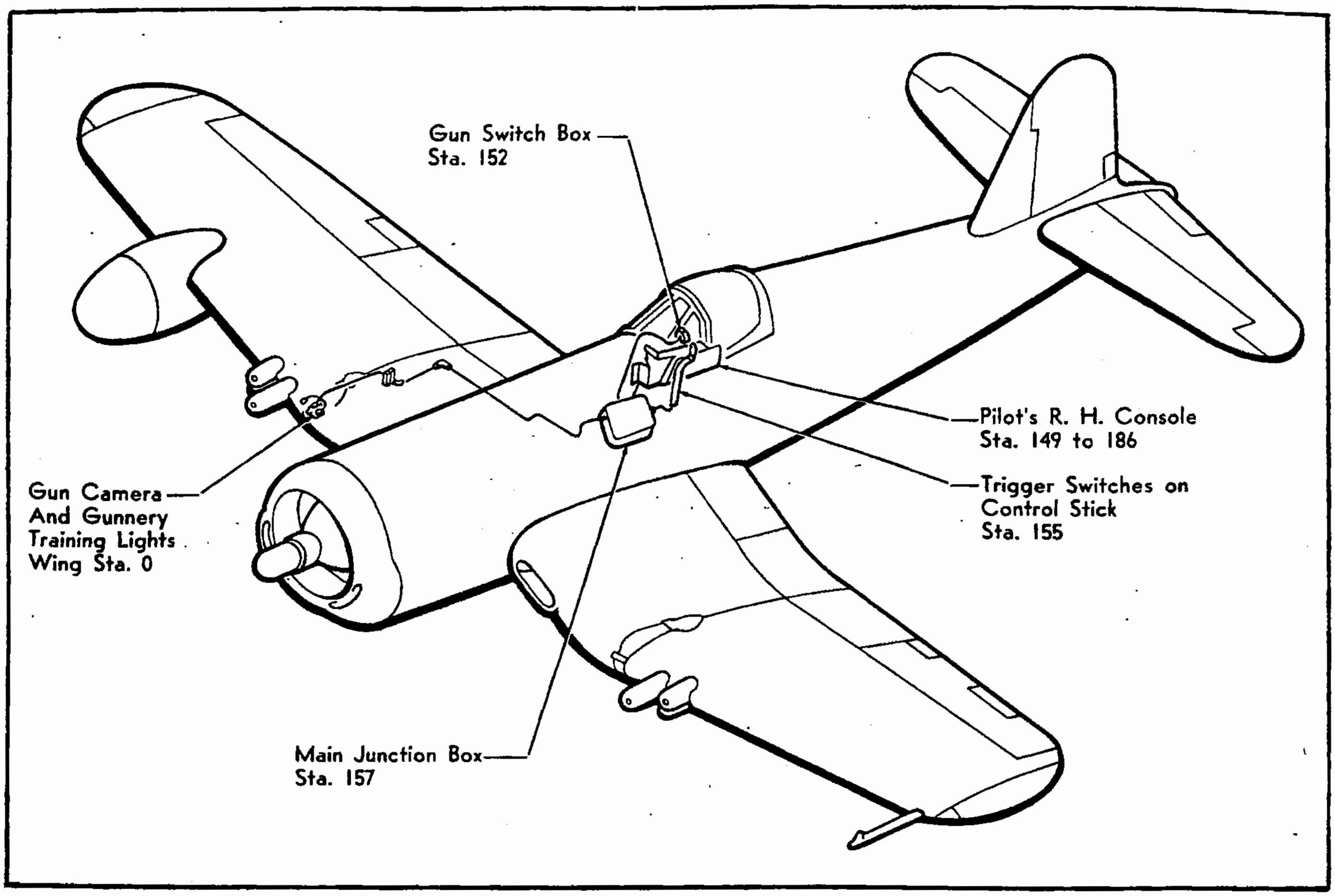


Figure A—17. (Sheet 2 of 2 Sheets) Gunnery Lights Circuit.

GUNNERY LIGHTS CIRCUIT WIRE TABLE (Continued)

WIRE NO.	NAF 1070	END TYPE		END TYPE		LENGTH IN.
		AN LUG	INS. SL. CVC	AN LUG	INS. SL. CVC	
AC5F18	AN18	659-2	860-16-3		860-18-3	59
AC5G18	AN18	659-2	860-16-3			17
AG1A18	AN18	659-2	860-16-3		860-18-3	55
AG1B18	AN18		860-18-3	659-2	860-16-3	17
AR1A18	AN18	659-2	860-16-3		860-18-3	54
AR1B18	AN18	659-2	860-16-3	659-2	860-16-3	17
HP1A18	AN18	659-2	860-16-3	659-2	860-16-3	47
HP1B18	AN18	659-2	860-16-3		860-18-3	95
HP1C18	AN18		860-18-3	659-3	860-16-3	42
HP1D18	AN18	659-2	860-18-3		860-18-3	60
LH1A18	AN18	659-2	860-16-3	659-2	860-16-3	65
LH2A18	AN18	659-2	860-16-3			9
LH3A18	AN18	659-2	860-16-3			9
LH4A18	AN18	659-2	860-16-3			5
LH5A18	AN18	659-2	860-16-3			5

GUNNERY LIGHTS CIRCUIT WIRE TABLE (Continued)

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
NA1A18	AN18	659-2	860-16-3	659-2	860-16-3	5½
NA2A18	AN18	659-2	860-16-3	659-2	860-16-3	5
NA3A18	AN18	659-2	860-16-3			6½
NA4A18	AN18	659-2	860-16-3	659-2	860-16-3	2
NA5A18	AN18	659-2	860-16-3			5
NA6A18	AN18	659-2	860-16-3			8
NA19A18	AN18	659-2	860-16-3		860-18-3	8
P6B14	AN14	659-4	860-14-3	659-4	860-14-3	37½
PA2A14	AN14	659-4	860-14-3	659-4	860-14-3	12
PA2C16	AN16	CVC-880-22	860-14-3		860-16-3	55
PA2D18	AN18	CVC-880-22	860-14-3			3
PA3A18	AN18	659-2	860-16-3		860-18-3	19
PA3B18	AN18		860-18-3	659-2	860-16-3	72
PA4A18	AN18	659-2	860-16-3		860-18-3	72
PA4B18	AN18		860-18-3	659-2	860-16-3	12
PA4C18	AN18	659-2	860-16-3	659-2	860-16-3	22
PA5A18	AN18	659-2	860-16-3	659-2	860-16-3	36
PA5B18	AN18	659-2	860-16-3	659-2	860-16-3	60
PA6A14	AN14	659-4	860-14-3	659-4	860-14-3	6

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFGRS. NAME AND NO.	NOMENCLATURE
1	VS-15442 Chance Vought Breeze Corp. E-1002-3-160	Plug
5	VS-59909 Chance Vought (made from AN3108-28-12P)	Plug
18	AN3122-1524	Lamp
27	AN3100-28-12S	Receptacle
72	VS-48746 Chance Vought Phillips Control Co. Spec. 12038-1	Relay
74	VS-58835 Chance Vought Plastic Mfgrs. P1456E	Grip Assembly
80	NAF1204-1	Relay
83	NAF1091-2-240	Shunt
96	AN3216-1	Switch
98	AN3102-18-4S	Receptacle
99	AN3102-24-7S	Receptacle
110	AN3106-24-7P	Plug
117	AN3160-5	Switch-breaker
121	AN3161-P10	Circuit Breaker
134	AN3106-18-4P	Plug
135	VS-44196 Chance Vought Ward Leonard Type WX	Resistor 2 ohm — 100 watts

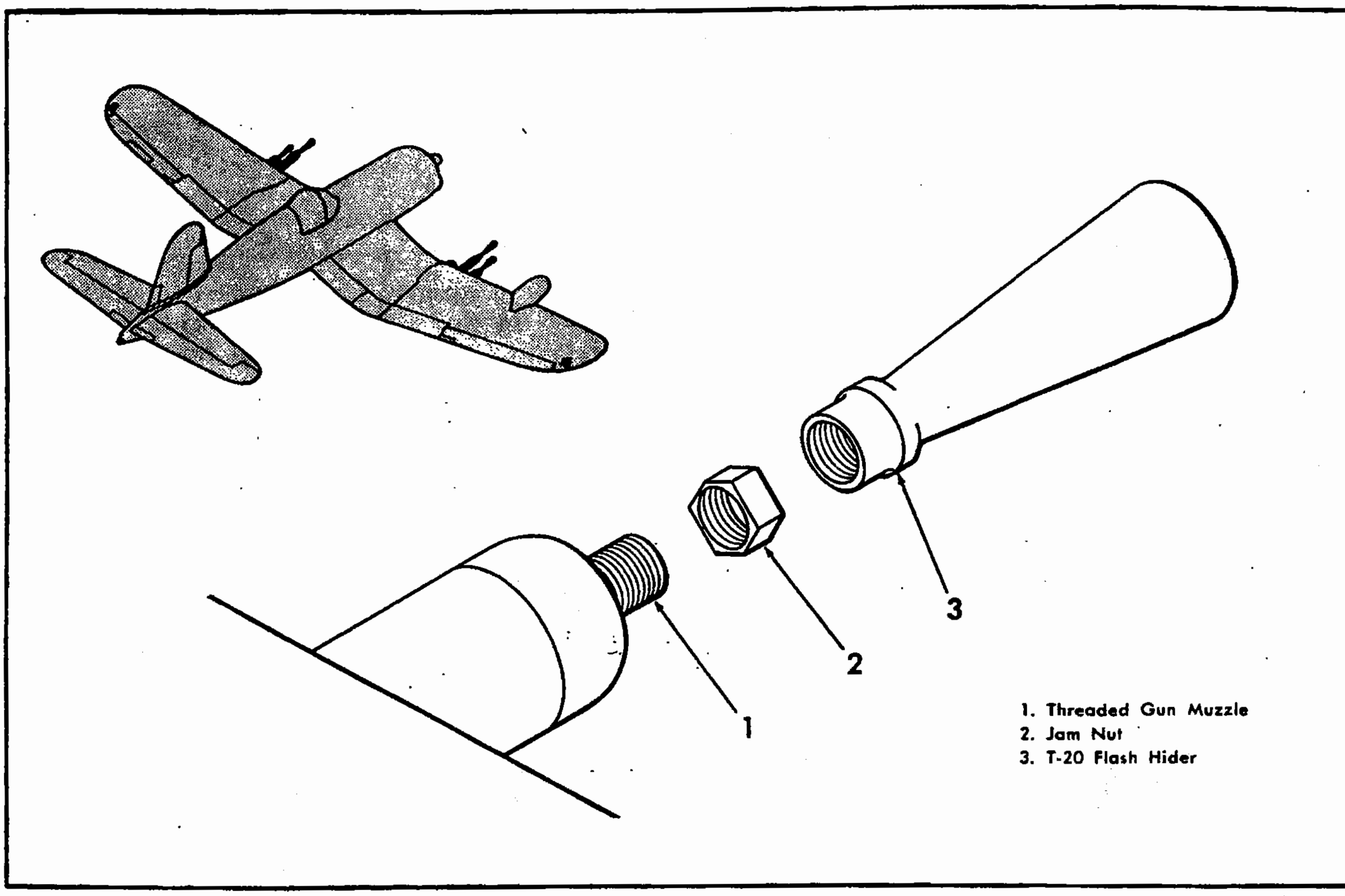


Figure A–18. 20 MM Gun T-20 Flash Hider.

A-113. T-20 FLASH HIDERS.

A-114. DESCRIPTION. *(See figure A-18.)* Four T-20 flash hiders are mounted on the muzzle ends of the 20mm guns. The flash hiders minimize the visible gun-flash when the guns are fired at night. The flash hider is simply a conical-shaped steel cylinder threaded internally on the small diameter end. It is screwed on the externally threaded muzzle end of the gun and locked by a jam nut.

A-115. REMOVING. To remove a flash hider, see figure A-18 and proceed as follows:

a. Loosen flash hider jam nut.

b. Unscrew flash hider from muzzle end of gun.

c. Remove jam nut.

A-116. INSTALLING. To install a flash hider, reverse the removal procedure.

A-117. ELECTRONIC EQUIPMENT POWER INPUT DESCRIPTION CHART.

	PRIMARY POWER SUPPLY		DC INPUT		AC INPUT		MAX. POWER		
EQUIPMENT TYPE DESIGNATION	Battery and Gen. Sys.	Motor Alt. Conv.	Voltage Range	Max. Amp.	Voltage Range	Max. Amp.	DC	AC	Pf
AN APS-19	28V DC	800-1D	26.5±10%	26.5	115±2%	5.7	700	650	1.0
AN APX-2	28V DC	800-1D	26±3.5	1.15	115±5%	1.4	30	160	1.0
AN/APN-1	28V DC		26.5±0.5	3.0			79.5		
AN/ARC-28	28V DC		26.5±0.5	30.0			795		

A-118. AN/APS-19 RADAR.

A-119. DESCRIPTION. *(See figure A-1 and figure A-19.)* The AN/APS-19 radar equipment consists of the following units: (1) C-282/APS-19 control box, (2) SN-35/APS-19 synchronizer-power, (3) ID-158/APS-19 radar indicator and associated equipment, (4) type 800-1D radar motor alternator, (5) radar power junction box, (6) NAF-1221-1 capacitor box, (7) RT-100/APS-19 receiver-transmitter, (8) AS-238/APS-19 antenna, and (9) J-209/APS-19 test box. The receiver-transmitter, antenna and test box are located in a special radar nacelle *(see figure A-19)* on the right hand outer panel. General access to these units is through a removable radome. The rest of the radar equipment is accessible through the radio compartment access door and the cockpit. The radar equipment is employed for search, intercept, aim, and beacon purposes. Search operation is used when the pilot wishes to detect targets on the earth's surface. The targets may be water-borne or located on the ground, and may be as far away as 100 miles. Intercept operation is used to "look" for air-borne targets. The equipment should enable the pilot to detect other aircraft at distances up to 8 miles. Aim operation is used when the pilot wishes to shoot down a target. Fifteen hundred yards is the maximum range of effectiveness for aim operation. Beacon operation is for homing navigation and can be used on ranges up to 150 nautical miles. All returning radar signals are projected on the radar scope on the instrument panel. For wiring diagram information, see figure A-21. For further information on the AN/APS-19 radar equipment see AN 16-30APS 19-3, Handbook of Maintenance Instructions for model AN/APS-19 Aircraft Radar Equipment.

A-120. C-282/APS-19 CONTROL UNIT

A-121. DESCRIPTION. *(See figure A-1.)* The radar control unit is located on the left hand control panel at the aft end. Before operation of the control unit is effective, the radar motor alternator switch-breaker and AN/APS-19 radar circuit breaker must be "on." The control unit is provided with a cover which may be placed over the TILT, FUNCTION, and TUNE controls during "AIM" operation. For wiring diagram information see figure A-21. The switches on the pilot's control unit are as follows:

a. FUNCTION. This switch turns the AN/APS-19 radar equipment on and off and selects for "BEACON," "SEARCH," or "INT'C'PT" operation. If the pilot desires temporarily to discontinue operation, turn to "STANDBY" until another tactical operation is wanted.

b. TUNE. When this control is in the extreme clockwise "AUTO" position the AFC (automatic frequency control) is in operation and will maintain maximum echoes automatically. If the AFC becomes inoperative, turn this control to "MANUAL" and tune the receiver until maximum echoes are seen.

c. GAIN. This control regulates the strength of the signals coming from the receiver and the amount of "snow" that is applied to the indicator screen. Manipulation of the GAIN control is seldom necessary if it is left in the "AUTO" position. At short ranges from surface and beacon targets, use of the "MANUAL" position will allow finer azimuth bearing readings. In manual operating gain is low if signals disappear, high if "snow" tends to blot out signals.

d. TILT. This is a knob and screwdriver adjustment for changing the antenna tilt vertically. The screwdriver adjustment must be made by qualified personnel only.

e. SCAN ANGLE. This controls the selection of the wide or narrow scan angle and has two positions: "30°," and "135°."

f. RANGE. This switch sets the range within which the operation takes place. The ranges "100," "50," "20," "8," and "2" can be used on "SEARCH" and "INT'C'PT" FUNCTION control. Range "150" can be used on "BEACON" only, and "AIM" (1500 yds.) can be used on "INT'C'PT" only. A mechanical interlock prevents positioning of the RANGE switch or "AIM" whenever the FUNCTION control is not on "INT'C'PT."

g. SEA SUPPRESS. This control enables the operator to suppress signals received, particularly heavy sea return. Turning the control clockwise suppresses the returning signals. It is only usable on intercept, that is, when the scanner is in spiral operation.

A-122. RADAR MOTOR ALTERNATOR.

A-123. DESCRIPTION. *(See figure A-20.)* The radar motor alternator (Eclipse type 800-1D) is located on the center radio shelf on the centerline and is just inboard of the VHF No. 2 transmitter-receiver. This unit is essentially a dc motor and ac generator with rotors on a common shaft. It operates on the 28-volt dc power supply and generates single-phase, 800-cycle, 115-volts ac required by the AN/APS-19 radar system and AN/APX-2 IFF identification equipment. An integral carbon pile voltage regulator maintains a constant ac supply of 115 volts over the entire rated operating range of the motor alternator. A built-in starting solenoid closes the 28-volt dc circuit to the motor alternator whenever the radar FUNCTION switch or IFF master control switch are turned "on." The 28-volt dc power circuit to the alternator is controlled by the radar motor alternator switch-breaker located on the inclined section of the right hand control panel. This switch should be left in the "ON" position. For wiring diagram information see figure A-21.

A-124. REMOVING. To remove the motor alternator, make certain all electrical power is "off" and proceed as follows:

a. Remove the bolt and nut which secures each of the two motor alternator mounting straps.

b. Remove the two electrical leads to the alternator.

c. Slide the alternator aft off mounting plate.

A-125. INSTALLING. To install the alternator, reverse the removal procedure.

A-126. NAF-1221-1 CAPACITOR BOX.

A-127. DESCRIPTION. The capacitor box is located on the upper radio shelf on the right hand side, just forward of the radio shelf opening. This unit is a compensating device for the motor alternator. For wiring diagram information see figure A-21.

A-128. REMOVING. To remove the capacitor box, make certain all electrical power is "off" and proceed as follows:

a. Remove two electrical leads to box.

b. Remove four mounting screws and nuts.

A-129. INSTALLING. Reverse the removal procedure.

A-130. RADAR POWER JUNCTION BOX.

A-131. DESCRIPTION. The radar power junction box is secured to the underside of the center radio shelf, just aft of and above the power synchronizer. This box is a terminal point for the AN/APS-19 radar and AN/APX 2 IFF power cables. It also contains a radio noise filter for the AN/APN-1 radio altimeter. For wiring diagram information see figure A-21.

A-132. REMOVING. To remove the radar power junction box, make certain all electrical power is "off" and proceed as follows:

a. To facilitate working conditions it is advisable to pull the radar power synchronizer aft (see paragraph A-140).

b. Remove the junction box cover.

c. Remove the six mounting screws from the inside of the box which secure it to the underside of the center radio shelf.

A-133. INSTALLING. To install the radar power junction box, reverse the removal procedure.

A-134. ID-158 APS-19 RADAR INDICATOR.

A-135. DESCRIPTION. The radar indicator is located at the top of the instrument panel in the center. This unit makes visible to the pilot the incoming radar signals. The units comprising the indicator are the bezel (retaining cap with filter), amber filter, cathode ray tube and housing, and the snap-on rear cover which contains an electrical lead disconnect socket which engages with the electrical plug on the back of the cathode ray tube. The bezel accommodates the altimeter limit indicator lights. An adjustable polaroid filter is provided which can be attached to the indicator. An adjustable hood is also provided which slips onto the front of the indicator and secures into position by tightening a wing nut. The hood can be adjusted vertically. When not in use the hood is stowed around the control stick. For wiring diagram information see figure A-21.

A-136. REMOVING. To remove the radar scope, make certain all electrical power is "off" and proceed as follows:

a. Remove the three screws on the face (bezel) of the radar scope.

b. Pull out face of radar scope just enough to provide space to disconnect altimeter limit indicator light electric leads.

CAUTION

Extreme care should be taken when pulling out bezel and when disconnecting altimeter limit light electrical leads. These leads tend to break very easily.

c. Pull radar indicator housing out of instrument panel (about 12 inches).

d. Disconnect altimeter lights lead on side of housing.

e. Disconnect intensifier lead to cathode ray tube.

f. Pull out cathode ray tube.

g. Turn housing clockwise to unlock it from rear cover and pull out.

h. Remove left hand instrument access door. Work rear cover unit out through access door. To remove rear cover from airplane, it is necessary to break wire connections at points where they are soldered to electric lead socket. This requires removal of a snap ring, unscrewing a cap nut on the back end of the rear cover, and sliding rear cover down cable lead to gain access to wire lead terminals.

A-137. INSTALLING. To install the radar indicator, reverse the removal procedure.

A-138. SN-35 APS-19 SYNCHRONIZER-POWER.

A-139. DESCRIPTION. The power synchronizer is mounted on the lower radio shelf from which it extends aft on the left hand side. It is accessible through the radio compartment access door. This unit provides the timing reference for the entire radar system and furnishes the various operating voltages required by the AN/APS-19 system. On the front panel of the unit are two receptacles for pressurized connectors, magnetron seasoning switch, horizontal centering adjustment, vertical centering adjustment, brilliance adjustment and focus adjustment. The dust cover, with its built-in cooling system, encloses the chassis. The sides, top and rear of the cover are double-walled, and at the rear, between the walls, are located two blowers driven by a dual shaft motor comprising the cooling system. The heat created by the synchronizer-power chassis is drawn off through vents in the upper side of the dust cover, and the incoming air is filtered to remove dust. The chassis will slide out of its dust cover. The synchronizer section includes the main-gate circuits, trigger-peaking circuits, gating, intensifying, and delay circuit, and sweep circuits that make it possible for the returning signals to be presented on the indicator screen. For wiring diagram information see figure A-21. For further information on the power synchronizer see AN16-30APS19-3, Handbook of Maintenance Instructions for Model AN/APS-19 Aircraft Radar Equipment.

A-140. REMOVING. To remove the power synchronizer, make certain all electrical power is "off" and proceed as follows:

a. Disconnect two electrical leads at aft end of power synchronizer.

b. Break safety-wire and unfasten the two snapslide fasteners at aft end of power synchronizer.

c. Lift up and then pull the power synchronizer aft. Lift synchronizer from the rack.

A-141. MAINTENANCE. Since maintenance of this unit is limited to repairs which can be done when equipment is installed, routine servicing consists only of electrical and ground cable inspection, installation, inspection, and replacement of damaged or broken units. For adjustments and further maintenance procedures refer to AN16-30APS19-3, Handbook of Maintenance Instructions for Model AN/APS-19 Aircraft Radar Equipment.

A-142. INSTALLING. To install the power synchronizer, reverse the removal procedure.

A-143. RT-100/APS-19 RECEIVER-TRANSMITTER.

A—144. DESCRIPTION. *(See figure A-20.)* The transmitter-receiver is a dual chassis assembly endorsed in a pressurized cylindrical dust cover and secured to a shock mounting within the radar nacelle. It is located just behind the radar antenna unit. Access to this unit is gained by removing a radome and rotating the antenna. A motor-driven blower is mounted adjacent to the transmitter-receiver to cool the unit. Another blower is mounted on the chassis plate to circulate the air directly over the magnetron. On the front panel of the transmitter-receiver are a receptacle for a pressurized connector, a connection for a wave guide to the antenna and a receptacle for a coaxial connector. Access to the beacon local oscillator, radar local oscillator, and TR box tuning adjustments is provided on the sides of the dust cover. Access holes aligned with the dust cover adjustment holes are provided on the nacelle skin. They are covered by two plates located on the inboard and underside of the nacelle. The plates are secured by Dzus fasteners. For wiring diagram information see figure A-21. For additional information on the transmitter-receiver see AN16-30APS19-3, Handbook of Maintenance Instructions for Model AN/APS-19 Aircraft Radar Equipment.

A-145. REMOVING. To remove the transmitter-receiver, make certain all electrical power is "off" and proceed as follows:

a. Remove single screw located on bottom center line of radome. Rotate radome counterclockwise (facing aft) to free its studs from the nacelle locking slots. Pull radome off nacelle. *(See figure A—19).*

b. Disconnect flexible waveguide which leads from transmitter-receiver to rear of antenna. This is done by reaching behind antenna on the outboard side and rotating waveguide quick-disconnect retainer.

c. Remove the upper and lower mounting bolts and nuts which secure the inboard antenna spider legs to the nacelle. Ease the tension on the outboard spider leg mounting points by loosening the bolt attachments. Rotate the antenna outboard. *(See figure A-19.)*

d. Disconnect single wire lead to external blower on top of transmitter-receiver.

e. Unscrew and disconnect the coxial cable plug from the rear of the directional coupler on the waveguide.

f. Disconnect electrical lead plug which connects to receptacle (J-101) on front of transmitter-receiver.

g. Break safety-wire and unfasten snapslide fasteners from the two mounting studs at the front of the transmitter-receiver.

h. Lift up transmitter-receiver to clear mounting studs from fastener holes, and pull forward out of nacelle.

A-146. MAINTENANCE. Since maintenance of this unit is limited to repairs which can be done when equipment is installed, routine servicing consists only of electrical and ground cable inspection, installation, inspection, and replacement of damaged or broken units. For adjustments and further maintenance procedures refer to AN16-30APS19-3 Handbook of Maintenance Instructions for Model AN/APS-19 Aircraft Radar Equipment.

A-147. INSTALLING. To install the transmitter-receiver, reverse the removal procedure.

A-148. AS-238/APS-19 ANTENNA.

A-149. DESCRIPTION. The antenna is mounted in the forward end of the nacelle, its parabolic reflector (disc) extending into the removable radome. The antenna consists of waveguide components, with a feed horn at the end. This with the parabolic reflector, projects a five degree beam of r-f energy into space and receives the reflected signals from the target. Search (azimuth) and spiral scans are provided by the antenna. Both 30 degree and 135 degree scans are provided. The wide angle spiral scan makes 15 complete cycles of nod motion per minute, which is the equivalent to scanning over any object in the field of view at the rate of 60 times per minute. The narrow spiral scan makes 60 cycles of the nod motion per minute, which is the equivalent of scanning over any object in the field of view at the rate of 240 times per minute. The wide search scan is a time scan traveling at 15 cycles per minute, so it crosses the field of view 30 times per minute. The narrow search scan travels at the rate of 60 cycles per minute and thus crosses the field of view 120 times per minute. The antenna is mounted in the nacelle by means of four mounting flanges at the end of the legs of the mounting spider. For access to the rear of the antenna, it is only necessary to remove the bolts from the inboard legs and rotate the antenna outboard. For wiring diagram information see figure A-21. For further information on the antenna see AN16-30APS 19-3, Handbook of Maintenance Instructions for Model AN/APS-19 Aircraft Radar Equipment.

A-150. REMOVING. To remove the antenna, make certain all electrical power is "off" and proceed as follows:

Note

Extreme care must be taken when handling antenna.

a. Remove single screw located on bottom centerline of radome. Rotate radome counterclockwise (facing aft) to free its mounting studs from the nacelle locking slots and pull radome off nacelle.

b. Disconnect flexible waveguide which leads from transmitter-receiver to rear of antenna. This is done by reaching behind antenna on the outboard side and rotating waveguide quick-disconnect retainer.

c. Remove the upper and lower mounting bolts and nuts which secure the inboard antenna spider legs to the nacelle. Ease the tension on the outboard spider leg mounting points by loosening the bolt attachments. Rotate the antenna outboard.

d. Disconnect electric lead to antenna.

e. Remove upper and lower mounting bolts which secure antenna spider legs on the outboard side. Remove antenna from nacelle.

A-151. INSTALLING. To install the antenna, reverse the removal procedure.

Note

At present, the antenna is not provided with boresight adjustment facilities, but will be at some future date.

A-152. J-209 APS-19 TEST BOX.

A-153. DESCRIPTION. *(See figure A-20.)* The test box is located on the outboard side of the nacelle, aft of the transmitter-receiver. It is accessible through the test box access door. The test box provides a convenient means for checking the critical points in the radar system including the various operating voltages. Because of its accessibility, test equipment may be connected to this unit for field maintenance. In addition, a switch is mounted on the test box to stop scanner motion. For wiring diagram information see figure A-21. For further information on the use of this box see AN16-30APS-19-3, Handbook of Maintenance Instructions for Model AN/APS-19 Aircraft Radar Equipment.

A-154. REMOVING. To remove the test box, make certain all electrical power is "off" and proceed as follows:

a. Open test box access door on the outboard side of the nacelle.

b. Remove four mounting screws.

c. Allow test box to drop down to clear access opening.

d. Reach through access opening and loosen cable clamps as necessary.

e. Pull test box out of access opening.

f. Remove protective coating on cable clamp on back of test block. Loosen clamp screws.

g. Pull test box out from back plate to expose soldered wire connections. To detach test box it is necessary to break wire connections.

A-155. INSTALLING. To install the test box, reverse the removal procedure .

A-156. RADAR NACELLE.

A-157. DESCRIPTION. *(See figure A-19.)* The radar nacelle is located on the outer right hand panel. It is faired into the wing and fastened by screws. The nacelle is aluminum with a removable plastic nose (radome). Contained in the nacelle are the AS-238/APS-19 antenna, the RT-100/APS-19 transmitter-receiver and the J-209/APS-19 test box.

A-158. REMOVAL. To remove the radar nacelle turn all electrical power "off" and proceed as follows:

a. Remove AS-238/APS-19 antenna, RT-100/APS-19 transmitter-receiver, and J-209/APS-19 test box by following the procedures outlined in paragraph A-150, paragraph A-143, and paragraph A-152, respectively.

b. Remove mounting screws on top and bottom of nacelle.

c. Slide nacelle off.

A-159. MAINTENANCE. The aluminum portion of the nacelle requires no special maintenance. The removable plastic radome CW-22 A/A must not be painted. Touching up of the chipped and scratched portions is permitted if the radome material has not been damaged. Non-specular light gray lacquer, specification AN-L-2I or M-485 must be used. The use of zinc chromate primer is prohibited. Under no circumstances shall any paint remover or stripper be used on this radome.

A-160. INSTALLING. To install the radar nacelle, reverse the removal procedure.

Note

Nacelle CW-144/APS-19, cannot be installed on the bomb rack of the F4U-5N airplane since there is no provision for installing it.

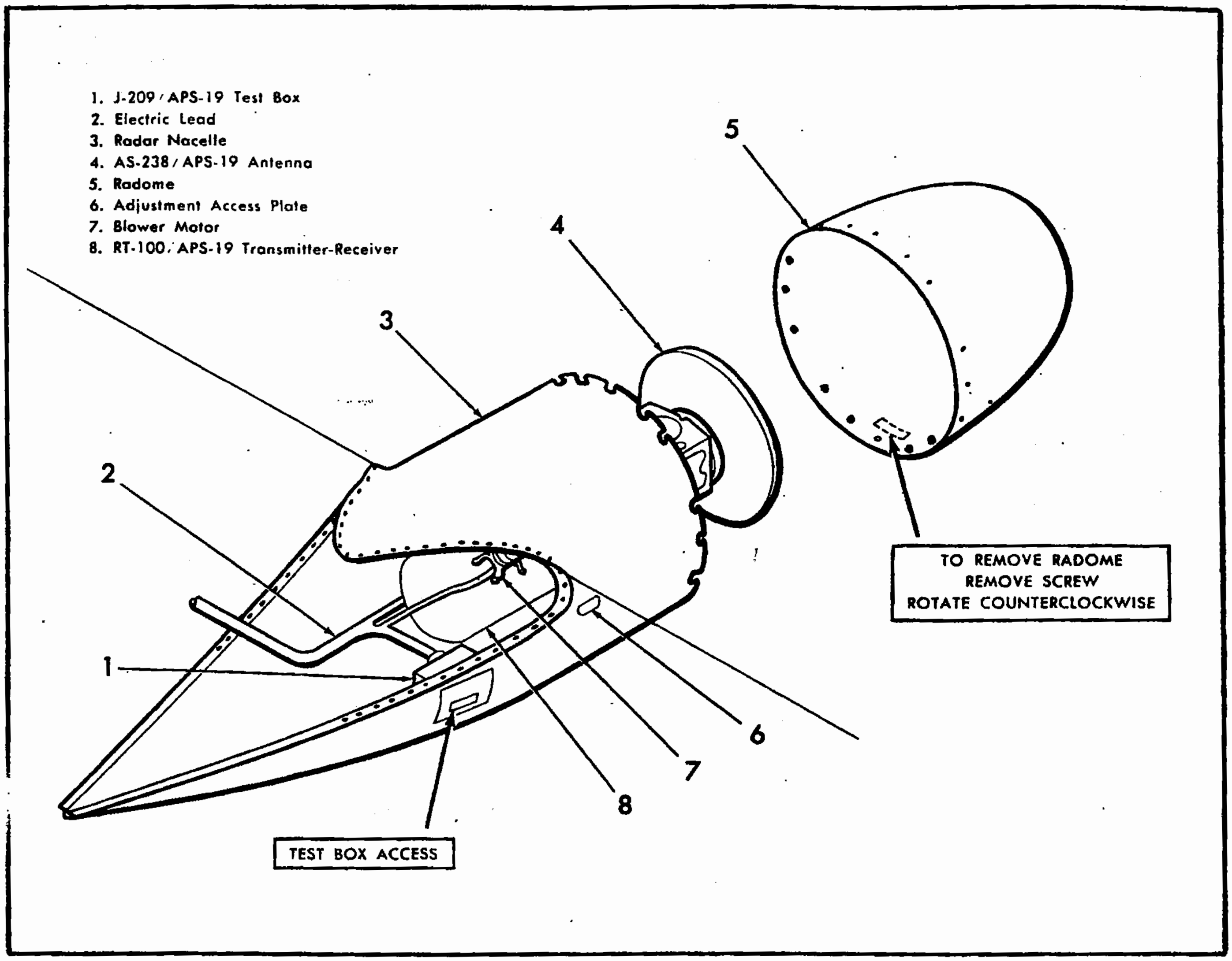


Figure A—19. Radar Nacelle with Radome Removed.

