AIR PUBLICATION

2847A & B
VOLUME I

LINCOLN B I & II

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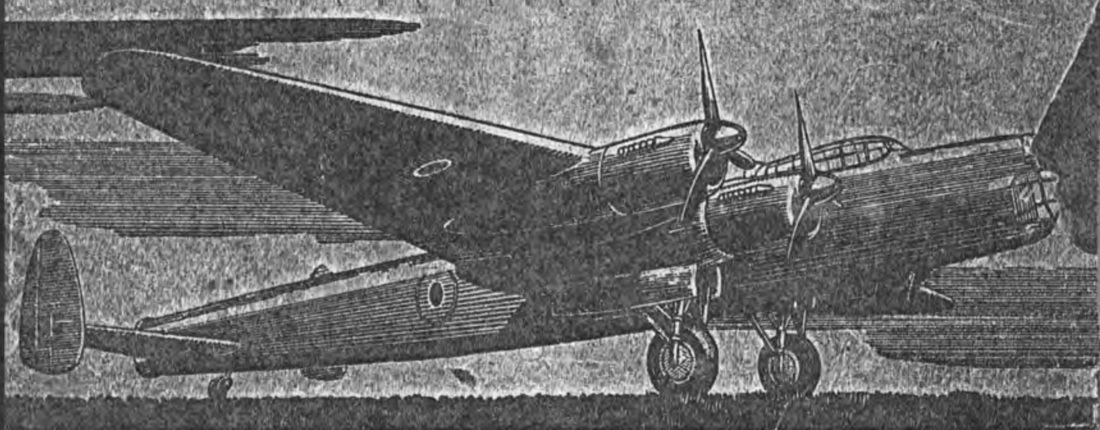

AIR MINISTRY

PREPARED BY DIRECTION OF
THE MINISTER OF AIRCRAFT
PRODUCTION

PROMULGATED BY ORDER
OF THE AIR COUNCIL

P5803/ 10/44

List of Sections

Preliminaries:—

Leading Particulars

Introduction

Sections:—

NOTE

A list of contents is given at the beginning of each section or chapter

P9754 M /G4066 3/64 1050 C & P Gp. 1

Leading Particulars

NAME: LINCOLN B Mk. I AND II

TYPE: FOUR-ENGINED, MID-WING MONOPLANE
DUTY: HEAVY BOMBER
NO. OF CREW: 7 (INCLUDING PILOT)

Main Dimensions

For main dimensions, control surface settings and ranges of movement, see general arrangement diagram, fig. 1

Alighting Gear

MAIN WHEEL UNITS—

Type Two retractable single-wheel units with twin shock-absorber struts

Track ... ... 23 ft. 9 in.

	75,000 lb. max. A.U.W.	*above 75,000 lb. A.U.W.*
Shock-absorber struts	Dowty oleo-pneumatic	Dowty oleo-pneumatic
Type	A.9833	A.4487
Air pressure (no load),	1,200–1,250 lb. per sq. in.	1,200–1,250 lb. per sq. in.
Fluid	D.T.D.44D (Stores Ref. 34A/43 or 141) or	D.T.D.585 (Stores Ref. 34A/159)
Wheels	A.H.8268	A.H.8405
***Tyres—**		
Covers ...	H.J.—R14—N (64 x 22·50—26)	H.J.—R16—N (64 x 22·50—26)
Tubes	H.J.8	H.J.8
Brakes	A.H.8269	A.H.8269
**Working pressure—differential valve at neutral	125 lb. per sq. in.	125 lb. per sq. in.

TAIL WHEEL UNIT—

Type ... ... Non-retractable, castering

	7,800 lb. tail load	above 7,800 lb. tail load
Shock-absorber strut	Dowty oleo-pneumatic	Dowty oleo-pneumatic
Type	A.6840	A.6840
Air pressure (no load)	650–700 lb. per sq. in.	725–775 lb. per sq. in.
Fluid	D.T.D.44D (Stores Ref. 34A/43 or 141) or	D.T.D.585 (Stores Ref. 34A/159)
Wheel	A.H.8013	A.H.8403
***Tyre—**		
Cover	NX. R.30 (Twin contact) 12·50—10	FF. ER.17–N (Normal section) 32 x 10·00—15
Tube	N.X.2	F.F.2

*For inflation pressures, refer to A.P.2847A and B, Vol. II, Part 2

**Maximum pressure on either side with full rudder must not exceed 150 lb. per sq. in.

(continued overleaf)

LEADING PARTICULARS—*CONTINUED*

Hydraulic Systems

GENERAL SERVICES—

Fluid ... ... Specification D.T.D.585 (Stores Ref. 34A/159)

System capacity ... ... 19 gall. approx.

Automatic cut-out—

Cutting-in pressure ... ... 180 lb. per sq. in.
Cutting-out pressure ... ... 800–850 lb. per sq. in.

Accumulator inflation pressure ... ... 220 lb. per sq. in

Emergency system (undercarriage and flaps only) air bottles inflation pressure ... 1,200 lb. per sq. in.

TURRETS—

Nose ... ...
Tail ... ...
} Specification D.T.D.585 (Stores Ref. 34A/159)

Header tank inflation pressure ... ... 15 lb. per sq. in.
(F.N. tail turret only)

Pneumatic System

Air bottle inflation pressure ... ... 450 lb. per sq. in.
Reducing valve pressure ... ... 220 lb. per sq. in.
Maintaining valve pressure ... ... 160 lb. per sq. in.

Nitrogen System

Nitrogen bottle inflation pressure ... ... 1,800 lb. per sq. in.

Power Plants

Name ... ... { Merlin 85 (Lincoln B. Mk. I) / Merlin 68 (Lincoln B. Mk. II)

Type ... ... 12-cylinder, 60° V-type, pressure-liquid-cooled, fitted with a two-speed, two-stage liquid-cooled supercharger with inter-cooler

Number ... ... Four

Fuel ... ... 100 octane D.E.D.2475 (Stores Ref. 34A/75)

OIL—

Tropical climates, Summer ...
" " Winter ...
Temperate climates, Summer ...
" " Winter ...
} Specification D.E.D/2472/B/O (Stores Ref. 34A/32). Key letter X

COOLANT—

Engine system supercharger intercooler ...30% ethylene glycol D.T.D.344A (Stores Ref. 33C/559) and 70% distilled water

OIL DILUTION SYSTEM—

Valve Ref. 5U/1567
Voltage 24
Jet Ref. 5U/1561
Size of jet ... ... 0·089 in. dia.

Fuel pumps on distributor tanks ... Pulsometer, type F.B. Mk. I

Fuel pressure warning switches setting ... ... $10\frac{1}{2}$ lb. per sq. in.

LEADING PARTICULARS—*CONTINUED*

Propellers

	Mk. I aircraft	*Mk. II aircraft incorporating Mod. No. 1469*
TYPE	Hamilton A5/148	De Havilland D.20/445/1-5 with C.S.U. AY202 and spinner 4RD/3
CONTROL	Constant speed, feathering	Constant speed, feathering
PITCH SETTING—		
Basic	26°	24°
Fine	26°	25°
Feathered	91°	89°
Diameter	13 ft.	13 ft.
Relief valve pressure	*This information will be issued later*	*This information will be issued later*
Direction of rotation	Right-hand tractor	Right-hand tractor

Tank Capacities

FUEL TANKS—

No. 1 tanks, one port, one starboard, each	580 gall.	1,160 gall.
*No. 2 tanks, one port, one starboard, each	545 gall.	1,090 gall.
*No. 3 tanks, one port, one starboard, each	300 gall.	600 gall.
Total fuel (normal)		2,850 gall.
Fuselage auxiliary tank No. 1		400 gall.
Fuselage auxiliary tank No. 2		400 gall.
Total fuel (overload)		3,650 gall.

OIL TANKS (two port and two starboard)—

Inboard tanks, each	oil 37½ gall.; air space 4½ gall.	75 gall.
Outboard tanks, each	oil 37½ gall.; air space 4½ gall.	75 gall.
Total oil		150 gall.

De-icing fluid tank (windscreen de-icing) 4 gall. (approx.) de-icing fluid (Stores Ref. 33C/720)

**The capacities of No. 2 and 3 tanks of aircraft not incorporating Mod. No. 1476 may be somewhat less than stated*

Electrical System

Wiring system ... Breeze
Type ... Earth return

Generators—
Type ... P.—6,000 w. (Stores Ref. 5U/2730)
Number ... Two (one on each inboard engine auxiliaries gearbox)

Alternators—
Type ... U.—1,200 w. (Stores Ref. 5U/349)
Number ... Two (one on each outboard engine auxiliaries gearbox)

Accumulators—
Type ... 12-volt, 40 amp. hr.
Number ... Four, connected to give 24-volt, 80 amp. hr. supply

Airspeed Indicator Pressure Head

For particulars of position and incidence see relevant fig. in Section 11

Introduction

● **1.** The **LINCOLN B Mk. I and II** are all-metal mid-wing monoplanes, having four Merlin 85 and four Merlin 68 power plants, respectively, and variable-pitch constant speed propellers. Mk. I and II aircraft differ mainly in respect of the power plants and associated services and controls. The aircraft are designed and equipped for heavy bomber duties and carry a crew of seven consisting of a captain, second pilot, air observer (navigator-air-bomber), two wireless operator-air gunners and two air gunners.

● **2.** The fuselage is constructed of light alloy and incorporates transverse formers braced with longitudinal stringers covered with a light-alloy skin. Two longerons carry the cross members of the main floor in which the bomb gear is housed. To facilitate transport the fuselage is divided into four sections, viz.: front section comprising the nose and front centre sections, the intermediate centre section consisting of the fuselage between the spars and the centre part of the main plane, the rear centre section, and the rear fuselage which carries the tail unit.

● **3.** The main plane is of the two-spar type and consists of two intermediate planes attached to the centre plane, which is integral with the fuselage centre section, and two outer planes. The intermediate and outer planes are tapered in plan and elevation. The skin covering is of light-alloy sheet, and the leading edge is reinforced for barrage balloon protection and is fitted with cable cutters. Six fuel tanks are housed in the main plane, one between each inboard nacelle and the fuselage and two in each intermediate plane. The two inboard fuel tanks are the rigid type, and the other four are the collapsible pattern and removable from the top side of the main plane. The main undercarriage units are housed in the inboard engine nacelles (*see* para. 7).

● **4.** The tail plane construction is similar to that of the main plane. The twin fins and rudders are attached to the extreme ends of the tail plane, and these and the elevators are covered with light-alloy skin.

● **5.** The entrance door is on the starboard side of the fuselage just forward of the tail plane. The door opens inwards and entry is made by means of a ladder, fitted with hooks for attachment to the bottom of the door frame.

● **6.** The flying controls are conventional pendulum-type rudder pedals operating the rudders and a handwheel type control column operating the ailerons and elevators. Tubular push-pull connections are used, except for the aileron controls in the fuselage which consist of chains, tie rods and cables. Trimming tabs are inset in the trailing edges of the rudders, elevators and ailerons, and balance tabs are fitted to the elevators and ailerons. A Mk. VIII automatic pilot is fitted. Hydraulically-operated split-trailing edge flaps extend from the fuselage sides to the ailerons.

● **7.** The undercarriage consists of two retractable main wheel units, one under each inboard engine nacelle, and a fully-castering non-retractable tail wheel unit. Each main wheel unit is retracted backwards and upwards into the engine nacelle by means of two hydraulic jacks. When retracted the units are completely faired in by doors which are interconnected with the shock-absorber struts and close automatically when the wheels retract. A compressed air system is installed for lowering the main wheels in an emergency.

● **8.** The four engines, which are equipped with two-stage, two-speed superchargers, are mounted on nacelle structures built out from the centre and intermediate plane spars, and are fitted with Rolls-Royce Bendix carburettors. The fuel supply is by gravity from the main tanks to distributor tanks mounted on the rear face of the inboard engine firewalls, and thence to the engines. Pulsometer pumps are mounted on the base of the distributor tanks. The normal supply to the engines on either side is from the relative tanks but when required all four engines may be fed from one side by means of a cross-feed system. The inboard oil tanks are mounted behind the front spar in the undercarriage compartments, and the outboard tanks in the engine sub-frames.

INTRODUCTION—*CONTINUED*

● **9.** A single pump mounted on each inboard engine auxiliaries gearbox supplies power for the hydraulic operation of the retractable main wheel units, main plane flaps, bomb door jacks and fuel jettison system. A single hydraulic pump mounted on the port inboard engine auxiliaries gearbox supplies the power for the tail turret (an hydraulic header tank for the tail turret system is mounted in the leading edge of the port main plane). An Arrow type compressor mounted on the port inboard engine auxiliaries gearbox, working at low pressure, operates the automatic pilot; a Heywood compressor on the starboard inboard engine gearbox, working at high pressure, operates the pneumatic brake system and the electro-pneumatic power plant controls. The latter comprise radiator shutter, supercharger (Mk. I aircraft only), slow-running cut-out and air cleaner controls. Two vacuum pumps on the port inboard engine gearbox operate the bomb sight and computor and another pump on the starboard inboard engine gearbox operates the gyroscopic instruments on the instrument-flying panel.

● **10.** The gun armament consists of one electro-hydraulically operated nose turret, one electrically-operated dorsal turret, and one hydraulically-operated tail turret. The nose and tail turrets each carry two 0·5 in. guns and the dorsal turret is fitted with two 20 mm. guns. Alternative armament may, in some cases, take the place of the nose turret. Provision is also made for under-defence, a single hand-held gun being supplied to special order only. Various bomb loads may be carried in the bomb compartment in the lower portion of the fuselage.

● **11.** An earth-return wiring system is used. The D.C. power supply is provided by two 24-volt, 6 k.w. generators, driven through the auxiliary gearboxes of the inboard engines. The generators are connected in parallel for the charging of four 12-volt, 40 amp. hr. accumulators, the latter being interconnected to give a 24-volt, 80 amp. hr. supply to operate all the general electrical services. Two power distribution panels, situated port and starboard respectively in the fuselage centre section, carry two Type 23 voltage-control regulators, two Type J cut-outs and Type D circuit breakers. The Type 23 regulators are connected in parallel to a master voltage-control regulator, Type 32. Type A circuit breakers control various banks of fuses to the general services. Three distributor boxes are provided. Two 1,200-watt U-type alternators, driven through the outboard engine auxiliaries gearboxes, supply the current for the radio installations. The radio equipment consists of an electrically-remotely-controlled transmitter/receiver installation for the pilot, with fire control facilities at the pilot's, air-bomber's and astro-dome stations; I.F.F. at the navigator's station; and a general purpose transmitter/receiver at the wireless operator's station. Beam approach equipment is also installed. Inter-communication between members of the crew is provided by independent use of the amplifier and the pilot's transmitter/receiver. Independent fixed aerials are fitted for all sets, and an additional trailing aerial for the general purpose set.

● **12.** Hand-operated de-icing equipment is provided for the air-bomber's window and the pilot's windscreen.

● **13.** Provision is made in the fuselage between the main plane spars for the fitting of armour-plate doors if required. The formers at certain positions are reinforced with armour plate. Emergency exits in the roof of the fuselage, and a parachute exit in the floor of the nose, are provided.

● **14.** Other equipment includes portable oxygen apparatus, F.24 camera, signal pistol, hand signal lamp, reconnaissance flares, sea marker's, fireman's axes, asbestos gloves, first-aid outfits, fire extinguishers, type Q flotation dinghy, type K dinghies and an Elsan sanitary closet.

1

• PILOT'S CONTROLS AND EQUIPMENT

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PILOT'S CONTROLS AND EQUIPMENT

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

1. This section is a general guide to the location of controls and equipment in the pilot's cockpit, and indicates briefly the method, where this is not apparent, of operation of the controls. The use of capital letters in the text and illustration keys indicates that these are actual control and other markings.

2. Some information is given about equipment elsewhere in the aircraft with which the pilots should be acquainted. Main services are briefly described.

Seats

3. The first pilot's seat is mounted on a raised floor on the port side of the cockpit, has hinged armrests and is adjustable for height by movement of a lever on the left-hand side; the safety harness is released by a lever on the right armrest. Armour plate, including a hinged panel behind the pilot's head, is fitted to the back of the seat.

4. The second pilot's seat is on the starboard side of the cockpit. The backrest is a strap of canvas webbing, and a tubular footrest is mounted below the pilot's floor. When the seat is not required the backrest is released from the attachment to the first pilot's seat and the end dropped between the formers which carry the second pilot's seat. The seat is then folded up against the fuselage starboard side, and secured by a strap to the cockpit rail. The footrest is slid under the pilot's floor.

Rudder pedal adjustment

5. Each footrest is independently adjustable by holding aside the spring-loaded latch on each inside pedal arm and raising and moving the footrest over the spring-loaded ratchet mechanism on the pedal arm.

Fuel system

6. ***General.***—Six self-sealing fuel tanks, numbered 1, 2 and 3 on each side outboard from the fuselage, are fitted in the main plane. The four outboard tanks are the collapsible type. The capacities are given in Leading Particulars. Two small distributor tanks, one on the firewall of each inboard power plant, are fed, by gravity, from the main tanks. Fuel may be drawn from the distributor tanks by the engine pumps, or delivered to the engines under pressure by the Pulsometer electric pumps which are mounted below the distributor tanks. The fuel systems in the port and starboard planes are identical and entirely independent, but are interconnected by a cross-feed pipe and cock. This cock is normally kept shut. No tank selector cocks

Pilot's controls and equipment

are fitted, all the tanks on each side feeding together into the fuel distributor tank (ground servicing cocks only are provided in the delivery lines).

7. ***Master engine cocks.***—The fuel supply to each engine is controlled by a master cock, the pilot operating the four cocks from levers on either side of the control pedestal (*see fig. 1*).

8. ***Cross-feed cock.***—The cross-feed cock is mounted on the floor just forward of the front spar, with the control handle visible through the front spar cover.

9. ***Electric fuel pumps.***—Two pulsometer pumps are fitted to each distributor tank, each pump being controlled by a switch on the flight engineer's panel. Push-buttons below the switches are used for testing the pumps in conjunction with the ammeter on the panel. The switches should remain OFF for testing.

10. The main purpose of the electric fuel pumps is to maintain pressure at altitude. They are also used for carburettor priming before starting the engines, at take-off and for landing; the pumps on the delivery side must be ON when the cross-feed cock is opened to supply all the engines from one side. The following warning label appears on the flight engineer's panel:—

BOOSTER PUMPS MUST NEVER BE ON WITH MASTER ENGINE COCK OPEN AND ENGINE STATIONARY UNLESS SLOW-RUNNING CUT OUT SWITCH IS IN IDLE CUT OFF (DOWN) POSITION AND AIR SUPPLY NOT LESS THAN + 160 LB. ON THE GAUGE.

For further information on the use of the pumps, see Pilot's Notes.

11. ***Nitrogen system.***—Nitrogen is introduced into the tanks as the fuel is withdrawn, to minimise fire risk. The control cock is on the starboard side of the fuselage, approximately mid-way between the front and rear spars.

12. ***Auxiliary fuel system.***—Provision is made for carrying one or two auxiliary fuel tanks in the bomb compartment. These tanks are connected so that they may be used to refuel either of, or both, the No. 1 tanks, delivery being controlled by two cocks behind the front spar. The pump switches and test push-buttons are on the flight engineer's panel.

13. ***Fuel jettisoning.***—The hydraulic control handle projects through the floor on the left of the pilot's seat. For the method of using this system, *see Sect. 2.*

Hydraulic system

14. The general services hydraulic system derives its power from two pumps, one on each inboard power plant auxiliary gearbox, and feeds the following services:—

(i) Main undercarriage.

(ii) Flaps.

(iii) Bomb doors

(iv) Fuel jettison system

Provision is made for emergency operation by compressed air (*see Sect. 2*), of the first two circuits.

Pneumatic system

15. This system operates:—

Wheel brakes.

Radiator shutters.

Supercharger change-speed (Mk. I aircraft only).

Slow-running cut-outs.

Hot and cold air intakes (some early aircraft excepted).

Air cleaner.