A-161. GROUND OPERATION CHECK. A 28-volt dc power supply must be available from either an external source or from the airplane's generator. Prior to checking the AN/APS-19 radar set the control switches must be in the following positions: FUNCTION- "OFF," TUNE- "AUTO," GAIN- "AUTO," SCAN ANGLE- "135°," RANGE - "2," SEA SUPPRESS - "OFF." Turn the motor alternator power switch and the AN/APS-19 circuit breaker to "ON" and proceed as follows:

a. Turn the FUNCTION selector to "SEARCH." Wait three minutes before proceeding since a delay of three minutes is required by a time delay relay.

b. Note the appearance of the base and sweep lines. Clear lines indicate proper focus.

c. Check the alignment and the centering of the representation on the indicator.

d. A little "snow" indicates proper brilliance.

e. If the echo images disappear or appear erratic, AFC is not functioning properly and "MANUAL" operation of TUNE is necessary. This control is very sensitive and adjustments must be made carefully.

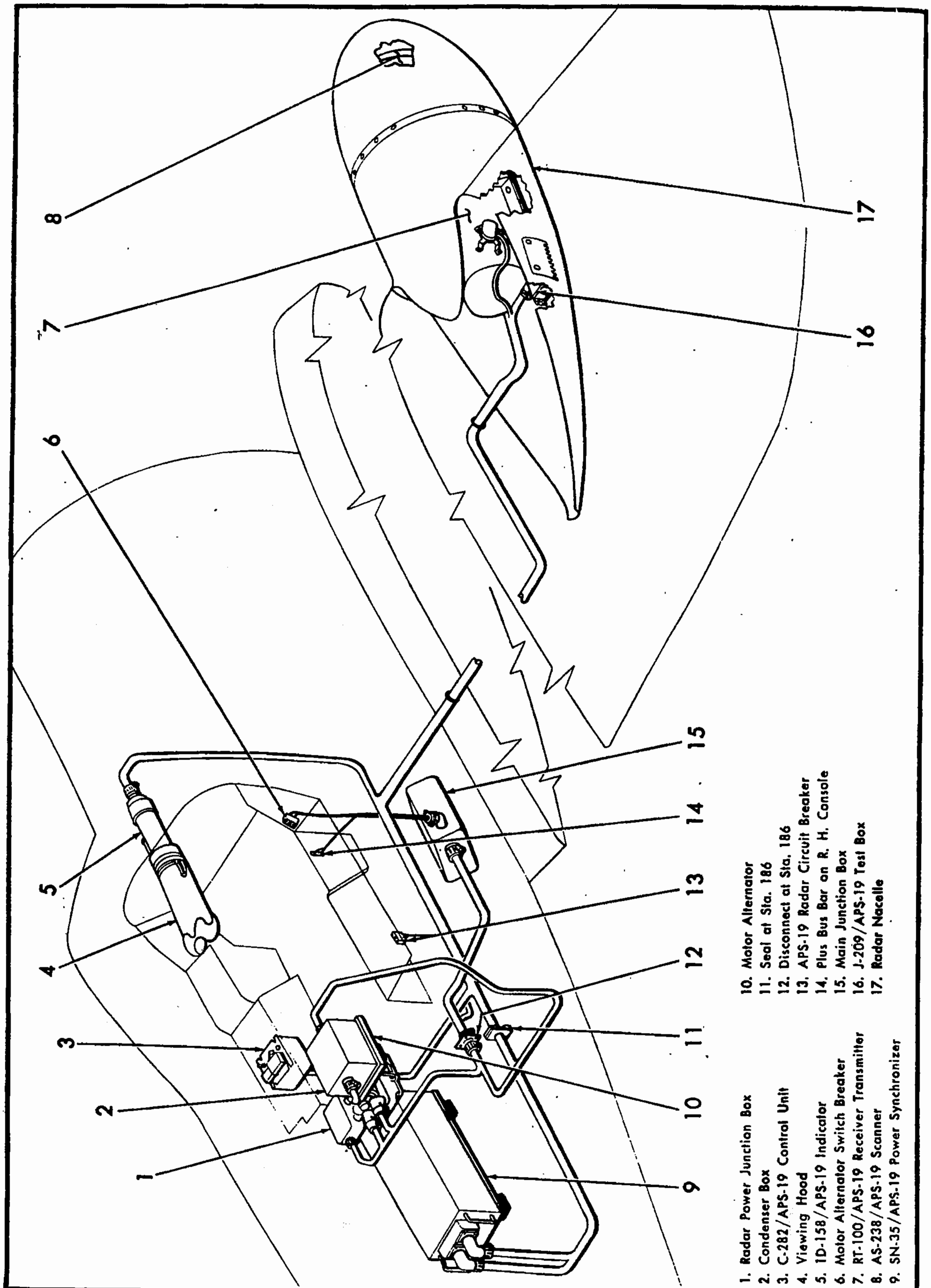
f. Turn the RANGE knob counterclockwise to increase the range. New images should appear and the old ones should lower on the screen. At sea it is possible that as the range is increased no new images will appear.

g. Vary the angle of tilt and note fading and reappearance of echoes.

h. Check other FUNCTION settings. Do not turn to "OFF" since the radar set will be inoperative for three minutes.

i. Change the SCAN ANGLE to "30°". The sweep should be more rapid.

Further checks must be made by qualified personnel only. For additional infomation refer to AN16-30APS19-3, Handbook of Maintenance Instructions for Model AN/APS-19 Aircraft Radar Equipment.



1. Radar Power Junction Box
2. Condenser Box
3. C-282/APS-19 Control Unit
4. Viewing Hood
5. ID-158/APS-19 Indicator
6. Motor Alternator Switch Breaker
7. RT-100/APS-19 Receiver Transmitter
8. AS-238/APS-19 Scanner
9. SN-35/APS-19 Power Synchronizer
10. Motor Alternator
11. Seal at Sta. 186
12. Disconnect at Sta. 186
13. APS-19 Radar Circuit Breaker
14. Plus Bus Bar on R. H. Console
15. Main Junction Box
16. J-209/APS-19 Test Box
17. Radar Nacelle

Figure A–20. AN/APS-19 Radar Reference Diagram.

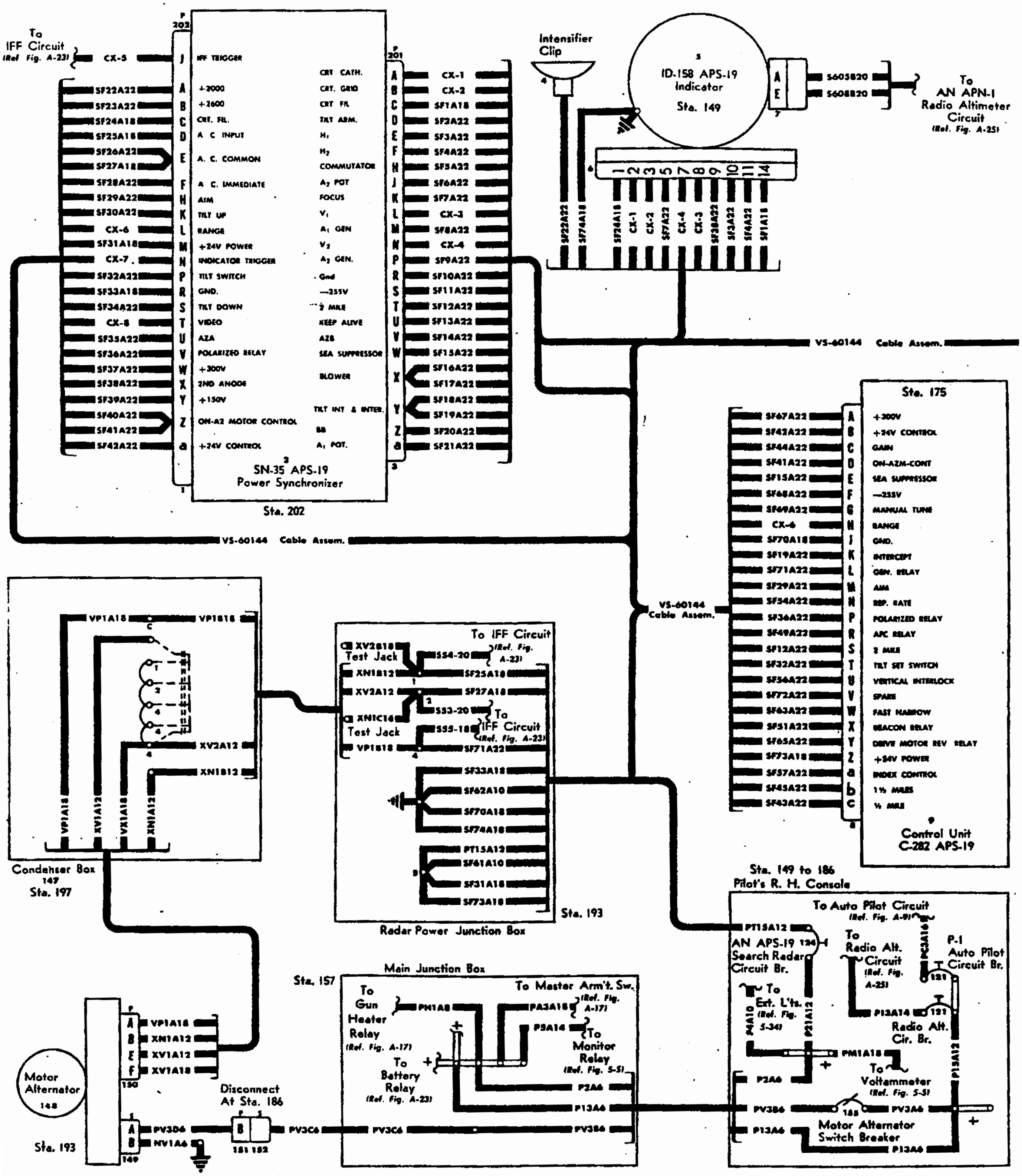


Figure A—21. (Sheet 1 of 2 Sheets) AN/APS-19 Radar Cabling Diagram.

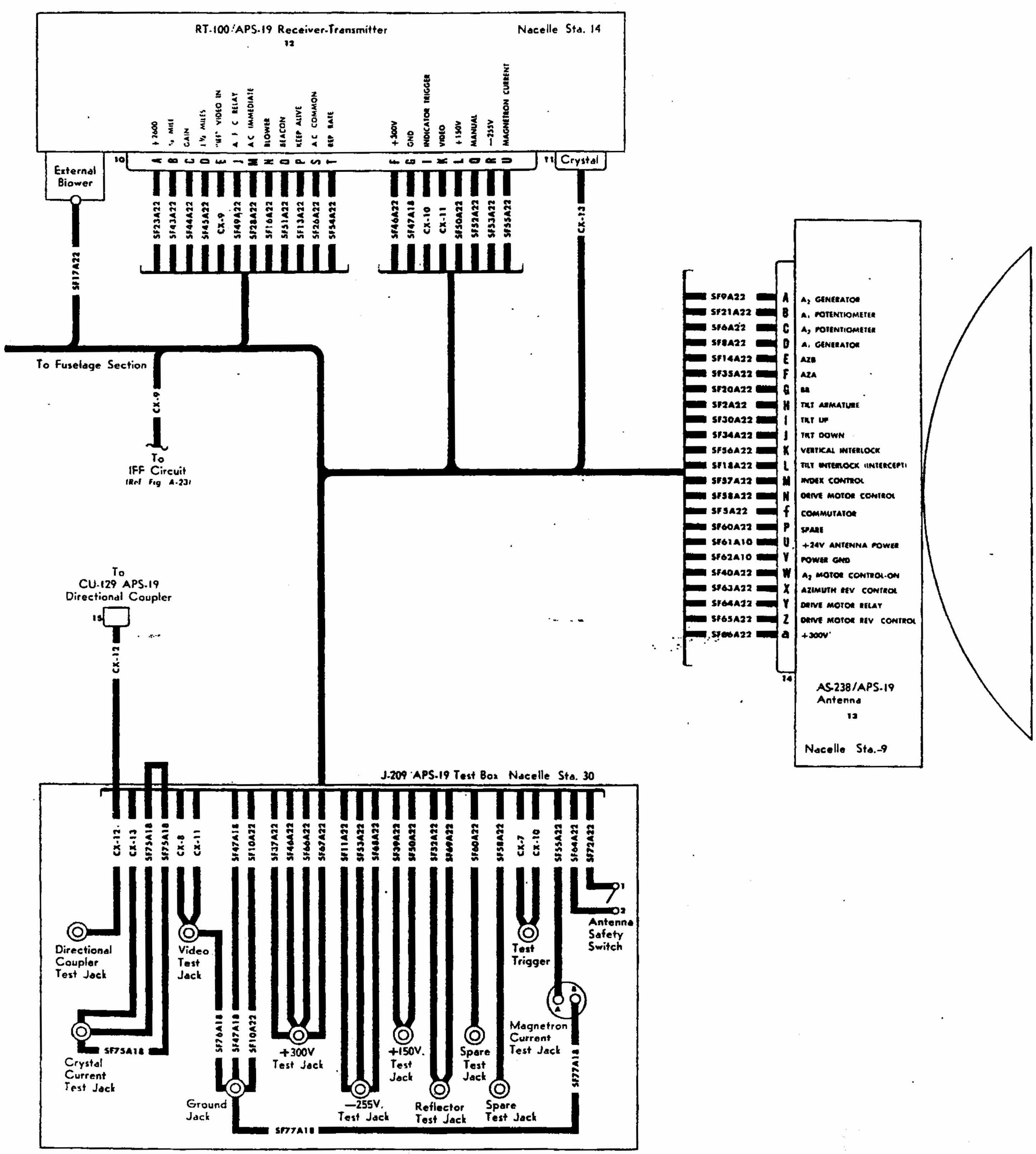


Figure A—21. (Sheet 2 of 2 Sheets) AN/APS-19 Radar Cabling Diagram.

ELECTRICAL POWER SUPPLY TO AN/APS-19

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
NV1A6	AN6		860-6-3	659-30	860-6-3	20
P2A6	AN6	659-30	860-6-3	659-30	860-6-3	30
P13A6	AN6	659-30	860-6-3	659-30	860-6-3	30
P15A12	AN12	659-5	860-10-3	659-5	860-10-3	24
P21A12	AN12	659-5	860-10-3	659-5	860-10-3	32
PT15A12	AN12	659-5	860-10-3	659-5	860-10-3	72
PV3A6	AN6	659-30	860-6-3	659-30	860-6-3	30
PV3B6	AN6	659-30	860-6-3	659-30	860-6-3	40
PV3C6	AN6	659-30	860-6-3		860-6-3	50
PV3D6	AN6		860-6-3		860-6-3	40
VP1A18	AN18		860-18-3	659-2	860-16-3	50
VP1B18	AN18	692-2	860-16-3	659-2	860-16-3	55
VX1A18	AN18		860-18-3	659-2	860-16-3	50
XN1A12	AN12		860-12-3	659-5	860-10-3	50
XN1B12	AN12	659-5	860-10-3	659-5	860-10-3	55
XN1C16	AN16	659-4	860-14-3	CVC-880-22	860-14-3	5
XV1A12	AN12		860-12-3	659-5	860-10-3	50
XV2A12	AN12	659-5	860-10-3	659-5	860-10-3	55
XV2B18	AN16	659-4	860-14-3	CVC-880-22	860-14-3	5

MASTER ELECTRICAL PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFGRS. NAME AND NO.	NOMENCLATURE
121	AN3161-P10	Circuit Breaker
124	AN3161-P35	Circuit Breaker
147	NAF1222-1	Condenser Box
148	Type 800-1D (GFE)	Motor Alternator
151	AN3100-22-12P	Receptacle
152	AN3106-22-12S	Plug

AN/APS-19 WIRE TABLE *(See figures A-20 and A-21)*
CABLE ASSEMBLY VS-60144

WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES
CX-1	240	CX-12	45	SF10A22	444
CX-2	240	CX-13	54	SF11A22	444
CX-3	240	SF1A18	240	SF12A22	252
CX-4	240	SF2A22	468	SF13A22	516
CX-5	120	SF3A22	240	SF14A22	468
CX-6	156	SF4A22	240	SF15A22	252
CX-7	444	SF5A22	468	SF16A22	516
CX-8	444	SF6A22	468	SF17A22	504
CX-9	492	SF7A22	240	SF18A22	468
CX-10	48	SF8A22	468	SF19A22	252
CX-11	48	SF9A22	468	SF20A22	468

AN APS-19 WIRE TABLE (Continued)

CABLE ASSEMBLY VS-60144 (Continued)

WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES
SF21A22	468	SF40A22	468	SF60A22	96
SF22A22	240	SF41A22	156	SF61A10	414
SF23A22	468	SF42A22	156	SF62A10	414
SF24A18	240	SF43A22	372	SF63A22	372
SF25A18	96	SF44A22	372	SF64A22	96
SF26A22	468	SF45A22	372	SF65A22	372
SF27A18	96	SF46A22	48	SF66A22	96
SF28A22	468	SF47A18	48	SF67A22	372
SF29A22	156	SF49A22	372	SF68A22	372
SF30A22	468	SF50A22	48	SF69A22	372
SF31A18	96	SF51A22	372	SF70A18	99
SF32A22	156	SF52A22	48	SF71A22	99
SF33A18	96	SF53A22	48	SF72A22	372
SF34A22	468	SF54A22	372	SF73A18	99
SF35A22	468	SF55A22	48	SF74A18	186
SF36A22	156	SF56A22	372	SF75A18	4
SF37A22	444	SF57A22	372	SF76A18	4
SF38A22	240	SF58A22	96	SF77A18	6
SF39A22	444				

AN/APS-19 EQUIPMENT PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFGRS. NAME AND NO.	NOMENCLATURE
1	Sperry No. 703284 (GFE)	Plug
2	SN-35/APS-19 (GFE)	Power Synchronizer
3	Sperry No. 703321 (GFE)	Plug
4	Sperry No. 219125 (GFE)	Clip
5	ID-158/APS-19 (GFE)	Indicator
6	Sperry No. 813290 (GFE)	Disconnect
7	Sperry Manufactured (Furnished with Indicator)	Plug
8	Sperry No. 703280 (GFE)	Plug
9	C-282/APS-19 (GFE)	Console Control Panel
10	Sperry No. 703283 (GFE)	Plug
11	Sperry No. 813851 (GFE)	Plug
12	RT-100/APS-19 (GFE)	Receiver-Transmitter
13	AS-238/APS-19 (GFE)	Antenna Scanner
14	Sperry No. 809945 (GFE)	Plug
15	Sperry No. 815131 (GFE)	Plug

A-162. AN/APX-2 IFF IDENTIFICATION SYSTEM (WITH INTERROGATOR-RESPONSOR).

A-163. DESCRIPTION. *(See figure A-2 and A-22.)* The AN/APX-2 IFF system consists essentially of an RT-24/APX-2 receiver-transmitter, a C-241 APX pilot control unit, a C-56/APX-2 operator control unit, two AS-32/APX-1 antennas and an SA-3 A impact destructor switch. The two basic purposes of this equipment are to enable the airplane in which it is installed to: (1) identify itself as friendly when it is challenged by appropriately equipped air, ship, and ground forces, (2) challenge aircraft and ships for identification. Two supplementary purposes of the IFF equipment are to enable the aircraft in which it is installed to: (1) indicate that it is in distress by means of an IFF response reserved for that purpose, and (2) serve as a beacon on which other appropriately equipped airplanes can "home." Provisions are also incorporated for destroying the IFF equipment to prevent its falling into enemy hands. Power for the IFF system is obtained from the single-phase, 800-cycle, 115-volt ac radar motor alternator (see paragraph A-123). Twenty-eight volt dc power is also employed to drive the sweep and blower motors, energize the relays, and, when necessary, explode the destructors. The IFF system has three frequency bands designated as follows:

a. "A"-Band. This is a swept frequency band ranging from 157 to 187 megacycles used for identifying as friendly the ship in which it is installed. The "A"-band may be coded in any one of six codes as designated. The "A"-band may also be usd to transmit emergency (distress width) reply pulses. It can be operated alone or on a time-sharing basis with the "G"-band.

b. "G"-BAND. The "G"-band is preset to a designated frequency within 194 to 212 megacycles. The "G"-band is employed for special fighter direction purposes and always operates on a time-sharing basis with the "A"-band. The "G"-band cannot be coded.

c. INTERROGATOR-RESPONSOR. The interrogator-responsor operates on a preset frequency within the range of 160 to 184 megacycles. The interrogator makes it possible for the pilot to challenge air or sea forces for IFF identification. The IFF identification reply is picked up by the responsor and projected on the radar scope. For further information on the AN/APX-2 IFF equipment see AN 08-20-12, Handbook of Maintenance Instructions for Model AN APX-2 Aircraft IFF Equipment. For wiring diagram infromation see figure A-23.

WARNING

IFF equipment employs high voltages which are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised when working with this equipment.

A-164. TROUBLE SHOOTING. If at any time the IFF equipment fails to operate, the proper maintenance personnel should be notified. Check to make certain that the ac and dc pilot lamps on the operator control unit go on when the radar motor alternator power switch, motor alternator circuit breaker, IFF circuit breaker and IFF master control switch are turned "ON". Check for burned out fuses on the operator control unit and on the receiver-transmitter. Make certain that all cable connections are tight. If trouble is not caused by power source failure or if fuses repeatedly burn out, isolate the trouble by replacing each IFF unit (including cables) until the defective unit is located. For wiring diagram information see figure A-23. For more detailed information on trouble shooting and testing of the IFF equipment see AN 08-20-12, Handbook of Maintenance Instructions for Model AN APX-2 Aircraft IFF Equipment.

A-165. C-241 APX PILOT CONTROL UNIT.

A-166. DESCRIPTION. *(See figure A-2.)* The pilot control unit is located on the right hand control panel in the cockpit. It permits the control of all operating functions of the equipment by the pilot. Before operation of the control unit switches is effective, the motor alternator power switch, motor alternator circuit breaker, and IFF circuit breaker must be "ON". The control unit incorporates five switches as follows:

a. A master control switch, which is also the on-off switch for the entire equipment (after the motor alternator has been turned "ON"). It has one "OFF" and four operating positions: "NORM," "INT ONLY," "ROOSTER," and "EMERGENCY". A guard latch prevents accidental rotation of this switch to its "EMERGENCY" position. The "NORM" position permits operation of the "A"-band transpondor. The "INT ONLY" position cuts out any frequency bands in operation ("A," "A/G," or "R") and permits operation ot the interrogator-responsor only. The "EMERGENCY" position causes the "A"-band transpondor to send out distress width pulses whenever the "A"-band transpondor is interrogated. The "ROOSTER" position adapts the "G"-band frequency to an "R"-band frequency for special beacon purposes and cuts out operation of the "A"-band.

b. A code selector switch which has seven positions: "1," "2," "3," "4," "5," "6," and "DESTRUCT." This switch permits the "A"-band swept frequency to be coded in any one of six codes, as determined by a selected combination of narrow pulses, wide pulses and blanks. The "DESTRUCT" position completes a circuit direct from the battery to the receiver-transmitter destructors and is used by the pilot whenever the airplane is forced to land in enemy territory.

c. An INT switch which has three positions: "OUT," "CONT," and "TMPRY". This switch cuts out, or brings into position the interrogator-responsor on a continuous or momentary basis, depending on whether the switch is in the "CONT" or "TMPRY" position. This switch operates independently of the "INT ONLY" position on the master control switch, in that when the master control switch is in "NORM," "ROOSTER" or "EMERGENCY" position, the interrogator-responsor will still operate alternately with "A," "G" or "R" bands. A suppression circuit disables all other bands during the brief operative periods of the interrogator-responsor. As stated above, when the master control switch is in "INT ONLY," the suppression circuit disables the "A," "G" and "R" bands permanently until the switch is moved to another position. This permits the interrogator-responsor to operate alone.

d. A "G"-band switch which has three positions: "G," "OUT," and "B-M". This switch cuts out or brings into operation the "G"-band transpondor on a time-sharing basis with the "A"-band transpondor. The "G"-band never operates alone.

e. A gain control which is a knob-adjustment potentiometer, by means of which the pilot can obtain a clearer IFF reply signal on the radar scope.

Note

For a description of the various IFF frequency bands and their purpose see paragraph A-163.

The pilot control unit switches permit four modes of operation as listed in the following table:

PILOT CONTROL UNIT

SWITCH POSITIONS

MODES OF OPERATION	*MASTER CONTROL SWITCH*	*"G"-BAND SWITCH*	*INT SWITCH*	*CODE SELECTOR*
MODE I				
a. "A"-band transpondor alone	"NORM"	"OUT"	"OUT"	As designated
b. "A"-band time-sharing with "G"-band transpondor.	"NORM"	"G"	"OUT"	As designated
c. "A" or "A. G" operation plus interrogator-responsor operation.	"NORM"	"OUT" or "G"	"CONT" or "TMPRY"	As designated
MODE II				
a. Interrogator-responsor operation alone.	"INT ONLY"	Inoperative	"CONT" or "TMPRY"	Inoperative
MODE III				
a. Rooster operation alone ("G"-band range shifted to rooster frequency)	"ROOSTER"	Inoperative	"OUT"	Inoperative
b. Rooster operation plus normal. Interrogator-responsor operation.	"ROOSTER"	Inoperative	"CONT"	Inoperative
MODE IV				
a. "EMERGENCY" "A"-band operation alone. (Distress Pulses)	"EMERGENCY"	"OUT"	"OUT"	Inoperative
b. "EMERGENCY" "A"-band operation time-sharing with normal "G"-band operation.	"EMERGENCY"	"G"	"OUT"	Inoperative
c. Either (a) or (b) above, plus normal interrogator-responsor operation.	"EMERGENCY"	"OUT" or "G"	"CONT" or "TMPRY"	Inoperative

A-167. RT-24/APX-2 RECEIVER-TRANSMITTER.

A-168. DESCRIPTION. *(See figure A-22.)* The receiver-transmitter is located on the lower radio shelf on the right hand side and is accessible through the radio compartment access door. This unit is mounted on an MT-108/APX-1 shock mount. The RT-24/APX-2 receiver-transmitter consists essentially of an RT-57/APX-2 interrogator-responsor and an RT-55/APX transpondor contained within a common housing, but physically separated into two chassis. Thirteen receptacles are provided in the unit for screw-in destructors, which can be exploded by throwing the guard-protected destruct switch on the pilot control unit when there is danger of the equipment falling into enemy hands. The upper chassis is devoted exclusively to the transpondor elements of the equipment. All "A"-band components are mounted in or on the chassis itself while the exclusively "G"-band components are mounted on a separate chassis. The upper chassis of the receiver-transmitter unit also contains a motor-driven sweep mechanism, cam-actuated switches and a relay. These parts control the "A"-band sweep and, together with the selector switch on the operator control unit, the coding of the "A"-band replies. A second relay energized by rotating the master control switch to its "EMERGENCY" position, initiates the transmission of very wide (distress) pulses in the "A"-band replies. A third relay, energized by the closing of the "G"-band switch initiates time-sharing operation of the "A"-band with the "G"-band. The time-sharing switching control alternately switches the "A"-band off and on while simultaneously switching the "G"-band on and off. The operating periods for the two bands, when time-sharing, are equal.The lower chassis of the receiver-transmitter contains the interrogator-responsor, a common power supply for both chassis and a blower. The interrogator-responsor operates on a preset frequency within the range of 160 megacycles to 184 megacycles. Tactical considerations determine the exact frequency designated for use in a specific area or for a specified length of time. Normally, the interrogator-responsor is not kept in continuous operation. It is switched on by means of the INT switch whenever the pilot wishes to challenge an unknown craft whose presence is either suspected, or revealed by radar. The responsor section is held in an inoperative state except during a brief "receptive period" immediately following each transmitted interrogation pulse. IFF replies from other airplanes are amplified by an r-f amplifier, further amplified by a superregenerative receiver oscillator, diode detected, amplified in a video chain, and delivered via a video output terminal and inter-unit cabling to the radar scope. The common power supply for the receiver-transmitter is obtained from the single-phase, 800-cycle, 115-volt ac radar motor alternator (Eclipse Type 800-1D). Twenty-eight volt dc power is also employed to drive the sweep and blower motors, energize the relays, and, when necessary, explode the destructors. For further information on the RT-24/APX-2 receiver-transmitter see AN 08-20-12, Handbook of Maintenance Instructions for Model AN/APX-2 Aircraft IFF Equipment.

WARNING

All thirteen destructors must be taken out of the receiver-transmitter unit as soon as it is removed from the aircraft. The destructors must be handled and stored in complete accordance with existing regulations dealing with IFF destructors.

A-169. REMOVING. To remove receiver-transmitter, make certain that all electrical power is "off" and proceed as follows:

a. Disconnect all electrical leads to receiver-transmitter.

b. Disconnect bonding.

c. Break safety-wire and unscrew knurled nuts until they are disengaged from mounting projections and pivot downward.

d. Slide receiver-transmitter unit aft from mount.

e. To remove the MT-108/APX-1 shock mount remove sixteen screws which secure shock mount to lower radio shelf.

A-170. MAINTENANCE. Since maintenance of this unit is limited to repairs which can be done when equipment is installed, routine servicing consists only of electrical and ground cable inspection, blown fuse replacement, installation inspection, and the replacement of broken or damaged units. For further information refer to AN 08-20-12, Handbook of Maintenance Instructions for Model AN/APX-2 Aircraft IFF Equipment.

A-171. INSTALLING. To install the receiver-transmitter, reverse the removal procedure.

A-172. C-56/APX-2 OPERATOR CONTROL UNIT.

A-173. DESCRIPTION. (*See figure A-22.*) The C-56/APX-2 operator control unit is located at approximately station 235, just above the auto pilot servo amplifier mounted on the left hand radio shelf. It is accessible through the radio compartment access door. The primary function of this unit in the F4U-5N airplane is to serve as a junction box. The switches on the operator control unit would normally be used by the radar operator in airplanes manned by both pilot and radar operator. In the F4U-5N airplane, however, these switches are left in the "OFF" position and the pilot controls the IFF equipment from the cockpit. The operator control unit incorporates a gain set control which is a screwdriver-adjustment potentiometer. This control limits the amount of responsor gain that may be obtained by adjustment of the gain controls. It is preset and locked by the radio maintenance crew. Two functional fuses (and two spares) and two pilot lamps for the ac and dc power lines are also attached to the front face of the control unit. For further information on the C-56/APX-2 operator control unit refer to AN 08-20-12, Handbook of Maintenance Instructions for Model AN/APX-2 Aircraft IFF Equipment.

A-174. REMOVING. To remove the operator control unit, make certain that all electrical power including external power is "off" and proceed as follows:

a. Remove four electric leads to operator control unit.

b. Remove six screws which secure control unit mounting bracket to airplane.

c. Remove mounting bracket from control unit by removing four screws.

A-175. INSTALLING. To install the operator control unit, reverse the removal procedure.

A-176. SA-3/A IMPACT DESTRUCTOR SWITCH.

A-177. DESCRIPTION. (*See figure A-22.*) The SA-3/A impact destructor switch is secured to the forward face of bulkhead 218 just below the ceiling and above the upper radio shelf. It is accessible by working through the radio access door and reaching upwards through the opening in the upper radio shelf. This switch unit is electrically connected to the battery on one side, and to the receiver-transmitter destructors on the outer side. It is wired in parallel to the pilot operated destruct switch. In a forced landing in enemy territory, the pilot normally actuates the destruct switch to destroy the IFF equipment. However, if the pilot is unable to operate this switch and the airplane crashes, the impact switch will automatically trip and close the circuit directly from the airplane battery to the destructors. Operation of the battery switch does not effect either one of the destruct circuits as they are wired directly to battery. For further information on testing the SA-3/A impact switch see AN 08-20-12, AN/APX-2 Aircraft IFF Equipment. Testing of the destruct circuits and impact switch should be performed by qualified radio maintenance personnel.

A-178. REMOVING. To remove the SA-3/A impact switch, proceed as follows:

a. Disconnect the electric lead from the impact switch to the operator control unit.

b. Remove the two bolts and nuts which secure the impact switch mounting clamp to bulkhead 218.

c. To remove the impact switch from the airplane it is necessary to disconnect the two wires from the impact switch to the operator control unit plug. Break the wire connections at the plug. Pull the impact switch forward to clear the wire leads from the grommet holes in bulkhead 218 and remove the unit from the airplane.

A-179. AN-32/APX-1 ANTENNAS.

A-180. DESCRIPTION. (*See figure A-22.*) Two identical antennas are employed for the receiver-transmitter, one for the transpondor section, the other for the interrogator-responsor section. The antennas are quarter-wave length tapered steel rods with button ends. The skin of the airplane serves as a ground. The interrogator-responsor antenna extends from the underside of the airplane at approximately station 250. The transpondor antenna extends from the top side of the airplane in a vertical line with interrogator-responsor antenna. The antennas are accessible through the radio compartment access door. Two antenna extenders provide a means of obtaining various antenna rod lengths for optimum performance in different ranges within the interrogator-responsor frequency band. When not in use, these extenders are stored in the lower front panel of the receiver-transmitter unit.

A-181. REMOVING. To remove an antenna, make certain that all electrical power is "off" and proceed as follows:

a. Work through radio access door and disconnect electric lead to antenna.

b. Remove eight screws and nuts which secure antenna to airplane.

A-182. INSTALLING. To install the antenna, reverse the removal procedure.

A-183. GROUND OPERATIONAL CHECK. Make a visual check of the receiver-transmitter unit for proper installation and check that all eight destructors are in place and tightly screwed into their respective jacks. Then proceed as follows:

a. Make sure a complete destructor circuit test has been made. For details of this test see AN 08-20-12.

b. Check the control unit for proper code setting.

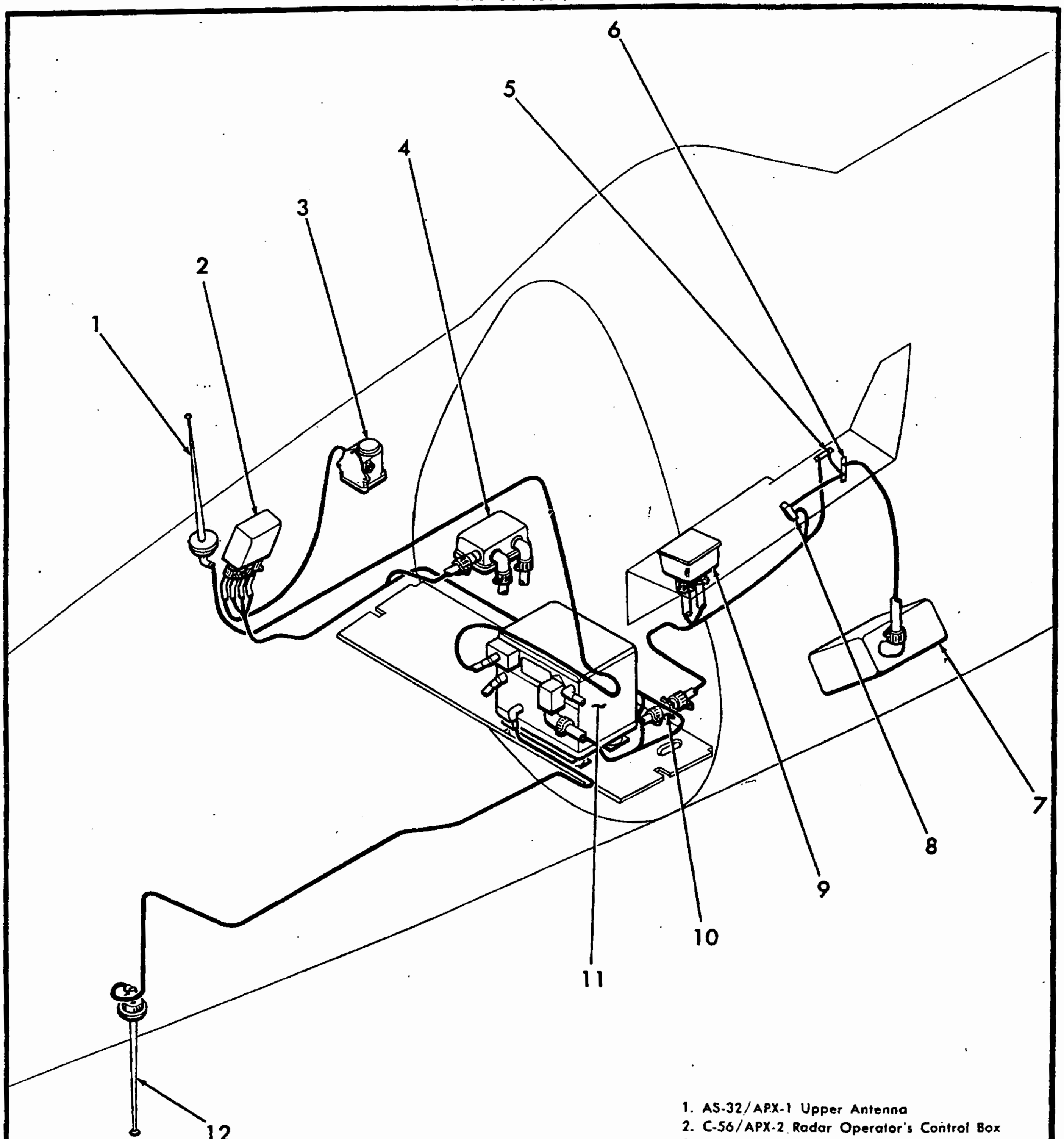
c. With the engine running above generator cut-out speed or using an external power source of 28 volts dc proceed as follows:

(1) Turn the motor alternator circuit breaker, the IFF circuit breaker, and the motor alternator power switch "ON."

(2) Check reception of responsor signals on the radar scope.

(3) Check both reception and transmitting by headphone monitoring.

More detailed ground checks should be made by qualified personnel. For additional information refer to AN 08-20-12.



1. AS-32/APX-1 Upper Antenna
2. C-56/APX-2 Radar Operator's Control Box
3. Impact Switch
4. Radar Power Junction Box
5. "IFF Destruct" Circuit Breaker
6. Plus Bus Bar on R. H. Console
7. Main Junction Box
8. "IFF Radio" Circuit Breaker
9. C-241/APX "IFF" Control Panel
10. Disconnect at Sta. 186
11. RT-24/APX-2 Receiver-Transmitter
12. AS-32/APX-1 Lower Antenna

Figure A—22. AN APX-2 IFF Reference Diagram.

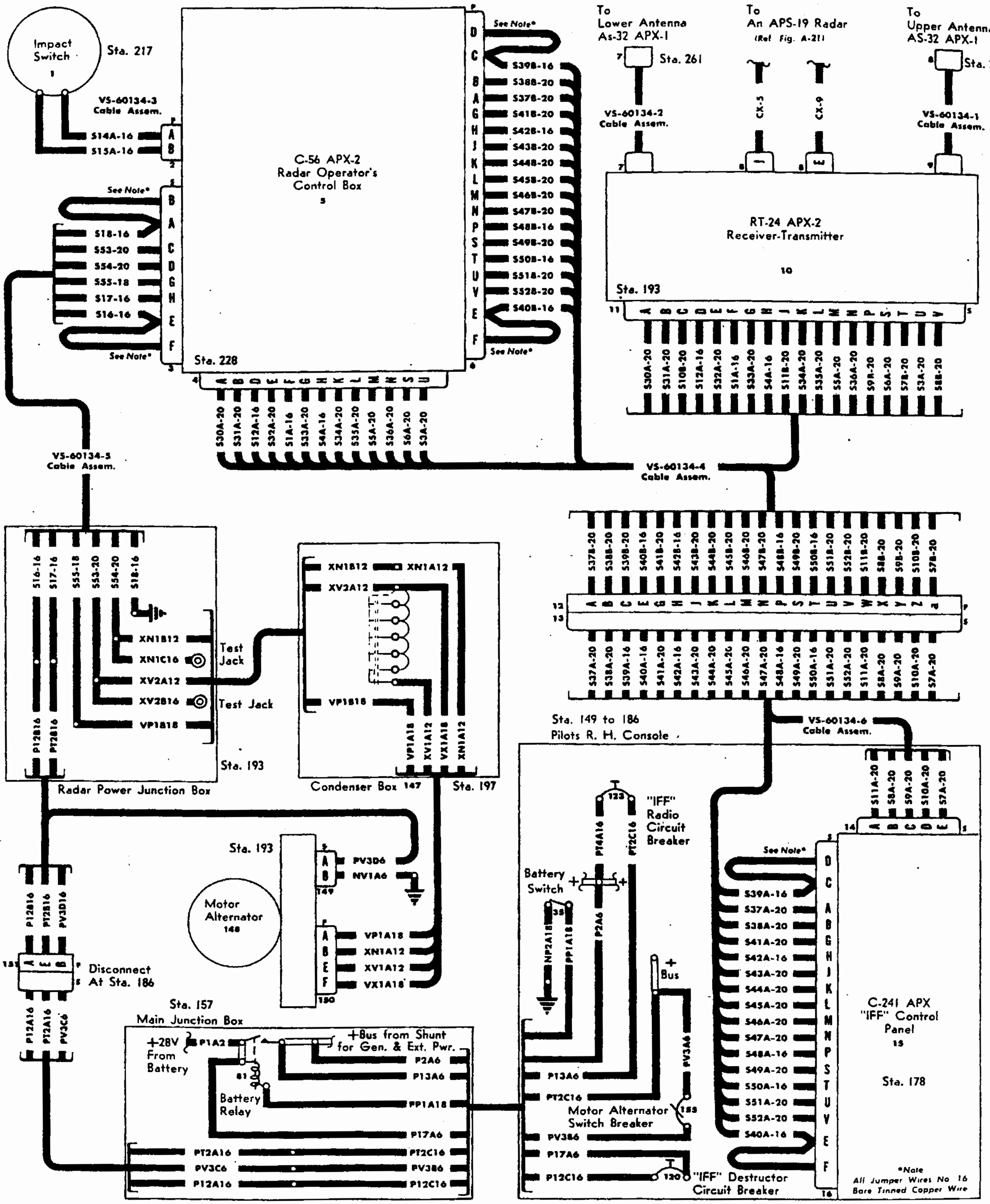


Figure A—23. AN/APX-2 IFF Cabling Diagram.

ELECTRICAL POWER SUPPLY TO AN APX-2

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE AN LUG	END TYPE INS. SL. CVC	END TYPE AN LUG	END TYPE INS. SL. CVC	LENGTH IN.
NP2A18	AN18	659-2	860-16-3	659-2	860-16-3	6
NV1A6	AN6		860-6-3	659-30	860-6-3	20
P2A6	AN6	659-30	860-6-3	659-30	860-6-3	30
P12A16	AN16	659-4	860-16-3		860-16-3	40
P12B16	AN16		860-16-3	659-4	860-14-3	20
P12C16	AN16	659-4	860-14-3	659-4	860-14-3	36
P13A6	AN6	659-30	860-6-3	659-30	860-6-3	30
P17A16	AN16	659-4	860-14-3	659-4	860-14-3	36
PP1A18	AN18	659-2	860-16-3	659-2	860-16-3	48
PT2A16	AN16	659-4	860-14-3		860-16-3	90
PT2B16	AN16		860-16-3	659-4	860-14-3	20
PT2C16	AN16	659-4	860-14-3	659-4	860-14-3	35
PV3A6	AN6	659-30	860-6-3	659-10	860-6-3	30
PV3B6	AN6	659-30	860-6-3	659-10	860-6-3	40
PV3C6	AN6	659-30	860-6-3		860-6-3	50
PV3D6	AN6		860-6-3		860-6-3	40
PV4A16	AN16	659-4	860-14-3	659-4	860-14-3	30
VP1A18	AN18		860-18-3	659-2	860-16-3	50
VP1B18	AN18	659-2	860-16-3	659-2	860-16-3	55
VX1A18	AN18		860-18-3	659-2	860-16-3	50
XN1A12	AN12		860-12-3	659-5	860-10-3	50
XN1B12	AN12	659-5	860-10-3	659-5	860-10-3	55
XN1C16	AN16	659-4	860-14-3	CVC-880-22	860-14-3	5
XV1A12	AN12		860-12-3	659-5	860-10-3	50
XV2A12	AN12	659-5	860-10-3	659-5	860-10-3	55
XV2B16	AN16	659-4	860-14-3	CVC-880-22	860-14-3	5

MASTER ELECTRICAL PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFGRS. NAME AND NO.	NOMENCLATURE
35	AN3022-2	Switch
81	NAF 1204-3	Relay
120	AN3161-P5	Circuit Breaker
123	AN3161-P20	Circuit Breaker
147	Type A (GFE)	Condenser Box
148	Type 800-1D (GFE)	Motor Alternator
149	AN3108-22-1S	Plug
150	AN3108-22-5P	Plug
151	AN3100-20-8P	Receptacle
152	AN3106-20-8S	Plug

AN APX-2 WIRE TABLE

(See figures A-22 and A-23)

CABLE ASSEMBLY VS-60134-1

WIRE NO.	LENGTH INCHES
RG-8/U Coaxial Cable	80

CABLE ASSEMBLY VS-60134-2

WIRE NO.	LENGTH INCHES
RG-8/U Coaxial Cable	80

CABLE ASSEMBLY VS-60134-3

WIRE NO.	LENGTH INCHES
S14A-16	36
S15A-16	36

CABLE ASSEMBLY VS-60134-4

WIRE NO.	LENGTH INCHES
S1A-16	24
S3A-20	24
S4A-16	24
S5A-20	24
S6A-20	24
S7B-20	28
S8B-20	28
S9B-20	28
S10B-20	28
S11B-20	28
S12A-16	24
S30A-20	24

WIRE NO.	LENGTH INCHES
S31A-20	24
S32A-20	24
S33A-20	24
S34A-20	24
S35A-20	24
S36A-20	24
S37B-20	24
S38B-20	24
S39B-16	24
S40B-16	24
S41B-20	24

WIRE NC.	LENGTH INCHES
S42B-16	24
S43B-20	24
S44B-20	24
S45B-20	24
S46B-20	24
S47B-20	24
S48B-16	24
S49B-20	24
S50B-16	24
S51B-20	24
S52B-20	24

CABLE ASSEMBLY VS-60134-5

WIRE NO.	LENGTH INCHES
S16-16	36
S17-16	36

WIRE NO.	LENGTH INCHES
S18-16	36
S53-20	36

WIRE NO.	LENGTH INCHES
S54-20	36
S55-18	36

CABLE ASSEMBLY VS-60134-6

WIRE NO.	LENGTH INCHES
S7A-20	40
S8A-20	40
S9A-20	40
S10A-20	40
S11A-20	40
S37A-20	40
S38A-20	40

WIRE NO.	LENGTH INCHES
S39A-16	40
S40A-16	40
S41A-20	40
S42A-16	40
S43A-20	40
S44A-20	40
S45A-20	40

WIRE NO.	LENGTH INCHES
S46A-20	40
S47A-20	40
S48A-16	40
S49A-20	40
S50A-16	40
S51A-20	40
S52A-20	40

AN/APX-2 EQUIPMENT PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFGRS. NAME AND NO.	NOMENCLATURE
1	VS-33536 Chance Vought Walter Kidde No. 80800	Impact Switch
2	AN3106-14S-7P	Plug
3	AN3106-18-8S	Plug
4	AN3106-22-14P	Plug
5	C-56/APX-2 (GFE)	Radar Operator's Control Box
6	AN3106-22-30P	Plug
7	Navy Type 49190 (GFE)	Plug
8	Navy Type 49195 (GFE)	Plug
9	NAF47848-1	Plug
10	RT-24 APX-1 (GFE)	Receiver-Transmitter
11	AN3108-22-14S	Plug
12	AN3106-28-12P	Receptacle
13	AN3106-28-12S	Plug
14	AN3106-16S-1S	Plug
15	C-241 APX (GFE)	"IFF" Control Panel
16	AN3106-22-30S	Plug

A-184. AN/APN-1 RADIO ALTIMETER SYSTEM.

A-185. DESCRIPTION. (*See figure A-3, and figure A-24.*) The radio altimeter system consists essentially of an RT-7/APN-1 transmitter-receiver, two antennas (AT-4/ARN-1) for transmission and receiving, an ID-14B/APN-1 altitude indicator incorporating a power switch and a high and low range switch, and a SA-1/ARN-1 altitude limit switch which operates in conjunction with the altitude indicator and with the altitude limit indicator light. The 28-volt dc power circuit to the radio altimeter system is controlled by a circuit breaker on the circuit breaker panel. With the circuit breaker closed and the battery switch "ON" power to radio altimeter system may be obtained by turning the altitude indicator power switch "on." The primary function of the radio altimeter is to provide direct measurement of "absolute altitude" (terrain clearance) during flight. This is accomplished by measuring electrically the time interval required for a transmitted signal to travel to the earth and return to the aircraft. The altimeter equipment is designed to measure altitude accurately in two ranges; low range-0 to 400 feet, and high range-400 to 4,000 feet. The range control on the altitude indicator must be switched from low range to high range when the aircraft exceeds 400 feet, otherwise, the indicator will not show the correct altitude. The altitude limit switch provides a means for the pilot to select a minimum altitude at which a red warning light will go on and warn him that he has dropped below that altitude. All units in the radio altimeter system are readily accessible through the radio compartment access door and the cockpit. To place the altimeter equipment in operation on the ground see figure A-3 and proceed as follows:

a. Make certain that an external source of 28-volt dc power is available.

b. Check to see that radio altimeter circuit breaker is on.

c. Set the range switch in low range (whenever below 400 feet) by turning counterclockwise.

d. Set the altitude limit switch for the desired "preset altitude" (altitude below which, red light should turn on). The red light can be set to go "on" at any range from 50 to 300 feet when the range control is set in low range.

e. Turn "ON" the power switch located on the altitude indicator. After the equipment warms up and the indicator moves from its sub-zero stop position to some other position, the altitude limit indicator (red light) will go "on" indicating that airplane is below the "preset altitude" setting of the limit switch (airplane on ground will always be below "preset altitude" as minimum setting on limit switch is 50 feet).

A-186. TROUBLE SHOOTING. If at any time the altimeter indications appear inconsistent or fluctuate abnormally, the proper maintenance personnel should be notified. In the event of failure to operate, first check for a burned out fuse. Make certain that all cable connections are tight, and that normal battery voltage is being delivered to the equipment. If the trouble is not thus remedied, substitute a transmitter-receiver unit of the same type and voltage rating (which has been calibrated for the correct residual altitude) to determine whether the trouble is in this unit or in another part of the equipment. For wiring diagram information on the radio altimeter system see figure A-25. For more detailed information on trouble shooting and testing see AN 08-10-265, Handbook of Operating Instructions for Radio Sets AN/APN-1, AN/APN-1A, AN/APN-1B and AN/APN-1X.

WARNING

This equipment employs high voltages which are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised when working with this equipment.

A-187. ID-14B/APN-1 ALTITUDE INDICATOR.

A-188. DESCRIPTION. (*See figure A-3.*) The altitude indicator is mounted on the instrument panel on the left hand side. It consists of a sub-zeroed dc meter calibrated to hundreds of feet, and is equipped with two switches. The power switch (knob marked "ON" with clockwise arrow) controls the entire battery input supply to the altimeter. The range switch (knob marked RANGE) controls the input to a range relay in the radio altimeter transmitter-receiver. When this switch is in low range (counterclockwise) position, the face of the indicator reads from zero to four hundred feet. In the high range (clockwise) position the indicator reads from zero to four thousand feet. The scale numerals 0-1-2-3-4 for low range are changed to 0-10-20-30-40 for high range by means of a shutter operated from the shaft of the range switch. When on the ground always set the range switch in low range (counterclockwise) before turning on the radio altimeter system.

CAUTION

When the airplane is on the ground, the altitude indicator pointer may not indicate zero altitude exactly. NEVER ATTEMPT TO ADJUST THE EQUIPMENT TO OBTAIN A ZERO READING FOR THIS CONDITION.

For additional information on the ID-14B-APN-1 altitude indicator see AN 08-10-265, Handbook of Operating Instructions for Aircraft Radio Altimeter Equipment.

A-189. REMOVING. To remove the altitude indicator, observe the instrument removal procedure given in paragraph 4-1276.

A-190. INSTALLING. To install the altitude indicator, reverse the removal procedure in paragraph 4-1276.

A-191. SA-1/ARN-1 ALTITUDE LIMIT SWITCH AND ALTITUDE LIMIT INDICATOR LIGHT.

A-192. DESCRIPTION. (*See figure A-3.*) The altitude limit switch (SA-1/ARN-1) is located on the right hand side of the instrument panel. This unit contains a rotary switch and resistor assembly which functions as a voltage divider. The setting of the switch determines at what altitude the altitude limit indicator (red light in radar scope) will turn "on." In the F4U-5N airplane, this light is used as a signal to warn the pilot when he has fallen to a minimum altitude below which he does not care to descend. The pilot may select the minimum altitude point for the light to turn on by setting the altitude limit switch at the altitude step desired. The altitude steps range from 50 to 300 in steps of 25. When the altitude indicator is set in low range (0 to 400 feet) the altitude steps on the limit switch are designated as 50 feet to 300 feet. When the indicator is set in high range the altitude steps on the limit switch are to be multiplied by ten and, therefore, will be designated as 500 feet to 3,000 feet. The switch is easily turned by a large bar knob which is provided with a pointer to indicate the altitude setting. The altitude limit indicator light is screwed into the bezel of the radar scope which projects out from the instrument panel cover. It is a three-volt light and is provided with a resistor to step down the 28-dc voltage to three volts. The resistor is located just aft of bulkhead 186 and is secured to the underside of the lower radio shelf on the left hand side. The two other indicator lights on the radar scope head are not connected into the electrical circuit at present. For wiring diagram information see figure A-25.

A-193. REMOVING. To remove the altitude limit switch, altitude limit indicator light and resistor, make certain battery switch is off and proceed as follows:

a. Remove the altitude limit switch by observing the instrument removal procedure as described in paragraph 4-1276.

b. Remove the altitude limit indicator light by unscrewing the light from the radar scope bezel in the cockpit.

c. Remove the resistor by working through the radio compartment access door and reaching forward to bulkhead 186. Disconnect the two electric leads to the resistor. Remove the resistor from its bracket by taking out the long bolt and nut which secures the resistor to the bracket.

A-194. INSTALLING. To install altitude limit switch, indicator light or resistor, reverse the removal procedures above.

A-195. RT-7/APN-1 TRANSMITTER-RECEIVER.

A-196. DESCRIPTION. (*See figure A-24.*) The radio altimeter transmitter-receiver (RT-7/APN-1) is located at approximately station 230, on a support secured to the floor of the airplane just aft of the radio compartment access door. This unit is mounted on a MT-14/ARN-1 shock mount. Power is supplied by the 28-volt dc circuit when the power switch on the altitude indicator is "ON." The power circuit supplies current to the heater circuits, dynamotor and relay contacts inside the transmitter-receiver. The transmitter-receiver unit is designed to generate and then transmit a frequency modulated signal to the transmitting antenna. The transmitted signal is radiated to a reflecting surface, i. e., the earth, and the reflected signal is received on the receiving antenna from which it is fed into the balanced detector located in the transmitter-receiver. Additional elements in the transmitter-receiver essentially measure electrically the time interval required for the transmitted signal to travel to the earth and return to the airplane. An indicator counter produces a dc voltage approximately proportional to the frequency of the signal. This current is applied to the grid of the indicator amplifier and then goes to the altitude indicator which is a dc meter directly calibrated in hundreds of feet. Protection against damage of equipment from short circuits is provided by a special fuse located at the lower left hand corner of the front panel of the transmitter-receiver. A spare fuse is also provided.

CAUTION

When necessary to replace fuse use only the following: "LITTLEFUSE" #1443 (3-ampere special); "BUSSMAN" #MDM-3 (3-ampere slow burning); or "LITTLEFUSE" #1094 (5-ampere).

All adjustment points on the transmitter-receiver are covered to prevent tampering by unqualified personnel. Adjustments must be made by qualified radio maintenance personnel. For additional information on the RT-7/APN-1 transmitter-receiver, see AN 08-10-265, Handbook of Operating Instructions for Aircraft Radio Altimeter Equipments.

A-197. REMOVING. To remove the transmitter-receiver, make certain that battery switch is "OFF" and proceed as follows:

a. Detach the six electric leads to the transmitter-receiver.

b. Break safety-wire on each of the four snap slide fasteners on the transmitter-receiver and slide fasteners away from the mounting pins. Transmitter-receiver may now be removed from the airplane.

c. To remove shock mount assembly remove eight screws and nuts which secure it to support shelf.

A-198. MAINTENANCE. Since maintenance of this unit is limited to repairs which can be done when equipment is installed, routine servicing consists only of electrical and ground cable inspection, blown fuse replacement, installation inspection, and the replacement of broken or damaged units. Refer to Handbook AN08-10-265 for additional information.

CAUTION

The radio transmitter-receiver is adjusted for correct calibration by authorized personnel only. The "residual altitude" for which the transmitter-receiver has been compensated is recorded for future reference in the card holder provided on the instrument panel. When replacing a transmitter-receiver the new unit must must be identically adjusted by authorized personnel.

A-199. INSTALLING. To install the transmitter-receiver, reverse the removal procedure.

A-200. AT-4 ARN-1 RADIO ALTIMETER ANTENNAS.

A-201. DESCRIPTION. (*See figure A-24.*) The radio altimeter system employs two identical antennas (AT-4/ARN-1), one for transmission, the other for receiving. The transmitting attenna is located just aft of the lower cockpit access door. The receiving antenna is located at approximately station 265. Both units project from the underside of the airplane. The electric receptacle of the receiving antenna is accessible by entering through the radio compartment access door and crawling to the rear of the airplane. The receptacle for the transmitting antenna is accessible by reaching aft from the lower cockpit access opening. The antenna is a 440-megacycle half-wave dipole. Its horizontal radiating member is in two cylindrical sections tapered at the outer ends and separated by an insulator at the center. A bolt at each end screws into an insulating rod which holds the two sections together. Two quarter-wave length stream-lined vertical members connect the radiating members rigidly to the mounting plate. The function of the antennas is to direct a frequency modulated signal from the transmitter-receiver to the earth and to pick up this same signal reflected by the earth's surface and return it to the transmitter-receiver.

A-202. REMOVING. To remove either one of the antennas, make certain that the battery switch is "OFF" and proceed as follows:

a. Disconnect the electrical lead to the antenna.

b. Remove the four bolts and nuts which secure the antenna mounting plate to the airplane.

A-203. INSTALLING. To install an antenna, reverse the removal procedure.

A-204. GROUND OPERATIONAL CHECK. Engine must be running above generator cut-out speed or a 28-volt dc external power source must be used. Turn the battery switch and the radio altimeter circuit breaker "ON" and proceed as follows:

a. Set altitude limit switch for any desired altitude.

b. Set the range switch for low range (turn counter-clockwise).

c. Turn indicator power switch "ON". Red warning light will go "on" after equipment warms up. Indicator should deflect.

d. Change to high range (turn clockwise). Indicator deflection should be different than for low range.

Note

Deflections do not indicate accuracy of the radio altimeter. On the ground the indicator will not read zero.

Calibration of the radio altimeter and further ground checks must be made by qualified personnel. For additional information refer to AN 08-10-265, Handbook of Operating Instructions for Aircraft Radio Altimeter Equipments.

1. RT-7/APN-1 Transmitter-Receiver
2. Radar Power Junction Box
3. Indicator Light Resistor
4. 1D-14B/APN-1 Altitude Indicator
5. Altitude Indicator Light on Search Radar Indicator
6. AT-4 ARN-1 Receiving Antenna
7. Disconnect at Sta. 186
8. AT-4 ARN-1 Transmitting Antenna
9. Radio Altimeter Circuit Breaker
10. SA-1/ARN-1 Altitude Limit Switch

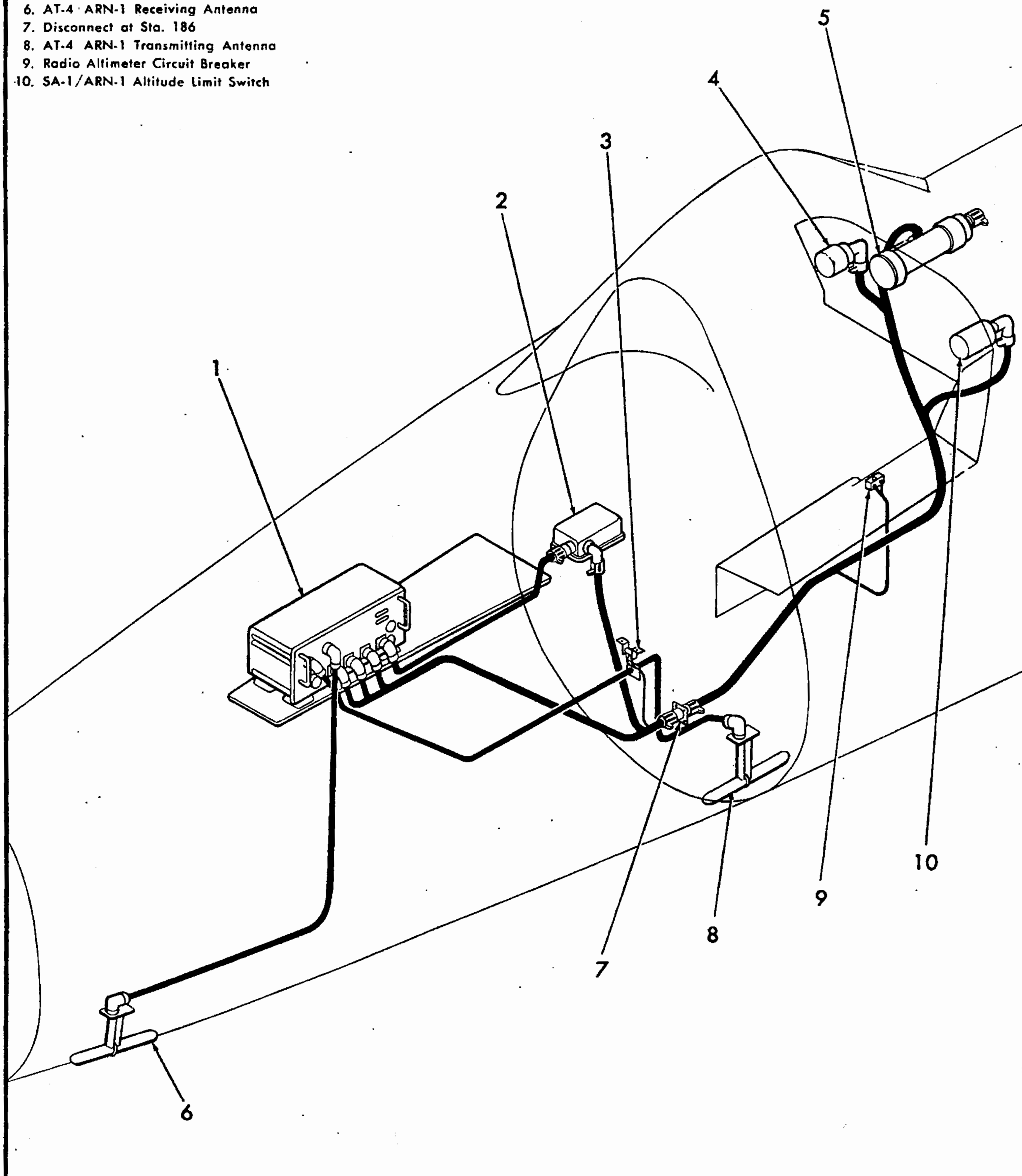


Figure A—24. AN APN-1 Radio Altimeter Reference Diagram.

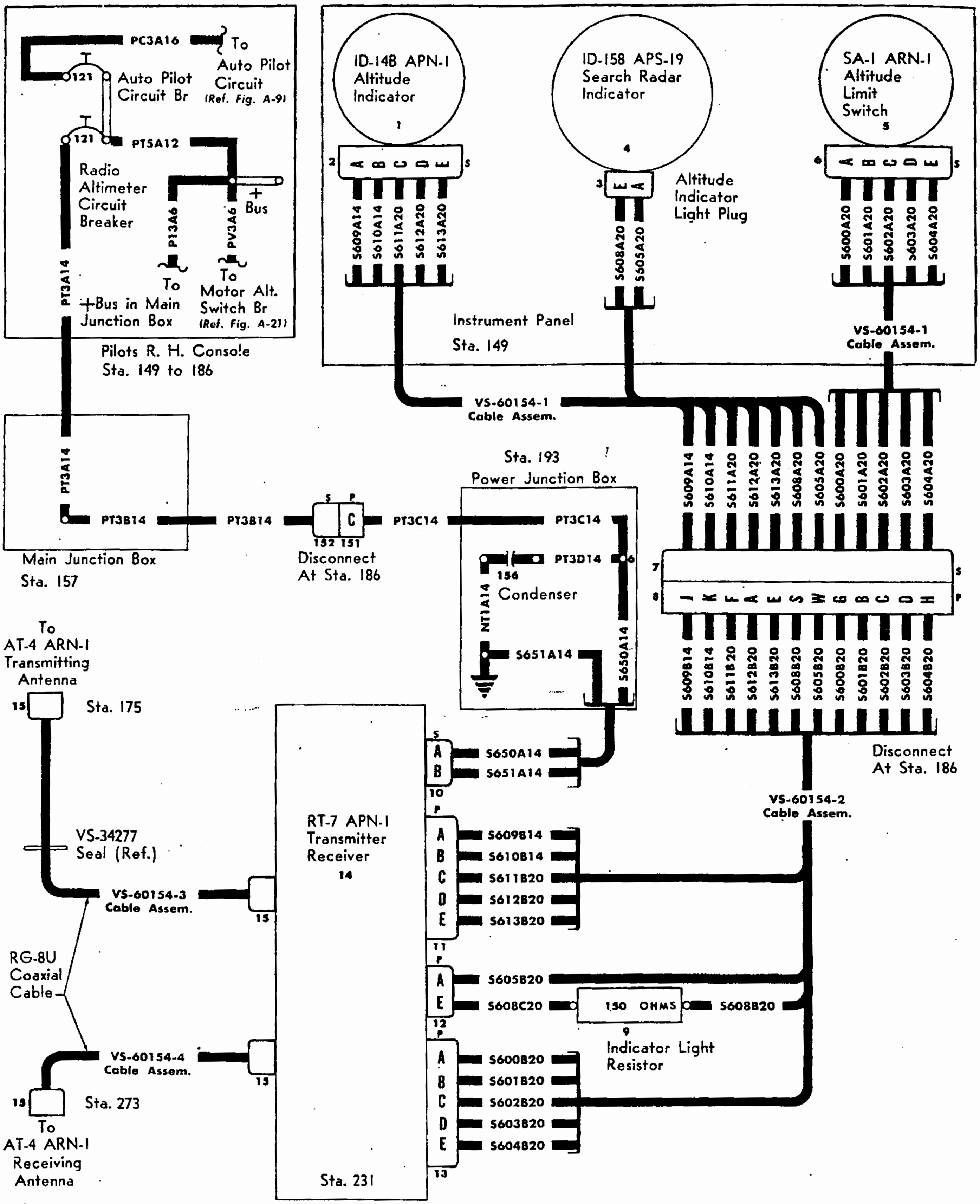


Figure A—25. AN APN-1 Radio Altimeter Cabling Diagram.