A Heywood compressor is fitted on the starboard inboard auxiliary gearbox and charges an air bottle mounted in the roof of the fuselage nose. The wheel brakes are controlled by a lever (with a parking catch) on the handwheel. Differential control is provided by the rudder pedals, and a triple pressure gauge is fitted on the left side of the instrument panel.

Note . . . A pressure-maintaining valve in the supply line from the air bottle allows pressure to be supplied to the power plant services only if the pressure in the air bottle exceeds 160 lb. per sq. in.: this is to ensure sufficient pressure for the brakes. Before attempting to operate the power plant services, therefore, it is necessary to check on the triple pressure gauge that the pressure in the air bottle is at least 160 lb. per sq. in.

Pilot's controls and equipment

Vacuum system

16. Three suction pumps are fitted, two connected to one pipe line on the auxiliaries gearbox driven by the port inboard engine, and one on the auxiliaries gearbox driven by the starboard engine. The two supply lines are controlled by a vacuum change-over cock on the right side of the instrument panel. At NORMAL, the single pump is connected to the instrument-flying panel, and the two pumps to the Mk. XIVA bomb sight and computor, with a branch to other special equipment when fitted. At EMERGENCY, these connections are reversed. The vacuum gauge is connected to the pipe line from the instrument-flying panel.

Electrical system

17. One 24-volt, 6 kw. generator is fitted on each inboard engine auxiliaries gearbox. As the generators are connected in parallel the failure of either does not involve the failure of any particular service. A voltmeter, two generator charge warning lamps, two "push-to-break" switches (for testing), two generator switches, and one emergency master switch are mounted on a panel on the starboard side forward of the front spar. The cut-outs, voltage regulators, and circuit breakers are on two panels on the port and starboard sides of the fuselage, respectively, between the spars. THE GROUND/FLIGHT switch is on the starboard of these two panels. The ground supply socket is mounted on the starboard side above the rear end of the bomb door. Current for the radio installation is supplied by two 1,200-watt U-type alternators, driven through the outboard engine auxiliary gearboxes.

Heating and ventilation

18. The admission of hot air into the section of the fuselage forward of former 8 is controlled by a knob on the starboard side just forward of the front spar. To introduce hot air turn the knob counter-clockwise. An adjustable extractor louvre is provided on the port side of the fuselage nose.

Oxygen

19. The pilot's flexible oxygen pipe is secured by spring clips to the port cockpit rail. The economiser is located below the rear end of the pilot's floor together with the second pilot's economiser and flexible pipe. A regulator, which controls the supply throughout the aircraft, is fitted on the right of the instrument panel. A portable oxygen bottle for the pilot is mounted on the back of his seat.

Lighting, signalling and operational equipment

20. ***Headlamp.***—The headlamp is controlled by a switch on the panel on the starboard side forward of the front spar and may be used alone or in conjunction with the identification lamps.

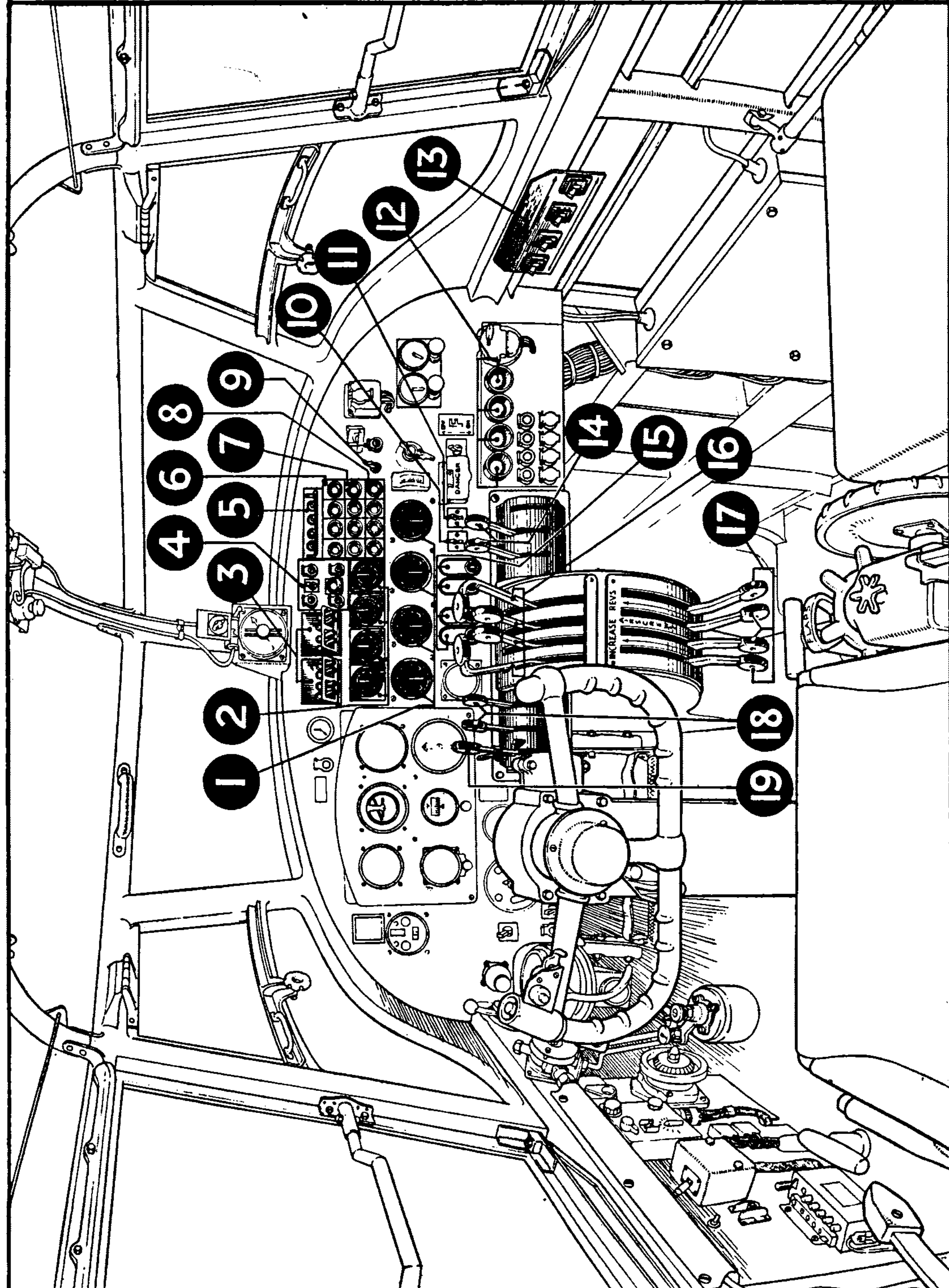
21. ***Signal pistol.***—This is stowed on the top of the front spar, and an upward-firing position is provided in the roof just forward of the front spar. The cartridges are stowed in spring clips on the starboard side near the firing position. The pistol stowage is omitted from aircraft incorporating Mod. No. 1620, and the pistol is stowed in the roof of the fuselage.

22. ***Flares.***—A twin-cell flare chute is fitted in the rear centre section and is electrically controlled by the air bomber. Stowages for three photo-flash flares are provided on the port side of the rear centre section fuselage.

23. ***Sea-marking equipment.***—Stowages for six sea-markers or flame floats—two on the starboard side and four on the port side—are provided in the rear section fuselage.

Pressure head heater switch

24. The switch, and a test push-button interconnected with the ammeter, are on the left-hand side of the flight engineer's panel.



ENGINE CONTROLS AND INSTRUMENTS

FIG. 1

KEY TO FIG. I

Starting, running and stopping

Engine speed indicators (4) 1

Boost gauges (4) 2

Ignition switches (8) 3
Two sets of 4, switches of each set operable independently, or in unison by using bridge plate.

Supercharger M.S.-AUTO switch, warning lamps (4) and test push-button 4
Electro-pneumatically controlled on Mk. I aircraft—not operative if air pressure is below 160 lb. per sq. in. Electrically controlled on Mk. II aircraft.
Switch up—M.S.
Switch down—AUTO (F.S. gear automatically engaged by altitude switch at pre-determined height).
Warning lamp—red when F.S. gear engaged.
Test push-button—press to short altitude switch for ground testing.

Slow-running cut-off switches (4) protected by guard rail 5
Not operative if air pressure is below 160 lb. per sq. in.
Switch down—IDLE CUT-OFF—for starting, stopping and parking.
Switch up—ENGINE ON—when engines running smoothly.

Starting push-buttons (4) 6

Booster coil push-buttons (4) 7

Oil pressure gauges (4) 15

Throttle control levers (4) 16
Stop provided in each gate. On Mk. I aircraft full movement gives maximum boost. On Mk. II aircraft, maximum boost obtained by operating boost cut-out control. Friction adjuster on R.H. side of quadrant.

Boost cut-out control 19
Operative on Mk. II aircraft (Merlin 68 engines) only—see throttle control lever (16).

Fuel

Engine priming push-buttons (4) 8
Carburettors primed by switching on electric fuel pumps.

Priming master switch and warning lamp 9

Master fuel cocks, starboard (2) 14
Lever up—ON.
Lever down—OFF.

Master fuel cocks, port (2) 18
Levers up—ON.
Levers down—OFF.

Propellers

Feathering push-buttons (4) ... 12

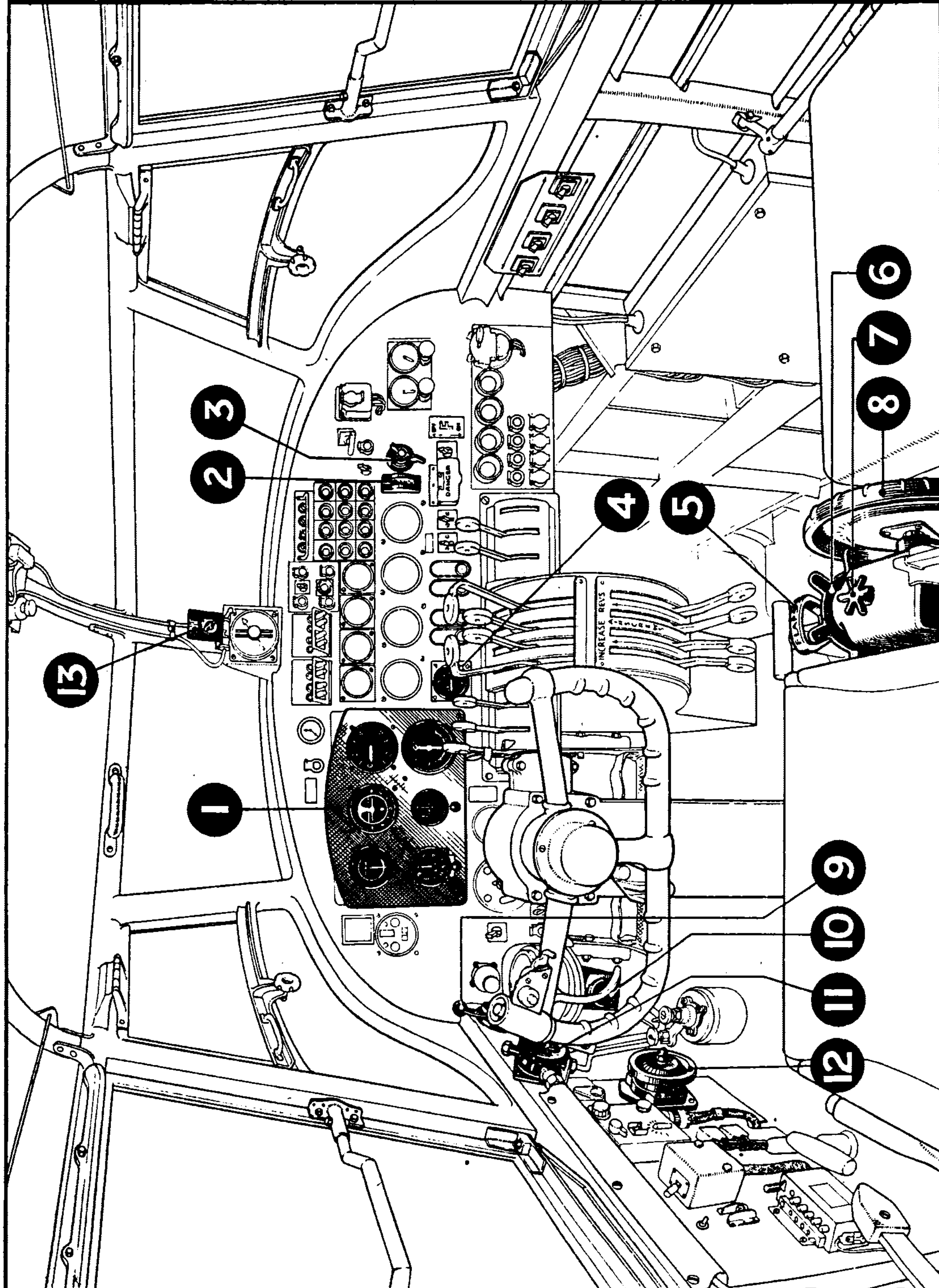
Propeller control levers (4) ... 17
Levers up—INCREASE REVS.
Levers down—DECREASE REVS.
Friction adjuster on L.H. side of quadrant.

Miscellaneous

Air cleaner switch 10
Not operative if air pressure is below 160 lb. per sq. in. Not operative unless undercarriage retracted. Switch up—Cleaners held "in" by spring-return pneumatic jacks. Switch down—Cleaners pushed "out".

Hot and cold air-intake switch 11
Not operative if air pressure is below 160 lb. per sq. in. Electro-pneumatically controlled. Not operative on some early aircraft.

Radiator shutter control over-ride switches (4) 13
Switches up —AUTOMATIC—for starting engines and for take-off.
Switches down—OPEN—for taxying only. Not operative if air pressure is below 160 lb. per sq. in.



FLYING CONTROLS AND INSTRUMENTS

KEY TO FIG. 2

Flying controls

Aileron trimming tab control handwheel 6
Operate in natural sense. Nearby indicator shows tab position.

Rudder trimming tab control handwheel 7
Operate in natural sense. Nearby indicator shows tab position.

Elevator trimming tab control handwheel... 8
Operate in natural sense. Nearby indicator shows tab position.

Automatic pilot, Mk. VIII

Clutch lever 9

Air pressure and trim gauge 10

Cock 11
A stop prevents movement of cock control to OUT—with this installation gyro unit is always on.

Pitch control 12

Selector lever 13

Lever to left—JINK.
Lever vertical—OFF.
Lever to right—COURSE.

Flaps

Flaps position indicator 4

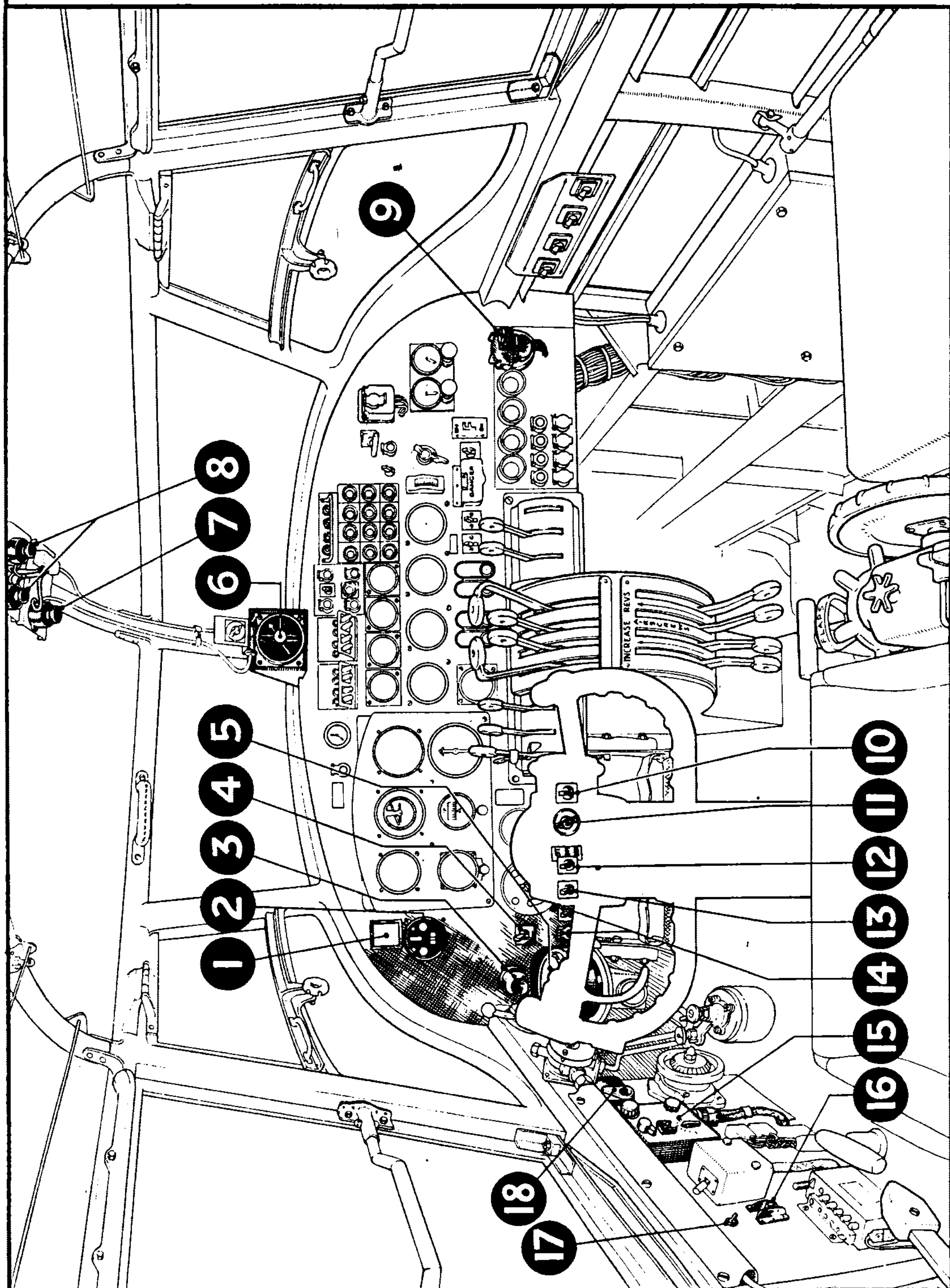
Flaps control handle 5
Operate in natural sense. A spring-loaded catch indicates neutral position, to which handle must be returned as soon as position indicator shows desired setting. No indicator switch.

Miscellaneous

Instrument-flying panel 1

Suction gauge 2

Vacuum change-over switch 3
NORMAL—Single pump connected to instrument-flying panel, other two pumps to bomb sight and computor, with branch to special equipment when fitted.
EMERGENCY—Connections reversed.



NAVIGATIONAL, SIGNALLING AND LIGHTING EQUIPMENT

FIG. 3

FIG. 3

This leaf issued with A.L. No. 16
March, 1945

KEY TO FIG. 3

Navigational

A.S.I. correction card holder **1**

Beam approach visual indicator **2**

P4 compass lamp switch... ... ... **3**

P4 compass **5**

D.R. compass repeater **6**

Navigation lamps switch **12**
Left—OFF. Vertical—DIM. Right—BRIGHT. Master switch (14) must be ON.

Beam approach control unit **15**

Isolation switch for navigator's telephone **17**

Signalling

Downward identification lamp colour selection switch ... **4**
Up—RED. Middle—GREEN. Down—AMBER

Signalling switchbox **9**
R.H. switch not connected.

Resin lamps OFF–ON switch **13**
Master switch (14) must be ON. Colour selection switch on panel on starboard side forward of front spar.