ELECTRICAL POWER SUPPLY TO AN APN-1

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE		END TYPE		LENGTH IN.
		AN LUG	INS. SL. CVC	AN LUG	INS. SL. CVC	
NT1A14	AN14	659-4	860-14-3	659-4	860-14-3	5
P15A12	AN12	659-5	860-10-3	659-5	860-10-3	24
PT3A14	AN14	659-4	860-14-3	659-4	860-14-3	40
PT3B14	AN14	659-4	860-14-3		860-14-3	50
PT3C14	AN14		860-14-3	659-4	860-14-3	20
PT3D14	AN14	659-4	860-14-3			5

MASTER ELECTRICAL PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFGRS. NAME AND NO.	NOMENCLATURE
121	AN3161-P10	Circuit Breaker
151	AN3100-22-12P	Receptacle
152	AN3106-22-12S	Plug
156	VS-51122 P. R. Mallory and Co. Their No. CA-275X	Condenser

AN/APN-1 WIRE TABLE *(See figures A-24 and A-25)*

CABLE ASSEMBLY VS-60154-1

WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES
S600A-20	68	S604A-20	68	S610A-14	68
S601A-20	68	S605A-20	68	S611A-20	68
S602A-20	68	S608A-20	68	S612A-20	68
S603A-20	68	S609A-14	68	S613A-20	68

CABLE ASSEMBLY VS-60154-2

WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES	WIRE NO.	LENGTH INCHES
S600B-20	64	S605B-20	64	S610B-14	64
S601B-20	64	S608B-20	12	S611B-20	64
S602B-20	64	S608C-20	52	S612B-20	64
S603B-20	64	S609B-14	64	S613B-20	64
S604B-20	64				

CABLE ASSEMBLY VS-60154-3

WIRE NO.	LENGTH INCHES
RG-8/U Coaxial Cable	90

CABLE ASSEMBLY VS-60154-4

WIRE NO.	LENGTH INCHES
RG-8/U Coaxial Cable	48

CABLE ASSEMBLY VS-60154-5

WIRE NO.	LENGTH INCHES
S650A-14	36
S651A-14	36

AN/APN-1 EQUIPMENT PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFGRS. NAME AND NO.	NOMENCLATURE
1	ID-14B/APN-1 (GFE)	Altitude Indicator
2	AN3108-18-30S or AN3108-18-20S (Pos. "5")	Plug
3	Sperry Manufactured (Furnished with Indicator)	Plug
4	ID-158 APS-19	Radar Indicator
5	SA-1/ARN-1 (GFE)	Altitude Limit Switch
6	AN3106-18-20S	Plug
7	AN3106-28-11S	Plug
8	AN3100-28-11P	Receptacle
9	VS-61047 Chance Vought Ward Leonard Electric Co. Type "O"	Resistor Assembly Resistor
10	AN3108-18-5S	Plug
11	AN3108-18-30P or AN3108-18-20P (Pos. "5")	Plug
12	AN3108-18-20P	Plug
13	AN3108-18-31P	Plug
14	RT-7 APN-1 (GFE)	Transmitter-Receiver
15	Navy Type 49190 (GFE) or Navy type 49195 (GFE)	Plug

A-205. AN/ARC-28 VHF RADIO COMMUNICATION.

A-206. DESCRIPTION. *(See figures A-2 and A-26.)* The AN/ARC-28 communication equipment enables the airplane to serve as a relay point for extending the range of two-way VHF radio communication with modulated signals, as, for example, between a ground station or ship and a second aircraft in flight. By this method the equipment is capable of extending consistent VHF communication beyond the ordinary horizon limitation. The AN/ARC-28 equipment is made up of two RT-18/ARC-1 transmitter-receivers, an RE-51/ARC-28 relay unit, a C-390/ARC-28 control unit, two C-115/ARC-1 control units, and two AN-104BX antennas. The F4U-5 airplane communication system uses a single RT-18/ARC-1 transmitter-receiver, a single C-115/ARC-1 control unit, and an AN-104BX antenna. General access to the communication equipment may be gained through the radio compartment access door and the cockpit. Power for the communication equipment is supplied when the battery switch (28-volt dc external power when on the ground) and MASTER panel master radio switch are "ON." Reception volume on all channels is controlled by the COMM VOLUME control also located on the MASTER panel. Transmission on all channels is controlled by the microphone switch on the throttle. The headphone and microphone extension is plugged into the radio jack plug located on the bulkhead aft of the pilot's right shoulder. The three control units for the communication system are located on the right hand control panel and may be identified by the decals RELAY, VHF NO. 1, and VHF NO. 2. The RELAY panel permits automatic relay operation of the transmitter-receivers together, or selection of either transmitter-receiver for local operation. The VHF NO. 1 and VHF NO. 2 control units permit channel selection for the transmitter-receivers. For information on related communication equipment in the F4U-5 airplane see paragraph 5-142 through paragraph 5-158. For wiring diagram information see figure A-27.

WARNING

THE PLATE VOLTAGE USED IN THIS EQUIPMENT IS DANGEROUS TO LIFE. EXTREME CAUTION SHOULD BE TAKEN WHENEVER ANY WORK IS BEING DONE ON THIS EQUIPMENT. MAKE CERTAIN THAT ALL POWER (INCLUDING EXTERNAL POWER) IS "OFF"

A-207. AN/ARC-28 RADIO CONTROL PANELS AND RELATED SWITCHES.

A-208. DESCRIPTION. *(See figure A-2.)* The AN/ARC-28 equipment includes three pilot control units on the right hand control panel, two of which are identical. The battery switch (or 28-volt dc external power) and the master radio switch on the panel designated MASTER must be "ON" before operation of the AN/ARC-28 control units is effective. It is also necessary to have the ARC-28 RELAY, VHF NO. 1, and VHF NO. 2 circuit breakers "on". These three circuit breakers are located on the circuit breaker panel. Reception volume on all channels is controlled by the COMM VOLUME control also located on the MASTER panel. Transmission on all channels is controlled by the microphone switch on the throttle. The C-390/ARC-28 control unit is identified by the decal RELAY and incorporates a single switch having the following positions: "OFF", "VHF 1," "VHF 2," "RELAY". When this switch is on "OFF," all power to the two transmitter-receivers and the relay unit is removed. In "VHF 1" position, power is applied to No. 1 transmitter-receiver, and in "VHF 2" position power is applied to No. 2 transmitter-receiver. When rotated to the fourth position, "RELAY," both transmitter-receivers have power applied as well as the relay unit, permitting automatic relay operation of the communication system. The two C-115/ARC-1 control units may be identified by the decals VHF NO. 1 and VHF NO. 2. These control units provide individual operation of either the No. 1 or No. 2 transmitter-receivers depending on whether the C-390/ARC-28 control unit switch is in "VHF 1"or "VHF 2" position. One only of the same type control unit is used in the F4U-5 airplane. Each control unit provides a CHAN SEL switch for selecting one of nine main channels, a GUARD-MAIN switch which provides a choice of operation on the selected main channel or the guard channel, or operation on the selected main channel and monitoring on the guard channel. The GUARD-MAIN switch positions are "GUARD," "BOTH," and MAIN T/R". Windows are provided to show the guard and main channel operating conditions. The guard channel window shows "OFF," "R," or "T/R," indicating that the guard channel is turned off, is set for reception only, or is set for transmission and reception. The main channel window shows the number (1 to 9) of the selected main channel when the main channel is in an operating condition, or "OFF" when the equipment is set for operation on the guard channel only. For wiring diagram information see figure A-27.

A-209. AUTOMATIC RELAY OPERATION. For automatic relay operation of the communication equipment, see figure A-2 and proceed as follows:

CAUTION

Each time the equipment is turned on, allow at least 30 seconds for the vacuum tubes to reach operating temperature before using the equipment for relay operation or before operating the throttle switch if local control is desired.

a. Attach an external source of 28-volt dc power. Make certain that the ARC-28 RELAY, VHF NO. 1, and VHF NO. 2 circuit breakers are "on."

b. Turn "ON" master radio switch.

c. Rotate the RELAY control unit knob to the "RELAY" position.

d. Rotate the channel selector switches on the VHF NO. 1 and VHF NO. 2 control units to the two frequency channel designated for relay operation. The equipment will be ready for automatic relay operation as soon as the vacuum tubes reach operating temperature.

e. To change the frequency combination of the system, simply rotate the channel selector switches to the positions designated.

f. Monitoring will give an indication to the operator that the equipment is operating properly.

A-210. LOCAL TRANSMITTER-RECEIVER OPERATION. To operate either the VHF NO. 1 or VHF NO. 2 transmitter-receiver individually, see figure A-2 and proceed as follows:

a. Attach an external source of 28-volt dc power. Make certain that the ARC-28 RELAY, VHF NO. 1, and VHF NO. 2 circuit breaker are "on."

b. Turn "ON" the master radio switch on the MASTER panel.

c. Rotate the RELAY control unit knob to "VHF 1" or "VHF 2" position, depending on which transmitter-receiver is to be used.

CAUTION

Whenever switching from "OFF" to "VHF 1" or "VHF 2," or from "VHF 1" to VHF 2" ("VHF 2" to "VHF 1"), or "VHF 1" or "VHF 2" to "RELAY," allow 30 seconds for transmitter-receiver warm-up before operation.

d. Set "GUARD-BOTH-MAIN T/R" switch and CHAN SEL switch on either VHF NO. 1 or VHF NO. 2 panel (depending on whether RELAY control unit switch is set at "VHF 1" or "VHF 2") as required for guard or main channel operation.

e. For transmission depress microphone button on throttle handle. To adjust reception volume turn COMM VOLUME knob on MASTER panel.

A-211. RT-18/ARC-1 TRANSMITTER-RECEIVERS.

A-212. DESCRIPTION. (*See figure A-26.*) Two identical transmitter-receivers are used in the AN/ARC-28 communication system. The VHF No. 1 transmitter-receiver is mounted on the upper radio shelf, while the VHF No. 2 unit is mounted directly beneath on the center radio shelf on the left hand side. Both units are accessible through the radio compartment access door. The F4U-5 airplane employs a single transmitter-receiver of the same type. The two transmitter-receivers in the F4U-5N may be operated individually (when the RELAY control unit switch is in "VHF 1" or "VHF 2" position) for local control or together (when the RELAY control unit switch is in "RELAY") for automatic relay operation. The two transmitter-receivers operating together in automatic relay operation enable the airplane to serve as a relay point for extending the range of two-way VHF radio communication with modulated signals, as, for example between a ground station or ship and a second airplane in flight. For a description of the transmitter-receiver see paragraph 5-146. For wiring diagram information see figure A-27.

A-213. REMOVING. To remove a transmitter-receiver, make certain all electrical power is "off" and proceed as follows:

a. Disconnect antenna lead which connects to receptacle on aft end of transmitter-receiver.

b. Break safety-wire and unscrew two wing nuts until they are free of mounting projections on aft end of transmitter-receiver.

c. Pull unit aft until its self-aligning quick-disconnect cannon plug disengages from rack receptacle.

d. Lift unit off of mounting rack.

A-214. MAINTENANCE. Since maintenance of this unit is limited to repairs which can be done when equipment is installed, routine servicing consists of electrical and ground cable inspection, installation, inspection, and replacement of damaged or broken units. For adjustments and further maintenance procedures, refer to AN16-30ARC28-3, Handbook of Maintenance Instructions for Model AN/ARC-28 Aircraft Radio Equipment.

A-215. INSTALLING. To install a transmitter-receiver, reverse the removal procedure.

A-216. RE-51/ARC-28 RELAY UNIT.

A-217. DESCRIPTION. (*See figure A-26.*) The relay unit is located on the upper radio shelf and is used to interconnect the two transmitter-receivers for automatic relay operation. It is operated when the RELAY control unit switch is placed in the "RELAY" position. This unit contains two tubes, six relays and other components required for automatic switching. It is shock mounted on an MT-335/ARC-18 mounting plate. For wiring diagram information see figure A-27.

A-218. REMOVING. To remove the relay unit, make certain all electrical power is "off" and proceed as follows:

a. Remove four electric leads to unit.

b. Break safety-wire and unfasten the snap slide fasteners from mounting studs.

c. Lift unit from mounting base.

A-219. MAINTENANCE. Since maintenance of this unit is limited to repairs which can be done when equipment is installed, routine servicing consists only of electrical and ground cable inspection, installation inspection, and replacement of damaged or broken units. For adjustments and further maintenance procedures, refer to AN16-30ARC28-3, Handbook of Maintenance Instructions for Model AN/ARC-28 Aircraft Radio Equipment.

A-220. INSTALLING. To install the relay units, reverse the removal procedure.

A-221. AN-104BX ANTENNAS.

A-222. DESCRIPTION. (*See figure A-26.*) The AN/ARC-28 radio equipment includes two identical antennas (AN-104BX), one mounted on the top of the fuselage at station 218, the other mounted on the tail cone at station 362. The antenna at station 218 serves the VHF No. 1 transmitter-receiver for both receiving and transmission and is accessible through radio access door. The antenna at station 362 serves the VHF No. 2 transmitter-receiver for receiving and transmission and is accessible through the tail wheel well. Each is a quarter wave, base-fed type antenna. For wiring diagram information see figure A-27.

A-223. REMOVING. To remove an antenna, proceed as follows:

a. Disconnect electrical lead at base of antenna.

b. Separate antenna wire leading from vertical fin to top of antenna mast at 60 pound break-away link (on forward antenna only).

c. Remove two mounting brackets which secure antenna to mounting plate inside of airplane. Each bracket is secured by two bolts.

d. Disconnect four bondings by removing nut and bolt which secures each one.

e. Remove eight screws and nuts which secure antenna retaining plate (with grommet) to skin of airplane.

f. Pull antenna mast out from fuselage.

A-224. INSTALLING. To install an antenna, reverse the removal procedure.

A-225. GROUND OPERATIONAL CHECK. A 28-volt dc external power source must be available or the airplane's engine must be running above generator cut-out speed. Turn the ARC-28 RELAY, VHF NO. 1, and VHF NO. 2 circuit breakers, the battery switch and the master radio switch "ON." Proceed as follows:

a. Rotate the RELAY control unit knob to "VHF 1" and check transmitting and receiving with ship or ground station or another airplane.

CAUTION

Each time the equipment is turned on allow at least 30 seconds for warm-up of vacuum tubes before using the equipment. When change of RELAY control is made allow 30 seconds before operation.

b. Switch to "VHF 2" and check transmitting and receiving.

c. Rotate RELAY control unit knob to "RELAY" and rotate channel selector switches on VHF NO. 1 and VHF NO. 2 control units to the two frequency channels designated for relay operation, giving the desired frequency combination.

d. Monitoring will indicate proper operation of equipment.

Further checks must be made by qualified personnel only. For additional information refer to AN16-30ARC28-3, Handbook of Maintenance Instructions for Model AN/ARC-28 Aircraft Radio Equipment.

MASTER ELECTRICAL PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFGRS. NAME AND NO.	NOMENCLATURE
120	AN3161-P5	Circuit Breaker
121	AN3161-P10	Circuit Breaker
123	AN3161-P20	Circuit Breaker

AN/ARC-28 EQUIPMENT PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFGRS NAME AND NO.	NOMENCLATURE
1	C-115/ARC (GFE)	Control Unit
2	C-390/ARC-28 (GFE)	Control Unit
3	C-127/ARC (GFE)	Control Unit
4	NAF1124-17	Throttle Switch
5	AN3106-20-1S	Plug
6	AN3106-20-16S	Plug
7	AN3106-20-1P	Plug
8	AN3106-20-14S	Plug
9	AN3106-28-12S (Pos. "W")	Plug
10	AN3100-28-12P (Pos. "W")	Receptacle
11	AN3106-28-12S	Plug
12	AN3100-28-12P	Receptacle
13	J-193/AR (GFE)	Junction Box
14	AN3106-20-27P	Plug
15	AN3100-20-27S	Receptacle
16	AN3100-20-16P	Plug
17	Navy Type 49190 (GFE) or Navy Type 49195 (GFE)	Plug
18	RT-18/ARC-1 (GFE)	Receiver-Transmitter
19	AN3106-20-16S (Pos. "4")	Plug
20	RE-51/ARC-28 (GFE)	Relay Unit

WIRES FROM THROTTLE SWITCH TO TERMINAL STRIP

WIRE NO.	LENGTH INCHES
RV16D20	30
RV28C20	30
RV29A20N	30

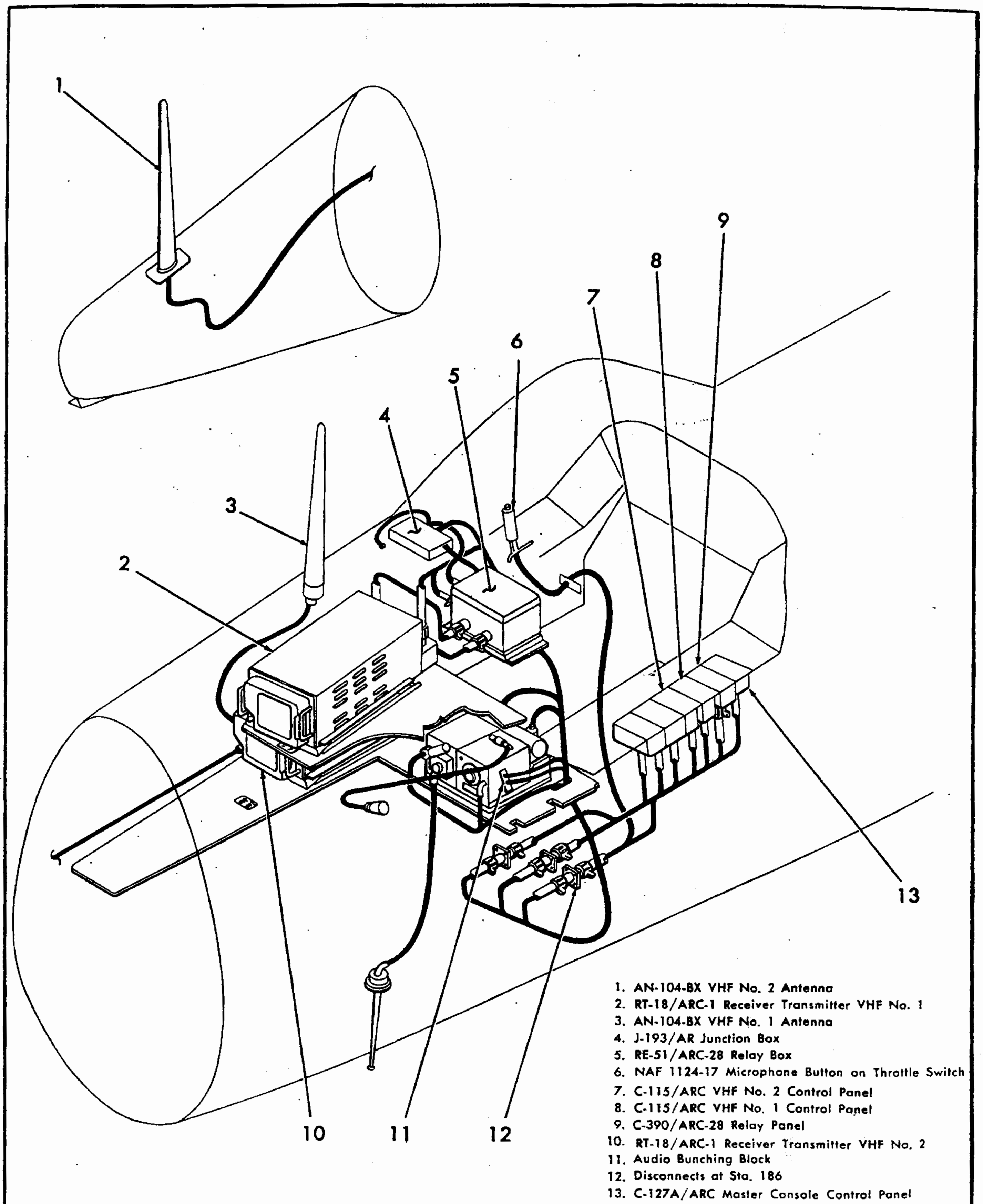


Figure A–26. AN/ARC-28 VHF Radio Reference Diagram.

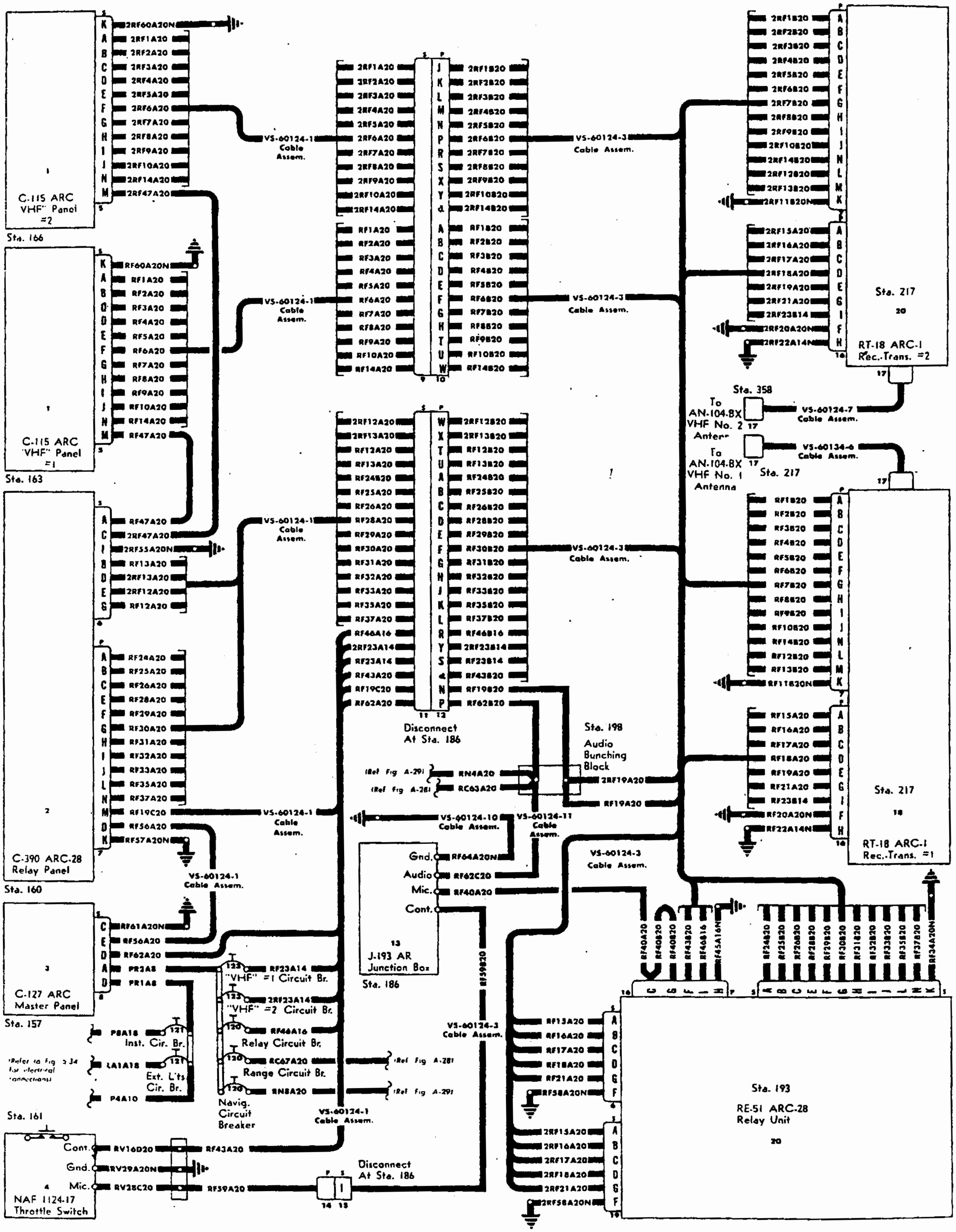


Figure A—27. AN ARC-28 VHF Radio Cabling Diagram.

AN/ARC-28 WIRE TABLE (See figures A-26 and A-27)

CABLE ASSEMBLY VS-60124-1

WIRE NO.	LENGTH INCHES
PR1A8	18
PR2A8	18
RF1A20	64
RF2A20	64
RF3A20	64
RF4A20	64
RF5A20	64
RF6A20	64
RF7A20	64
RF8A20	64
RF9A20	64
RF10A20	64
RF12A20	56
RF13A20	56
RF14A20	64
RF19C20	58
RF23A14	84
RF24A20	58

WIRE NO.	LENGTH INCHES
RF25A20	58
RF26A20	58
RF28A20	58
RF29A20	58
RF30A20	58
RF31A20	58
RF32A20	58
RF33A20	58
RF35A20	58
RF37A20	58
RF43A20	98
RF46A16	64
RF47A20	15
RF55A20N	18
RF56A20	15
RF57A20N	48
RF60A20N	24
RF61A20N	18

WIRE NO.	LENGTH INCHES
RF62A20	58
2RF1A20	64
2RF2A20	64
2RF3A20	64
2RF4A20	64
2RF5A20	64
2RF6A20	64
2RF7A20	64
2RF8A20	64
2RF9A20	64
2RF10A20	64
2RF12A20	56
2RF13A20	56
2RF14A20	64
2RF23A14	84
2RF47A20	16
2RF60A20N	24

CABLE ASSEMBLY VS-60124-2

WIRE NO.	LENGTH INCHES
RF59A20	98

CABLE ASSEMBLY VS-60124-6

WIRE NO.	LENGTH INCHES
RG-8/U Coaxial Cable	20

CABLE ASSEMBLY VS-60124-3

WIRE NO.	LENGTH INCHES
RF1B20	97
RF2B20	97
RF3B20	97
RF4B20	97
RF5B20	97
RF6B20	97
RF7B20	97
RF8B20	97
RF9B20	97
RF10B20	97
RF11B20N	44
RF12B20	86
RF13B20	86
RF14B20	97
RF15A20	14
RF16A20	14
RF17A20	14
RF18A20	14
RF19A20	70
RF19B20	50
RF20A20N	38
RF21A20	14
RF22A14N	37

WIRE NO.	LENGTH INCHES
RF23B14	38
RF24B20	78
RF25B20	78
RF26B20	78
RF28B20	78
RF29B20	78
RF30B20	78
RF31B20	78
RF32B20	78
RF33B20	78
RF34A20N	38
RF35B20	78
RF37B20	78
RF40A20	60
RF40B20	12
RF43B20	78
RF45A16N	36
RF46B16	78
RF58A20N	43
RF59B20	52
RF62B20	49
2RF1B20	74
2RF2B20	74

WIRE NO.	LENGTH INCHES
2RF3B20	74
2RF4B20	74
2RF5B20	74
2RF6B20	74
2RF7B20	74
2RF8B20	74
2RF9B20	74
2RF10B20	74
2RF11B20N	21
2RF12B20	63
2RF13B20	63
2RF14B20	74
2RF15A20	35
2RF16A20	35
2RF17A20	35
2RF18A20	35
2RF19A20	60
2RF20A20N	28
2RF21A20	35
2RF22A14N	26
2RF23B14	70
2RF58A20N	18

CABLE ASSEMBLY VS-60124-7

WIRE NO.	LENGTH INCHES
RG-8/U Coaxial Cable	175

CABLE ASSEMBLY VS-60124-10

WIRE NO.	LENGTH INCHES
RF64A20N	30

CABLE ASSEMBLY VS-60124-11

WIRE NO.	LENGTH INCHES
RF62C20	30

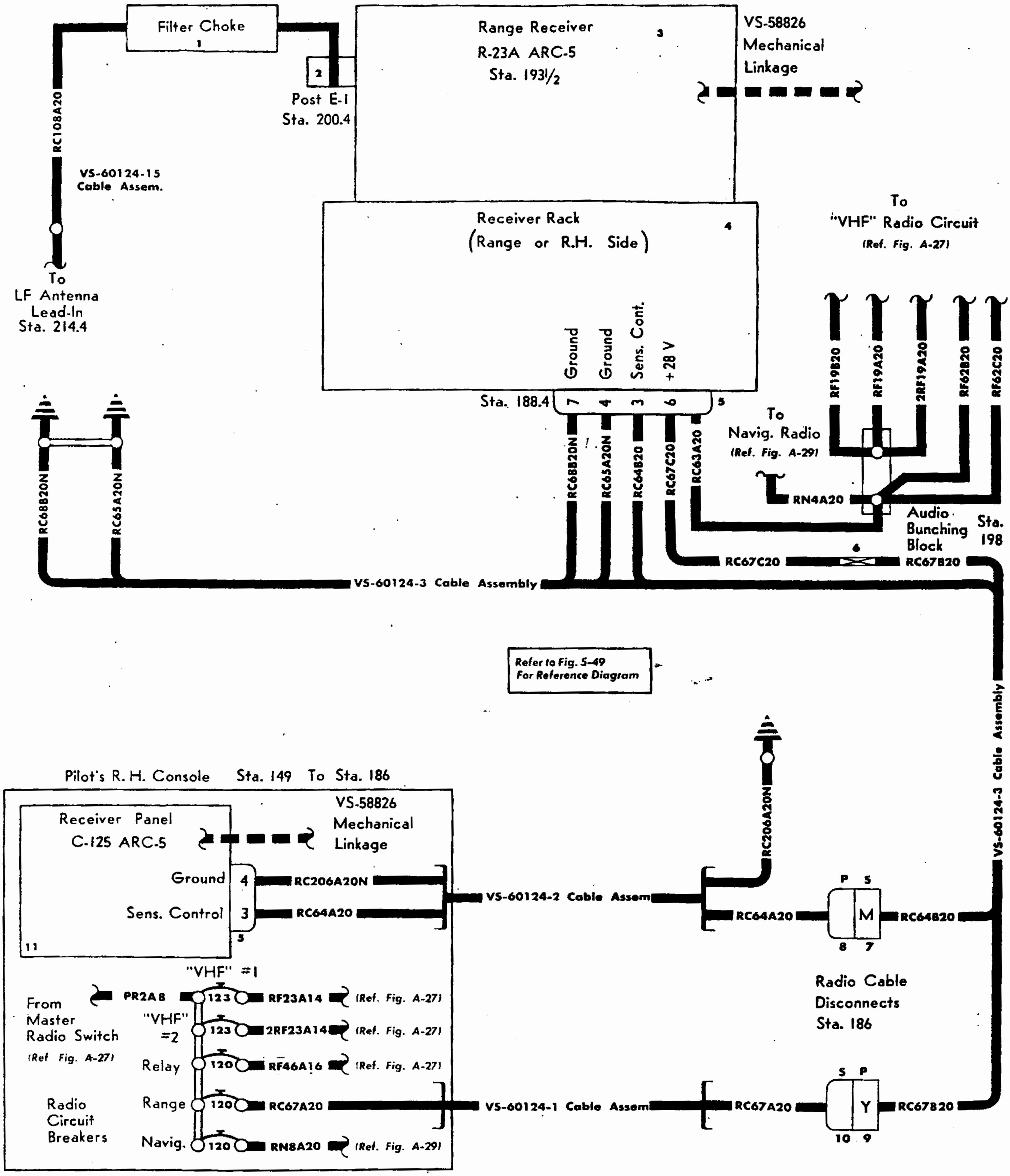


Figure A–28. R-23A/ARC-5 Receiver Cabling Diagram.

AN/ARC-5 WIRE TABLE *(See figures A-28 and 5-49)*

CABLE ASSEMBLY VS-60124-1

WIRE NO.	LENGTH INCHES
RC67A20	84

CABLE ASSEMBLY VS-60124-2

WIRE NO.	LENGTH INCHES
RC64A20	72
RC206A20N	18

CABLE ASSEMBLY VS-60124-3

WIRE NO.	LENGTH INCHES
RC63A20	45
RC64B20	36
RC65A20N	33
RC67B20	22
RC67C20	24
RC68B20N	33

CABLE ASSEMBLY VS-60124-15

WIRE NO.	LENGTH INCHES
RC108A20	24

AN/ARC-5 EQUIPMENT PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFGRS. NAME AND NO.	NOMENCLATURE
1	VS-45384	Filter Choke
2	ARC-4667 (GFE)	Post
3	R-23A/ARC-5 (GFE)	Range Receiver
4	MT-63/ARC (GFE)	Receiver Rack
5	ARC-9125 (GFE)	Plug
6	AN753-B1 (GFE)	Coupler
7	AN3100-20-27S	Receptacle
8	AN3106-20-27P	Plug
9	AN3100-28-12P (Pos. "W")	Receptacle
10	AN3106-28-12S (Pos. "W")	Plug
11	C-125/ARC-5 (GFE)	Console Control Panel

MASTER ELECTRICAL PARTS LIST

120	AN3161-P5	Circuit Breaker
123	AN3161-P20	Circuit Breaker

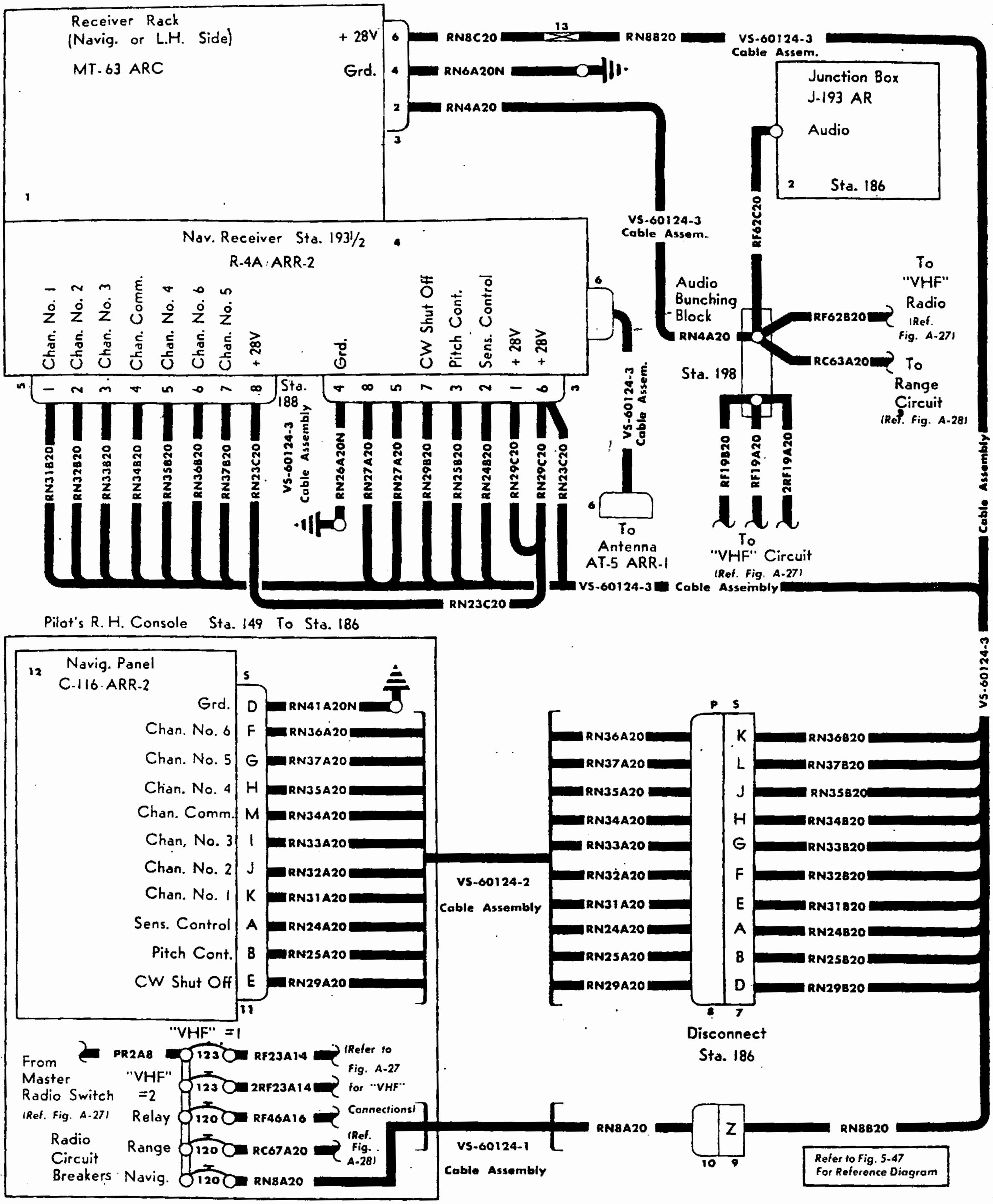


Figure A—29. R-4A ARR-2A Receiver Cabling Diagram.

AN/ARR-2A WIRE TABLE *(See figures A-29 and 5-47)*

CABLE ASSEMBLY VS-60124-1

WIRE NO.	LENGTH INCHES
RN8A20	84

CABLE ASSEMBLY VS-60124-2

WIRE NO.	LENGTH INCHES
RN24A20	68
RN25A20	68
RN29A20	68
RN31A20	68

WIRE NO.	LENGTH INCHES
RN32A20	68
RN33A20	68
RN34A20	68
RN35A20	68

WIRE NO.	LENGTH INCHES
RN36A20	68
RN37A20	68
RN41A20N	18

CABLE ASSEMBLY VS-60124-3

WIRE NO.	LENGTH INCHES
RN4A20	34
RN6A20	29
RN8B20	22
RN8C20	21
RN23C20	12
RN24B20	42

WIRE NO.	LENGTH INCHES
RN25B20	42
RN26B20N	18
RN29B20	42
RN31B20	42
RN32B20	42

WIRE NO.	LENGTH INCHES
RN33B20	42
RN34B20	42
RN35B20	42
RN36B20	42
RN37B20	42

CABLE ASSEMBLY VS-60124-5

WIRE NO.	LENGTH INCHES
RG-8/U Coaxial Cable	60

CABLE ASSEMBLY VS-60124-11

WIRE NO.	LENGTH INCHES
RF62C20	30

AN/ARR-2A EQUIPMENT PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFGRS. NAME AND NO.	NOMENCLATURE
1	MT-63/ARC (GFE)	Receiver Rack
2	J-193/AR (GFE)	Junction Box
3	ARC-9125 (GFE)	Plug
4	R-4A/ARR-2 (GFE)	Receiver
5	B-33059-2 (GFE)	Plug
6	Navy Type 49190 (GFE) or Navy Type 49195 (GFE)	Plug
7	AN3100-20-27S	Receptacle
8	AN3106-20-27P	Plug
9	AN3100-20-12P (Pos. "W")	Receptacle
10	AN3106-28-12S (Pos. "W")	Plug
11	AN3106-20-27S (Pos. "8") or AN3106-20-1S (Pos. "8")	Plug
12	C-116/ARR-2 (GFE)	Console Control Panel
13	AN753-B1	Coupler

MASTER ELECTRICAL PARTS LIST

120	AN3161-P5	Circuit Breaker
123	AN3161-P20	Circuit Breaker

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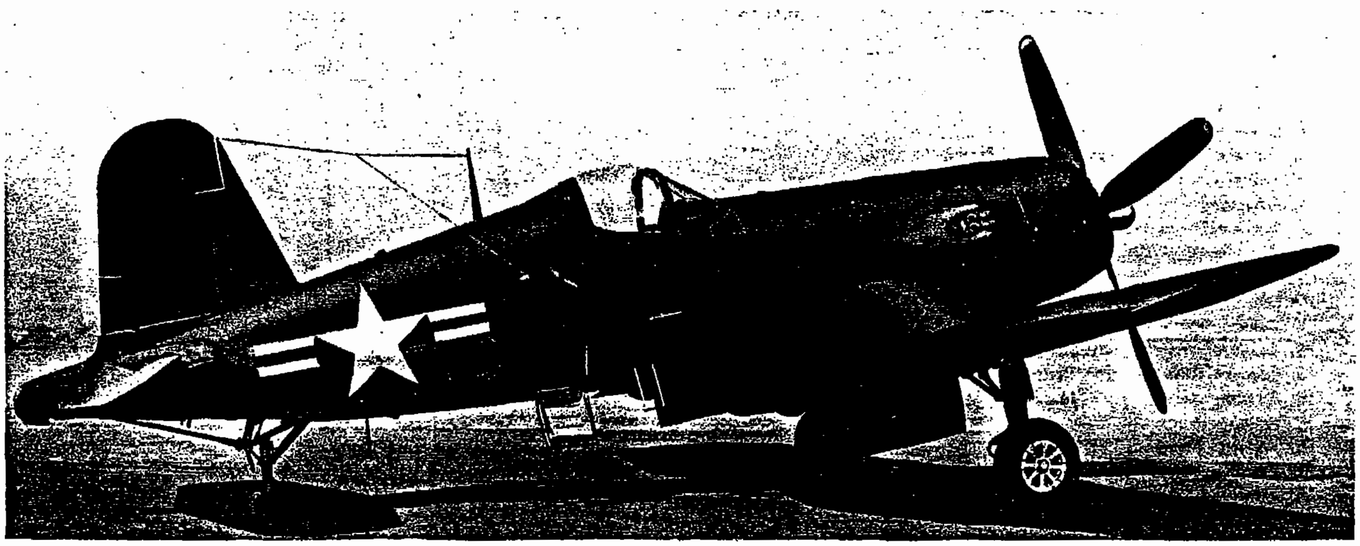
APPENDIX II

PHOTOGRAPHIC EQUIPMENT



B-1. PHOTOGRAPHIC EQUIPMENT.

B-2. DESCRIPTION. *(See figure B-1.)* The F4U-5P airplane is a photographic reconnaissance adaptation of the F4U-5 airplane. It is the same basic airplane, the main difference being the incorporation of provisions for remote camera control and the relocation of the remote indicating compass transmitter (21) from fuselage station 260 to the fin. The photographic equipment is installed in the fuselage and controlled from the cockpit. The equipment, less the camera, consists of the following:

a. The fuselage installation contains an access door (that is used for entry into both the radio and camera compartments); one vertical and two oblique sliding camera doors; the camera door actuating cables, gear boxes and electric actuating motor; an adapter in which the camera is mounted; an electrical actuating motor for rotating the camera adapter; shock mounts and shock mount housings; a solenoid actuated sway brace; four adjustable brace assemblies to secure the lens cone of the camera in position; an oil deflector for each of the three doors; and a vacuum system to retain the film in the focal plane of the camera magazine.

b. The cockpit installation contains the intervalometer and three camera control panels, two of which are located on the right hand cockpit control panel. The forward panel on the right hand control panel carries five camera position selector push-button switches, a green camera position light and three amber camera door position lights. The control panel aft and inboard of this carries the master camera switch, the door operating switch, the manual and automatic camera operating switch and the film breakage and intervalometer warning lights. The remaining camera control panel on the left hand control panel in the cockpit contains the manual picture switch which is located forward of the master water injection switch.

c. An extension has been added to each upper exhaust stack to divert exhaust gases away from the side camera openings; see paragraph B-78.

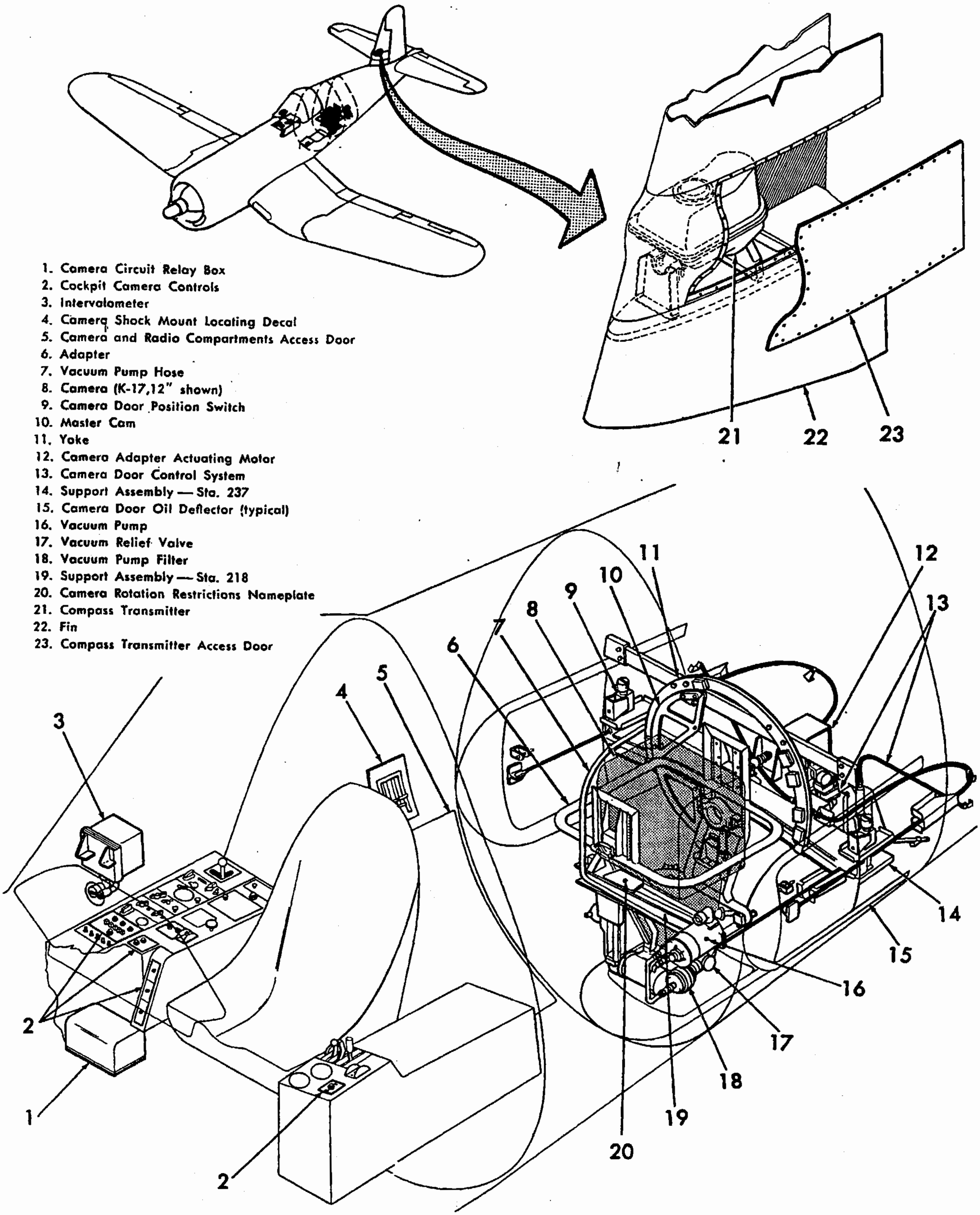
B-3. FUSELAGE PHOTOGRAPHIC INSTALLATION EQUIPMENT.

B-4. CAMERA COMPARTMENT ACCESS DOOR.

B-5. DESCRIPTION. Access to the camera compartment is gained through the radio compartment access door; see paragraphs 4-285 to 4-289 and figure 4—42.

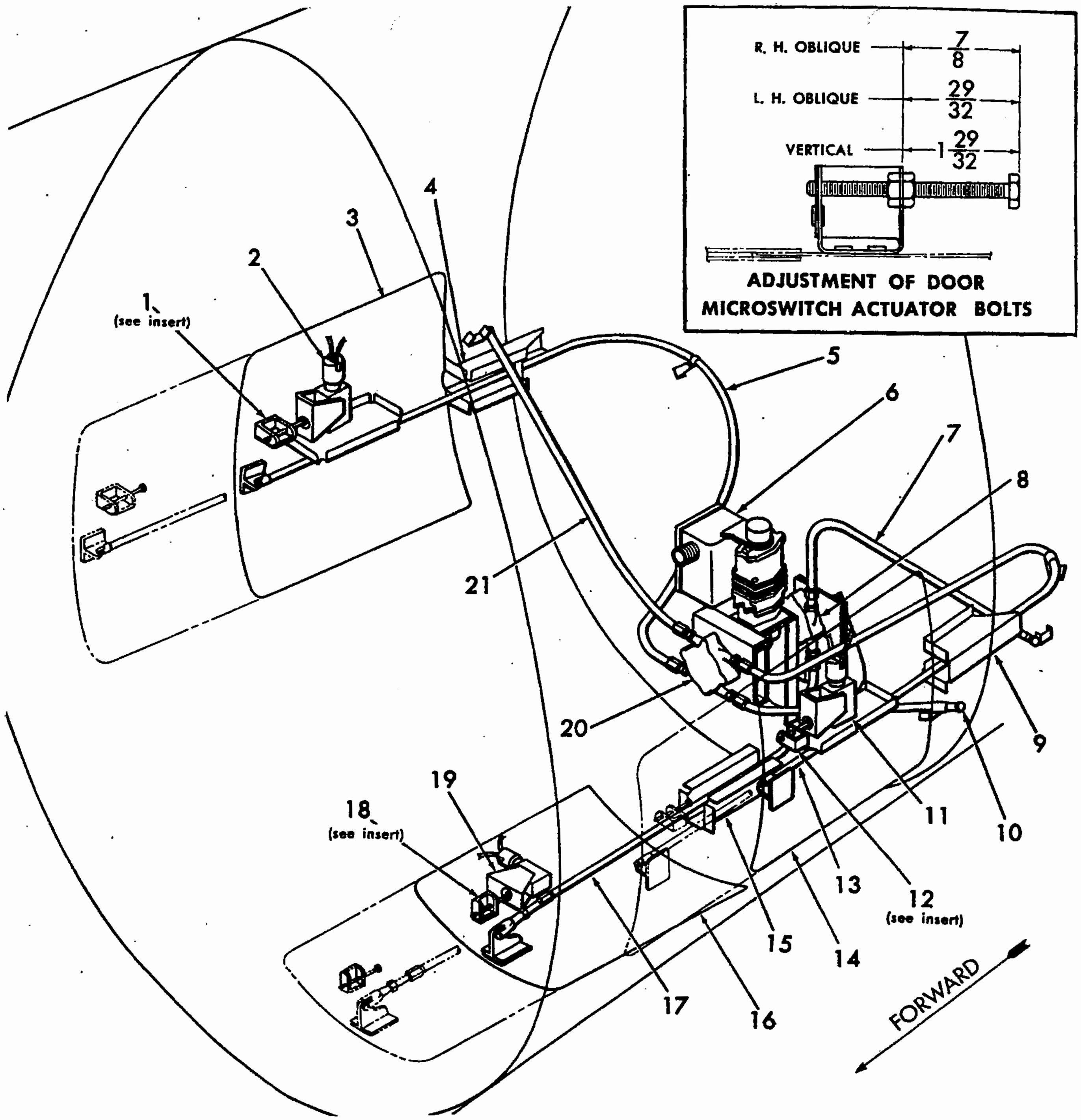
B-6. CAMERA SLIDING DOORS.

B-7. DESCRIPTION. *(See figure B-2.)* Three electrically operated sliding doors are installed between fuselage stations 223 and 247.5 and cover three cutouts 11 inches wide and 12.125 inches long in the fuselage skin panels. One door (16) for vertical photography is located in the bottom fuselage skin panel, and one door (3) (14) for oblique photography, is located in each fuselage side panel. The doors slide aft approximately 9-1/4 inches, riding on fillers between the fuselage skin and the oil deflector ring which lie outside of the normal contour of the fuselage. At the forward end



1. Camera Circuit Relay Box
2. Cockpit Camera Controls
3. Intervalometer
4. Camera Shock Mount Locating Decal
5. Camera and Radio Compartments Access Door
6. Adapter
7. Vacuum Pump Hose
8. Camera (K-17,12" shown)
9. Camera Door Position Switch
10. Master Cam
11. Yoke
12. Camera Adapter Actuating Motor
13. Camera Door Control System
14. Support Assembly — Sta. 237
15. Camera Door Oil Deflector (typical)
16. Vacuum Pump
17. Vacuum Relief Valve
18. Vacuum Pump Filter
19. Support Assembly — Sta. 218
20. Camera Rotation Restrictions Nameplate
21. Compass Transmitter
22. Fin
23. Compass Transmitter Access Door

Figure B—1. Photographic Equipment and Location of Compass Transmitter.



1. Camera Door Microswitch Actuator, R.H.
2. Camera Door Microswitch, R.H.
3. Camera Door, R.H. (open)
4. Camera Door Teleflex Cable Support, R.H.
5. Camera Door Teleflex Actuating Cable, R.H.
6. Camera Door Actuator Motor
7. Teleflex Cable Spent Travel Tube, Vertical
8. Aft Teleflex Cable Gear Box
9. Camera Door Teleflex Cable Support, L.H.
10. Teleflex Cable Spent Travel Tube, R.H.
11. Camera Door Microswitch, L.H.
12. Camera Door Microswitch Actuator, L.H.
13. Camera Door Teleflex Actuating Cable L.H.
14. Camera Door, L.H.
15. Camera Door Teleflex Cable Support, Vertical
16. Camera Door, Vertical
17. Camera Door Teleflex Actuating Cable, Vertical
18. Camera Door Microswitch Actuator, Vertical
19. Camera Door Microswitch, Vertical
20. Forward Teleflex Cable Gear Box
21. Teleflex Cable Spent Travel Tube, L.H.

Figure B—2. Camera Door Control Installation.

of each door is a bracket, supporting an actuator bolt (1) (12) (18) which makes contact with microswitches (2) (11) (19) located on the fuselage frame at fuselage station 237 when the doors are opened. The doors carry additional fittings to which Teleflex door operating cables are attached. These cables (5) (13) (17) connect the doors to an electric actuating motor (6) located at fuselage station 250. The electric circuit is such that the camera will operate only when the doors are fully open. When the head of the bolt contacts the microswitch, an electric circuit is closed, energizing three amber door position lights (left, vertical and right), indicating that the doors are fully open and the camera lens is not masked. The control panel, containing the door position lights, also carries a green camera position light which is lighted when the camera is in the selected position, and five camera position switches for the three degree left and right, the fifteen degree left and right, and the vertical positions.

B-8. REMOVING ACTUATOR BOLT ASSEMBLY.

a. To remove the actuator bolt: Unscrew the bolt from the two nuts that hold it in the bracket.

b. To remove the microswitch: Remove the two screws and nuts which hold the switch in the bracket at fuselage station 235.

Note

The three actuator bolt assemblies are all removed in the same manner.

B-9. INSTALLING. The actuator bolts and microswitches are installed by reversing the removal procedure given in paragraph B-8.

B-10. ADJUSTING. *(See figure B-2.)* To adjust the three actuator bolts to the correct length so that the head of the bolt will contact the microswitch observe the following procedure:

a. The bottom actuator bolt (18) is adjusted to a length of 1 29/32 inches, measured from the face of the bracket to the top of the bolt head.

b. The left hand actuator bolt (12) is adjusted to a length of 29/32 inch, measured from the face of the bracket to the top of the bolt head.

c. The right hand actuator bolt (1) is adjusted to a length of 7/8 inch, measured from the face of the bracket to the top of the bolt head.

Note

The adjusting lengths given above are design calculations. If, due to the tolerances allowed in manufacturing, they are not applicable, the bolts should be adjusted so that they contact the microswitches when the doors are fully open.

B-11. SLIDING DOOR CABLES AND GEAR BOXES.

B-12. DESCRIPTION. *(See figure B-2.)* The sliding door cables and gear box installations of the door control system consists of the necessary Teleflex cable, conduits, gear boxes, connectors and swivel ends. When the Teleflex cables are actuated by the electric door control actuating motor (6) and gearing, all doors (3) (14) (16) are opened or closed simultaneously. The door actuator motor (6), located at fuselage station 250, has a splined shaft which protrudes from its fore and aft sides. This splined shaft, which is driven by the actuator motor, is coupled by means of adapters to two gear boxes (8) (20), each box containing a gear having 80 teeth. The front gear box (20), located at fuselage station 248.5, opens and closes the right and left hand side doors; the rear gear box (8), located at fuselage station 254.5, opens and closes the bottom door. The front adapter fits over the forward spline of the actuator drive shaft, and into the front gear box. This adapter is 2 inches in length. The rear adapter, which is 2.69 inches long, couples the actuator motor (6) to the rear gear (8) in the same manner. Both gear boxes are manufactured by Teleflex, Inc. of Philadelphia, Pa., their part numbers for the front and rear boxes being B-5869 and B-5867 respectively.

B-13. REMOVING. *(See figure B-2.)* Working through the camera compartment access door the sliding door cables and gear boxes may be removed as follows:

a. Disconnect the Teleflex cable ends from the fittings on the three doors by removing the nut, bolt and washers that attach the rod end adjusting clevis to the fitting.

b. Disconnect the Teleflex cable ends from the three spent tube ties by removing the screw and nut that hold the clamp at each tie.

c. Remove the Teleflex control installations from the gear boxes as described in paragraphs 4—602 through 4—604G.

d. Remove the four bolts which hold the front gear box (20) to the channel at fuselage station 249.

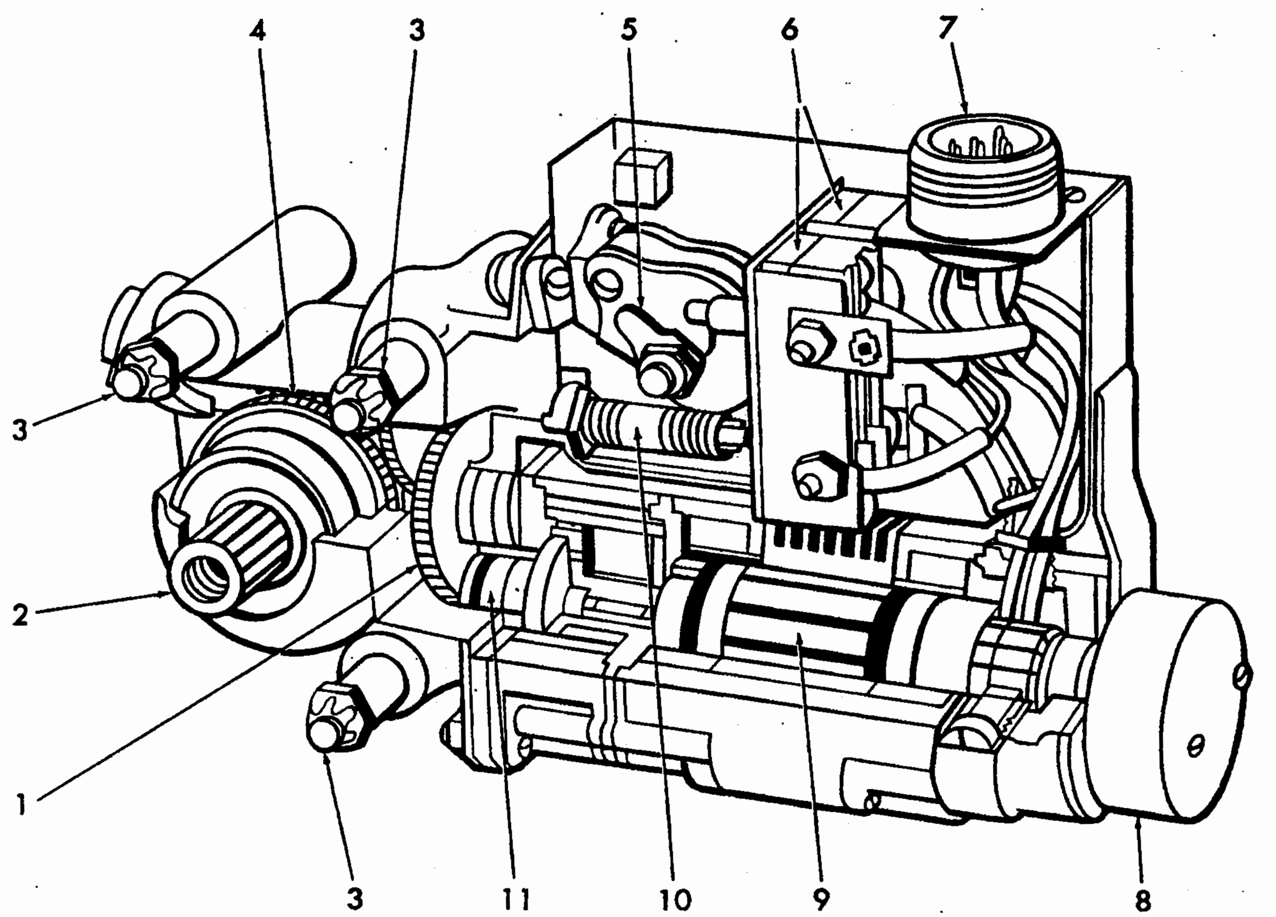
e. Remove the three bolts which pass through the support channel at fuselage station 253 and hold the rear gear box (8) to the support assembly at fuselage station 255.

f. Slide the gear boxes off their splined adapters and remove the adapters.

B-14. INSTALLING. Install the sliding door cables and gear boxes by reversing the removal procedure given in paragraph B-13.

B-15. SLIDING DOOR ACTUATING MOTOR.

B-16. DESCRIPTION. *(See figure B-3.)* The door actuating motor, located at fuselage station 250, is manufactured by Lear, Inc., of Grand Rapids, Michigan, their part number 111-BL, and is an electrically operated mechanism which actuates the threaded Teleflex cables attached to the bottom and left and right side camera doors. The actuator is energized through a toggle switch located on the right hand control panel in the cockpit. Basically, this rotary actuator is an electric motor (8) energized by the airplane power source, having an electromagnetic clutch and brake (9). The motor furnishes power to a reduction gear train (10) which, in turn drives an output shaft (11) extending through both sides of the actuator. This shaft has external splines at each outer end. Rotary motion of the shaft is transmitted to the two gear boxes through two adapters. Rotary motion of the gears in the gear boxes causes linear motion of the threaded Teleflex cables in mesh with each gear, with consequent movement of the camera doors. An output worm and gear (2) enables the output shaft (11) to rotate either way to open or close the camera doors. When the motor is energized, a clutch coil and a clutch-drive disc are subjected to a magnetic force which overcomes a spring-loaded brake and attracts a clutch-driven disc from the restraining brake. In so doing, the rotational energy of the electric motor and its clutch-driven disc is transferred to the reduction gear train, by means of the driven-disc and its pinion, and to the splined gear box drive shaft. Thus, electric motor torque is transferred to the gear train through the friction of the clutch-drive and clutch-driven plates. Opening the circuit will break the magnetic field of the clutch coil, releasing the driven disc which is disengaged by a spring holding the driven disc against the breaking surface, and leaving no driving contact between the motor and the gear train. A motor thermal protector (7) automatically opens the circuit on overload or overheating. It closes the circuit when normal load returns or heat dissipates. An adjustable cam (4) is located on each side of the actuator housing. The two cams are driven by the cam control worm (3) which is connected to the reduction gear train (10) and control the travel of the Teleflex cables by opening or closing limit switches (5) which open or close the electrical circuit.



1. Reduction Gear Train
2. Output Shaft
3. Mounting Bolts
4. Output Worm and Gear
5. Adjustable Cam
6. Limit Switches
7. Receptacle
8. Motor Thermal Protector
9. Motor Rotor
10. Cam Control Worm
11. Electromagnetic Clutch and Brake

Figure B–3. Sliding Door Actuating Motor.

B-17. REMOVING. Working from inside the fuselage the sliding door actuating motor is removed as follows:

a. Remove the front cables, gear box and adapter as described in paragraph B-13.

b. Disconnect wiring by removing the plug at the top of the actuating motor.

c. Remove the three nuts that hold the actuating motor to the support channel at fuselage station 253.

d. Remove the three bolts by removing the two channels from the actuating motor.

e. Disconnect the actuating motor from the rear gear box by sliding it out of the splined adapter.

B-18. INSTALLING. To install the sliding door actuating motor reverse the removal procedure given in paragraph B-17.

B-19. ADJUSTING. *(See figure B-3.)* The amount of travel of the Teleflex cable is controlled by the setting of the adjustable cam (4) on either side of the rotary actuator housing. These cams are preset for specified rotation by the manufacturer. For the sliding door actuating motor the cams are adjusted so that the Teleflex cables move the doors 9 1/4 inches. If it should be necessary to adjust the actuator the following procedure should be followed:

a. Remove the four screws, located on the right side of the actuator, which hold the cover plate.

b. Using an Allen wrench loosen the adjusting cam (4) (the front cam for the side doors and the rear cam for the bottom door) and adjust it so that it will move the doors 9 1/4 inches.

c. The doors should be fully closed in the closed position, and in the open position the actuating bolt must strike the microswitch or the camera will not operate.

d. When the proper adjustment has been made, lock the adjusting cam (4) in place and replace the cover plate.

B-20. CAMERA ADAPTER.

B-21. DESCRIPTION. *(See figure B-4.)* A steel tubular adapter (2) located at fuselage station 229 forms a cradle into which the camera (11) is mounted. The adapter is supported fore and aft on supporting members located at fuselage stations 218 and 237, and can be rotated laterally a maximum of 174 degrees into any one of five camera positions by means of an electrically-driven rotary actuator (14). The positions are: three degrees from the horizontal to left and right; fifteen degrees from the horizontal to left and right and to the vertical. An aluminum alloy cam (18) carrying two phenolic blocks or camera position microswitch actuating cams, is attached to the adapter. When the adapter is rotated, cam action closes and opens position microswitches as required to complete the circuit for Camera operation. *(See figure B-6.)* The right hand half of the upper adapter ring (4) is detachable for the purpose of facilitating camera installation. This section of the adapter is held in place by locking pins (3) which pass through both the removable tubing and the fixed tubing of the adapter. The locking pins are secured in place by spring-loaded toggles. When the locking pins are removed, their loss is prevented by their attachment to the removable tube by a bead chain. The camera adapter is mounted on the fuselage adapter supports by means of two adapter trunnions (2) secured to the upper fore and aft vertical members of the adapters. The forward adapter trunnion is full round and rotates in an adapter trunnion bearing secured to the adapter support at fuselage station 218. This bearing is manufactured in two halves. The upper half, when opened, rotates about a bolt in the lower half which is rigidly secured to the adapter support. When closed, the upper half of the adapter trunnion bearing is secured to the lower half by an eyebolt and wing nut. Both halves are bored to receive the forward adapter trunnion. The aft adapter trunnion is of like construction and installation, with the exception that the shaft of this fitting is half round to match the half round shaft of the adapter actuating motor. The rear adapter trunnion fits into the rear adapter trunnion bearing located on the adapter support at fuselage station 242.25. Also secured to the adapter are two fore and aft housings for the camera shock mounts. These shock mount housings are also manufactured in halves. The lower half (15) of each is bolted to the adapter in a preselected position. The upper half (9) of each shock mount housing is completely detachable, and is secured to the lower half by two pins (5). When the housing is closed about the camera shock mounts, these two pins pass through both housing halves, locking them in position. The pins are secured by latches (10) attached to the upper halves of the housing which, when depressed, lock the pins into the shock mount housing. Each pin is attached to the shock mount housing by a chain.

B-22. REMOVING. Working through the camera compartment access door remove the camera adapter from its mounting as follows:

a. Remove the yoke and switches assembly as described in paragraph B-27.

b. Remove the safety wire from the wing nuts on the two adapter mounting fittings at stations 218 and 237.

c. Loosen and remove the wing nuts and eyebolts from the lower halves of the two mounting fittings.

d. Open the upper halves of the adapter mounting fittings.

e. Pull back the sleeve and spring that couples the half round rear adapter trunnion to the half round adapter actuating motor shaft.

f. Lift the adapter out and remove it through the camera compartment access door.

g. To remove the cam assembly from the adapter remove the three bolts that attach the cam to the mounting lugs on the adapter.