Distress switch **16**

Call lamp and push-button **18**

Lighting

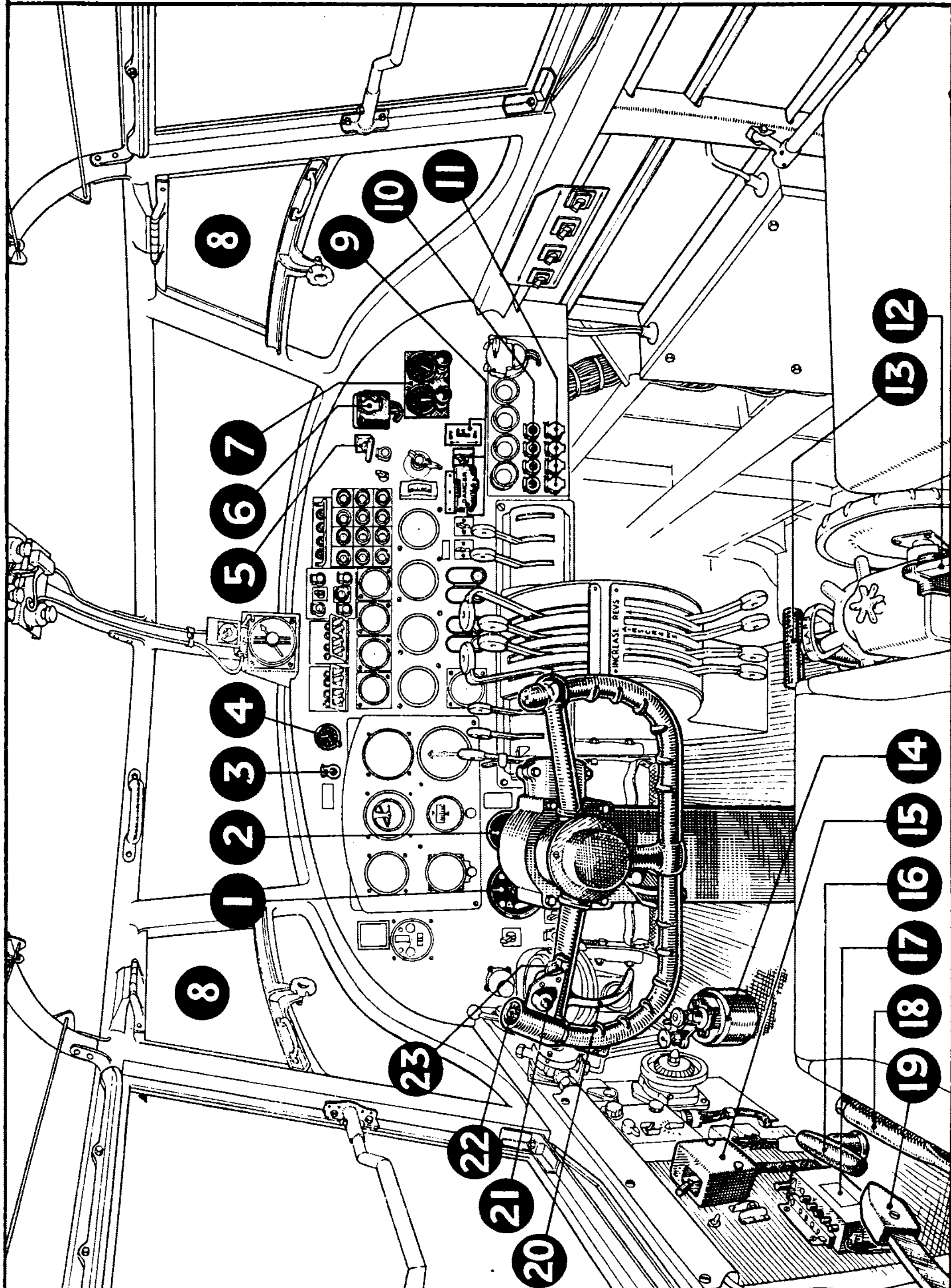
Repeater compass lamp switch **7**

Cockpit floodlight switches (2) **8**

Glider tow tail lamp switch **10**

Landing lamps switch **11**
Left-lamps OFF and retracted.
Vertical—LOW. Lamps on and beam dipped.
Right—HIGH. Normal beam.
Master switch (14) must be ON.

External lamps warning lamp and master switch **14**
Operation of master switch to OFF extinguishes all external lights.



OPERATIONAL AND MISC. CONTROLS AND INSTRUMENTS

FIG 4

FIG 4

KEY TO FIG. 4

Operational

Camera warning lamp ... 3

Glider release handle ... 13

Bomb door lever 19

Lever up—doors closed.
Lever down—doors open. Bomb release system inoperative until doors partly open.
To open bomb doors by hand pump for bombing up requires fifteen minutes strenuous pumping and it is recommended that doors are opened by pilot before switching off engines.

Bomb release button 22

Operation releases single bombs or sticks of bombs fuzed and selected by air bomber.

Alighting gear

Alighting gear position indicator 1

Indicator becomes operative when GROUND FLIGHT switch turned to FLIGHT.
Two green lights—locked DOWN. Two red lights—unlocked. No light—locked UP. A warning horn sounds if either inboard throttle closed unless undercarriage is locked DOWN.

Alighting gear control lever 12

Operate in natural sense. Spring-loaded safety bolt must be held out while lever raised; re-engagement automatic when lever pushed down.

Brakes

Brakes lever 20

Brakes lever parking catch 23

Emergency

Bomb jettison handle 5

To jettison bombs, pull handle.

Containers jettison push-button (shielded)... 6

Jettison containers before jettisoning bombs.

Destructor OFF–ON switch and push-buttons (buttons shielded) 9

Fire warning lamps (4) 10

Fire extinguisher push-buttons (4) (shielded) 11

Fuel jettison handle 16

For operation, refer to Section 2.

Miscellaneous

Triple air-pressure gauge 2

Time clock 4

Oxygen flow and contents gauges 7

Direct-vision windows 8

To open, rotate knob counter-clockwise, and pull down: pull handle inwards.

Windscreen de-icing pump 14

Mixer box 15

Transmitter-receiver controller ... 17

Seat-adjusting lever 18

Press-to-transmit push-button 21

2 • EMERGENCY CONTROLS, EQUIPMENT AND EXITS

(11065) T14574/G2588 1050 11/44 M20691 C & P 752

EMERGENCY CONTROLS, EQUIPMENT AND EXITS

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

General

1. The emergency equipment and exits are illustrated in fig. 1, and further details of the automatic fire extinguishers and dinghy inflation equipment are shown in fig. 2 and 3, respectively. The ribs and formers referred to in the following paragraphs may be located by referring to Sect. 4, Chap. 3, fig. 5.

Undercarriage and flaps operation

2. A compressed air system is provided for emergency operation of the undercarriage and flaps if the hydraulic system fails. The control valve is operated by a remote control knob just forward of the engineer's instrument panel. When this emergency control is operated the undercarriage main wheel units are lowered irrespective of the position of the normal hydraulic control lever, but the lever should be placed and left in the DOWN position for and after landing, otherwise loss of air pressure may cause the undercarriage locks to be released and the undercarriage to collapse.

3. Operation of the emergency air control also admits compressed air to the flaps control valve, and after the main wheels have been lowered the flaps may be lowered by selecting FLAPS DOWN in the normal manner.

4. It is possible to raise the flaps after lowering them by the emergency method, but it is not advisable to do this as there may not be sufficient air pressure to re-lower them. If it is essential to raise the flaps, great care must be taken to operate them in stages.

Fuel jettisoning

5. The contents of both No. 1 fuel tanks may be jettisoned by lifting, and turning anti-clockwise, the hydraulic control handle at the left of the pilot's seat. Speed should be reduced to 150 m.p.h. I.A.S. and the flaps lowered 15 deg. before jettisoning. It is recommended that the valve should be closed while there is still between 75 and 100 gallons in each tank, as below this content the fuel runs out more slowly and may get splashed over the fuselage, with consequent danger of fire.

6. The jettison system must not be operated unless the pressure shown on the gauge of the hydraulic accumulator exceeds 650 lb. per sq. in. When the flaps are lowered prior to jettisoning, the accumulator pressure should build up rapidly to 650–850 lb. per sq. in. If, however, a lower pressure is indicated one of the main hydraulic systems should be operated momentarily: e.g. the bomb door operating lever should be moved to OPEN and then returned at once to CLOSED. This will cause the automatic cut-out to function and the hydraulic pumps to build up the pressure in the system. In this case, to ensure the most efficient operation of the jettison system the control valve should be opened as the rising pressure passes 650 lb. per sq. in., and a member of the crew should watch the gauge and signal the pilot at this moment. If the pressure fails to build up, jettisoning should not be attempted.

Bomb jettisoning

7. The complete bomb load (excluding bomb containers) may be jettisoned after the bomb doors have been opened, by means of the

Emergency Controls, Equipment and Exits

jettison press-button on the right side of the instrument panel. If bomb containers are carried they should be jettisoned first, using the bomb container jettison switch to the right of the press-button.

Note .... In early aircraft a jettison handle may be fitted and the press-button disconnected.

Coolant system

8. Provision is made for the isolation of the cabin heating radiator in the fuselage rear centre section, to prevent loss of coolant from the port inboard engine if the fuselage section of the cabin heating installation is damaged. Two stop cocks for this purpose are fitted near the fuselage floor just forward of the rear spar.

Radiator shutters

9. The radiator shutters can be opened by means of the over-ride switches on the starboard side of the cockpit, if failure of the thermostatic switches prevents automatic opening with consequent overheating.

Automatic fire extinguishers

10. Eight Graviner automatic fire extinguishers are fitted, two for each engine (*see fig. 2*). In each inboard nacelle the extinguishers are mounted on the rear face of the front spar in the undercarriage compartment; in the outboard nacelles an extinguisher is attached to each side of the engine sub-frame. Flexible delivery pipes are led forward from the extinguisher bottles through the firewalls, one leading to the carburettor air intake on each power plant, and the other to the spray pipes (*see A.P.2861A, Vol. I*).

11. Six flame switches, connected to one of the four warning lamps incorporated in the feathering push-buttons on the pilot's panel, are provided in each power plant. In the event of a fire the operation of a flame switch causes the warning lamp to light, at the same time making connection between the fire extinguisher circuit and a circuit from the feathering push-button. When a warning lamp lights the appropriate feathering button should be operated as soon as is practicable. This also closes the fire-extinguisher circuit which operates the bottle to the carburettor air intake immediately. A delay action switch causes the spray-pipe extinguisher to operate after a delay of 15 seconds.

12. If it is required to use the fire extinguisher without feathering there are four push-buttons mounted on the instrument panel below the propeller feathering push-buttons. In the event of a crash the extinguishers are operated automatically by an inertia switch on the starboard side of the floor of the fuselage nose.

Hand fire extinguishers

13. Six portable extinguishers are provided in the fuselage, stowed in the following positions:—

(i) On the starboard side of the nose, between formers G and H.

(ii) On the port cockpit rail, forward of former B.

(iii) On the forward face of a panel at the forward end of the navigator's table.

(iv) On the starboard side just forward of the front spar.

(v) On the starboard side aft of the main floor (under-defence station).

(vi) On the port side just forward of the tail turret.

Radio demolition switches

14. The I.F.F. emergency push-buttons are on the right-hand side of the pilot's instrument panel.

Parachutes and parachute exits

15. Exit by parachute should be made through the hatch in the floor of the nose by all members of the crew if time is available. The hatch, which is hinged on the starboard side, is opened by lifting the handle on the port side. To hold the door open a spring catch is provided on the starboard side of the fuselage. The main entrance door may be used as a parachute exit only in extreme emergency.

Emergency Controls, Equipment and Exits

16. Back-type parachutes are provided for all members of the crew except the mid-upper and rear gunners. Parachute stowages for the latter are near their respective stations, as follows:—

(i) On the starboard side of the fuselage just aft of the mid-upper turret.

(ii) On the starboard side of the fuselage just forward of the tail turret.

Air/sea rescue equipment

17. ***Type Q dinghy.***—A type Q dinghy for the crew is stowed in a blow-out compartment in the starboard trailing edge of the centre plane (*see fig. 3*). Two methods of operation are provided:—

(i) An immersion switch on the starboard side inside the nose of the fuselage at former G, which automatically releases the dinghy on contact with salt water.

(ii) A manual release cord, which runs through separate lengths of tube between formers 13 and 35, and is operated by pulling down a loop between any two tubes or by an external loop at former 34.

18. A dinghy radio, a type 4 emergency pack, and an Avro type emergency pack are stowed with the dinghy and secured to it. For information on the standard equipment stowed with the dinghy see A.P.1182, Vol. I, Part 3, and 1182C, Vol. I. The contents of the emergency pack, Avro, Part No. 2/Z/1670, are described in fig. 6: those of the emergency pack, type 4, are:—

First-aid, large	1
Pistol, 1 in. Dinghy	1
Tins, cartridges	15
Ration, Mk. II	1
De-salting units	4
Tins, water	2

19. The dinghy stowage (*see fig. 3*) consists of a box between trailing section ribs 29 and 31, the webs of the ribs forming the sides. The ends are light-alloy panels with top-hat-section stiffeners, and the bottom is formed from a flat panel strengthened by a corrugated panel beneath. The lid, which contains an inspection window over the operating head, is secured by a rubber angle strip. This strip is attached to the frame forming the top edge of the stowage, and fits into a built-up channel on the edge of the lid, permitting the latter to be forced off by the expansion of the dinghy when inflated. Carbon dioxide for inflation is contained in a bottle attached to the dinghy, but supported on two cradles whilst in the stowage. The dinghy is secured to the outer of the two cradles by a painter attached by a clove hitch to the dinghy handline.

20. ***Type K dinghies.***—Stowages are provided for seven type K dinghies (*see fig. 1*).

Portable oxygen bottles

21. Seven portable oxygen bottles are stowed in wire mesh containers at the following positions:—

(i) Under the starboard side decking of the nose turret installation.

(ii) On the back of the pilot's seat.

(iii) One on each of the two vertical stays just forward of the astro-dome.

(iv) On the starboard side of the fuselage just forward of the rear spar.

(v) On the face of the bulkhead at the rear end of the bomb compartment.

(vi) On the starboard side of the fuselage just forward of the tail turret.

Exits in roof

22. Two "push-out" type emergency exits are provided in the roof of the fuselage, one in the canopy above the pilot and the other just forward of the rear spar. These must not be used as parachute exits.

Fireman's axes

23. Stowages are provided on the starboard side of the fuselage for two fireman's axes, one just forward of the rear spar and the other just forward of the main door.

Asbestos gloves

24. A stowage for asbestos gloves is provided just above the axe forward of the rear spar.

Emergency Controls, Equipment and Exits

First-aid outfit

25. A first-aid outfit is stowed on the starboard side of the fuselage aft of the main door.

Signal pistol

26. A signal pistol is stowed on the top of the front spar and an upward firing position is provided just forward of the front spar. The cartridges are stowed in spring clips on the starboard side near the firing position. No pistol stowage is fitted to aircraft incorporating Mod. No. 1620, and the pistol is stowed in the roof of the fuselage.

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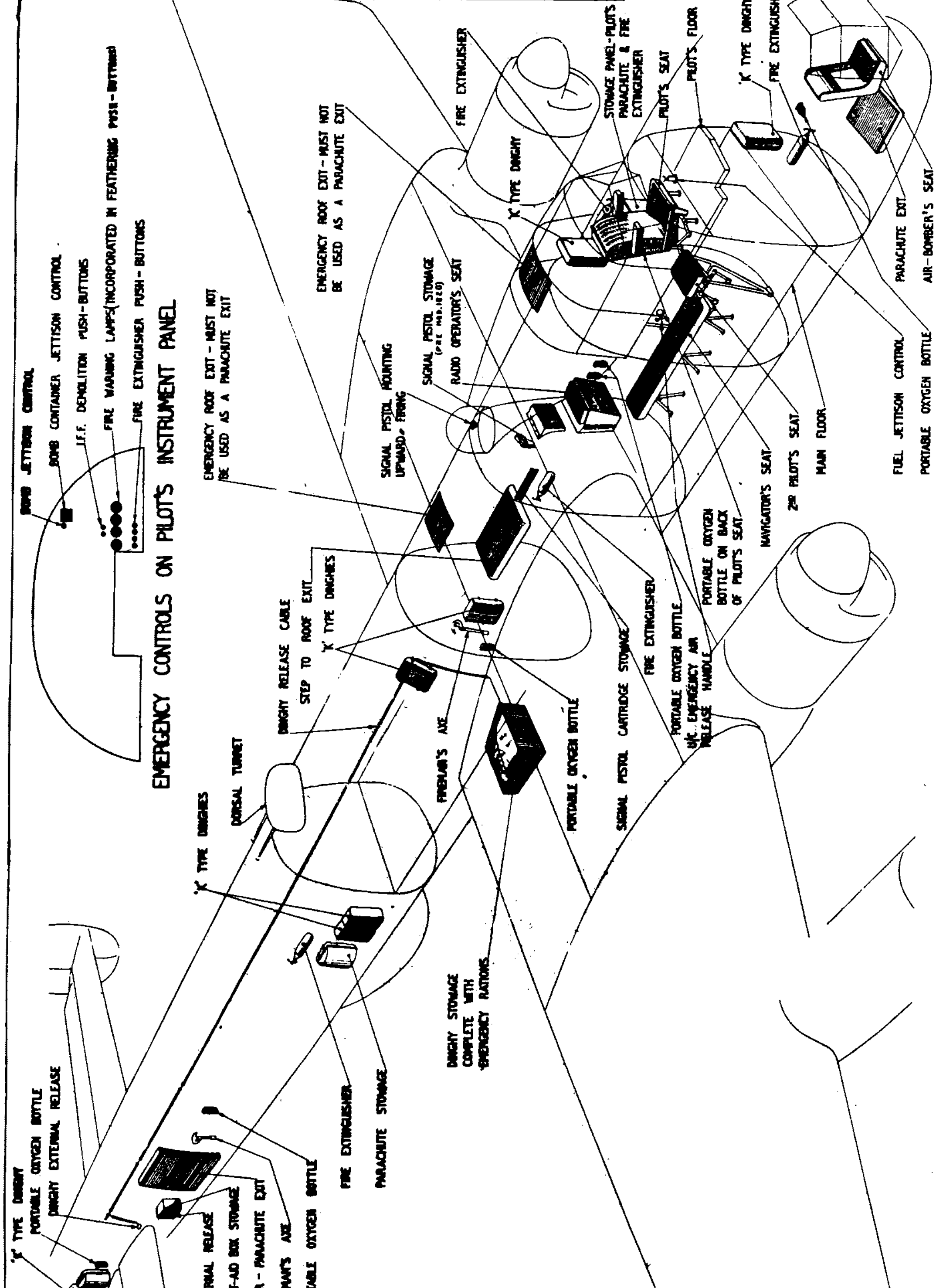

FIG. 1 GENERAL EMERGENCY EQUIPMENT & EXITS FIG. 1

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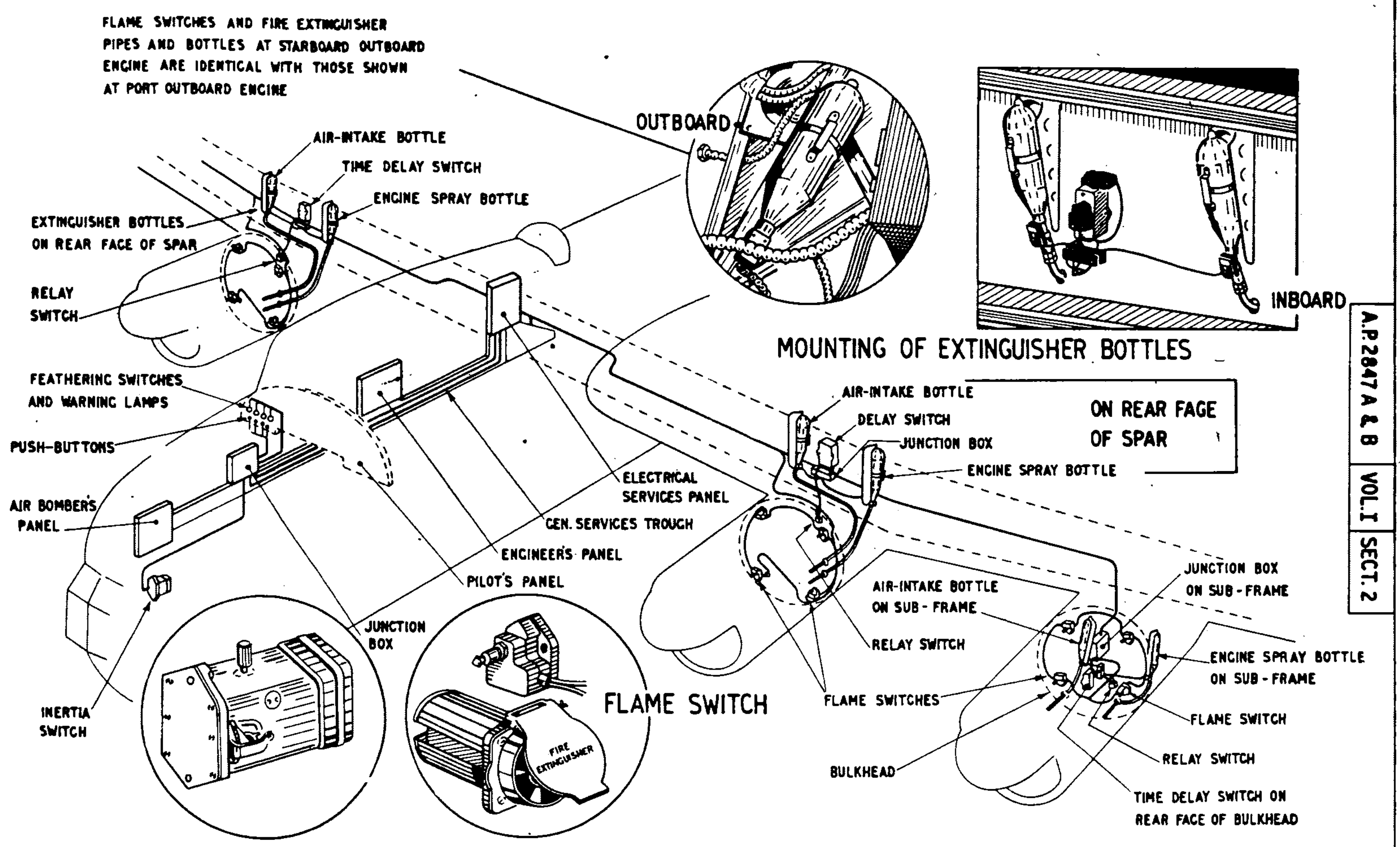
FIG. 2

FIRE EXTINGUISHER SYSTEM



FOR THE FIRE EXTINGUISHER PIPES IN THE POWER PLANTS AND THE OTHER TWO FLAME SWITCHES SEE A.P. 2861 VOL. I.