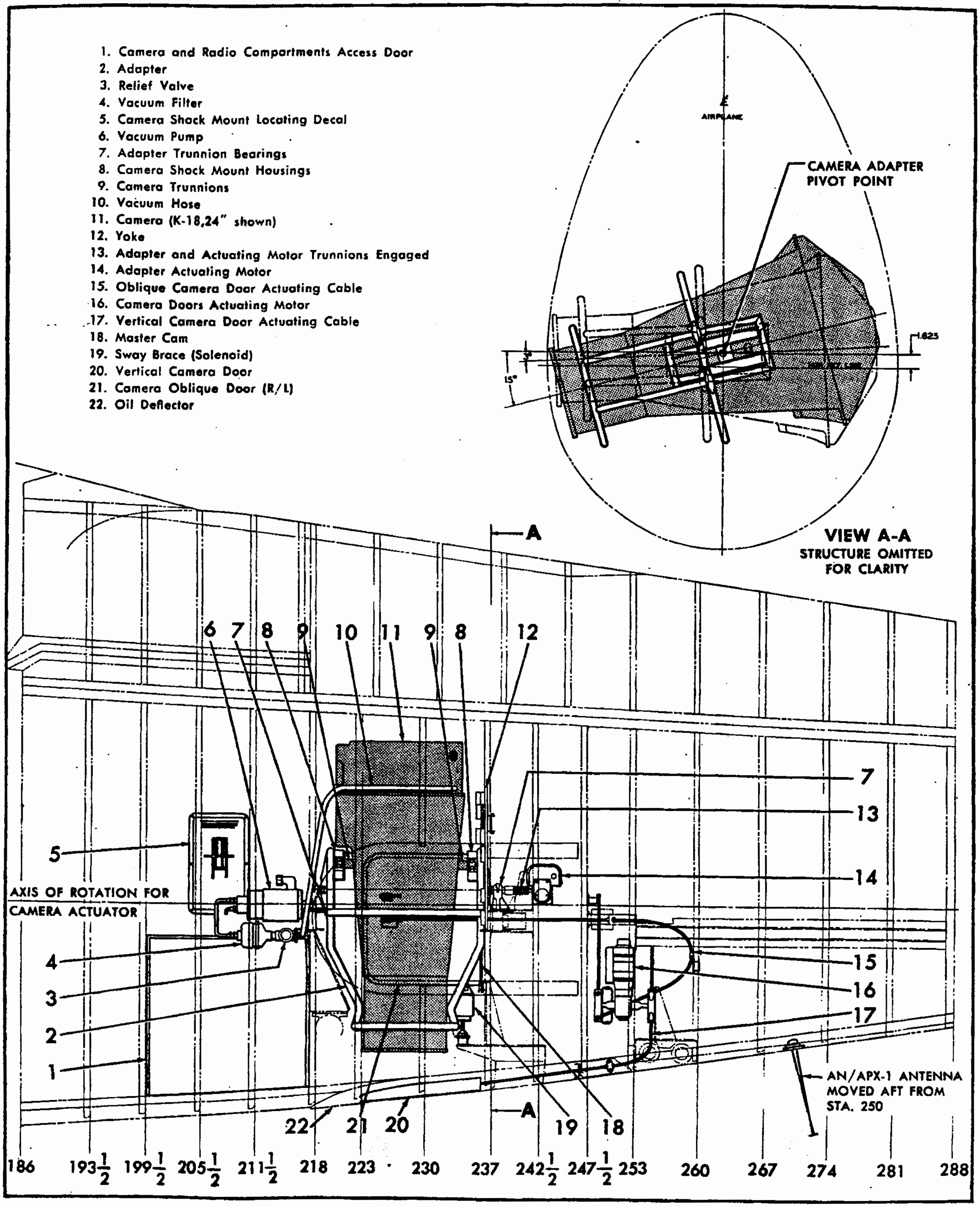


Figure B—4. Camera Installation.

B-23. INSTALLING. To install the adapter in the airplane reverse the removal procedure in paragraph B-22.

B-24. CAMERA ADAPTER ACTUATING MOTOR.

B-25. DESCRIPTION. *(See figure B-4.)* The camera adapter actuating motor (14), a rotary actuator manufactured by Lear, Inc. of Grand Rapids, Michigan, their part number 111 BJ-1, is located at approximately fuselage station 242.5 on the rear camera adapter support. The adapter motor has the same principle of operation as the camera door actuating motor (see paragraph B-15). The motor is coupled to the rear trunnion of the adapter by means of the half round end of the adapter trunnion mating with that of the actuator motor-driven shaft. The two shaft ends are secured together by a spring-loaded sleeve fitting over the joined shafts (13). The purpose of this motor is to rotate the camera adapter (2) and its mounted camera (11) to any of the five positions, i.e., three and fifteen degrees from the horizontal left and right, and vertical. Nine microswitches are secured to an aluminum alloy yoke (12) attached at its base to the rear adapter support and at its upper portion to a channel support extending laterally across the fuselage. Two additional switches are carried by a bracket mounted on the bottom sway brace support. These switches are identified by numbers stamped on the yoke. Eight of these switches are position switches, and three are employed in conjunction with the camera door microswitches to complete the camera system circuit when the doors are open. The eight switches, when actuated by the master cam attached to the adapter, restrict camera adapter rotation by the actuating motor to the position selected by the pilot. Position of the camera adapter is controlled through the camera control panel on the right hand console forward of the "MASTER" and "VHF" radio panels. The control panel *(see figure B-11)* has five push-buttons corresponding to the positions specified; in addition, a green indicator light is provided to indicate when the camera is in any one of the five positions, but it is not lighted when the camera is in transit. A polarized relay in the camera adapter actuator motor energizes directional circuits so that clockwise or counterclockwise rotation of the motor and adapter take place. Microswitches 1, 3, 5 and 7 control clockwise rotation and switches 2, 4, 6 and 8 control counterclockwise rotation. In addition to the internal magnetic clutch in the motor, a friction clutch has been incorporated to prevent damage to the motor. This clutch has been adjusted to slip at 400 pound-inches.

B-26. REMOVING. Access for removal of the camera adapter actuating motor is obtained through the camera compartment access door.

a. Disconnect the wiring from the actuator at the quick-disconnect plug on the receptacle bracket.

b. Remove the four nuts and bolts that attach the actuating motor to the rear camera adapter support at fuselage station 242.5.

c. Pull back the sleeve and spring that couples the half round rear adapter trunnion to the half round adapter actuating motor shaft and remove the actuating motor.

B-27. REMOVING THE YOKE AND SWITCHES ASSEMBLY. Working through the camera compartment access door remove the yoke and switches installed as follows:

a. Remove the four nuts and bolts that attach the base of the yoke to the rear adapter support.

b. Remove the four nuts and bolts that attach the channel, upon which the yoke is mounted to the two end channels on each side of the fuselage at station 237.

c. Disconnect the wiring from the switches at the quick-disconnect plug just to the right of the yoke.

d. Remove the channel and the yoke containing the switches as a unit.

e. If it is necessary to replace any of the switches, they can be removed by removing the two nuts, screws and lockwashers that attach the switches to the yoke.

Note

The lockwashers are installed between the yoke and the nut.

f. Remove the bracket containing the two bottom switches by removing the four nuts and bolts that hold the bracket to its mounting aft of the sway brace pad.

B-28. INSTALLING. To install the camera adapter actuating motor and the yoke and switches assembly reverse the procedures given in paragraphs B-26 and B-27.

B-29. ADJUSTING. The adjustment of the camera adapter actuating motor installation is limited to the correct positioning of the switches on the yoke and the lower bracket with respect to the master cam and the two phenolic cams. To aid in obtaining the correct adjustment, the slots for the switches on the yoke and the lower bracket are drilled to a length of 11/16 inch. These slots enable the position of the switches to be adjusted to obtain the correct camera setting for the five positions (three and fifteen degrees from the horizontal on the right and left sides and vertical). The holes for the two phenolic cams in the master cam are drilled oversize to provide room for adjusting the position of the two cams.

B-30. CAMERA SHOCK MOUNTS.

B-31. DESCRIPTION. *(See figure B-5.)* The camera shock mounts are fitted over the mounting trunnions of the camera before the camera is placed in the adapter and shock mount housings. The shock mounts consist of circular cases carrying spring-loaded bushings which fit over the two camera mounting trunnions. After the shock mounts are placed over the camera trunnions, the camera and its shock mounts are installed in the shock mount housing on the adapter. The same shock mount housing is used for all installations.

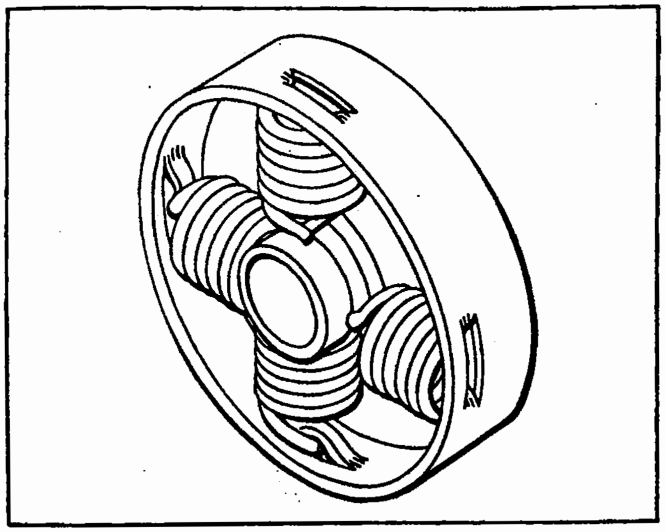


Figure B—5. Camera Shock Mount.

B-32. REMOVING. The camera shock mounts are removed when the camera is removed from the adapter. They slide right off the camera mounting trunnions.

B-33. INSTALLING. The camera shock mounts are fitted over the camera mounting trunnions before the camera is placed in the adapter and shock mount housings.

B-34. SOLENOID ACTUATED SWAY BRACE.

B-35. DESCRIPTION. *(See figure B-6.)* When the adapter is in position, a solenoid sway brace (12) on the aft side of the camera adapter engages with one of five serrated steel sway brace pads (13) installed along the fuselage frame at fuselage station 237 on the bottom and both sides of the airplane. Before the camera adapter can be rotated, the solenoid (12) is disengaged electrically from the fuselage sway brace pad (16) and then strikes a microswitch (11) above the solenoid, closing the camera adapter actuated motor circuit, and rotation follows. Upon reaching the position selected, the solenoid is de-energized and a spring within the solenoid forces the serrated pad (13) on the end of the solenoid to engage with its mating pad (16) on the fuselage frame which coincides with the position selected. By this action, the sway brace stabilizes the camera adapter and the camera during camera operation.

B-36. REMOVING. Working through the camera compartment access door remove the solenoid actuated sway brace installation as follows:

a. Disconnect the wiring from the two terminals at the top of the solenoid.

b. Drill off the peened end of the pin that locks the solenoid mating pad on its rod and unscrew the pad from the rod.

c. Remove the four nuts, bolts and washers that hold the solenoid and microswitch mounting brackets to the two angles welded to the adapter at station 237.

d. Lift the solenoid and microswitch assembly out of the bearing plate assembly and remove it from the airplane.

e. To remove the solenoid from its mounting bracket remove the four nuts, screws and lockwashers that attach it to the bracket.

f. To remove the microswitch from its mounting bracket remove the two nuts, screws and lockwashers that attach it to the bracket.

g. To remove any of the give sway brace mating pads mounted on the fuselage remove the two nuts and bolts that hold the pad in its mounting channel.

B-37. INSTALLING. To install the solenoid actuated sway brace assembly reverse the removal procedure given in paragraph B-36.

B-38. ADJUSTING. The adjustment of the solenoid actuated sway brace installation is limited to adjusting the position of the limit switch mounted above the solenoid. The switch is mounted in two slots so that its position can be adjusted to enable the cap of the solenoid to contact it when the solenoid is disengaged from the fuselage sway brace pad.

B-39. CAMERA BRACES.

B-40. DESCRIPTION. *(See figure B-7.)* Four adjustable brace assemblies (2) are located on the lower ring of the camera adapter for the purpose of securing the lens cones of the camera in position and reducing vibration. These brace assemblies consist of sponge rubber pads (3) cemented to a ball and socket fitting (4). The adjustable rods (5) of the braces are secured in the adapter tubing by means of two nuts (6) (9).

B-41. REMOVING. If it is necessary to replace any of the braces, they may be removed as follows:

a. Drill off the peened end of the pin that locks the outer adjusting nut to the threaded rod, and remove the pin.

b. Remove the outer adjusting nut.

c. Remove the camera brace from the lower adapter ring.

B-42. INSTALLING. To install any of the camera braces observe the following procedure:

a. Screw the inner locking nut on the threaded rod.

b. Slide on the spacer.

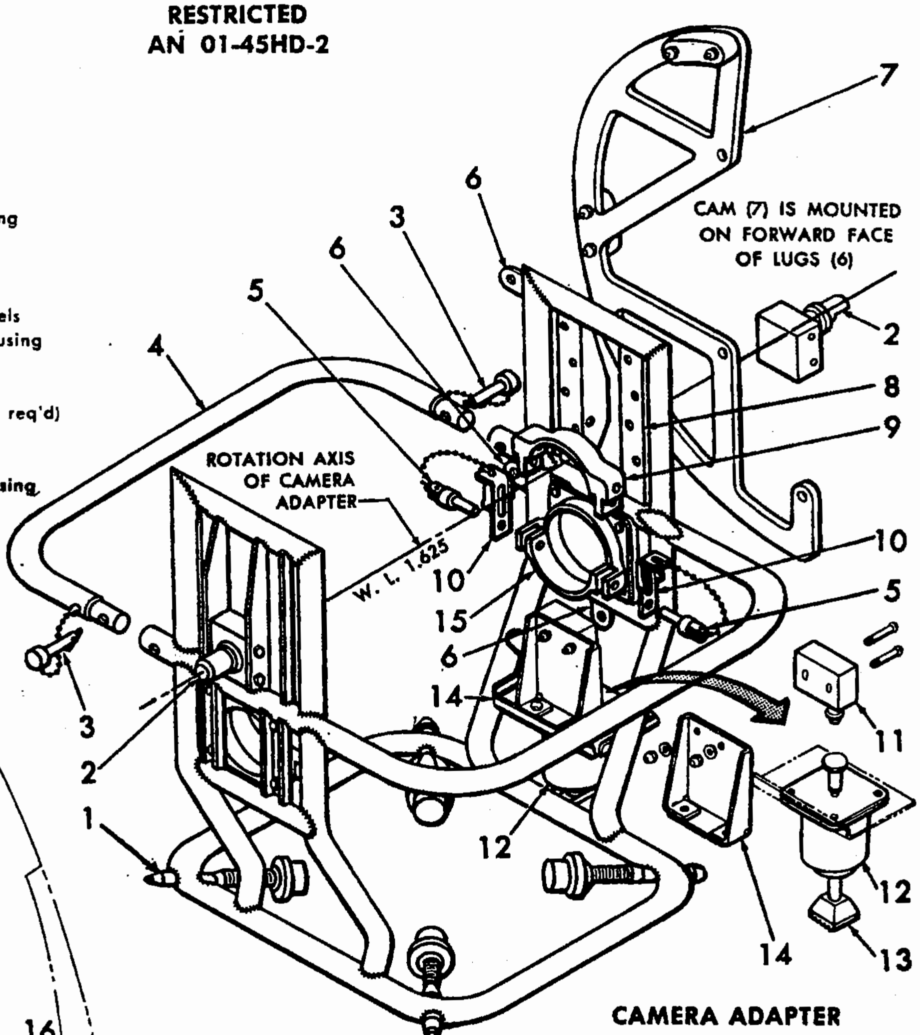
c. Insert the threaded rod into the holes in the lower adapter ring and screw on the outer adjusting nut.

d. Insert the locking pin through the holes in the outer adjusting nut and threaded rod and peen the ends.

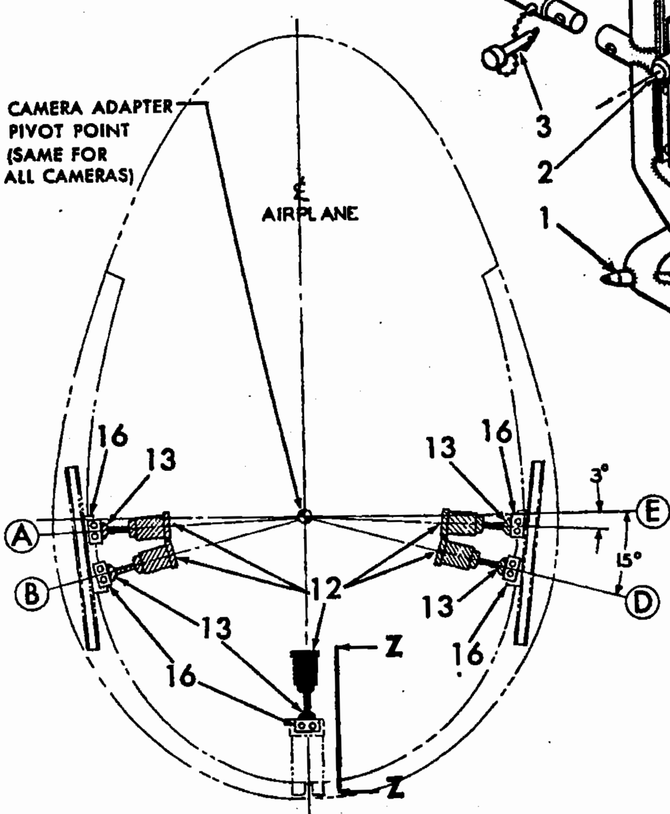
e. Grind the ends of the pin flush after peening.

B-43. ADJUSTING. The braces are to be adjusted so that they secure the lens cones of the camera in position. When installing the camera in the adapter, tighten the

1. Braces
2. Adapter Trunnion
3. Toggle Bolt Assembly
4. Removable Section Upper Adapter Ring
5. Retaining Pin
6. Cam Assembly Mounting Lug
7. Cam Assembly
8. Camera Shock Mount Support Channels
9. Upper Half Camera Shock Mount Housing
10. Retaining Pin Latch
11. Limit Switch
12. Sway Brace Stabilizing Solenoid (one req'd)
13. Sway Brace Pad
14. Adapter Sway Brace Support Bracket
15. Lower Half Camera Shock Mount Housing
16. Fuselage Sway Brace Pad (five req'd)

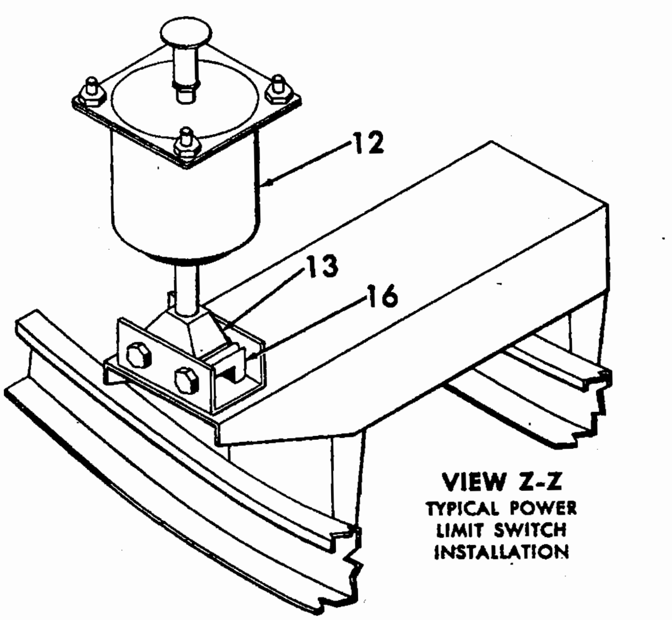


CAMERA ADAPTER



LOOKING AFT AT STA. 237

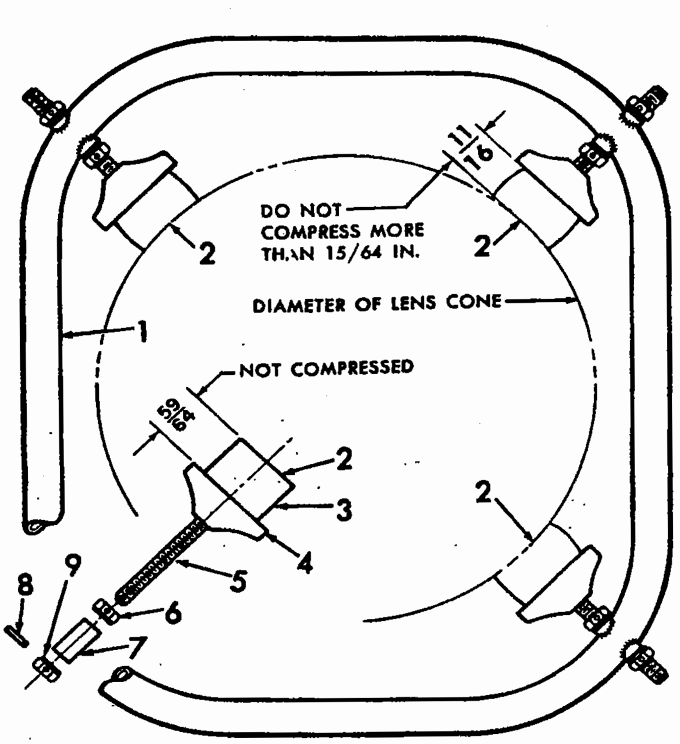
SHOWING SWAY BRACES AND ACTUATOR OF CAMERA POWER LIMIT SWITCHES IN FIVE POSITIONS



VIEW Z-Z
TYPICAL POWER LIMIT SWITCH INSTALLATION

A. Centerline of Sway Brace — 3° Oblique Position, R.H.
B. Centerline of Sway Brace — 15° Oblique Position, R.H.
C. Centerline of Sway Brace — Vertical Position,
D. Centerline of Sway Brace — 15° Oblique Position, L.H.
E. Centerline of Sway Brace — 3° Oblique Position, L.H.

Figure B—6. Camera Adapter and Rotation Diagram.



1. Lower Adapter Ring
2. Brace
3. Pad
4. Support
5. Threaded Rod
6. Locking Nut
7. Spacer
8. Pin
9. Adjusting Nut

Figure B—7. Camera Braces.

four braces by tightening the outer adjusting nut on the threaded rod of each brace afterward locking the braces by means of the inner locking nut.

Note

> The rubber pads of each brace which rest against the lens cone should not be compressed to less than 11/16 inch.

B-44. OIL DEFLECTORS.

B-45. DESCRIPTION. *(See figure B-4.)* Three oil deflectors (22) of .025 inch aluminum alloy are provided for the protection of the camera lens, and are secured to the exterior of the fuselage skin panels containing the camera doors.

B-46. VACUUM SYSTEM.

B-47. DESCRIPTION. *(See figure B-1.)* The vacuum system consists of a vacuum pump (16), Eclipse type 1504 or 1511, a Purolator filter (18), type PR362, and a Bendix relief valve (regulator) (17), type 691-11A, all located on the left hand side of the camera compartment, forward of fuselage station 218, with a hose connection (7), leading to the camera magazine from the regulator. The purpose of the vacuum system is to hold the film flat against the back of the camera magazine. The vacuum pump setting is 5.5 (plus or minus .5) inches of mercury. A capacitor, or condenser, manufactured by the Solar Manufacturing Corporation of Bayonne, New Jersey, their part number XDMRW-6-1-10-20, is installed in the vacuum pump electrical circuit to suppress radio noise created by the pump motor.

B-48. REMOVING. Working through the camera compartment access door remove the vacuum system unit as follows:

a. Disconnect the hose connection, leading from the regulator to the camera magazine, at the regulator.

b. Disconnect the electrical wiring from the vacuum pump.

c. Remove the four screws on the sides of the vacuum system mounting bracket that attach the bracket to the fuselage.

d. Remove the bracket with the vacuum system attached as a unit.

e. To remove the filter and relief valve assembly from the mounting bracket, remove the two nuts and screws that hold the two attaching clamps, and unscrew the fitting that attaches the tube from the pump to the filter.

B-49. INSTALLING. To install the vacuum system reverse the procedure given in paragraph B-48.

B-50. CAMERA.

B-51. DESCRIPTION. The equipment furnished in the F4U-5P will permit the accomplishment of aerial photographic reconnaissance with any of the following camera installations: K-17, 12 inch; K-17, 24 inch and K-18, 24 inch. The camera is rotated so it can operate from any of the following five positions: three and fifteen degrees down from the horizontal on both right and left side and the vertical position.

Note

> The above cameras are not furnished with the airplane.

B-52. INSTALLATION. The camera should be prepared for use before installing it in the airplane as follows:

a. Remove the lens cap.

b. Load the magazine; seating the spools correctly.

c. Attach the magazine securely to the camera and check the engagement of the camera-to-magazine coupling by winding the camera by hand. If engaged, the knobs on the ends of the film spool will turn.

d. Remove the dark slide.

e. Set the magazine counter to zero.

f. Set the shutter and diaphragm according to estimated light conditions over area to be photographed.

g. Check the lens element for security.

h. Clean the lens and filter.

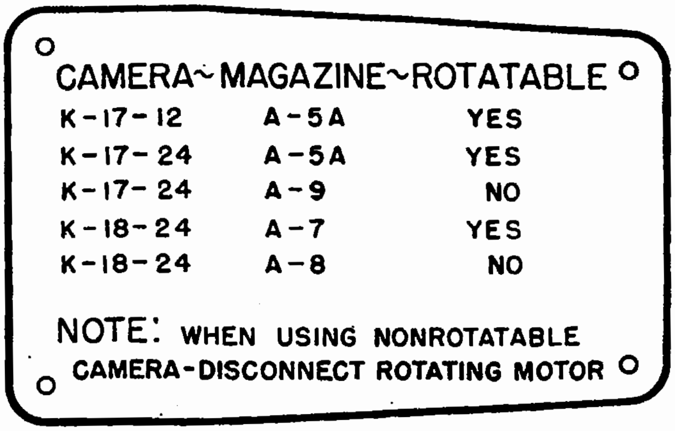


Figure B—8. Camera Magazine Decal.

i. Set the intervalometer counter to zero.

j. Fill out the data card, recording the number of the camera, cone and magazine. A plate *(see figure B-8.)* mounted on the forward adapter pivot support notes the restrictions on rotation of the adapter and camera when using the various types of camera magazines.

B-53. In addition to preparing the camera for installation, the camera adapter should be in the vertical position and made ready to receive the camera. Proceed as follows:

a. Remove the right hand half of the upper ring of the adapter by removing the two pins securing the member to the adapter.

CAUTION

It is imperative that this section of the adapter be replaced and locked in position at all times especially after camera installation.

b. Loosen the four braces on the lower ring of the adapter. These braces stabilize the camera during flight.

c. Install the camera shock mount housings in the proper hole location in the fore and aft vertical members of the adapter to accommodate the particular camera to be used. A decalcomania *(see figure B-9),* located over the camera compartment access door, indicates the position in which various cameras should be installed in the adapter. The shock mount housings, which support the camera and its shock mounts in the adapter, are secured to the adapter by four bolts. Three camera locations are indicated in the adapter by the decalcomania; four bolt holes are for the installation of the K-18, 24 inch camera and four bolt holes are for the K-17, 24 inch camera; all bolt holes are above the adapter trunnions. These holes are drilled in supporting channels to which the adapter trunnions are attached. Four additional bolt holes for mounting the K-17, 12 inch camera are located in the channels below the adapter trunnions. To install the camera in any of the positions desired, it is necessary only to remove the four bolts attaching each shock mount housing to the adapter, insert the locating bolts of the housing in the proper combination of holes in the channels; secure the bolts and mount the camera.

d. Remove the upper half of the shock mount housings by releasing the latches on both sides of each housing which secure the retaining pins, and withdraw the pins attaching the upper halves of the shock mount housings to their lower halves.

B-54. Two men are required to make the camera installation *(see figure B-10),* one man inside the fuselage and one man outside on the right hand side of the airplane. Access to the camera compartment and the camera mounting adapter is gained through the camera compartment access door on the right hand side of the

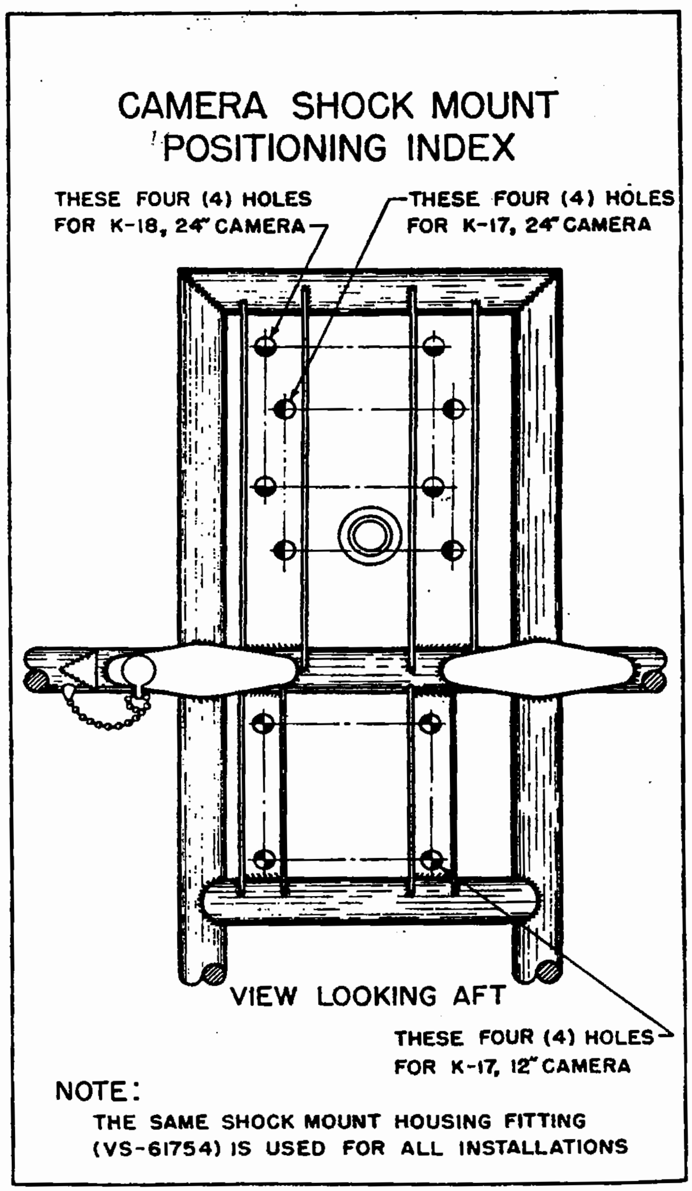


Figure B—9. Camera Shock Mount Positioning Decal.

airplane. After entry into the radio compartment, the man to receive and install the camera positions himself astride the elevator torque tube and faces aft toward the camera compartment and the camera mounting adapter. The second man is stationed outside with the camera. The camera is then installed in the airplane as follows:

a. The camera is passed to the man in the fuselage and placed in the upright position with the magazine end of the camera uppermost.

b. The assistant, on the outside, aids in positioning the camera by reaching through the open vertical camera (radio access) door and guiding the lens cone between the four braces on the lower adapter ring, afterward tightening the braces against the lens cone when the camera is secured *(see figure B-7)*.

Note

It is recommended for ease of handling, that the magazine be installed after the camera is mounted in the adapter. Care should be taken that no damage to the camera lens occurs. This can best be prevented by the use of a lens covering as an added precaution. Remove lens cover after installation is completed.

c. In mounting the K-17, 12 inch and K-18, 24 inch cameras in the airplane, it should be noted that the camera mounting trunnions are not on the centerlines of the camera and, therefore, should be mounted so that the centerlines of the cameras and the apertures in the airplane coincide. The trunnions of the K-17, 12 inch camera are 13/32 inch off the camera centerline. To mount this camera in the adapter to permit alignment of the camera and the aperture centerlines, the K-17, 12 inch camera should be positioned in the adapter with the camera case motor facing left, bringing the data card forward. The K-17, 24 inch camera trunnions are located on the camera centerline, but should be mounted in the adapter with the camera case motor to the right which brings the vacuum nipple to the left. The K-18, 24 inch camera trunnions are 9/32 inch off the camera centerline and should be mounted in the airplane with the vacuum nipple and the film winding crank forward and the data card to the left.