FIG. 2

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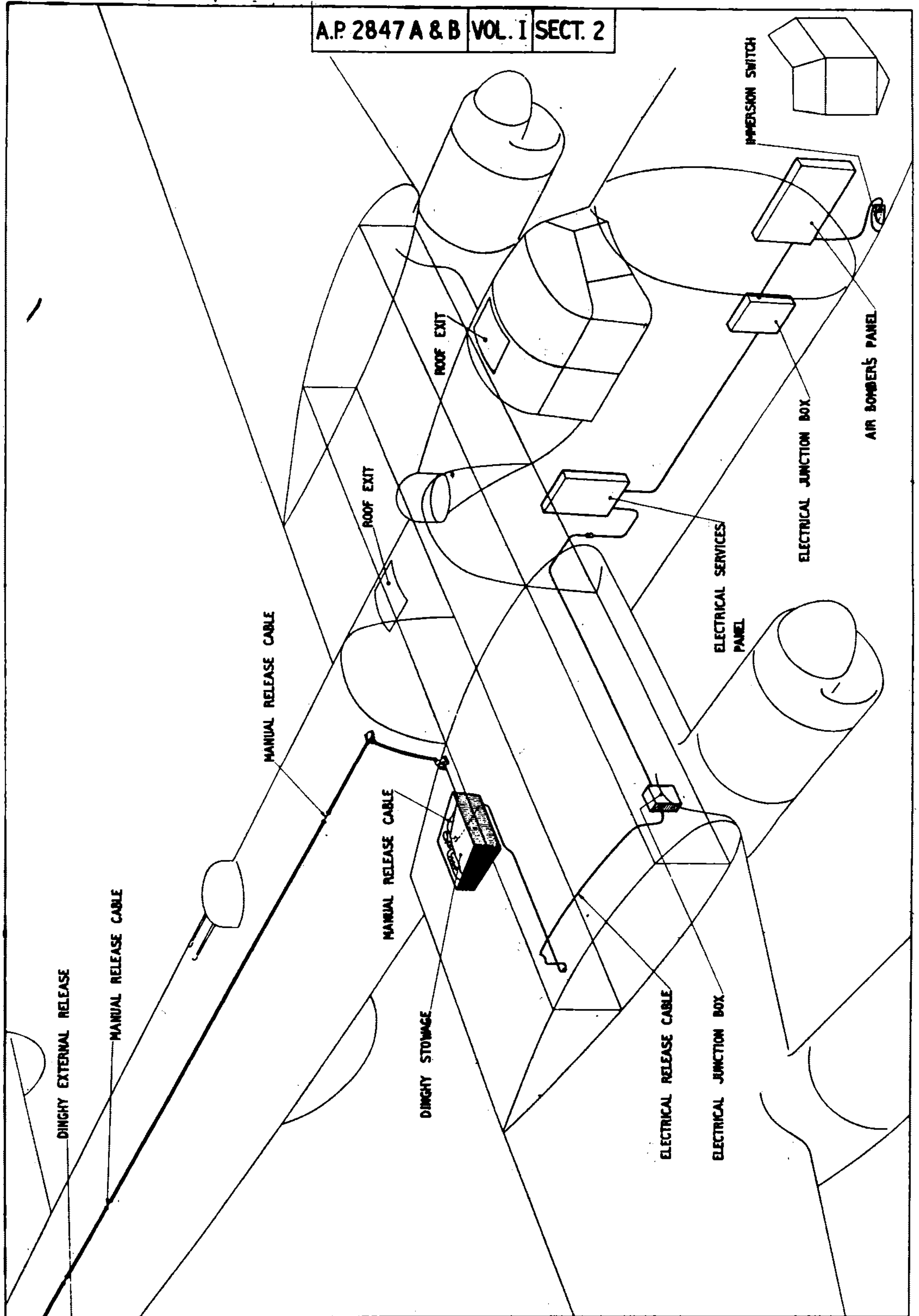

FIG. 3 — DINGHY INSTALLATION. — FIG. 3

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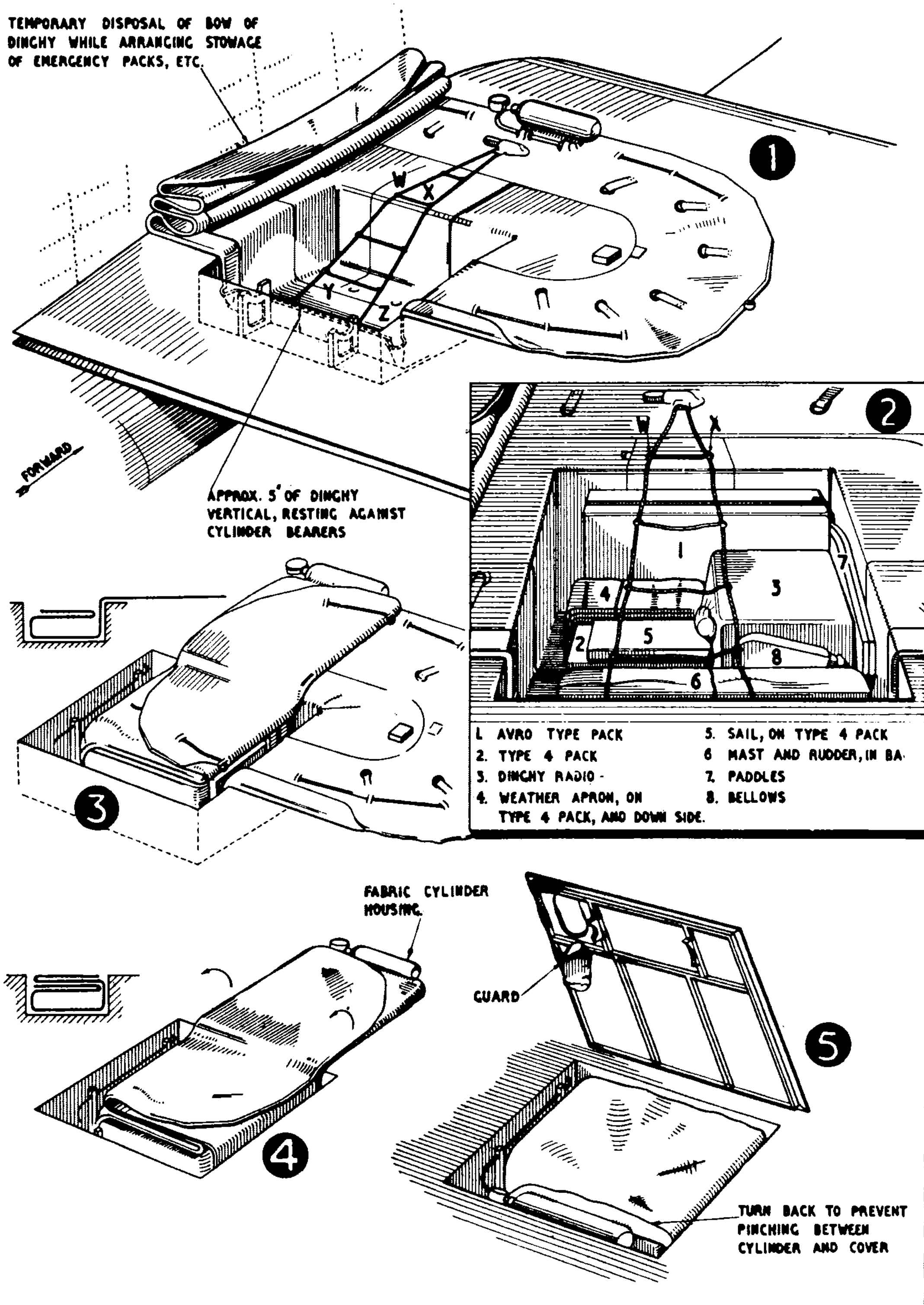
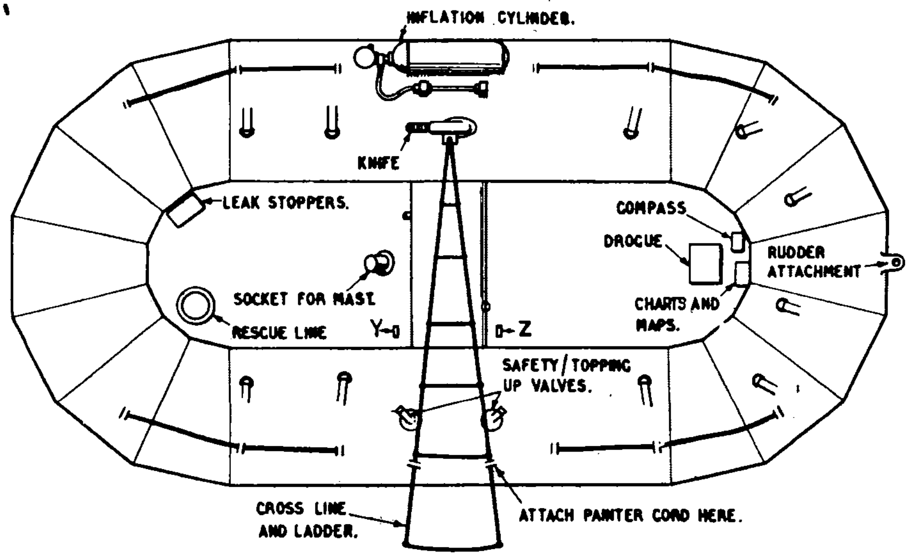


FIG. 4 — STOWING Q-TYPE DINGHY (I) — FIG. 4



STOWING INSTRUCTIONS

1. Lay the dinghy, thoroughly deflated, on wing surface with inflation cylinder forward and lined up to suit position of bearers. Deflate by means of pump until all creases appear as knife edges.
2. Check that the inflation pipe is connected to the correct valve of the inflation manifold, i.e. with the operating head towards the bow of the dinghy, and towards the inboard side of the stowage.
3. Ease the dinghy into the stowage as indicated in fig 4 leaving approximately 5 in of the dinghy vertical against the cylinder bearers.
4. Withdraw dust caps from safety/topping up valves to ensure pressure relief after inflation.
5. Lay dinghy painter cord on stowage floor between bearers, one end (as labelled) tied to cylinder bearer, the other end tied to dinghy at position indicated above. Cord 20 ft. long, 8 ozs. F.32.
6. Place emergency packs, sailing gear bags, paddles, bellows, weather apron (if not integral with dinghy) and dinghy radio in positions shown in fig. 4, taking care that all are below the dinghy ladder. Attach these items to dinghy at positions indicated in notes in fig. 6.
7. Complete folds shown in fig 4 so that cylinder housing rests on cylinder bearers in stowage.
8. Lash cylinder into its housing on the dinghy, and place on bearers in such a way that crutches in stowage and on cover rest on fabric of cylinder housing, and NOT on dinghy itself. See fig 4
9. Check by trial that stowage cover can be correctly seated without necessity for more than 30 lbs. external pressure. To achieve this, it may be necessary to displace folds locally in order to eliminate high spots.
10. Connect inflation pipe from dinghy to operating head of inflation cylinder.
11. Connect the remote manual cable to operating head, and align and lock operating head drum. It should be noted that a guard is provided on the stowage cover to separate operating cable from dinghy.
12. Reduce length of electric lead to 8 in. (measured from top of plug pins to point at which lead leaves sleeve on operating head) by hanking and binding firmly with insulating tape. Connect plug into socket.
13. Ensure that dinghy is clear of operating cable, assemble and fix cover by means of screws (see detail.) Check that guard on cover correctly separates dinghy from cable, by removal of inspection window if necessary. Seal by applying one thin coat of Cerric D.3659 (Store ref. 33C/685) adhesive on surface to be covered by fabric strip. Place 3 in. fabric strip in position, apply a further coat of adhesive, allow to dry, and re-camouflage.

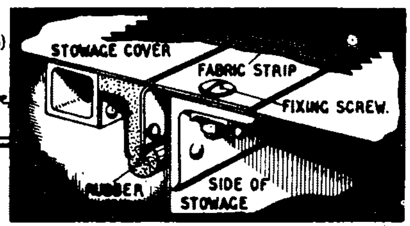


FIG. 5 — STOWING Q-TYPE DINGHY (2) — FIG. 5

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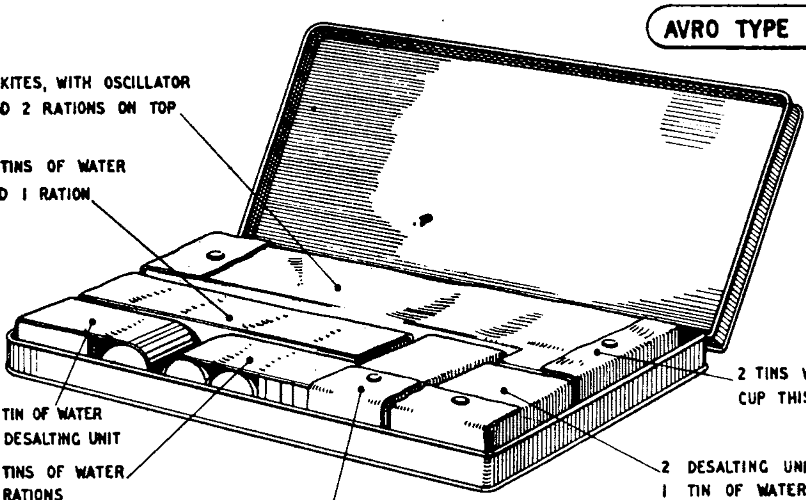


SECURING EQUIPMENT IN DINGHY

Avro type pack connected to patch Z by its own lanyard.
Type 4 pack connected to patch Y by its own lanyard.
Dinghy radio connected to patch Z by 16oz cord F.32.
Mast and rudder, in container, connected by two 16oz cords to patches Y and Z. These patches are shown in fig. 5.
Bellows, in bag attached to crossline at X by 2ft length of 16oz cord, so that bellows can be removed without cutting cord.
Paddles attached to dinghy crossline at X by 2ft of cord 4 F.35.
All connecting cords must be 12in longer than distance between attachment to dinghy and attachment to item, to allow freedom of movement when emerging.
Cords must not lie over any of the stowed items.
Dinghy crossline must lie OVER all the stowed items.
Weather apron lashed to type 4 pack in position shown in fig. 4, unless integral with dinghy.
Sail bag lashed to mast and rudder container at position shown in fig. 4.

★ Note:- In cases where dinghy is not provided with patches Y and Z, Avro type pack and dinghy radio are to be connected to dinghy crossline at X, type 4 pack at W, and mast and rudder container connected to crossline at W and X. See fig. 4.

FIG. 6 — STOWING Q-TYPE DINGHY (3) — FIG. 6

3

• CONTROLS AND EQUIPMENT AT CREW STATIONS

(11065) T14574/G2588 1050 11/44 M20691 C & P 752

CONTROLS AND EQUIPMENT AT CREW STATIONS

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

Introduction

1. The fuselage is divided, for purposes of description, into five parts, viz:— nose, front, intermediate centre and rear centre sections, and rear fuselage. The lay-out of the controls and equipment is illustrated and referenced in fig. 1, at the end of this section and a key faces the illustration. Emergency equipment is included but reference should be made to Sect. 2 for detailed information on this subject. A diagram showing rib and former positions will be found in Sect. 4, Chap. 3.

Cockpit heating

2. Hot air is delivered from two radiators connected to the inboard engine cooling systems. One radiator, mounted in the leading edge of the starboard main plane, and connected to the starboard inboard engine, heats the cockpit and nose by means of a perforated duct on the starboard side. The other, mounted on the starboard side of the fuselage just aft of the rear spar, is connected to the port inboard engine, and delivers hot air through a duct on the starboard side to the dorsal and tail turrets and to the cupola of the scanner installation.

3. The delivery of hot air in the forward system is controlled by a knob situated behind a sliding door on the starboard side of the fuselage just forward of the front spar. This knob operates a shutter in the air duct in the leading edge, and when turned anti-clockwise, opens the inlet to the cabin and closes the by-pass to the outer air. To assist the circulation of the air an adjustable extractor louvre is provided on the port side of the fuselage nose.

4. The rear system has a master control at the intake (*see* para. 2), similar to that described in para. 3, and individual controls at the following positions:—

(i) A rotary sleeve control at the outlet for the dorsal turret.

(ii) A rotary sleeve control at the junction with the duct to the scanner cupola.

(iii) A butterfly valve near the end of the duct to the tail turret. The control for this projects up through the walkway just forward of the turret.

5. As the two heating installations are separately controlled, and the interior of the fuselage is divisible at former 8 by a bulkhead and doors, either part of the fuselage, forward or aft of the bulkhead, can be heated independently of the other part.

Controls and Equipment at Crew Stations

Oxygen equipment

6. Flexible oxygen connections, with economisers, flowmeters and cut-off valves are provided at the crew stations in the fuselage and a supply is also taken to the dorsal and tail turrets. The cut-off valves are opened by the removal of the flexible pipe from the stowage or, in the case of the turret supplies, by the removal of the dummy sockets. The supply is controlled by the pilot through a regulator on his instrument panel. The oxygen bottles are stowed in a crate in the intermediate centre section of the fuselage, and a main high-pressure cut-off valve is provided at the front end of the crate. Portable oxygen bottles are provided at the crew stations.

Intercommunication

7. Microphone-telephone sockets are provided at each of the crew stations. By means of a change-over system in the care of the wireless operator, the microphone-telephone sockets used for intercommunication may also be employed for the purpose of transmitting and receiving through the general purpose radio installation. The navigator's telephone can be isolated by two switches, one on the navigator's panel and the other on the pilot's instrument panel.