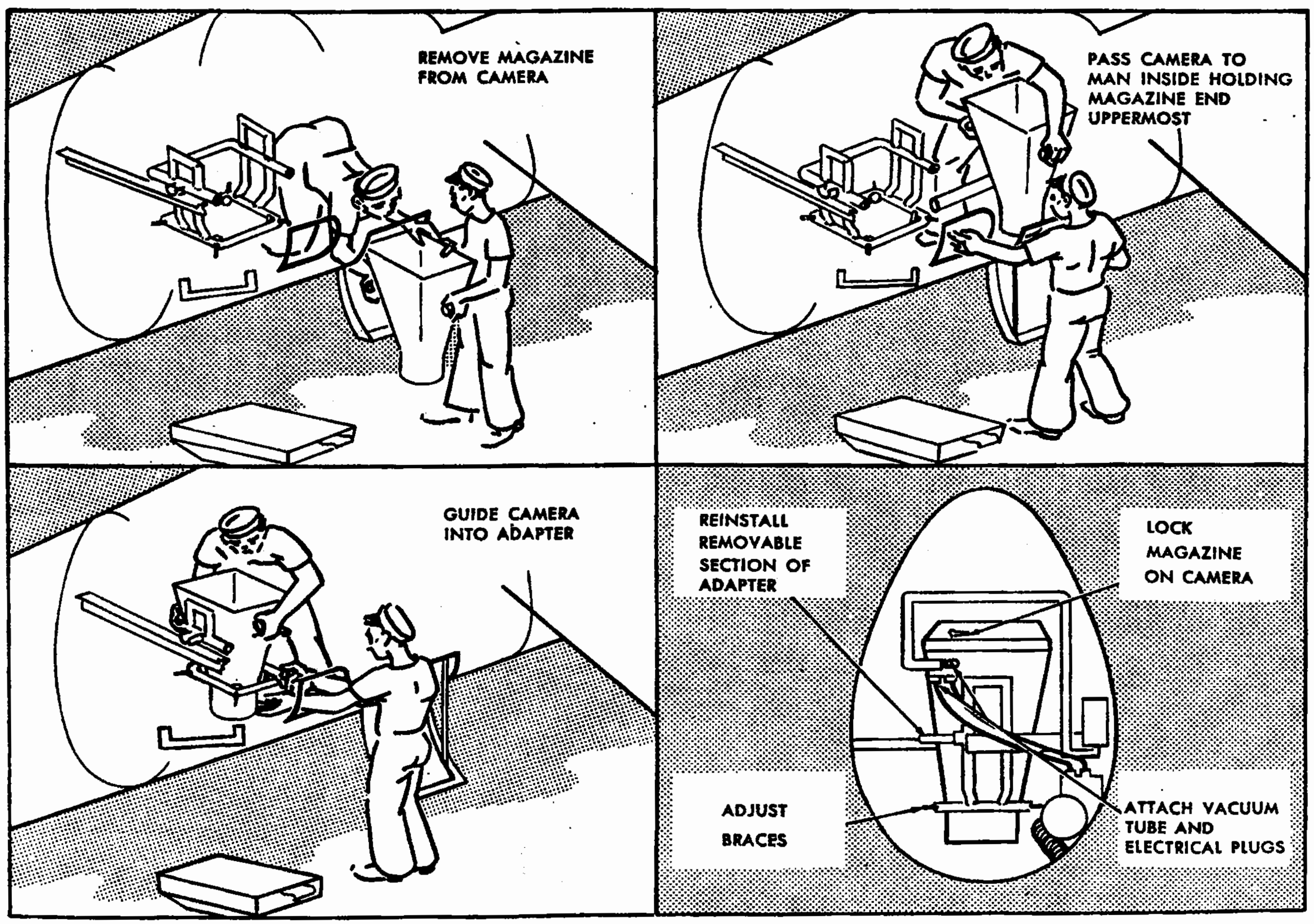


Figure B—10. Installation of Camera.

d. After the camera is positioned in the fuselage preparatory to mounting it in the adapter, place the camera shock mounts on the two camera trunnions.

e. Work the camera around to the right of the adapter on the side where the half of the upper ring has been temporarily removed.

f. Raise the camera and lower the camera trunnions and shock mounts into the bottom halves of the fore and aft shock mount housings previously located on the adapter in accordance with instructions contained on the decalcomania over the access door *(see figure B-9)*.

g. After the camera is mounted in the adapter, replace the upper halves of the shock mount housings over the lower halves. Secure the two halves by replacing the fore and aft retaining pins, afterward locking the retaining pins by means of the latches secured to the upper halves of the housings.

h. Replace the removable half of the upper ring of the adapter and lock it in position by means of the attached toggle bolts.

i. Tighten the four braces *(see figure B-7)* on the lower ring of the adapter against the lens cone of the camera by tightening the outer adjusting nut on the threaded rod of each brace, afterward locking the braces by means of the inner locking nut.

Note

The rubber pads of each brace which rest against the lens cone should not be compressed to less than 11/16 inch.

j. Examine the solenoid sway brace, located on the aft end of the adapter, for full contact of the serrated pad, on the fuselage frame.

k. Connect the vacuum system to the camera by means of the hose leading from the regulator.

l. Install the camera electrical control plug leading from the airplane electrical system into the camera receptacle. This plug has three prongs.

m. Install the film feed warning light plug leading from the airplane electrical system into the film feed receptacle on the camera. This plug has two prongs.

n. After all the photographic equipment has been installed in the airplane two men should check the entire installation, one man to operate the switches in the cockpit, and one to watch the camera.

o. Turn on master camera switch and open vertical and oblique sliding doors.

p. Check rotation of camera to all positions, and check door operation and position indicating lights.

q. Set intervalometer dial at nine seconds or more.

r. Place camera control switch in "AUTOMATIC".

s. Start the intervalometer and check its operation through two exposures. Turn off intervalometer switch.

t. Check manual selection by depressing the manual push-button for one exposure.

u. Turn off the master camera switch to avoid overheating the camera and intervalometer and to prevent excessive drain on the battery.

v. Check camera for security in camera mount.

w. Check vacuum system for leaks and readings, using a gage for the latter. Check sway bracing.

x. Check camera compartment and cockpit for loose gear.

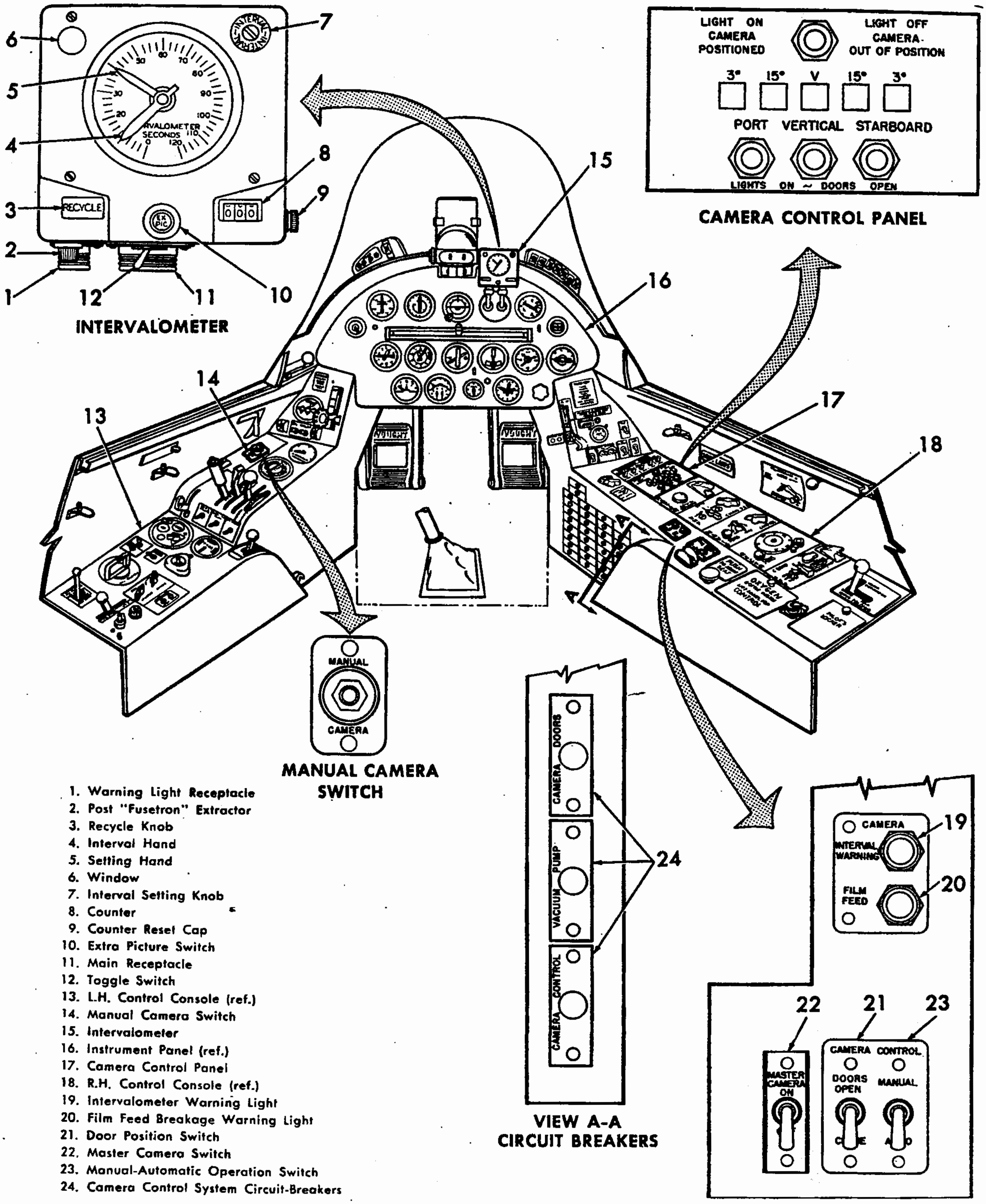
y. Remove dark slide.

z. Close camera doors.

B-55. COCKPIT PHOTOGRAPHIC INSTALLATION EQUIPMENT.

B-56. INTERVALOMETER.

B-57. DESCRIPTION. *(See figure B-11.)* A B-3B type intervalometer (15) is located on the instrument board above the climb indicator. The intervalometer is a 24 volt direct current electrical timing unit which automatically trips the camera shutter at predetermined intervals. Because of the location of the intervalometer at the top of the instrument board, the changes in instrument arrangement from that of the conventional F4U-5 are: the climb indicator has been moved to the right to a position above the elapsed time clock, and the Mark 1 rocket selector is relocated below the standby compass. The controls for the intervalometer consist of the power supply toggle switch (12), setting knob (7), recycle knob (3), and an "extra-picture" switch (10). Two cables are required to make connections to the camera and signal light. A dial on the intervalometer is graduated in seconds for direct indication of the interval between film exposures. A setting hand (5) indicates the selected interval on the dial and is controlled by the setting knob (7). An interval hand (4) indicates the number of seconds remaining before the camera will be tripped. The setting knob provides a means for setting the desired interval. The recycle knob provides a means of tripping the camera before completion of the interval. The "extra-picture" switch button, located below the dial, may be used at any time to take pictures whether the power supply toggle switch is "ON" or "OFF". The power supply toggle switch places the camera under automatic time-interval control when "ON". When the switch is "OFF," power is available for "extra-picture" push-button operation, but the automatic feature is eliminated. To the left of the dial is a signal light window (6). A Mazda 28-volt 313T3 1/4 bulb or equivalent acts as the signal light. An electro-magnet counter (8) indicates the number of exposures that have been made. This is manually reset to zero by depressing and turning the reset cap (9). Counter magnet assembly coils are energized whenever the camera shutter electric operating circuit is completed, either through automatic intervalometer operation or manually through the "extra-picture" switch. When energized, the magnet attracts its armature and brace assembly to which is attached an armature lever for operating the counter when the



1. Warning Light Receptacle
2. Post "Fusetron" Extractor
3. Recycle Knob
4. Interval Hand
5. Setting Hand
6. Window
7. Interval Setting Knob
8. Counter
9. Counter Reset Cap
10. Extra Picture Switch
11. Main Receptacle
12. Toggle Switch
13. L.H. Control Console (ref.)
14. Manual Camera Switch
15. Intervalometer
16. Instrument Panel (ref.)
17. Camera Control Panel
18. R.H. Control Console (ref.)
19. Intervalometer Warning Light
20. Film Feed Breakage Warning Light
21. Door Position Switch
22. Master Camera Switch
23. Manual-Automatic Operation Switch
24. Camera Control System Circuit-Breakers

Figure B—11. Camera Cockpit Controls.

shutter is tripped. A heater element maintains favorable temperature conditions for motor operation, and has a power rating of 20 watts. A thermostat makes contact, closing the heater element at 4°C (40°F) and breaks contact, opening the heater circuit at 32°C (90°F). A one ampere "Fusetron" protecting the intervalometer circuit from overload is located in the fuse extractor post (2). The motor is a unit designed to operate on a 28 volt dc power supply. Motor speed is held at 7200 rpm by means of a flyweight governor and regulator contact assembly. A fan circulates air within the case.

B-58. CAMERA CONTROL PANELS.

B-59. DESCRIPTION. *(See figure B-11.)* Two of the three camera control panels are located on the right hand console (18) in the cockpit. One (17) is located forward of the master switch and VHF panels and carries the five switches necessary for rotating the camera, as described in paragraph B-25. Forward of these switches is the green camera position light which is lighted when the camera is in position and not lighted during the time the camera is in transit. Included in this panel are three amber camera door position lights which are lighted when the camera doors are fully open. This panel is manufactured by Lear, Inc., Grand Rapids, Michigan, their part number 36202-Issue A. Forward of the oxygen bottle and seat adjustment control is a panel containing the master camera switch (22) (see paragraph B-71), door control switch (21) (see paragraph B-16), manual and automatic camera operation switch (23) (see paragraph B-60), the amber intervalometer warning light (19) (see paragraph B-65) and the red film feed warning light (20) (see paragraph B-67. Circuit breakers (24) for the camera control, vacuum pump and camera door circuits are located on the nose *(See figure B-11, view A-A)* of the console. The third camera control panel is located on the left hand console (13) in the cockpit and contains the manual picture switch (14) (see paragraph B-63).

B-60. MANUAL-AUTOMATIC SWITCH.

B-61. DESCRIPTION. *(See figure B-11.)* With the camera control switch (23) in the "AUTOMATIC" position, all pictures will be taken in accordance with the setting of the intervalometer, with no further attention required on the part of the pilot other than that of maintaining attitude and altitude conditions previously determined. However, if it is desired to take individual pictures the camera control switch should be placed in the "MANUAL" position, and the manual control push-button (14), located on the left hand control console forward of the master water injection switch, depressed for each picture desired.

B-62. MANUAL PICTURE PUSH-BUTTON.

B-63. DESCRIPTION. *(See figure B-11.)* The manual picture control switch (14) for taking selective pictures is located on the left hand control console (13), just forward of the master water injection switch. The purpose of the manual picture push-button is to permit the pilot to take individual pictures when the camera control switch is moved from the "AUTOMATIC" position to the "MANUAL" position. The push-button is depressed for each picture desired.

B-64. INTERVALOMETER WARNING LIGHT.

B-65. DESCRIPTION. *(See figure B-11.)* An amber intervalometer warning light (19) is located on the camera control panel on the right hand console just forward of the film feed breakage warning light (20). It is lighted two seconds before the intervalometer trips the camera during automatic operation.

B-66. FILM FEED BREAKAGE WARNING LIGHT.

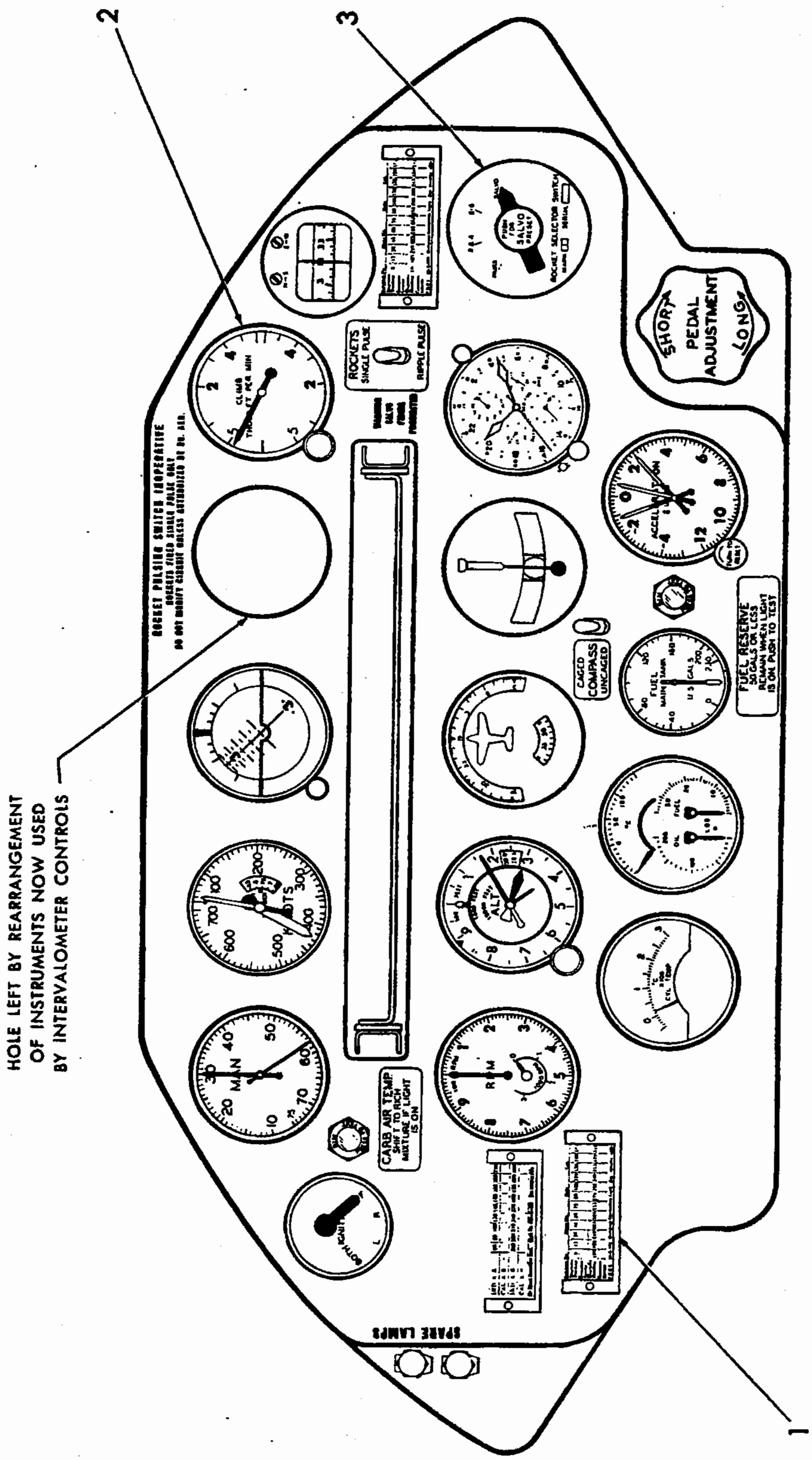
B-67. DESCRIPTION. *(See figure B-11.)* A red film feed breakage warning light (20) is located on the camera control panel on the right hand console. Whenever breakage in the film occurs during camera operation, the film breakage warning light is illuminated.

B-68. INSTRUMENT PANEL.

B-69. DESCRIPTION. *(See figure B-12.)* The instrument panel in the F4U-5P airplane is the same as in the F4U-5 airplane except as follows: The climb indicator is above the elapsed time clock and the Mark 1 rocket selector switch is relocated below the stand-by compass. The P-3 compass correction card is located on the left side below the airspeed correction card. A B-3B intervalometer is installed above the climb indicator at the top of the instrument panel.

B-70. PHOTOGRAPHIC EQUIPMENT ELECTRICAL SYSTEM.

B-71. DESCRIPTION. *(See figures B-14 and B-16.)* When the master camera switch, located on the camera control panel on the right hand console is moved to the "ON" position, power from the airplane's electrical system, a 28-volt direct current installation supplied by a 28-volt, 200 ampere generator, and a 24-volt, 17 ampere-hour battery, is directed to the camera electrical operating system. Operation of the camera system is as follows: With the master camera switch in the "ON" position, power flows from the plus bus of the airplane's electrical system to the camera control circuit breaker, to the camera bus, through a capacitor in this circuit to the vacuum pump. In addition, power passes from the plus bus through the camera door circuit breaker to the camera door circuit. The film feed breakage warning light (red) circuit is closed when film breakage occurs. The intervalometer warning light (amber) is lighted two seconds before the intervalometer trips the camera during automatic operation. With the camera door position switch in the "OPEN" position, power flows from the camera door circuit breaker through the camera door switch to the camera door actuating motor, and the three camera doors open simultaneously. Movement of the camera door switch to the "CLOSED" position allows power to flow to the other side of the door



1. P-3 Compass Correction Card
2. Climb Indicator
3. Mk 1 Rocket Selector Switch

Figure B—12. F4U-5P Instrument Panel.

circuit and the doors close. When the doors are fully opened they close microswitches, which are actuated by contact bolts on the doors, and allow power to flow from the camera bus to the door microswitches, and then forward to three amber door position lights, located on the right hand camera control panel forward of the "MASTER" and "VHF" switches. When lighted, these lights indicate that the camera doors are fully opened, and that the camera system will operate if the position light is on. To move the camera to any of the five positions shown (three and fifteen degrees down from the horizontal on both right and left sides and vertical) push the required button.

B-72. For the three degree left position as shown in figure B-13, power will flow from the camera bus through the camera control panel, aft to camera position microswitch No. 11, located on the yoke, and then to the relay in the camera adapter actuator control box. Power through this switch also energizes the normally closed green camera position indicator light circuit. This turns the light off during the time the camera is in transit. At the same time, the relay in the camera adapter actuator control box directs power to the sway brace solenoid, retracting the solenoid from its extended position. The solenoid in retracting closes a switch, located on a bracket above the solenoid, and in doing so, causes power flow to the camera adapter actuating motor which then rotates the adapter and the camera into the selected position. When the camera has reached this position, the aluminum master cam secured to the adapter opens camera position switch No. 1 and rotation ceases. Power to the relay in the camera control

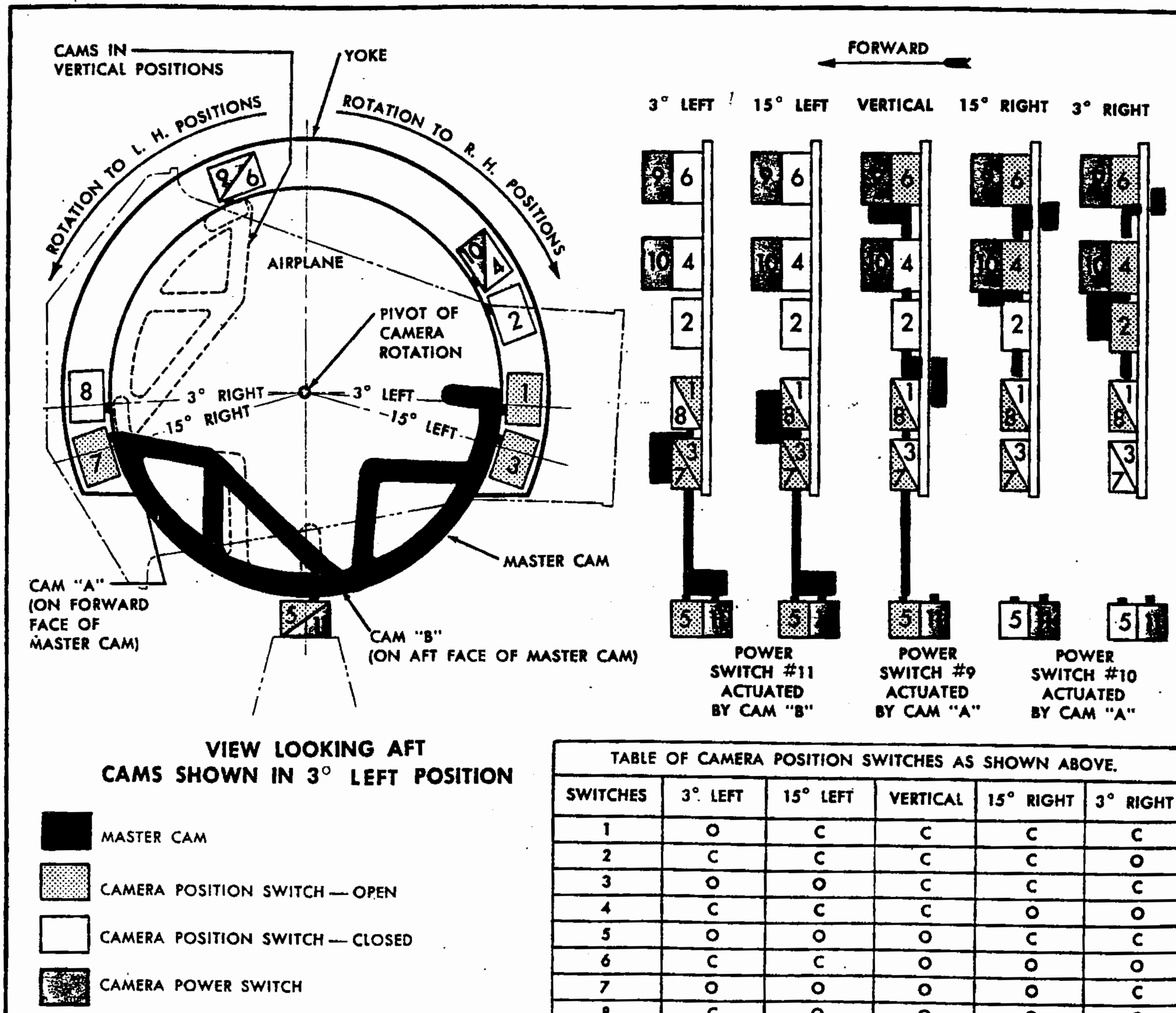


TABLE OF CAMERA POSITION SWITCHES AS SHOWN ABOVE.

SWITCHES	3° LEFT	15° LEFT	VERTICAL	15° RIGHT	3° RIGHT
1	O	C	C	C	C
2	C	C	C	C	O
3	O	O	C	C	C
4	C	C	C	O	O
5	O	O	O	C	C
6	C	C	O	O	O
7	O	O	O	O	C
8	C	O	O	O	O

Figure B–13. Switches Diagrams.

panel in the cockpit stops and the camera position indicating light goes on. Power is also cut off from the camera adapter actuator relay, de-energizing the actuator motor and the solenoid sway brace. The solenoid sway brace then extends and meshes with the serrated mating pad on the fuselage structure, locking the camera in position. With the doors fully opened, power flows from the plus bus and camera door microswitches to one side of three camera operation microswitches (No. 9-vertical, No. 10-right, and No. 11-left) completing the circuit to the camera and permitting camera operation. In the three degree left position No. 11 switch is actuated by a phenolic cam, located on the master cam, allowing power to flow to the relay in the cockpit relay box and then to the camera which is now ready to take pictures manually or automatically. When the camera control switch in the cockpit is moved to the "MANUAL" position power flows from the camera bus through the manual camera switch on the left hand console, to the camera control switch and the cockpit relay box, and then to the camera. The manual camera switch on the left hand control console, to the left of the intercooler and oil cooler door indicator, which is aft of the hydraulic pressure gage, is then depressed to complete the circuit. This switch must be depressed for each individual picture desired.

Note

The intervalometer power toggle switch should be moved to the "OFF" position during manual operation of the camera system in order to prevent a false recording of the number of pictures taken.

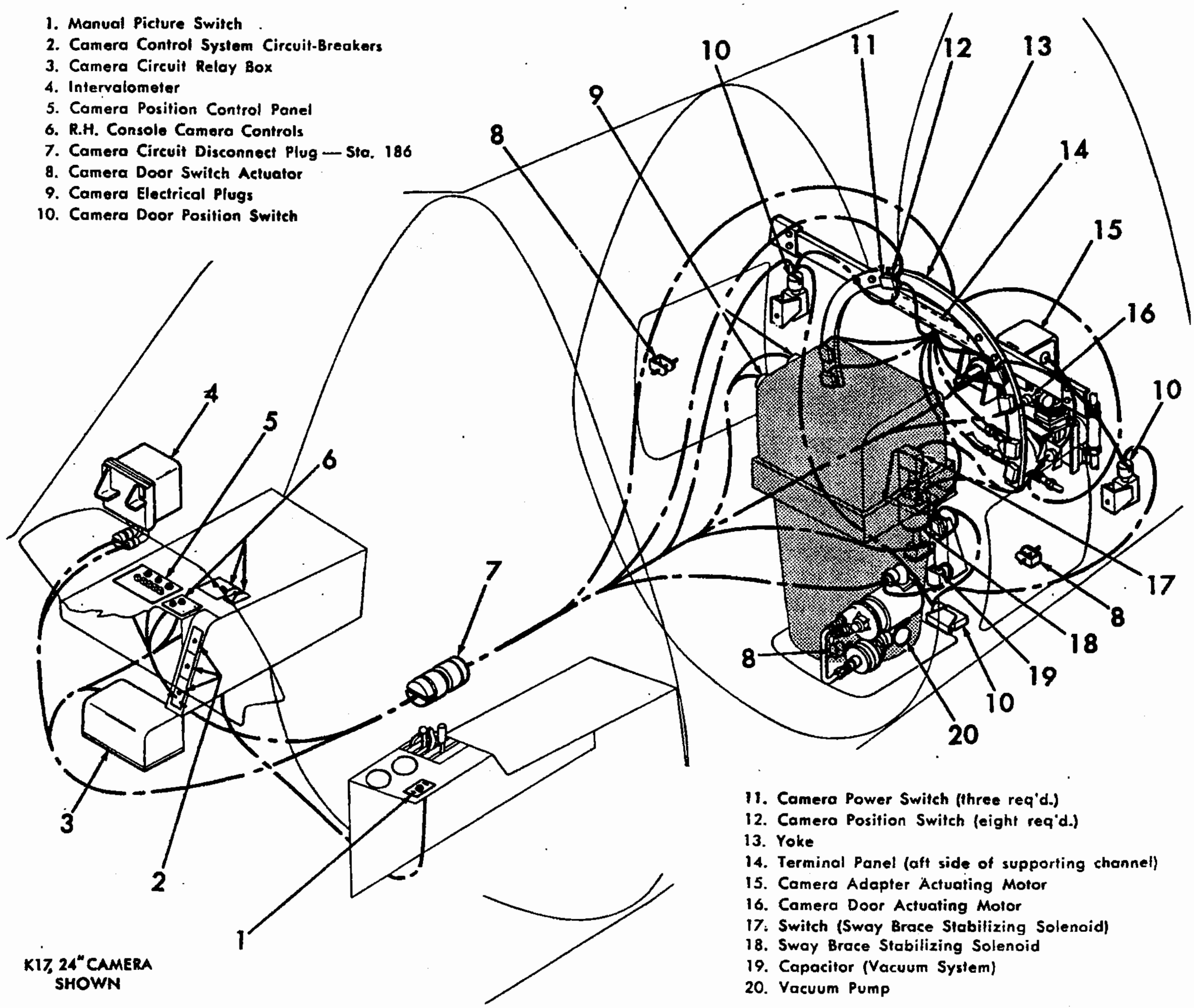
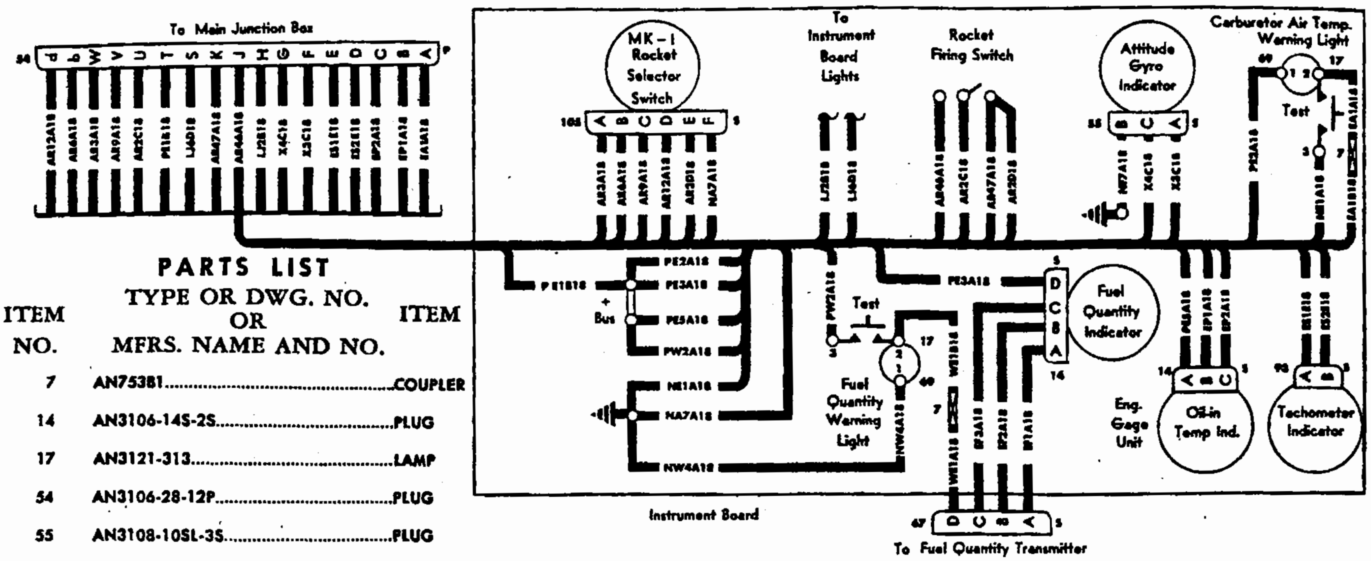


Figure B—14. Camera Electrical System.