Handrails

8. The handrails are painted yellow for ease of identification.

Electrical services panels

9. There are three electrical services panels in the fuselage, one in the front centre section and two in the intermediate centre section. The first is on the starboard side of the fuselage and is linked by a continuous enclosed cable trough with the auxiliary distribution box at the forward end of the section. On the top face of this panel are mounted the generator voltmeter, generator control, reset and emergency switches, and visual indicators for generator failure. At the rear end are switches for the head and signal lamps. Of the two panels in the intermediate centre section, one is on the port side and carries voltage regulators, circuit breakers and cut-outs. The other panel is the main electrical control panel and is on the starboard side; it carries the master switch and master regulator, voltage regulators, circuit breakers and cut-outs.

Nose

General

10. The nose constitutes that portion of the fuselage forward of the pilot's instrument panel and the bomb bay, a bulkhead separating it from the latter. The extreme forward end, which includes a central projecting frame glazed with flat transparent panels, forms the air bomber's station. In some aircraft, above the air bomber and remotely controlled by him, is a Boulton Paul type F electro-hydraulically operated gun turret, and behind the air bomber are the nose flare chute and camera stations.

Camera station

11. An F.24 camera is installed on an adjustable frame in the rear port side of the nose above a circular window in the floor. The control and heating switches are also on the port side, near the rear edge of the transparent panels.

Flare station

12. The flare station in the nose is used only for navigational aids and reconnaissance flares. It is equipped with an unarmoured single-cell flare chute (without a deflector) fitted centrally in the rear of the nose compartment. The chute is electrically operated but has a manual release in case of failure of the electrical circuit. The flare chute switches are on the automatic controls panel.

Air bomber's station

13. The air bomber's station with associated equipment occupies the lower portion of the nose compartment. The air bomber operates from a sitting position in the fore part of the nose. The seat slides in a fore-and-aft direction over a distance of 4 in., and may be locked in any one of five positions by a small lever in each side of the front of the supporting frame. Immediately behind the seat is the parachute

Controls and Equipment at Crew Stations

exit and behind this is the flare station. The air bomber's panel is on the starboard side of the aircraft opposite his seat. Immediately in front of the seat are the bomb-sight support brackets, and below it is the stowage for the bomb-firing switch and bomb-sight lead.

14. On the port side of the nose is the computor for the Mk. XIV bomb sight (in aircraft so equipped), and behind it is the automatic controls panel on which are mounted the camera, flare-chute and 'PRESS TO TRANSMIT' switches. An automatic bomb distributor, a preselector unit and bomb selector switchbox, and fuzing switches are mounted at the forward end of the air bomber's panel; control switches for the nose turret are mounted next to the automatic bomb distributor; stowages for the air bomber's height-and-speed computor, and for the switch for heating the 4,000 lb. bomb release gear, are mounted on the same panel. Above the panel is a hand fire extinguisher. Also on the port side are stowages for flares, flame floats and seamarkers, and, on the bulkhead behind the turret, a parachute pack.

15. On the starboard side are stowages for the following items of equipment:—under the rear of the turret mounting, portable oxygen supply; on the turret bulkhead door, 'K' type dinghy, flares, flame floats and seamarkers and a hand fire extinguisher. Also on the starboard side is a step for servicing the nose turret.

16. There is a hinged inspection door for the bomb compartment in the bulkhead at the rear of the nose, and a socket for connecting an inspection lamp.

17. ***De-icing for air bomber's window.***—Glycol de-icing is provided for the bottom centre panel of the air bomber's window, and is operated by a hand pump on the port side opposite the air bomber's seat. When operated once a minute the pump delivers fluid at the rate of two pints per hour. The reservoir, which also supplies the pilot's windscreen, is of approximately four gallons capacity and is fitted below the step at the rear of the nose. Further information on de-icing equipment can be obtained from A.P.1464B, Vol. I, Part 5, Sect. 11 (Old Publication), or A.P. 1464D, Vol. I, Part 2, Sect. 4 (New Publication).

Front centre section

General

18. The front centre section, comprising that part of the aircraft from the front spar to the cockpit instrument panel, houses the following stations: pilot's cockpit (*see Sect. 1*), flight engineer's and navigator's stations, wireless operator's station, and fighting control station. The starboard side of the compartment serves as a gangway between stations and provides access to the nose of the aircraft.

Flight engineer's and navigator's stations

19. ***General.***—The navigator's table is on the port side aft of the pilot's seat. The navigator's seat is a bench running fore and aft alongside the table.

20. ***Flight engineer's instrument panel.***—This panel is hinged at its lower edge and secured at its upper edge to the cockpit rail.

On the panel are mounted switches for:—
- (i) the electric pumps on the fuel distributor tanks
- (ii) the oil dilution system
- (iii) the heated pressure head
- (iv) the fuel pressure warning lamps

and gauges for:—
- (*a*) fuel contents
- (*b*) oil pressure
- (*c*) oil temperature and coolant temperature.

A knob for operating the emergency air system for main wheel unit and flap lowering is mounted on the face of the former at the forward edge of the panel.

21. ***Fuel contents gauges.***— Six fuel contents gauges, one for each tank, are mounted on the flight engineer's instrument panel. The gauges are calibrated for reading both when the aircraft is in flying and tail-down positions.

Controls and Equipment at Crew Stations

22. ***Fuel cross-feed cock.***—The cross-feed cock is mounted on the floor just forward of the rear spar, with the control handle visible through the front spar cover. It should be turned ON only when all engines must be fed from one side, and fuel pumps should be ON only at the side from which fuel is being fed

23. ***Navigator's equipment.***—The navigator's table is a permanent fixture containing a chart stowage and having an adjustable lamp which may be set in any desired position. In front of the table and attached to the port side of the aircraft, is the navigator's instrument panel and a pencil tray. Wireless installations in the rear fuselage are controlled and supplied from the same control panel and switch-unit as the installation fitted at the forward end of the table. The indicator for the latter is at the rear end of the table, and the whip aerial projects through the canopy aft of the D.F. loop, or through the fuselage roof at former 7, just aft of the front spar. Push-buttons and warning lamps for the same installation are fitted on the instrument panel, which also carries the D.R. compass repeater. The variation corrector is in the fuselage roof, and above the table is an astrograph.

24. There is a dome at the aft end of the canopy for taking sextant readings, and an anchorage for the air observer is attached to the floor just forward of the front spar step. The sextant is stowed on a panel at the forward end of the navigator's table, and a torch, an Aldis signalling lamp, and a hand fire extinguisher are also stowed on this panel. At the base of the main radio panel is a code-book stowage box. On the starboard side, opposite the table, are the recording drift sight and the navigator's oxygen connection and economiser. The stowage clips for the signal pistol cartridges are just forward of the front spar. A black-out curtain, which can be pulled down within 12 in. of the floor, is fitted at the forward end of the fuselage roof below the canopy and a curtain is also provided in the sextant dome. The observer's station is used also as the fighting control station, and a bullet-proof glass screen is fitted in the rear half of the sextant dome.

Radio station

25. The wireless operator's seat which is integral with the front spar cover and step, is on the port side, and faces forward. A general service installation and an amplifier are mounted on a transverse table at the rear end of the navigator's panel, and a further wireless installation is mounted on the port side aft of the rear spar. The wireless operator's oxygen cut-off valve, and the mic-tel distribution panel, are on the port side above the window, and forward of the window are the control units for the I.F.F. installation. At the end of the table is a hinged flap which, when lifted, gives access to the stowage below. There is an indicator for the scanner on the port side of the wireless operator's table, and above it is a range indicator for the installation in the rear of the aircraft. Below the table, on the port side, is a winch aerial, immediately in front of the wireless operator's seat; this aerial must be wound in before the bomb doors are opened. Access to the winch is obtained by lowering a sliding door in the side panel, and a spare reel is stowed under the step at the front spar. In the rear part of the canopy above the fuselage is mounted a D.F. loop, with a visual indicator on the port side at the wireless operator's station. A spare valve stowage is formed below the step at the front spar.

Intermediate centre section

General

26. The intermediate centre section of the fuselage extends between the front and rear spars and is divided at former 8 by a bulkhead comprising an armoured frame and two doors which are normally of plywood but may be of armour plate. The forward section contains the following equipment:— on the front spar, a holster for the signal pistol and stowage for the astro compass; on the front spar web, two air bottles for emergency lowering of the main wheels and flaps, and the distributor block, automatic cut-out, and high pressure filter of the hydraulic system; on the port side,

Controls and Equipment at Crew Stations

the hydraulic reservoir and emergency hand pump, wireless installation plugging board, nitrogen bottles for the fuel tank nitrogen fire prevention system, and methyl bromide bottle for fire prevention in the tank bays. On the starboard side are stowages for the following items of equipment:— flying control locking gear, 'K' type dinghy, parachute, nitrogen fire prevention bottle, methyl bromide bottle for fire prevention in the tank bays, fireman's axe, portable oxygen bottle and pouch for bomb winch handles. On the floor, at the port side, in the rear half of the section, is a crate for oxygen bottles; the main stop cock of the oxygen system is located at the forward end. Nitrogen bottles for fire prevention in the fuel tanks are stowed along the rear spar and in the middle of the section on both port and starboard sides; above the bottles on the starboard side is the main stop cock for the nitrogen system and below in the bomb bay curtain is the nitrogen charging point, which is reached through a small access door in the fuselage skin.

Rear centre section

General

27. The rear centre section consists of that part of the fuselage between the transport joint at the rear spar and that at former 27, including formers 22a, b, c, d and e between formers 22 and 23. The structure is reinforced at the forward end by two tie-rods from the floor to the top of the formers. It contains the flap jack, mounted in the forward end of the compartment, the dorsal turret, and a radio installation in the middle of the underside of the section, protected by a cupola fairing extending aft. This installation may be replaced by an under-defence gun mounted in the same aperture. In the bomb-bay curtain, on the starboard side, is the ground-starter socket.

Port side

28. The flying control rods run the full length of the section. Crates are mounted near the forward end to carry wireless equipment and beneath them is a pigeon box stowage. The mid-gunner's parachute is mounted below the dorsal turret, and immediately aft of it an I.F.F. wireless installation. On the rear face of the bulkhead at the aft end of the bomb bay is a portable oxygen bottle stowage. The oxygen installation for the under-defence gunner's position is mounted a little further aft. Above the under-defence position are mountings for Fraser Nash ammunition boxes, from which ammunition tracks run to the rear turret. Aft of the ammunition stowages, the dipole aerial and marker receiver are mounted.

Starboard side

29. The cabin heating duct, which is supplied by pipes entering the forward end of the fuselage from the port main plane, runs aft along the starboard side into the rear section; above it runs the duct which protects the manual release for the dinghy. The following equipment is mounted on the starboard side:— near the forward end, a 'K' type dinghy, stowages for desert equipment (if required), ammunition for the Martin dorsal turret (when fitted), and loose ammunition bags; two parachute and two 'K' type dinghy stowages. There is a step down from the floor over the bomb bay into the rear end of the section, in which is a parachute stowage, a fire extinguisher, and mounting for Fraser Nash ammunition boxes, with ducts running aft to the rear turret. There is also a wireless installation and D.R. compass and junction box. Further aft is the single-cell, armoured flare chute for photo-flash flares (*see* para. 30).

Flare chute

30. The chute for photo-flash flares is mounted at the rear end of the rear centre section on the port side. It is a single-cell armoured chute, fitted with a deflector which is lowered automatically when the bomb doors are opened. The chute is opened by an electrically-operated mechanism which is reset, when the door is closed again, by a foot-operated lever on the forward face of the chute. The flare is released by the air bomber operating a control switch (*see* para. 12), and a delay mechanism ensures that the camera does not begin to operate until a predetermined interval has elapsed. In case of failure of the electrical

Controls and Equipment at Crew Stations

mechanism the flare can be released by operating a small hand lever, covered by a guard, on the side of the chute.

Rear section

General

31. The rear fuselage comprises the tail end of the fuselage aft of former 27. It contains the tail turret, draughtproof screen and walkway, lavatory, tail wheel strut mounting beam and downward identification lamps.

Port side

32. The flying control rods continue through this section as far as former 39, where they are connected by appropriate levers to rods in the tail plane. Ammunition tracks run aft to the tail turret, connecting it with the Fraser Nash ammunition stowages in the rear centre section. There is an oxygen supply point just forward of the tail plane and a hand fire extinguisher immediately forward of the tail turret. A handrail is fitted to assist in entering and leaving the turret.

Starboard side

33. At the extreme forward end is a pigeon box stowage, and below it a fireman's axe. Between formers 30 and 32 is the main door into the fuselage, and above the door runs the cabin heating duct, which traverses the section from the transport joint to the tail turret, passing under the tail plane. Alongside the door is the dipstick stowage, and aft of this the first-aid box. Between the tail plane and tail turret are stowages for a portable oxygen bottle, parachute and 'K' type dinghy; above the last named is a short handrail. Below the rear end of the section, outside the fuselage, is fitted the type 'F' equipment, and, to special order only, a glider towing mechanism. The tail turret forms the end of the section.

P6090 M /G3024 1/45 1050 C & P Gp. 1

KEY TO FIG. 1

GENERAL EQUIPMENT

NOSE

Nose turret	1
Air bomber's transparent panelling	2
Flame floats and sea markers	3
Air bottle (pneumatic system)	4
Guards for de-icing tubes	5
Rudder pedals	6
Rudder pedal stop bracket	7
Glycol spray for air bomber's window	8
Bomb sight	9
Head lamp	10
Bomb sight control	11
Air extractor louvre	12
Air bomber's floor	13
Air bomber's chair	14
Mk. XIV bomb sight computor	15
Air bomber's panel	16
Mounting for computor and 4·5 in. flares	17
4·5 in. flare	18
Air temperature thermometer	19
Aerial mounting	20
Air filter	21
Immersion switch	22
Single-cell flare chute, Mk. VI	23
Glycol tank	24
Camera shade	25
Camera	26
Air intake throttle (auto pilot)	27
Inertia switches	28

FRONT CENTRE SECTION

Pilot's D.R. compass repeater	29
Radiator flap controls over-ride switch	30
Control column	31
Pilot's handgrip	32
Glider tow release	33
Pilot's auxiliary panel	34
Pilot's chair	35
Armour plating	36
Undercarriage warning buzzer	37
Intercommunication	38
Navigator's panel	39
Astrograph	40
Flight engineer's panel	41
Pilot's canopy blinds	42
Padding on former I	43
Navigator's black-out curtain	44
Anglepoise lamp	45
Window curtain	46
Signal pistol cartridges stowage	47
Armoured glass in astrodome	48
Astrodome black-out curtain	49
Signal pistol upward firing position	50
Astro compass rail and stowage	51
Pilot's windscreen de-icing hand-pump	52
Map stowages	53
Trimming tabs control box	54
Flight engineer's seat	55
Trough for conduits	56
Navigator's seat	57
Navigator's table	58
Trailing-aerial winch	59
Cabin-heating control	60
Wireless operator's harness	61
Valve stowage	62
Combined spar cover, wireless operator's seat, step and spare wheel stowage	63
Trough for conduits	64

INTERMEDIATE CENTRE SECTION

Signal pistol stowage	65
Armour protection, fire control station	66
No. reserved	67
Bulkhead	68
Nitrogen control and pressure gauge	69
Nitrogen bottles	70
Wireless installation crate	71
Methyl bromide bottle	72
Step at front spar	73
Flying controls locking gear	74
Oxygen bottles crate	75

REAR CENTRE SECTION

Single-cell flare chute, Mk.V	23
Inter-communication	38
No. reserved	67
Vertical reinforcing rods	76
Wireless crate	77
Cabin-heating control	78
Dorsal turret suppressors	79
Dorsal turret	80
Cabin-heating duct	81
Ammunition boxes	82
Ammunition duct	83
Card holder (compass deviation)	84
Handrail	85
Rear spar cover	86
Pigeon stowage	87
Call lamp	88
Ammunition stowage (dorsal turret)	89
Step	90
D.R. compass	91
No. reserved	92

REAR SECTION

Cabin-heating duct	81
Ammunition duct	83
Handrail	85
Pigeon stowage	87
Call lamp	88
Entrance step	93
Entrance door	94
Ammunition assister panels	95
Draught-proof door	96
Tail turret	97
Downward-identification lamps	98
Cabin lamp switch	99
Dipstick stowage	100
Lavatory	101
Walkway	102
Glider-towing equipment	103
Navigation lamps	104

EMERGENCY EQUIPMENT

Parachute stowage	A
Dinghy stowage	B
Parachute exit	C
Emergency air remote control	D
Emergency roof exit	F
Emergency air bottles	G
Dinghy manual release	H
First-aid external release	J
Dinghy external release	K
Fuel jettison control	L
First-aid box	X

P7176 M /G4639 4/45 1050 C & P Gp. 1

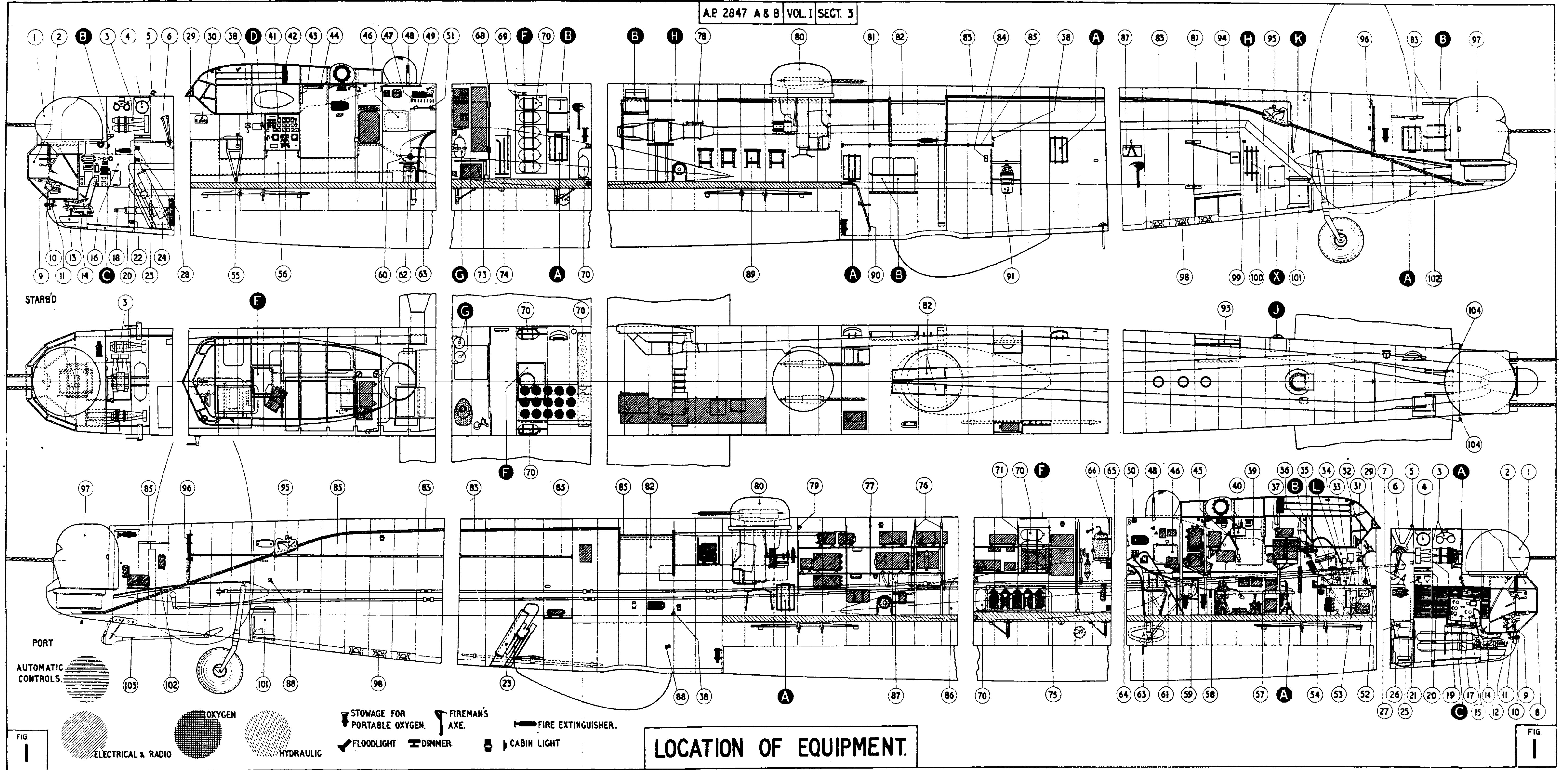


FIG. 1

LOCATION OF EQUIPMENT.