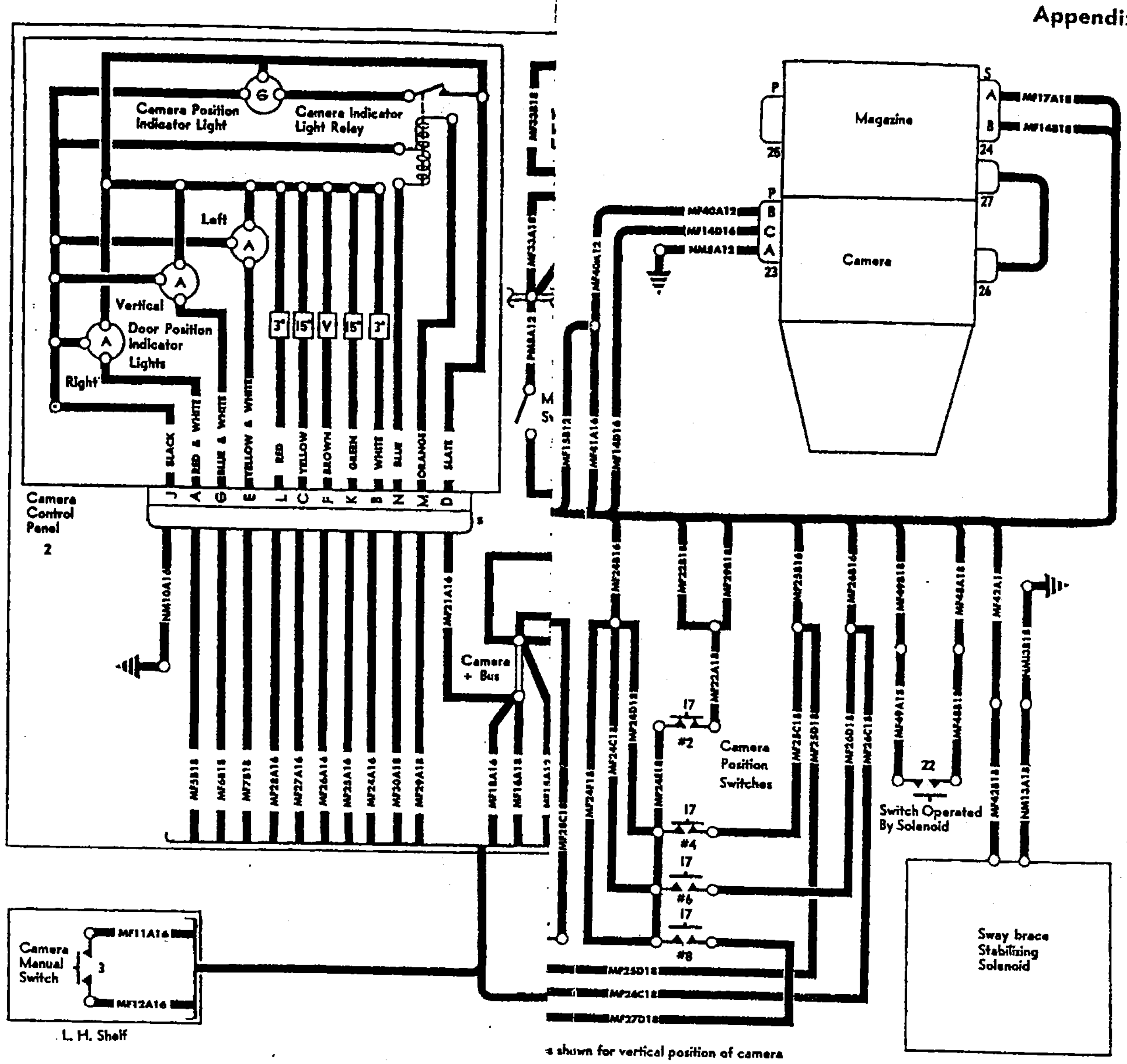
PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	ITEM
7	AN75381	COUPLER
14	AN3106-14S-2S	PLUG
17	AN3121-313	LAMP
54	AN3106-28-12P	PLUG
55	AN3108-10SL-3S	PLUG
69	VS-44422-1	LT. ASSEM.
93	AN3106-14S-1S	PLUG
105	AN3106-14S-6S	PLUG

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE		END TYPE		LENGTH IN.
		AN LUG	INS. SL. CVC	AN LUG	INS. SL. CVC	
AR2C18	AN 18	-	860-18-3	659-2	860-16-3	20
AR2D18	AN 18	-	860-18-3	659-2	860-16-3	8
AR3A18	AN 18	-	860-18-3	-	860-18-3	20
AR6A18	AN 18	-	860-18-3	-	860-18-3	20
AR9A18	AN 18	-	860-18-3	-	860-18-3	20
AR12A18	AN18	-	860-18-3	-	860-18-3	20
AR46A18	AN 18	-	860-18-3	659-2	860-16-3	20
AR47A18	AN 18	-	860-18-3	659-2	860-16-3	20
EA1A18	AN 18	-	860-18-3	753-A1	-	3
EA1B18	AN18	753-A1	-	-	-	26
EF1A18	AN 18	-	860-18-3	-	860-18-3	48
EF2A18	AN 18	-	860-18-3	-	860-18-3	48
EF3A18	AN 18	-	860-18-3	-	860-18-3	48
EP1A18	AN 18	-	860-18-3	-	860-18-3	36
EP2A18	AN 18	-	860-18-3	-	860-18-3	36
ES1E18	AN 18	-	860-18-3	-	860-18-3	46
ES2E18	AN 18	-	860-18-3	-	860-18-3	46
LJ2B18	AN 18	-	860-18-3	753-A1	-	8
LJ6D18	AN 18	-	860-18-3	753-A1	-	8
NA7A18	AN 18	-	860-18-3	659-2	860-16-3	14
NE1A18	AN 18	-	-	659-2	860-16-3	32
NF7A18	AN 18	-	860-18-3	659-2	860-16-3	20
NW4A18	AN 18	659-2	860-16-3	-	-	34
PE1B18	AN 18	-	860-18-3	659-2	860-16-3	16
PE2A18	AN 18	659-2	860-16-3	-	-	32
PE3A18	AN 18	-	860-18-3	659-2	860-16-3	34
PE5A18	AN 18	-	860-18-3	659-2	860-16-3	26
PW2A18	AN 18	-	-	659-2	860-16-3	34
WE1A18	AN 18	-	860-18-3	753-A1	-	54
WE1B18	AN 18	753-A1	-	-	-	3
X3C18	AN 18	-	860-18-3	-	860-18-3	24
X4C18	AN 18	-	860-18-3	-	860-18-3	24

Figure B—15. Instrument Panel Wiring Diagram.



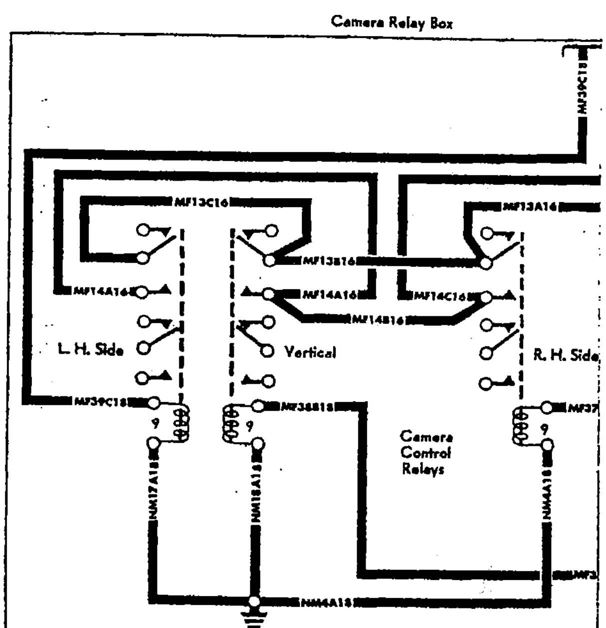


Figure B—16. Photogr

PARTS LIST

ITEM NO.	TYPE OR DWG. NO. OR MFRS. NAME AND NO.	ITEM
1	AN3106-20-1S	PLUG
2	VS-61435 CHANCE VOUGHT LEAR, INC. 36031 ISSUE	CONTROL PANEL
3	VS-47951 CHANCE VOUGHT AERO. ELECT. CO. 3N05-5P	SWITCH
4	AN3121-313	LIGHT
5	AN3161-P15	CIRCUIT BREAKER
6	AN3161-P10	CIRCUIT BREAKER
7	AN3022-2	SWITCH
8	AN3022-3	SWITCH
9	VS-48746 CHANCE VOUGHT PHILLIPS CONT. CORP. 27QA-6E	RELAY
10	AN3108-12S-3P	PLUG
11	AN3108-16S-6S	PLUG
12	VS-61429 CHANCE VOUGHT—TYPE B-3B (G. F. E.)	INTERVALOMETER
13	AN3106-28-11P	PLUG
14	AN3100-28-11S	RECEPTACLE
15	AN3108-16-11S	PLUG
16	VS-34986 CHANCE VOUGHT SOLAR MANUF. CORP. NO. XDMRW-6-1-10-20	CONDENSER
17	AN3234-1	SWITCH
18	AN3217-1	SWITCH
19	AN3100-20-27S	RECEPTACLE
20	VS-61750 CHANCE VOUGHT LEAR, INC. NO. 111BJ	ACTUATOR UNIT
21	AN3106-16S-1S	PLUG
22	AN3216-1	SWITCH
23	AN3106-16-6P (INTERVALOMETER)	PLUG
24	AN3108-12S-3S (FILM FEED)	PLUG
25	AN3102-16-11P (PORTABLE)	RECEPTACLE
26	AN3106-16-11S (GFE)	PLUG
27	AN3106-16-11P (GFE)	PLUG

REFERENCE FIGURE B—16.

WIRE TABLE

WIRE NO.	NAF 1070	END TYPE		END TYPE		LENGTH IN.
		AN LUG	CVC INS. SL.	AN LUG	CVC INS. SL.	
MF1A16	AN16	659-4	860-14-3	-	860-16-3	35
MF1B16	AN16	-	860-16-3	-	860-16-3	35
MF1C16	AN16	659-4	860-14-3	-	860-16-3	30
MF1D18	AN18	659-2	860-16-3	-	860-18-3	10
MF2A16	AN16	659-4	860-14-3	-	860-16-3	35
MF2B16	AN16	-	860-16-3	-	860-16-3	75
MF3A16	AN16	659-4	860-14-3	-	860-16-3	35
MF3B16	AN16	-	860-16-3	-	860-16-3	75
MF4A18	AN18	659-2	860-16-3	-	860-16-3	35
MF4B18	AN18	753-A1	-	-	860-18-3	55
MF4C18	AN18	CVC-880-22	860-16-3	753-A1	-	10
MF4D18	AN18	CVC-880-22	860-16-3	753-A1	-	10
MF4E18	AN18	753-A1	-	CVC-880-22	860-16-3	50
MF4F18	AN18	753-A1	-	CVC-880-22	860-16-3	25
MF4G18	AN18	753-A1	-	CVC-880-22	860-16-3	25
MF5A18	AN18	753-A1	-	CVC-880-22	860-16-3	5
MF5B18	AN18	-	-	-	860-18-3	30
MF5C18	AN18	-	860-18-3	753-A1	-	50
MF6A18	AN18	CVC-880-22	860-16-3	753-A1	-	5
MF6B18	AN18	-	860-18-3	-	-	30
MF6C18	AN18	753-A1	-	-	860-16-3	50
MF7A18	AN18	CVC-880-22	860-16-3	753-A1	-	5
MF7B18	AN18	-	860-18-3	-	860-18-3	30
MF7C18	AN18	753-A1	-	-	860-18-3	50
MF11A16	AN16	659-4	860-14-3	659-4	860-14-3	25
MF12A16	AN16	659-4	860-14-3	659-4	860-14-3	25
MF13A16	AN16	659-4	860-14-3	-	-	15
MF13B16	AN16	-	-	-	-	5
MF13C16	AN16	-	-	-	-	5
MF14A16	AN16	-	-	-	-	5
MF14B16	AN16	-	-	-	-	5
MF14C16	AN16	-	-	-	860-16-3	30
MF14D16	AN16	-	860-16-3	-	860-16-3	45
MF15A12	AN12	659-5	860-10-3	-	860-12-3	25
MF15B12	AN12	-	860-12-3	659-5	860-10-3	45
MF16A18	AN18	659-2	860-16-3	-	860-18-3	35
MF16B18	AN18	-	860-18-3	-	860-18-3	45
MF17A18	AN18	-	860-18-3	-	860-18-3	45
MF17B18	AN18	-	-	-	860-18-3	35
MF18A16	AN16	659-4	860-14-3	-	860-16-3	30
MF19A16	AN16	659-4	860-14-3	-	860-16-3	30
MF20A18	AN18	-	-	-	860-18-3	30
MF21A16	AN16	-	860-16-3	659-4	860-14-3	15
MF22A18	AN18	659-2	860-16-3	JON-110-880	860-16-3	60
MF22B18	AN18	659-2	860-16-3	-	860-18-3	20
MF23A18	AN18	659-2	860-16-3	JON-110-880	860-1-3	60
MF23B18	AN18	659-2	860-16-3	-	860-18-3	20
MF24A16	AN16	-	860-16-3	-	860-16-3	30
MF24B16	AN16	-	860-16-3	659-2	860-14-3	60
MF24C18	AN18	659-2	860-16-3	JON-110-880	860-16-3	15
MF24D18	AN18	659-2	860-16-3	JON-110-880	860-16-3	15
MF24E18	AN18	JON-110-880	860-16-3	JON-110-880	860-16-3	10
MF24F18	AN18	659-2	860-16-3	JON-110-880	860-16-3	20
MF25A16	AN16	-	860-16-3	-	860-16-3	30
MF25B16	AN16	-	860-16-3	659-2	860-14-3	60
MF25C18	AN18	659-2	860-16-3	JON-110-880	860-16-3	40
MF25D18	AN18	659-2	860-16-3	JON-110-880	860-16-3	35
MF26A16	AN16	-	860-16-3	-	860-16-3	30
MF26B16	AN16	-	860-16-3	JON-110-880	860-14-3	60
MF26C18	AN18	659-2	860-16-3	JON-110-880	860-16-3	40

WIRE TABLE (Continued) REFERENCE FIGURE B-16

WIRE NO.	NAF 1070	END TYPE		END TYPE		LENGTH IN.
		AN LUG	CVC INS. SL.	AN LUG	CVC INS. SL.	
MF26D18	AN18	659-2	860-16-3	JON-110-880	860-16-3	10
MF27A16	AN16	-	860-16-3	-	860-16-3	30
MF27B16	AN16	-	860-16-3	659-2	860-14-3	60
MF27C18	AN18	659-2	860-16-3	JON-110-880	860-16-3	50
MF27D18	AN18	659-2	860-16-3	JON-110-880	860-16-3	30
MF28A16	AN16	-	860-16-3	-	860-16-3	30
MF28B16	AN16	-	860-16-3	659-2	860-14-3	60
MF28C18	AN18	JON-110-880	860-16-3	659-2	860-16-3	25
MF28D18	AN18	JON-110-880	860-16-3	659-2	860-16-3	25
MF28E18	AN18	JON-110-880	860-16-3	659-2	860-16-3	5
MF28F18	AN18	JON-110-880	860-16-3	659-2	860-16-3	
MF29A18	AN18	-	860-18-3	-	860-18-3	50
MF29B18	AN18	659-2	860-16-3	-	860-18-3	80
MF30A18	AN18	-	860-18-3	-	860-18-3	50
MF30B18	AN18	659-2	860-16-3	-	860-18-3	80
MF33A18	AN18	659-2	860-16-3	-	-	10
MF33B18	AN18	-	-	-	-	2
MF34A18	AN18	CVC-880-22	860-16-3	659-2	860-16-3	20
MF34B18	AN18	JON-110-880	860-16-3	659-2	860-16-3	20
MF35A18	AN18	CVC-880-22	860-16-3	659-2	860-16-3	20
MF35B18	AN18	JON-110-880	860-16-3	659-2	860-16-3	20
MF36A18	AN18	CVC-880-22	860-16-3	753-A1	-	15
MF36B18	AN18	JON-110-880	860-16-3	753-A1	-	15
MF37A18	AN18	JON-110-880	860-16-3	659-2	860-16-3	40
MF37B18	AN18	659-2	860-16-3	-	860-16-3	40
MF37C18	AN18	659-2	860-16-3	-	860-18-3	60
MF38A18	AN18	JON-110-880	860-16-3	659-2	860-16-3	40
MF38B18	AN18	659-2	860-16-3	-	860-18-3	60
MF38C18	AN18	659-2	860-16-3	-	860-18-3	40
MF39A18	AN18	JON-110-880	860-16-3	659-2	860-16-3	50
MF39B18	AN18	659-2	860-16-3	-	860-18-3	50
MF39C18	AN18	659-2	860-16-3	-	860-18-3	60
MF40A12	AN12	659-5	860-10-3	-	860-12-3	30
MF41A16	AN16	659-4	860-14-3	-	860-16-3	20
MF42A18	AN18	659-2	860-16-3	-	860-18-3	20
MF42B18	AN18	659-2	860-16-3	659-2	860-16-3	30
MF48A18	AN18	-	860-18-3	659-2	860-16-3	30
MF48B18	AN18	JON-110-880	860-16-3	659-2	860-16-3	40
MF49A18	AN18	JON-110-880	860-16-3	659-2	860-16-3	30
MF49B18	AN18	-	860-18-3	659-2	860-16-3	40
NM4A18	AN18	659-2	860-16-3	-	-	5
NM5A12	AN12	659-5	860-10-3	-	860-12-3	5
NM6A16	AN16	659-4	860-14-3	-	860-16-3	5
NM7A18	AN18	659-2	860-16-3	-	860-18-3	5
NM8A16	AN16	659-4	860-14-3	-	860-16-3	5
NM9A16	AN16	659-4	860-14-3	-	860-16-3	5
NM10A16	AN16	659-4	860-14-3	-	860-16-3	5
NM13A18	AN18	659-2	860-16-3	659-2	860-16-3	30
NM13B18	AN18	659-2	860-16-3	659-2	860-16-3	20
NM14A18	AN18	659-2	860-16-3	-	-	10
NM15A18	AN18	659-2	860-16-3	-	-	10
NM16A16	AN16	659-4	860-14-3	-	860-16-3	5
NM17A18	AN18	659-2	860-16-3	-	-	5
NM18A18	AN18	659-2	860-16-3	-	-	5
PM8A12	AN12	659-5	860-10-3	659-5	860-10-3	5
PM9A12	AN12	659-5	860-10-3	659-5	860-10-3	5
PM9B16	AN16	659-4	860-14-3	659-4	860-14-3	2
PM10A12	AN12	659-5	860-10-3	659-5	860-10-3	5
PM11A14	AN14	659-4	860-14-3	659-4	860-14-3	5
PM12A16	AN16	659-4	860-14-3	659-4	860-14-3	5

B-73. For automatic operation the camera control switch must be moved to the "AUTOMATIC" position. When this is done, power flows from the camera bus to the intervalometer, through the camera control switch to one side of the relay in the cockpit relay box, and from there to the camera. With the intervalometer power supply toggle switch "ON", the intervalometer will trip the camera at regulated intervals previously determined. Operation of the system when other camera positions are selected is the same with the exception that other position microswitches are brought into action.

Note

This type control system prevents camera operation and film waste when the camera doors are not open.

Figure B-13 shows the position of the camera adapter and camera in the three degree left position and the relation of the yoke microswitches to the master cam. The chart below the illustration indicates the operation of the switches when the camera is in any of the selected positions.

B-74. RELOCATED EQUIPMENT.

B-75. P-3 COMPASS TRANSMITTER. The P-3 compass transmitter (see paragraph 4-1385) is located in the fin between ribs 12 9/16 and 25 1/8. To accommodate this installation, a blister is located on each side of the fin. Access is gained by removing a portion of the skin containing the blister.

B-76. RT-22/APX-1 IFF TRANSPONDER ANTENNA MAST. The antenna mast for the RT-22/APX-1 IFF Transponder (see paragraph 5-195) is moved aft to station 300 and a new cable assembly provided.

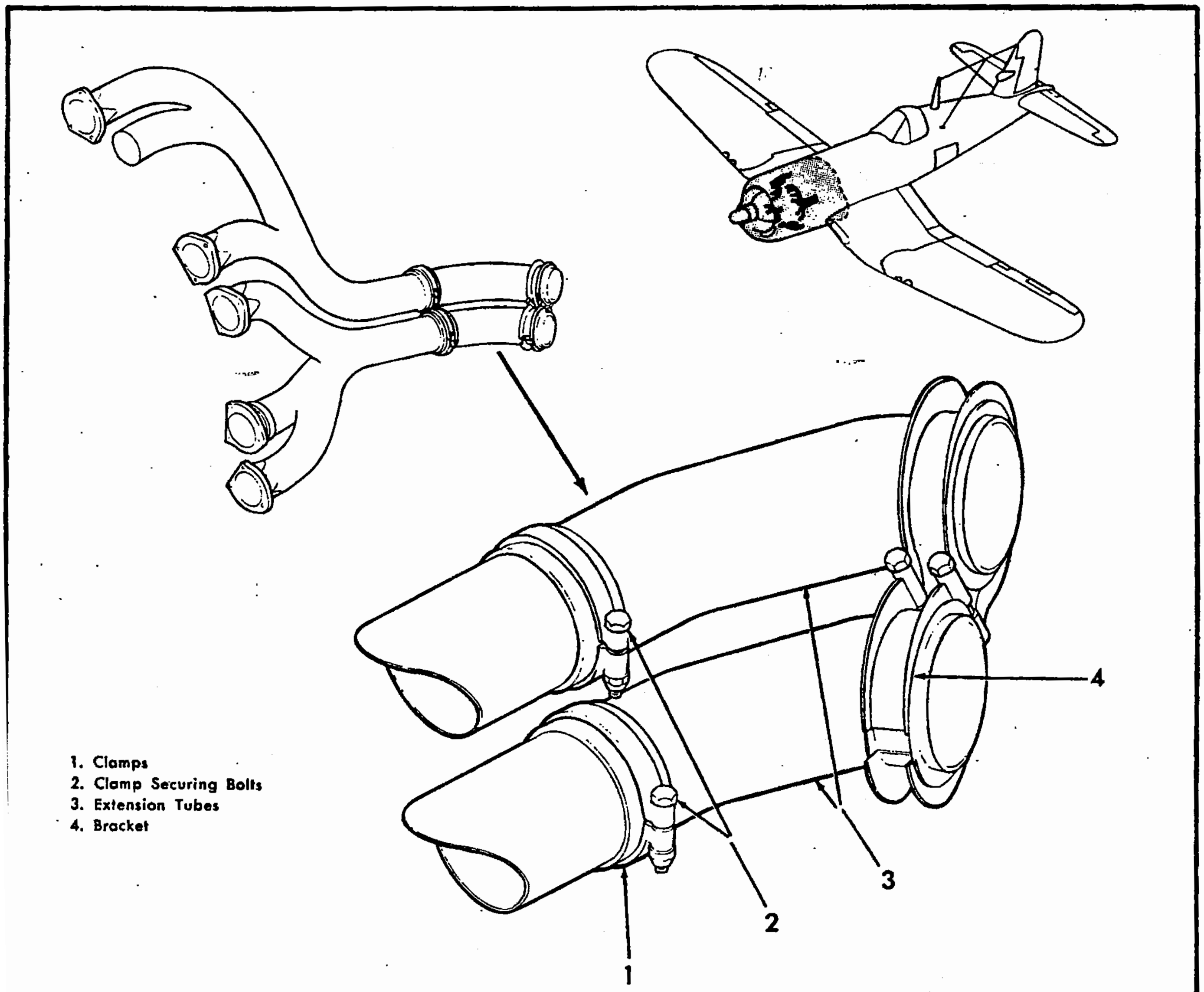


Figure B–17. Exhaust Stack Extension.

B-77. WINDSHIELD DECK COWL. A new windshield deck cowl (see paragraph 4-227) differs from that of the standard F4U-5 aircraft in that the aft edge cutout section extends five inches farther to the right.

B-78. EXHAUST STACK EXTENSIONS.

B-79. DESCRIPTION. *(See figure B-17.)* The exhaust stack extensions are clamped to the upper two exhaust stacks on each side of the airplane to divert the exhaust gases outward and downward away from the side camera openings. The exhaust stack extension assembly is composed of two stainless steel tubes that are clamped together at the aft end by a bracket and individually attached to the exhaust collectors by clamps.

B-80. REMOVING. *(See figure B-17).* To remove the exhaust stack extension remove two cotter pins, loosen two bolts, and slide extension off.

B-81. INSTALLING. Install the exhaust stack extension by reversing the removal procedure given in paragraph B-80.

B-82. CAMERA DOOR CONTROL CABLES CHART.

B-83. DESCRIPTION. Figure B-18 is to be used as a reference key in locating the camera door control cables defined in paragraph B-84.

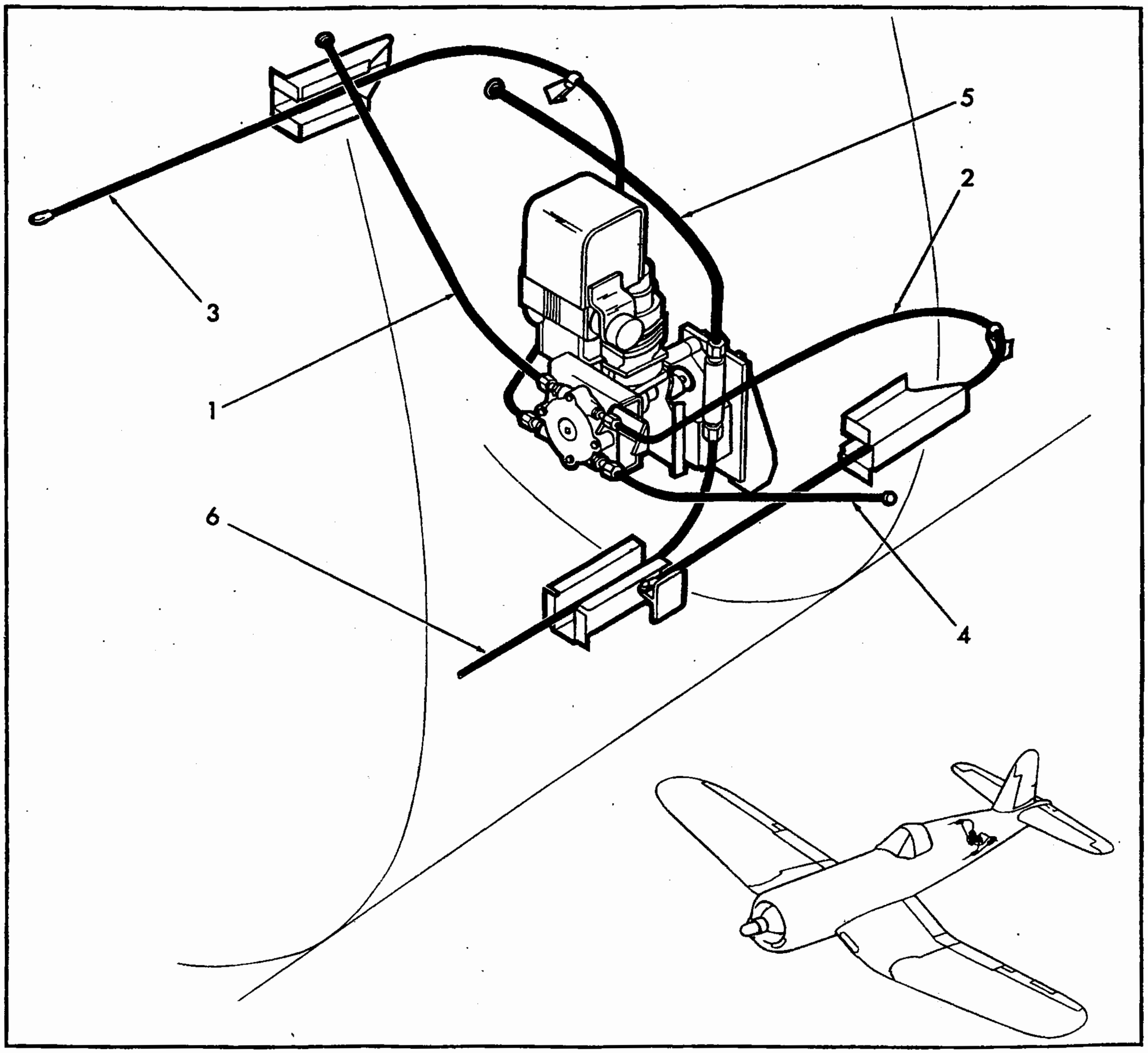


Figure B—18. Camera Door Control Cables Reference Diagram.

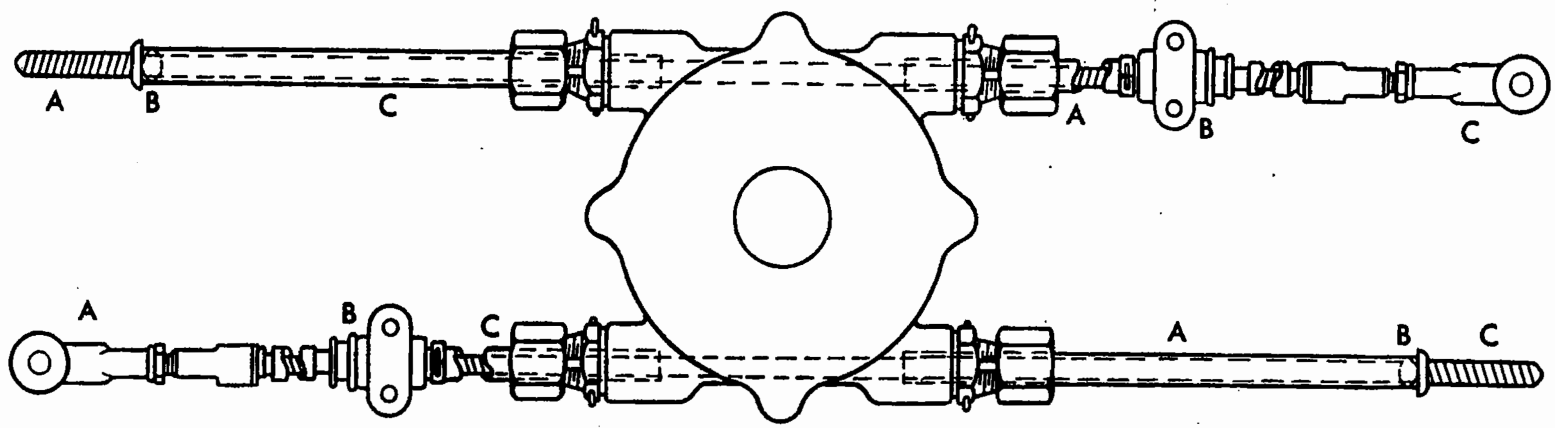
B-84. CAMERA DOOR CONTROL CAE

1. *VS-61452 (Ref.) Teleflex — Camera Doors Controls Instal. — Left Door Overtravel*

	Length
A. CVC-1201-2-650 Cable (SA118A-2)	65
B. CVC-1208-1 Plug (31308)	
C. VS-61737-4 (CVC-1202-1-185) Conduit (SA116A-1)	18½

2. *VS-61452 (Ref.) Teleflex — Camera Doors Controls Instal. — Left Door Operating*

	Length
A. VS-61737-2 (CVC-1202-1-350) Conduit (SA116A-1)	35
B. CVC-1232-80 Telescopic Unit (SA104A-80)	
C. AN486-3 Rod End	

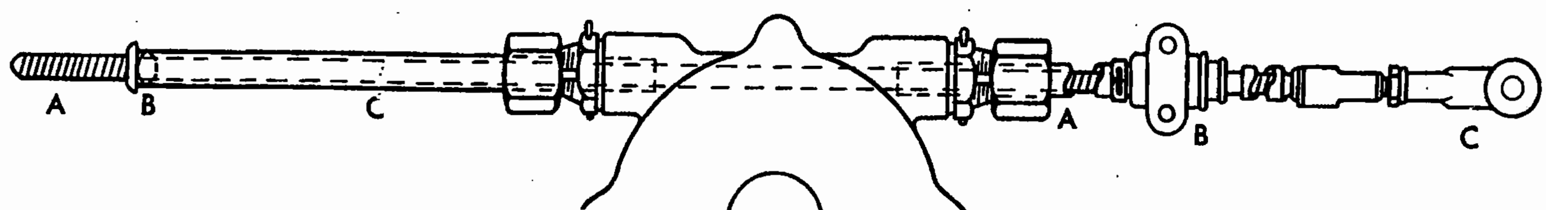


3. *VS-61452 (Ref.) Teleflex — Camera Doors Controls Instal. — Right Door Operating*

	Length
A. AN486-3 Rod End	
B. CVC-1232-80 Telescopic Unit (SA104A-80)	
C. VS-61737-5 (CVC-1202-1-350) Conduit (SA116A-1)	35

4. *VS-61452 (Ref.) Teleflex — Camera Doors Controls Instal. — Right Door Overtravel*

	Length
A. VS-61737-1 (CVC-1202-1-170) Conduit (SA116A-1)	17
B. CVC-1208-1 Plug (31308)	
C. CVC-1201-2-650 Cable (SA118A-2)	65



5. *VS-61452 (Ref.) Teleflex — Camera Doors Controls Instal. — Bottom Door Overtravel*

	Length
A. CVC-1201-2-380 Cable (SA118A-2)	38
B. CVC-1208-1 Plug (31308)	
C. VS-61737-3 (CVC-1202-1-190) Conduit (SA116A-1)	19

6. *VS-61452 (Ref.) Teleflex — Camera Doors Controls Instal. — Bottom Door Operating*

	Length
A. VS-61737-6 (CVC-1202-1-60) Conduit (SA116A-1)	6
B. CVC-1232-80 Telescopic Unit (SA104A-80)	
C. AN486-3 Rod End	

B-85. MAINTENANCE INSPECTION.

The following maintenance inspection information is presented in tabular form so that the mechanic can quickly locate the periodic inspections applicable to each system or section of the airplane. For explanation of the terms and symbols used in the table refer to paragraphs 7-1 through 7-4.

I—Inspect (visual only)
C—Check (functional)
R—Remove, recondition or replace
O—Overhaul on airplane

Item No.	NATURE OF INSPECTION	PREFLIGHT	DAILY	25-30 HOUR	50-60 HOUR	75-90 HOUR	100-120 HOUR	OTHER
	I. PHOTOGRAPHIC EQUIPMENT.							
A.	FUSELAGE INSTALLATION.							
1.	CAMERA.							
	a. Check camera for security in camera mount.	C						
2.	VACUUM SYSTEM.							
	a. Check for leaks and readings.	C		C	C	C	C	
3.	SWAY BRACING.							
	a. Check for security.	C		C	C	C	C	
	b. Check operation of solenoid.	C		C	C	C	C	
4.	CAMERA COMPARTMENT.							
	a. Inspect for loose gear.	I						
5.	OPERATIONAL CHECK.							
	a. Check rotation of camera to all positions.	C		C	C	C	C	
	b. Check operation of intervalometer.	C		C	C	C	C	
	c. Check operation of camera doors, and roor position lights.	C		C	C	C	C	
	d. Check manual selection by depressing manual push-button for one exposure.	C		C	C	C	C	
6.	EXHAUST STACK EXTENSION.							
	a. Check for presence of extension on each upper stack.	I						
B.	COCKPIT INSTALLATION.							
	a. Check operation of all photographic equipment switches and indicating lights.	C		C	C	C	C	
	b. Inspect cockpit for loose gear.	I						

pb 756 BLANK

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INDEX (continued)

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APPENDIX I

NIGHT FIGHTER EQUIPMENT

APPENDIX II

PHOTOGRAPHIC EQUIPMENT