FIG. 1

• INSTRUCTIONS FOR GROUND PERSONNEL 4

(11065) T14574/G2588 1050 11/44 M20691 C & P 752

CHAPTER I

LOADING AND C.G. DATA

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

Introduction

1. This chapter is concerned with loading of the aircraft, and with the effect upon the centre of gravity (C.G.) position of different distributions of loads. The data given enables investigation to be made into C.G. movements resulting from expenditure of loads, e.g. fuel and bombs, during flight, and conditions arising from movement of loads during flight.

2. For determination of the C.G. position, the aircraft is considered standing with the thrust line, or rigging datum line, horizontal and the undercarriage lowered.

Definition of C.G. position

3. The position of the C.G. is defined by its distance in inches, measured parallel to the fuselage datum line, from a reference point known as the C.G. datum point (*see para. 4*). The distance is called the moment arm (*see para. 5*) of the C.G. and is determined from the following expression:—

$$\frac{(\text{Tare weight (lb.)} \times \text{Tare moment arm (ft.)} + (\text{Weights of loads (lb.)} \times \text{respective arms (ft.)}) \times 12}{\text{Tare weight} + \text{Total weight of loads}}$$

$$\frac{\text{Tare moment} + \text{load moments} \times 12}{\text{Total weight}}$$

Datum point

4. The datum point is arbitrarily located by the manufacturer, and, on Lincoln aircraft, is indicated on both sides of the fuselage by a plug hole 15 in. forward of the front face of the main plane front spar and 2 in. below the fuselage datum line. The starboard plug hole can be used for suspending a plumb line, the datum point being used in this manner when the C.G. is to be determined by weighing (*see A.P.1464D, Vol. I*).

Loading and C.G. Data

Moments and moment arms

5. The moment of an item is the product of its weight (lb.) and its moment arm (in.) measured parallel to the fuselage datum line, from the datum point. The moment arm of a load lying forward of the datum point is negative (although the load itself is always positive) and the resultant moment is, therefore, negative. The moment arm and moment of a load lying aft of the datum point are positive.

C.G. range

6. The approved limits of C.G. travel are shown in fig. 1. The C.G. must always be kept within these limits, even after using nearly all fuel and oil, bombs, etc.

7. Movement resulting from retraction of the undercarriage is allowed for: the effect of undercarriage retraction may therefore be ignored when making calculations.

Determination of the C.G. position

8. To determine the C.G. position, the first step must be to ascertain the effect upon the basic tare weight and corresponding moment of modifications incorporated in the aircraft other than those already taken into account in the diagram (*fig. 1*) and the possible removal of an normally fixed items of equipment. Typical service load (T.S.L.) items and alternatives will be found in fig. 1 and 2 and these must be added to conform to the loading of the aircraft: generally it may be found more convenient to add the complete T.S.L. as an item, and correct for additional items or items not required.

Typical example

9. The following is a typical calculation, using R.A.F. Form 1504, of the C.G. position. To make the example as clear as possible the explanatory matter in the form has been omitted and only the calculations are given: the letter references are those used in Form 1504:—

(i) Calculation of effect of modification on tare weight and moment.

	Effect on weight (lb.) *Increase*	*Decrease*	*Moment (lb. ft.)* *Positive*	*Negative*
Fixed equipment removed				
Ballast weight in nose, including fairing		540	9,504	
Fixed equipment fitted				
Nose turret, Boulton Paul	220			3,872
	220	540	9,504	3,872
	(A)	(B)	(a)	(b)

	lb.		*lb. ft.*
From fig. 1—uncorrected tare weight (C)	43,778	Uncorrected tare moment (c) ...	191,930
From above—tare weight increase (A)	220	Tare moment increase (a) ...	9,504
(A+C)	43,998	(a+c)	201,434
From above—tare weight decrease (B)	540	Tare moment decrease (b) ...	3,872
Corrected tare weight (A−B+C)	43,458 (D)	Corrected tare moment (a−b+c)	197,562 (d)
Corrected tare weight	43,458 lb. (D)	Corrected tare moment... ...	197,562 (d)

(ii) Calculation of total weight and moment of removable items of military load.

	Weight *(lb.)*	*Moment (lb. ft.)* *Positive*	*Negative*
Typical service load, less bombs—from fig. 1	4,285	53,199	
Add 2 ·5-in. guns (nose turret)	140		2,590
Add 600 rounds ammunition	180		3,220
Totals	4,605	53,199	5,810
	(E)	(s)	(t)

Moment of removable items of military load = (s − t) = 53,199 − 5,810 = 47,389 lb. ft.
4,605 lb. (E), 47,389 lb. ft. (e).

Loading and C.G. Data

(iii) Calculation of weight and moment of fuel and oil loads.

Fuel and oil to be carried	Weight (lb.)	Moment (lb.ft.) Positive	Moment (lb.ft.) Negative
Fuel (No. 1 tanks) 845 gall. @ 7·2 lb. per gall.	6,084	29,812	
Fuel (No. 2 tanks) 1,100 gall. @ 7·2 lb. per gall.	7,920	41,184	
Fuel (No. 3 tanks) 600 gall. @ 7·2 lb. per gall.	4,320	24,840	
Oil (all tanks full) 150 gall. @ 9 lb. per gall.	1,350	3,105	
Totals	19,674 (F)	102,941 (u)	(v)

Moment of fuel and oil load = (u − v) = 102,941 (f) lb.ft.

(iv) Calculation of gross weight and moment of aircraft, excluding bombs.

	lb.		lb.ft.
Corrected tare weight (D)	43,458	Corresponding moment (d)	197,562
Weight of removable items of military load, excluding bombs (E) ...	4,605	Corresponding moment (e)	47,389
Weight of fuel and oil (F)	19,674	Corresponding moment (f)	102,941
Gross weight, excluding bombs (D+E+F) =	67,737 (G)	Corresponding moment (d+e+f)	343,892 (g)

(v) Calculation of maximum weight of bombs

	lb.
Maximum weight at which the aircraft may be taken off (H)...	75,000
Gross weight, excluding bombs (G)	67,737
Maximum weight of bombs (H − G) = ...	7,263 (J)

(vi) Calculation of position of centre of gravity

	lb.		lb.ft.
*Provisional weight of bomb load (*see below*) (K)	7,256	Corresponding moment (k) ...	27,815
Gross weight, excluding bombs (G)	67,737	Corresponding moment (g) ...	343,892
Provisional gross weight (K+G) ...	74,993 (L)	Corresponding moment (k+g)	371,707 (l)

$$\text{Position of C.G. of aircraft} = \frac{1 \times 12}{L} \quad \frac{371{,}707\ (\text{ft.}) \times 12}{74{,}993}$$

= 59·47 in. aft of the datum point.

*Provisional bomb load		Weight (lb.)	Moment (lb.ft.) Positive	Moment (lb.ft.) Negative
At Stations 6, 2 and 4	3 500-lb. bombs	1,500		13,380
	3 carriers	55		490
At Stations 8, 12 and 10	3 500-lb. bombs	1,500		3,810
	3 carriers	55		139
At Stations 14 and 15	2 500-lb. bombs	1,000	3,838	
	2 carriers	36	138	
At Stations 9, 11 and 7	3 500-lb. bombs	1,500	15,315	
	3 carriers	55	561	
At Stations 3, 1 and 5	3 500-lb. bombs	1,500	24,870	
	3 carriers	55	912	
		7,256	45,634	17,819

Loading and C.G. Data

(vii) Calculation of centre of gravity for landing, following partial expenditure of load.

	Weight (lb.)	Moment (lb. ft.) Positive	Negative
Fuel No. 1 tanks 845 gall.	6,084	29,812	
Fuel No. 2 tanks 1,000 gall.	7,200	37,440	
Fuel No. 3 tanks 400 gall.	2,880	16,560	
Oil 88 gall.	792	1,822	
Ammunition 600 rds. (from front turret)	180		3,220
Bombs	7,000	26,833	
		112,467	3,220
		3,220	
Total expended load	24,136	109,247	

Landing weight ... ... 74,993 − 24,136 = 50,857 lb.

Corresponding moment ... ... 371,707 − 109,247 = 262,460 lb. ft.

Position of C.G. when landing ... $= \frac{262,460 \text{ (lb. ft.)} \times 12}{50,857}$

= 61·93 in. aft of datum.

This is inside the prescribed limits and therefore no correction is necessary for landing. If, however, four 500 lb. bombs at the rear stations were brought back from the flight, the C.G. position to cover this would be determined as follows:—

	Weight (lb.)	Moment (lb. ft.) Positive	Negative
Expended load (as above)...	24,136	109,247	
Replace 3 500-lb. bombs	1,500	24,870	
Replace 1 500-lb. bomb	500	5,105	
Corrected expended load	22,136	79,272	

Landing weight ... ... 74,993 − 22,136 = 52,857 lb.

Corresponding moment ... ... 371,707 − 79,272 = 292,435 lb. ft.

Position of C.G. when landing ... ... $= \frac{292,435 \text{ (lb. ft.)} \times 12}{52,857}$

= 66·39 in. aft of datum.

This is outside the prescribed limits and must be corrected for landing by movement forward of a member of the crew, e.g.

Move mid-upper gunner, with parachute, from action station to rest station; deduct moment 2,284

290,151

New C.G. position for landing $= \frac{290,151 \times 12}{52,857}$

= 65·9 in. aft of datum.

Effect of modifications

10. The following is a list of modifications incorporated in the aircraft as shown in the diagram (*see fig. 1*).

1117,	1173,	1179,	1180,	1199,	1313,
1331,	1378,	1401,	1148,	1303,	1322.

Loading and C.G. Data

Any other modifications which individually or in the aggregate affect the maximum all-up weight for all forms of flying by one per cent., or move the C.G. of the tare aircraft by one per cent. of the mean chord (*see fig. 1 and 2*), whether by incorporation or deletion, must be taken into account when making calculations for any particular aircraft. In no circumstances may the C.G. be allowed to move beyond the prescribed limits.

11. The following are lists of approved modifications. The first and second lists, both of which are numerically collated, cover all modifications approved up to the end of November, 1945. The second list (*para. 12*), which gives Mod. numbers only, is of modifications having a negligible effect upon the C.G. Subsequent lists are of a temporary nature, the contents of which will periodically be transferred to the collated lists. Details of these modifications are given so that their effect may be taken into account during calculations, and in this connexion it should be noted that some of the early modifications may already be included in the diagrams (*see para. 10*).

Mod. No. and Class	*Subject*	*Weight (lb.) Increase*	*Weight (lb.) Decrease*	*Moment (lb.ft.) Positive*	*Moment (lb.ft.) Negative*
1117 4B	To introduce FN.121 rear turret until FN.82 is available ... ... (Fixed)		15		997
	(Removable)		196		10,278
1155 S.O.O.	Introduction of equipment type "F" removable fittings... ... ... (Removable)	10·5		215	
1163 2	Introduction of five additional nitrogen bottles (Fixed)	107		610	
1165 4B	To introduce a dual system of cockpit lighting (Fixed)	5·5			55
1173 4B	Introduction of metal shelves for wireless crates to replace wooden ones ... ... (Fixed)		34		459
1175 4B	Metal leading edge on fin ... ... (Fixed)		9		416
1183 4B	Introduction of additional oxygen equipment for flight engineer ... ... (Fixed)	4			45
1185 S.O.O.	Introduction of glider tug intercommunication (Fixed)	2·5			25
1199 S.O.O.	To substitute Flexatex C6 and C7 for Flexatex and Linatex C2 hose for long range fuel tanks 1-tank installation (Fixed)	1·5		3	
	2-tank installation (Fixed)	3·0		6	
1203 4B	Introduction of felt fabric in lieu of self-sealing covering on oil tank ... ... (Fixed)		40		92
1204 1	Introduction of improved nose ribs ... (Fixed)	21·5			16
1205 4B	Introduction of metal entrance door ... (Fixed)	2·5		103	1
1215 2	Introduction of revised flare chute installation (Fixed)		10	2,159	
1217 4B	T.R.1143A—Fixed fittings ... ... (Fixed)	36		95	

Loading and C.G. Data

Mod. No. and Class	*Subject*	*Weight (lb.)* *Increase*	*Decrease*	*Moment (lb. ft.)* *Positive*	*Negative*
1218 2	T.R.1143A—Removable fittings ... (Removable)	76		468	
1223 4B	Introduction of Mk. II clock for wireless operator (Removable)	0·5			1
1226 4B	Introduction of S.A.B.S. Mk. IIA fixed fittings (Fixed)	14·5			164
1227 S.O.O.	Introduction of S.A.B.S. Mk. IIA bomb sight—removable fittings ... ... (Removable)	69			1297
1228 2	Application to Lincoln aircraft cancelled	—	—	—	—
1229 4B	Deletion of bomb door emergency air system (cancelling Mod. 757) ... ... (Fixed)		21	224	
1239 4B	To tropicalise all "Lincoln" Mk. I, II, XV and 30 (Fixed)	3·5		136	
1241 4B	To strengthen attachment of the outer wing to the inner wing at the rear spar ... ... (Fixed)	4·0		35	
1244 4B	Introduction of 6 additional oxygen cylinders (Fixed) (Removable)	104 14		702 45	
1245 4B	Revision of bromide engine fire protection installation (Fixed)	6·5			17
1257 4B	Introduction of fixed fittings for filter unit type 173, TR.3160, B.A. and waveform generator type 43 (Fixed)	2·0		63	
1266 4B	To introduce A.R.I.5583 in place of A.R.I.5590 fixed fittings... ... ... (Fixed)	1		7	
1276 4B	Re-positioning of oil cooler ... ... (Fixed)	Nil			8
1291 4B	To increase size of holes and introduce $\frac{3}{4}$ in. and $\frac{7}{8}$ in. holes on tail plane centre joint	0·5		21	
1303 2	Introduction of Boulton & Paul type "D" rear turret (Fixed)		88		1,383
1313 2	To strengthen the gussets on rib 18 (trailing edge) (Fixed)	0·5		7	
1319 4B	Introduction of power unit type 173 and interchange plugging to 2-volt accumulators and to delete H.T. batteries for A.1134 ... ... (Fixed)	3		2	
1321 2	To introduce Q-type harness and provide for back-type parachute on pilot's seat ... (Fixed)	0·5			5
1326 4B	Revised method of sealing oil tank covering round fittings... ... ... (Fixed)		1·5		3
1329 2	To introduce revised clipping ... ... (Fixed)	1		5	
1331 4B	Introduction of walkway on either side of A.R.I.5590 scanner ... ... (Fixed)	7·0		196	
1332 4B	Installation of dry air sandwich windscreen (Fixed)	11			137

Loading and C.G. Data

Mod. No. and Class	Subject	Weight (lb.) Increase	Weight (lb.) Decrease	Moment (lb. ft.) Positive	Moment (lb. ft.) Negative
1337 2	Introduction of improved bomb aimer's escape hatch and improvement to bomb aimer's seat (Fixed)	3			45
1368 2	Introduction of static line for parachuting wounded men ... ... (Fixed)	0·5			7
	(Removable)	1·5			22
1375 2	Introduction of turret position indicator (Fixed)	1·5			3
1376 2	Installation of Mk. VI U.S.N. drift sight (Fixed)	9		351	
	(Removable)	10·5		410	
1378 1	Deletion of expansion joint between intermediate and outer wing ... ... (Fixed)		2		14
1393 2	Introduction of smooth contour tyres with hydraulic shimmy damper ... ... (Fixed)	77·5		3,643	
	or a friction shimmy damper with T.C. tyre (Fixed)	18		846	
1394 2	Introduction of additional stringer each side of centre in roof of fuselage, extending approximately 2 bays forward of the rear spar ... ... (Fixed)	1·5		11	
1395 2	Introduction of strengthened Lincoln undercarriage	44		78	
1396 4B	Introduction of strengthened undercarriage support beam ... ... (Fixed)	20		17	
1397 4B	To provide for increased clearance weights—to strengthen centre section top and bottom booms (Fixed)	8		70	
1398 4B	To increase thickness of front spar web in undercarriage bay ... ... (Fixed)	24		30	
1399 4B	To introduce improvements to Lincoln nose (Fixed)	11			206
1401 1	To modify aileron overbalance (Fixed)	13		152	
1403 2 S.O.O.	Modification to reinforce tank installation to allow carriage of 4,000 lb. bomb in normal slip (Removable)	2			839
1407 4B	Provision for fixed fittings for B.17 mid upper turret (Fixed)	4		56	
1409 4B	To introduce a waterproof cover over the T.R.3548 (Fixed)	0·5		26	
1417 4B	To strengthen the front and rear spar joints between intermediate and outer wing	6		41	
1421 4B S.O.O.	Introduction of crate for A.R.I.5593, 5548, 5625 and 5693 ... ... (Fixed)	5·5		107	
1425 2	Introduction of Mk. IV vent valves in nitrogen system, Ref. 6D/789 ... ... (Fixed)	3		45	

Loading and C.G. Data

Mod. No. and Class	Subject	Weight (lb.) Increase	Weight (lb.) Decrease	Moment (lb. ft.) Positive	Moment (lb. ft.) Negative
1432 4B	Introduction of ducting under cockpit windows for drainage ... ... (Fixed)	2·5			20
1433 4B	To protect feathering pump from water penetration (Fixed)	1·5		2	
1438 4B	To add lifting handle to Nos. 2 and 3 tank access panels, to facilitate removal of both panels and tanks (Fixed)	4·5		27	
1447 4B	To re-position certain instruments from Flight Engineer's panel ... ... (Fixed)	3			93
1449 2	To provide for back type parachute for W/T operator and delete all parachute stowages except at mid-upper and tail turret stations ... (Fixed)		17		89
1450 4B	Introduction of aerials and connectors for radio altimeter SCR.718C ... ... (Fixed)	5·5		55	
1451 4B	Introduction of I.F.F. Mk. III G.R.... (Fixed) (Removable)	4 1		17 22	
1455 4B	Introduction of tyres Code No. HJ–R16–N (Fixed)	92		63	
1461 2	Fitment of B.17 turret—removable parts (Fixed) (Removable)	144 66		2,837 2,271	
1466 4B	Introduction of windows for inspection of flaps and undercarriage in flight ... ... (Fixed)	0·5		14	
1467 4B for production. 2 retrospectively for tropics.	Introduction of metal deflector for fairing in lieu of wooden deflector for tail turret (superseding Mod. 1322) ... ... (Fixed)		5		261
1468 2	Introduction of Rotol 4 bladed propellers and G.R.F. C.S.U. ... ... (Fixed)		168	1,222	
1469 2	Introduction of De Havilland 4 bladed propellers and A.Y.202, C.S.U.... ... ... (Fixed)		20	146	
1476 2	To modify internal structure of Nos. 2 and 3 flexible fuel tanks ... ... (Fixed)	9		49	
1487 2 4B	Introduction of chordwise rib stiffeners in wing T/E (Fixed)	25		320	
1497 S.O.O.	Introduction of light alloy air intake sand seals for aircraft with Mod. 971 going to tropics	1			
1611 4B	To fit lighter type of Perspex blister for H.2.S. (Removable)		50		1,350
1620 4B	To delete stowage for signal pistol ... (Fixed)		1		1
1621 2	Introduction of additional stringer on front spar web, undercarriage bay ... ... (Fixed)	2		2	

Loading and C.G. Data

Mod. No. and Class	Subject	Weight (lb.) Increase	Weight (lb.) Decrease	Moment (lb. ft.) Positive	Moment (lb. ft.) Negative
1623 2	To introduce field circuit breakers in "P" type generator system and to delete emergency switch (Fixed)	6·5			15
1627 4B	Miscellaneous deletion to prepare for new Radar requirement for Tiger Force aircraft (Fixed)		357		3,387
	(Removable)		191	616	
1628 (Corr. 1) S.O.O.	Introduction of cover in lieu of B.17 mid upper turret (Fixed)		779·5		15,122
	(Removable)		690		13,386
1629 4B	To cancel Mods. 1421 and 1266				
	1421 (crate for A.R.I.5593)		5·5		107
	1266 (A.R.I.5583 in lieu of A.R.I.5590)		1		7
1634 2	To provide support on wing structure for the tops of flexible fuel tanks ... ... (Fixed)	17		100	
1637 4B	To reduce friction in aileron control circuit (Fixed)	2·5		4	
1645 2	Deletion of one hydraulic pump and flow valves from hydraulic circuit ... ... (Fixed)		33		24
1652	To change material of the cabin heating air intake from Pytram to light alloy... ... ... (Fixed)	4		44	
1659 2	Introduction of G.P.I. ... ... (Fixed)	17			77
	(Removable)		6	27	
1661 4B	To cancel Mod. 1419 (introduction of saddle tank) ...	—	—	—	—
1678 S.O.O.	Introduction of removable fittings for types "F" and "Z" transmitters ... ... (Removable)	12			138
1688 2	To introduce stronger brackets supporting top skin stringers in centre section wing ... (Fixed)	1·5		8	

12. The weight and effect on the C.G. of the following modifications is negligible:—

894, 919, 1148, 1160, 1169, 1179, 1180, 1194, 1206, 1207, 1210, 1225, 1274, 1275, 1281, 1288, 1294, 1301, 1305, 1306, 1317, 1322, 1323, 1334, 1339, 1340, 1352, 1354, 1357, 1367, 1370, 1372, 1382, 1383, 1386, 1404, 1405, 1408, 1412, 1416, 1420, 1427, 1429, 1431, 1434, 1435, 1436, 1442, 1458, 1459, 1460, 1471, 1473, 1474, 1490, 1494, 1495, 1608, 1613, 1616, 1619, 1625, 1626, 1654, 1668, 1677, 1679, 1685.

P10164 M10032/G266 5/46 1050 C & P Gp. 1

The following are Modifications approved during December, 1945, and January and February, 1946:-

Mod. No. & Class	Subject	Weight (lb.)	Moment (lb./ft.)
1168 4B	Introduction of Bromide protection for wing tank bays (Fixed)	+ 243	+ 996
1293 4B	Introduction of fixed fittings for type "Z" equipment (Fixed)	+ 4	- 45
1381 4B	Introduction of 8,000 lb. bomb doors and special fairing (Fixed)	+ 30.5	+ 443
Corr. to 1407 2	Provision of fixed fittings for B17 mid upper turret	No weight alteration	
1452 2	Introduction of twin cell flare chute in aft position (cancels mod. 1215)		
	Twin cell flare chute etc. (Fixed)	+ 93	+ 3,091
	2 single cell flare chutes etc. (Fixed)	- 66	- 1,180
	Flares, flame floats, photo flash (Removable)	+ 187	+ 9,030
Corr. to 1497 4B & 2	Introduction of light alloy air intake sand seals for aircraft with mod. 971 going to tropics	No weight alteration	
Corr. to 1627 4B	Miscellaneous deletions to prepare for new Radar requirement for Tiger Force aircraft		
	Wts. and moments read: ((Fixed)	- 357	- 3,387
	((Removable)	- 191	+ 616
	and should read: ((Fixed)	(-298	- 3,874
	(	(- 29	+ 218
	((Removable)	- 257	+ 1,171

(Over

This is A.L. No. 48 to A.P.2847A & B, Vol. I and concerns Sect. 4, Chap. 1.
Insert this "List of Mods. approved during December, 1945, and January and February, 1946", after the "List of Mods. approved during October and November, 1945" and make an entry in the Amendment Record Sheet.

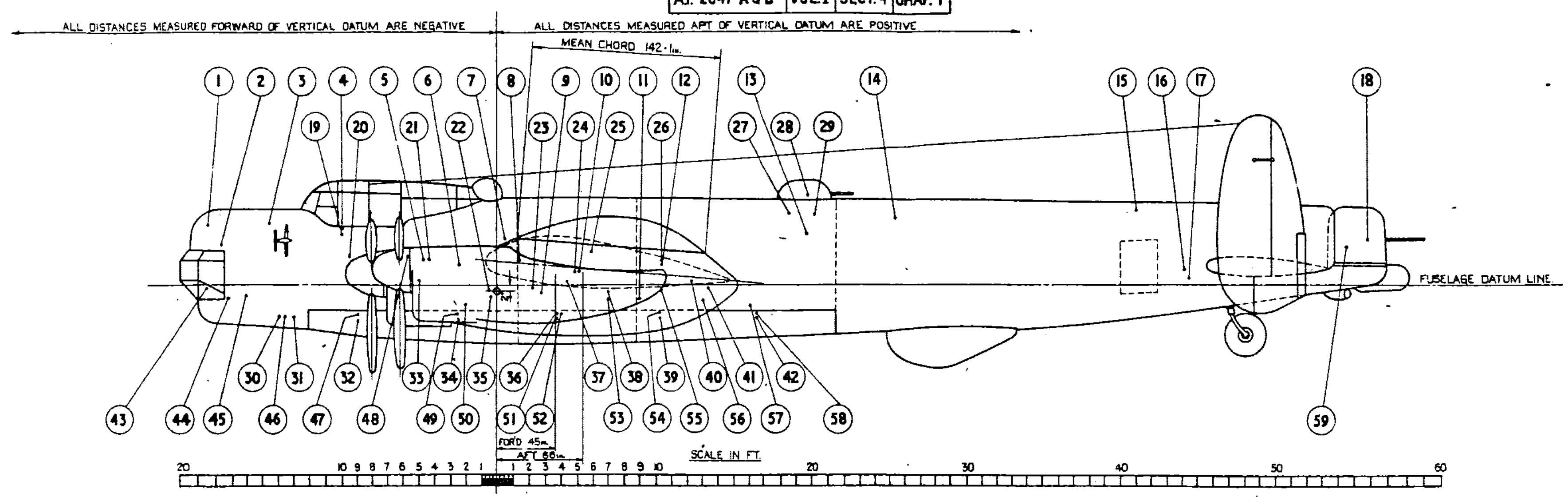
RESTRICTED
LINCOLN B MK. I & II
AIRCRAFT
Air Ministry, April, 1946.

Mod. No. & Class		Subject	Weight (lb.)	Mement (lb./ft.)
1632	2	Introduction of escape hatch in mid upper turret cover (Fixed)	+ 2	+ 39
1650	2 S00	To cater for carriage of Tallboy "M" (Fixed)	+ 182.5	+ 689
1663	4B	Introduction of stiffeners on front spar web above jacking pads and 5 pin jacking pads (Fixed)	+ 6.5	+ 10
1667	3A	To introduce upper identification lamp (Fixed)	+ 0.5	+ 21
1670	4B	Deletion of Mk. VI USN drift sight (Fixed)	- 9	- 351
		(Cancels Mod. 1376) (Removable)	- 10.5	- 410
1671	4B	To delete aerials and connectors for radio altimeter type SCR718A or C (Fixed) (Cancels Mod. 1450)	- 5.5	- 55
1672	2	Introduction of TR.1196 in standard position with revised aerial system (Fixed)	+ 14	+ 46
		(Cancels Mod. 1625) (Removable)	+ 35	+ 368
1687	2	Introduction of revised stowage for fireman's axe with stowage for asbestos gloves (Fixed)	+ 0.5	+ 4
		(Removable)	+ 1	+ 8
1689	2	To prevent ingress of water behind the front turret (Fixed)	+ 0.5	- 8
1690	2B	I Introduction of improved oil filter (Fixed)	+ 2	+ 1
1694	4B	Replacement of triple fusing unit bridge (Fixed)	- 2.5	+ 2

The following mods. have a negligible effect:-

1443, 1486, 1489, 1604, 1643, 1658, 1696, 1700, 1716, 1724

(2H) RTP9(a)/163/1050



REMOVABLE ITEMS OF MILITARY LOAD.

ITEM	Nº	WEIGHT (LB.)	ARM (FT.)	MOMENT (LB. FT.) FORWARD	MOMENT (LB. FT.) AFT
GUNS MID-UPPER (2 x ·5 in.)	28	140	+ 19·7		2,758
AMMO. IN TURRET 800 RDS.	29	242	+ 20·2		4,888
AMMO. IN BOXES 800 RDS. (RESERVE)	57	242	+ 16·1		3,896
GUNS IN REAR TURRET (2 x ·5 in.)	18	140	+ 55·9		7,826
AMMO. ON TRACKS (700 RDS.)	15	212	+ 41·0		8,692
AMMO. IN BOXES (1300 RDS.) RESERVE	14	393	+ 25·4		9,982
SIGHTING HEAD	43	16	− 18·5	296	
COMPUTOR	45	62	− 16	992	
SIGNAL PISTOL AND CARTRIDGES	7	6·5	+ ·5		3
BOMB FUSING	52	28·5	+ 3·96		113
ELECTRICAL EQUIPMENT	9	24	+ 2·7		64
NAVIGATIONAL INSTRUMENTS	48	32	− 5·7	182	
F.24 CAMERA	31	55	− 12·92	710	
OXYGEN, PORTABLE	11	43	+ 9		387
OXYGEN CHARGE	53	35·5	+ 7·08		251
B.B.P. CUTTERS & CARTRIDGES	8	44	+ 1·33		59
DINGHIES TYPE K. (7.)	41	128	+ 13·5		1,728
DINGHY, TYPE Q	26	97	+ 10·5		1,018
PACKS, TYPE S.	12	58	+ 10·5		609
FIRST-AID PACK	16	6	+ 44·2		265
T.1154 − R.1155.	6	155·5	− 2·4	373	
T.R. 1196	55	35	+ 10·5		368
BEAM APPROACH	50	44	− 2	88	
R.3090	13	36	+ 19·8		712
R.1355	5	75	− 4·8	360	
A.1134A.	21	25	− 4·4	110	
A.R.I. 5590. & A.R.I. 5559.	56	484	+ 13·93		6,744
T.1833. (DINGHY RADIO)	20	26	− 9·65		251
PILOT & PARACHUTE	19	200	− 10	2,000	
F/ENGINEER & PARACHUTE	4	200	− 10	2,000	
NAVIGATOR & PARACHUTE	33	200	− 5	1,000	
W/T OPERATOR & PARACHUTE	35	200	− 0·33	66	
AIR BOMBER & PARACHUTE	44	200	− 17·3	3,460	
MID-UPPER GUNNER & PARACHUTE	27	200	+ 18·5		3,700
REAR GUNNER & PARACHUTE	59	200	+ 54·6		10,920
				11,637	65,234
TYPICAL SERVICE LOAD (LESS BOMBS)		4285			53,597
POSITION OF C.G.	12·51 FT. OR 150·12 INCHS. AFT. OF DATUM.				

ALTERNATIVE ITEMS NOT INCLUDED IN TYPICAL SERVICE LOAD.

ITEM	Nº	WEIGHT (LB.)	ARM (FT.)	MOMENT (LB. FT.) FORWARD	MOMENT (LB. FT.) AFT
FLAME FLOATS (6)	3	70	− 14·5	1015	
PHOTO FLASH	46	21	− 13·5	283	
RECONNAISSANCE FLARES (4)	30	96	− 13·9	1,334	
SEA MARKERS − ALUMINIUM (6)	30	46	− 13·9	639	
MEMBER OF CREW ON REST SEAT	38	200	+ 7·08		1,416
MEMBER OF CREW AT URINAL POSITION	17	200	+ 44·3		8,860
GUNS FRONT TURRET (2 x ·5 in.)	1	140	− 18·5	2,590	
AMMO. IN TURRET (600 RDS.)	2	180	− 17·9	3,222	

MAXIMUM PERMISSIBLE WEIGHT.................75,000 LB.
LANDING WEIGHT.................65,000 LB.

NOTES:–
ITEM 9 (ELECTRICAL EQUIPMENT) INCLUDES:– ELECTRIC TORCHES, SUPPRESSOR & SIGNALLING LAMP.
ITEM 48 (NAVIGATIONAL INSTRUMENTS) INCLUDES:– MK. II ASTRO COMPASS MK. IA. ASTROGRAPH PRISMATIC BINOCULARS OSA. STANDARDS, NAVIGATIONAL COMPUTOR, MK. IX SEXTANTS, FINDER & IDENTIFIER, COMPASS SETS, PROTRACTORS & PILOT'S KNEE-TYPE WRITING PAD.
FOR FURTHER LOADING DATA & ITEMS OF FIXED MILITARY EQUIPMENT SEE FIG. 2.

FULL FUEL – 2,860 GALL. & 9-500 LB. BOMBS.

ITEM	Nº	WEIGHT (LB.)	ARM (FT.)	MOMENT (LB. FT.) FORWARD	MOMENT (LB. FT.) AFT
AIRCRAFT TARE.	37	43,778	+ 4·38		191,930
TYPICAL SERVICE LOAD (LESS BOMBS)	40	4,285	+ 12·51		53,597
FUEL (1160 GALL.) Nº 1. TANKS	24	8,352	+ 4·9		40,925
FUEL (1100 GALL.) Nº 2. TANKS	10	7,920	+ 5·2		41,184
FUEL (600 GALL.) Nº 3. TANKS	25	4,320	+ 5·75		24,840
OIL (150 GALL.)	23	1,350	+ 2·3		3,105
1 − 500 LB. BOMBS.	32	500	− 8·92	4,460	
1 − CARRIERS.	47	18	− 8·92	161	
3 − 500 LB. BOMBS.	34	1,500	− 2·54	3,810	
3 − CARRIERS.	49	55	− 2·54	140	
2 − 500 LB. BOMBS.	51	1,000	+ 3·83		3,830
2 − CARRIERS.	36	36	+ 3·83		138
3 − 500 LB. BOMBS.	39	1,500	+ 10·21		15,315
3 − CARRIERS.	54	55	+ 10·21		562
				8,571	375,426
ALL-UP WEIGHT		74,669			366,855
POSITION OF C.G.	4·91 FT. OR 58·92 INCHS. AFT OF DATUM.				

1-4,000 LB. BOMB & 6-1,000 LB. BOMBS.

ITEM	Nº	WEIGHT (LB.)	ARM (FT.)	MOMENT (LB. FT.) FORWARD	MOMENT (LB. FT.) AFT
AIRCRAFT TARE	37	43,778	+ 4·38		191,930
TYPICAL SERVICE LOAD (LESS BOMBS)	40	4,285	+ 12·51		53,597
3 − 1,000 LB. BOMBS (SHORT-TAILED)	32	3,000	− 8·92	26,760	
3 CARRIERS	47	55	− 8·92	491	
1 − 4,000 LB. BOMB.	51	4,000	+ 3·96		15,840
3 − 1,000 LB. BOMBS. (SHORT-TAILED)	42	3,000	+ 16·58		49,740
3 CARRIERS.	58	55	+ 16·58		912
FUEL (449 GALL.) Nº 1 TANKS.	24	3,233	+ 4·9		15,842
FUEL (1100 GALL.) Nº 2 TANKS.	10	7,920	+ 5·2		41,184
FUEL (600 GALL.) Nº 3 TANKS.	25	4,320	+ 5·75		24,840
OIL (150 GALL.)	23	1,350	+ 2·3		3,105
				27,251	396,990
ALL-UP WEIGHT		74,996			369,739
POSITION OF C.G.	4·93 FT. OR 59·16 INCHS. AFT. OF DATUM.				

6 − 2,000 LB. BOMBS.

ITEM	Nº	WEIGHT (LB.)	ARM (FT.)	MOMENT (LB. FT.) FORWARD	MOMENT (LB. FT.) AFT
AIRCRAFT TARE	37	43,778	+ 4·38		191,930
TYPICAL SERVICE LOAD (LESS BOMBS)	40	4,285	+ 12·51		53,597
3 − 2000 LB. BOMBS	34	6,000	− 2·54	15,240	
3 − CARRIERS	49	165	− 2·54	419	
3 − 2000 LB. BOMBS.	39	6,000	+ 10·21		61,260
3 − CARRIERS.	54	165	+ 10·21		1,685
FUEL (141 GALL.) Nº 1 TANKS.	24	1,015	+ 4·9		4,975
FUEL (1100 GALL.) Nº 2 TANKS.	10	7,920	+ 5·2		41,184
FUEL (600 GALL.) Nº 3 TANKS.	25	4,320	+ 5·75		24,840
OIL (150 GALL.)	23	1,350	+ 2·3		3,105
				15,659	382,576
ALL-UP WEIGHT		74,998			366,917
POSITION OF C.G.	4·89 FT. OR 58·7 INCHS. AFT OF DATUM.				

FIG. 1.

LOADING AND C.G. DIAGRAM

FIG. 1.

FP3851 M /G1506 7/45 1050 C.& P. Gp. 959 (4)

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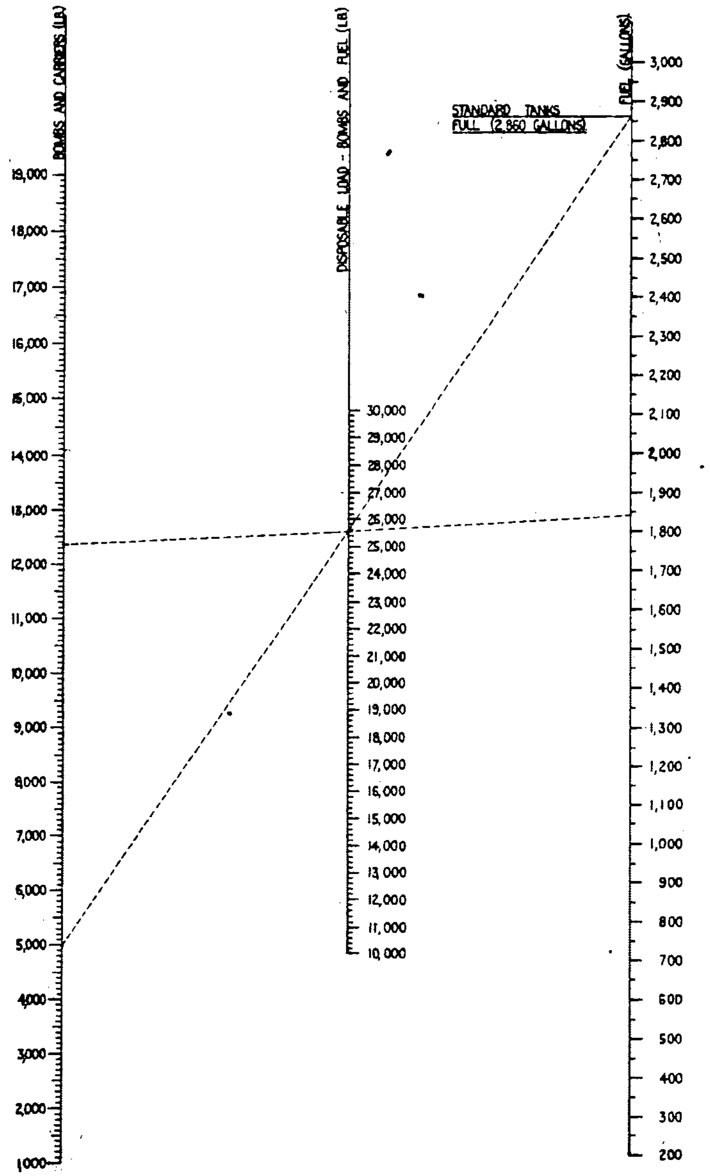


INSTRUCTIONS FOR USE OF CHART

THE PURPOSE OF THIS CHART IS TO SIMPLIFY THE ESTIMATION OF THE QUANTITY OF FUEL TO BE CARRIED WITH A GIVEN WEIGHT OF BOMBS AND CARRIERS OR ALTERNATIVELY THE WEIGHT OF BOMBS AND CARRIERS TO BE CARRIED WITH A GIVEN AMOUNT OF FUEL. IT SHOULD BE USED IN THE FOLLOWING WAY:—

THE TARE WEIGHT OF THE AIRCRAFT, THE WEIGHT OF OIL (150 GALLS.) AND THE SERVICE LOAD ARE ALL ADDED TOGETHER TO OBTAIN THE BASIC WEIGHT AS FOLLOWS:—

TARE WEIGHT	(FROM FIG. 1)	43,778 LB
150 GALLONS OIL	(FROM FIG. 1)	1,350 LB
SERVICE LOAD	(FROM FIG. 1)	4,285 LB
BASIC WEIGHT LESS FUEL, BOMBS AND CARRIERS		49,413 LB

THE ALLOWABLE WEIGHT FOR DISPOSABLE LOAD, I.E. FUEL, BOMBS AND CARRIERS IS THEN FOUND BY SUBTRACTING THE BASIC WEIGHT FROM THE MAXIMUM GROSS WEIGHT (75,000 LB.) AS FOLLOWS:—

MAXIMUM GROSS WEIGHT	75,000 LB
BASIC WEIGHT	49,413 LB
DISPOSABLE LOAD	25,587 LB

SUPPOSE IT IS NOW REQUIRED TO FIND THE QUANTITY OF FUEL WHICH CAN BE CARRIED WITH A GIVEN BOMB LOAD OF 12,000 LB. (PLUS CARRIERS 330 LB.):—

PLACE A RULE ACROSS THE DIAGRAM SO THAT IT INTERSECTS THE COLUMN FOR BOMBS AND CARRIERS AT 12,330 LB. AND THE COLUMN FOR DISPOSABLE LOAD AT 25,557 LB. THE MAXIMUM QUANTITY OF FUEL ALLOWED WITH THIS BOMB LOAD WILL THEN BE GIVEN AT THE INTERSECTION OF THE RULE THROUGH THE FUEL COLUMN, IN THIS CASE 1840 GALLONS.

SIMILARLY, IF IT IS REQUIRED TO FIND THE MAXIMUM WEIGHT OF BOMBS AND CARRIERS WHICH CAN BE CARRIED WITH A GIVEN QUANTITY OF FUEL (2,860 GALLONS - FULL FUEL)

PROCEED AS FOLLOWS:- PLACE A RULE ACROSS THE DIAGRAM SO THAT IT INTERSECTS THE COLUMN FOR FUEL AT 2860 GALLONS AND THE COLUMN FOR DISPOSABLE LOAD AT 25,587 LB. THE MAXIMUM WEIGHT OF BOMBS AND CARRIERS ALLOWED WITH THIS QUANTITY OF FUEL WILL THEN BE GIVEN AT THE INTERSECTION OF THE RULE THROUGH THE COLUMN FOR BOMBS, IN THIS CASE 4,990 LB.

NOTE

IT IS ASSUMED THAT FULL OIL (150 GALLONS) IS CARRIED ON EVERY OCCASION.

TARE WEIGHT 43,778 LBS.

THIS INCLUDES THE FOLLOWING ITEMS:—

BALLAST IN PLACE OF NOSE TURRET INCLUDING WEIGHT FOR GUNS AND AMMUNITION	540 LB
MID - UPPER TURRET GLEN MARTIN TYPE 23	558 LB
REAR TURRET BOULTON AND PAUL 'D' TYPE	419 LB
TURRET MOUNTINGS AND FITTINGS	205 LB
AMMUNITION BOXES, TRACKS AND MOUNTINGS FOR REAR TURRET	101 LB
FIXED BOMB AND FUSING GEAR	374 LB
BOMB SIGHT MOUNTINGS	50 LB.
FIXED EQUIPMENT FOR PYROTECHNICS	14 LB
ELECTRICAL EQUIPMENT	1,392 LB
FIXED PARTS INSTRUMENT EQUIPMENT, FLYING, ENGINE, NAVIGATIONAL, D. R. COMPASS	281 LB
AUTOMATIC CONTROLS AND F.24 CAMERA MOUNTING	101 LB
FIXED EQUIPMENT FOR OXYGEN INSTALLATION INCLUDING 15 OXYGEN CYLINDERS AND CRATE AND PORTABLE OXYGEN	379 LB
NITROGEN SYSTEM (12 BOTTLES)	266 LB
FIXED PARTS OF MISCELLANEOUS EQUIPMENT INCLUDING FIRE EXTINGUISHERS, SAFETY BELTS, MOUNTINGS FOR FIRST AID, METHYL BROMIDE. FIREMAN'S AXE, FITTINGS FOR SUN BLINDS, PARACHUTE STOWAGES, EMERGENCY TOOL KIT AND ELSAN	245 LB.
FIXED PARTS OF DINGHY INSTALLATION	54 LB
FIXED PARTS OF WIRELESS EQUIPMENT INCLUDING D.F. LOOP, INTERCOMMUNICATION, STANDARD BEAM APPROACH, AERIALS, T.1154/R.1155, T.R.1196, R.3090 AND A.R.I.5590/A.R.I.5559	1,202 LB
DE - ICING SYSTEM	60 LB
GLIDER TOW RELEASE	3 LB
CABLE CUTTING EQUIPMENT	21 LB
ARMOUR PLATING	345 LB

MAXIMUM ALL-UP WEIGHT FOR TAKE-OFF AND STRAIGHT FLYING - 75,000 LB.

MAXIMUM ALL-UP WEIGHT FOR LANDING - 65,000 LB.

LIMITS OF PERMISSIBLE C.G. TRAVEL

FORWARD LIMIT	45·0 IN. AFT OF DATUM POINT MEASURED PARALLEL TO DATUM.
AFT LIMIT	66·0 IN. AFT OF DATUM POINT MEASURED PARALLEL TO DATUM.

FIG. 2

LOADING & C.G. CHART.

FIG. 2

PP3851 M /G1506 7/45 1050 C & P Gp. 959 (4)

CHAPTER 2

GROUND HANDLING AND PREPARATION FOR FLIGHT

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

General

1. This chapter contains information on handling the aircraft on the ground and preparing it for flight. Ancillary equipment for handling and servicing is listed in the appropriate M leaflet of Vol. II, and special gear and tools are included in the Schedule of Spare Parts, Vol. III, Part 1, both of A.P. 2847A & B.

Towing

2. The towing arrangements are shown in fig. 1. Before towing, ensure that the undercarriage jury struts are in position between the top joint of the undercarriage strut and the locking joint on the retracting strut. It is necessary for someone to occupy the pilot's seat to apply the brakes when required.

3. ***Forward towing.***—The aircraft is towed forward by a towing bridle, Pt. No. 1/U.574 (Stores Ref. 26EA/3837) which is attached to the eyebolt at the bottom of the inner shock-absorber strut of each main wheel unit. The tail wheel steering arm, Pt. No. 1/U.572 (Stores Ref. 26EA/3835) should be used in conjunction with the towing bridle.

4. ***Backward towing.***—A towing bar, Pt. No. 1/U.573 (Stores Ref. 26EA/3836) mounted on two small wheels, is hooked to the bobbins at the end of the tail wheel fork, and secured in position by a spring-loaded plunger. The bar is fitted with a spring-loaded mechanism, which releases the aircraft if the pull exerted by the tractor exceeds a load of 4,750 lb. The release is spring-operated, and simple to re-engage. When using the tail towing bar the elevators must be locked in the neutral position (*see* para. 8).

Picketing

5. A picketing diagram is given in fig. 2. The picketing points on the aircraft can be used in conjunction with the standard picketing lay-out, concerning which full details are given in A.P.1464A, Vol.I (old publication), Part 8, Sect. 1, Chap. 2 or A.P.1464G, Vol. I (new publication), Part 2, Sect. 5, Chap. 2. The main plane is picketed from the shackles on the front spar between ribs 17A and 17B on the intermediate plane near the junction with the outer plane and at rib 2A near the junction of the intermediate plane and the centre plane. Doors in the skin on the underside of the plane give access to these shackles. The fuselage is picketed at the tail end by ropes lashed round the tail wheel axle and to eyebolts, Pt. No. 1/U.576 (Stores Ref. 26EA/4262), which are to be screwed into the sides of the fuselage, just above the rear end of the bomb doors. The eyebolts are part of the aircraft tool kit.

6. When the aircraft is picketed, the main wheels should be chocked and the chocks held in position by stakes. The outer picketing ropes on the main plane should be left slack on the picketing points and weighted with sand bags. After removing the picketing ropes from the aircraft, care should be taken to ensure that the special eyebolts in the sides of the fuselage are removed and replaced by standard screwed plugs. The weather covers (*see* para. 7) should be fitted when the aircraft is picketed.

Covers

7. Weather covers (*see* fig. 2) are provided for the power plants, canopy, nose (including

Ground Handling and Preparation for Flight

the turret), dorsal turret, tail turret, and for the pressure head.

Flying controls locking gear

8. This gear (*see* fig. 3) is stowed on the starboard side of the fuselage between the main plane spars, and consists of:—

(i) A strut to be fastened to the top of the pilot's seat and to a bracket on the control column.

(ii) A strut to be inserted at one end into the port cockpit rail, and fitted by two screwed hooks to the handwheel, to prevent it rotating.

(iii) A T-tube with a transverse member to be inserted in the hollow footrest of each rudder pedal and the other end attached to the bracket on the control column.

Location of servicing points

9. The locations of the inflation valves, filler caps and other servicing points are shown in fig. 4. Inflation pressures and specifications for fuel, oil, hydraulic fluid and de-icing fluid will be found in the Leading Particulars.

Dipsticks

10. Dipsticks for the fuel tanks are stowed in the fuselage on the starboard side, just aft of the main door. The oil tank dipsticks are stowed inside the filler necks. The dipstick for the header tank in the tail turret hydraulic system is integral with the filler cap.

WARNING—

It is of the utmost importance that the dipstick be used when filling the inboard oil tanks, as the position of the filler neck makes it possible to fill these tanks completely, thus allowing no air space.

Oil dilution system

11. An oil dilution valve is fitted in each power plant, and the push-button operating switches are on the flight engineer's panel. A description of the system will be found in A.P.2095 (Pilot's Notes—General) and the method of operating it is described in A.P.2847A & B—Pilot's Notes. Operating times are:—

1 min. at air temperatures down to —10 deg. C.

2 min. at air temperatures below —10 deg. C.

Electric priming system

12. The electrical priming system for the engines consists of an electric pump on the firewall of each inboard nacelle, and a solenoid-operated valve on the firewall of each of the four nacelles. The solenoid valves are controlled by four push-buttons on the pilot's instrument panel, labelled ENGINE PRIMING, and the switch for the electric pumps, with a warning lamp, is on the right of the push-buttons. Each outboard delivery pipe is provided with a bleed connection to the carburettor vapour vent pipe at a union on the firewall. Access for cleaning purposes to the small hole forming the bleed is obtained by disconnecting the bleed pipe from the adaptor, and then the adaptor from the union. A small filter is fitted between the adaptor and the union. The object of the bleeds is to ensure that all air locks in the pipes are driven out.

13. The engines should be primed separately just before starting. The procedure is as follows:—

(i) Switch on the priming pump and allow it to run for at least half a minute to ensure that fuel under pressure is available at the valve inlet and that all air locks have been driven out.

(ii) To open the solenoid valve for actual injection press the push-button for the following times:—

Air temp. °C	*Time to inject in seconds*
+30	2
+20	3
+10	4½
+ 5	6
0	7½
− 5	14

Alternative hand-priming system

14. An alternative hand-priming system may be found on some aircraft. The electric pumps and solenoid-operated valves are omitted, and a Ki-gass hand pump is mounted in each inboard nacelle below the fuel distributor tank. The delivery lines remain as described for the electric priming system.

15. Details of the operation of the hand-priming system will be added later.

Ground Handling and Preparation for Flight

Topping up cooling systems

16. The aircraft must be in the tail-down attitude and the engines must be cold. Both the main and intercooler systems should be topped up to the lower edge of the filler opening with the correct mixture of glycol and distilled water (*see* Leading Particulars). Care should be taken to avoid splashing of coolant, since glycol will damage the rubber-covered cables of the power plant. The normal loss of coolant is small, and if more than four pints in the main system and two pints in the intercooler system are required to restore the respective levels an examination for leaks should be made and the functioning of the relief valve checked.

Draining fuel, oil, and cooling systems

17. For draining instructions *see* Chap. 3 of this Section.

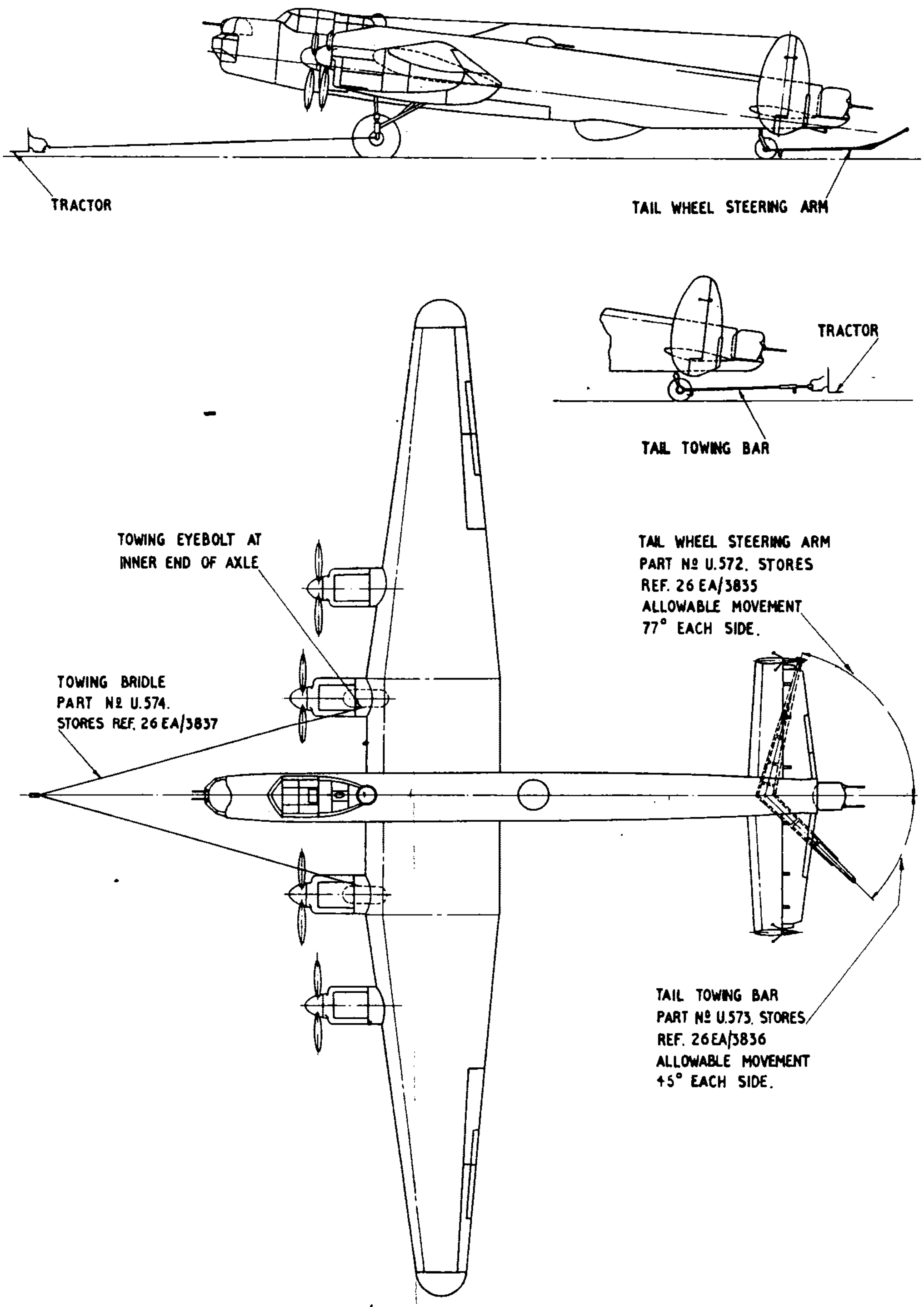
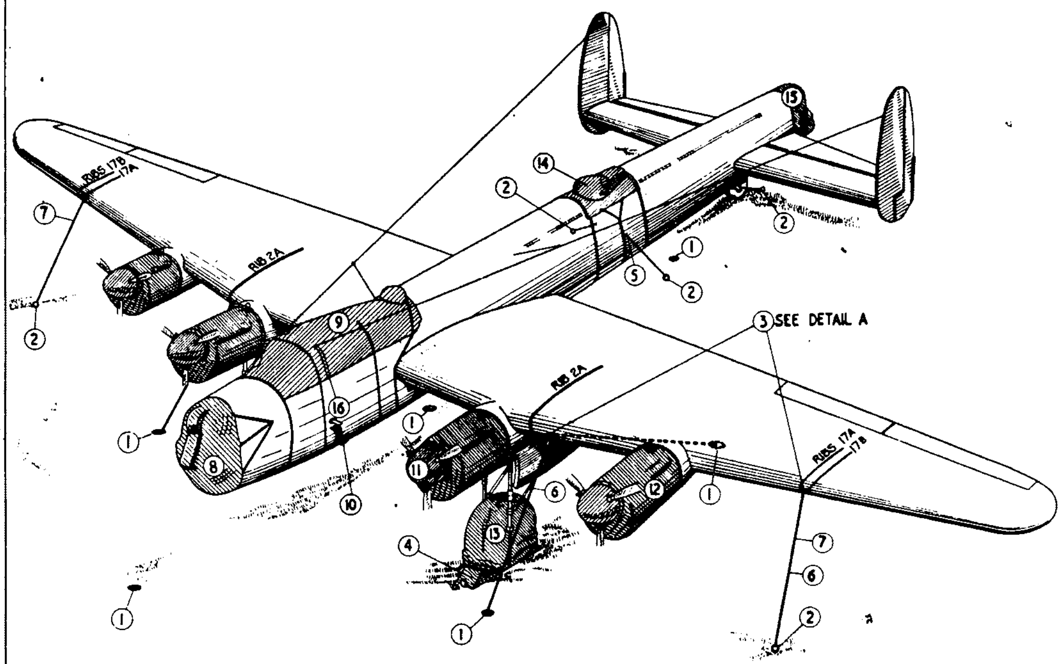


FIG. 1 — TOWING — FIG. 1



PICKETING

(1) STANDARD PICKETING POINTS.

(2) SCREW PICKETS.

(3) LARGE PICKETING SHACKLES PROVIDED ON FRONT SPAR AT RIBS 2A AND BETWEEN RIBS 17A AND 17B. SEE DETAIL A

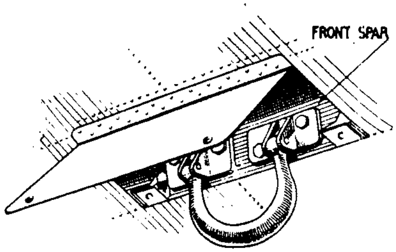
(4) CHOCK MAIN WHEELS, SECURE CHOCKS IN POSITION BY STAKES.

(5) SCREWED PICKETING POINT ON LONGERON AT FORMER 22. REMOVE PLUG AND FIT EYEBOLT PART Nº 1/U576 (STORES REF. 26EA/4262.)

(6) PICKETING ROPES

(7) ROPES AT TWO OUTER POSITIONS TO BE LEFT SLACK ON PICKETING POINTS AND WEIGHTED WITH SANDBAGS.

NOTE.
AIRCRAFT MUST BE PLACED CENTRALLY ON THE PICKETING POINTS SO THAT 3 POINTS LIE UNDER ℄ OF FUSELAGE AND TWO OUTER POINTS ARE LOCATED APPROX. 6FT. FORWARD OF THE WING LEADING EDGE.



DETAIL A

PICKETING SHACKLES ON FRONT SPAR

COVERS

(8) NOSE COVER PART Nº 1/Z.2918 (STORES REF. 27D/2278) TAPES TIED TO AERIAL BRACKET.

(9) CANOPY COVER PART Nº 1/Z.2908 (STORES REF. 27D/2279) TAPES TIED UNDERNEATH THE FUSELAGE

(10) PRESSURE HEAD COVER PART Nº 1/Z.2512 (STORES REF. 27D/NIV.)

(11) SPINNER COVER PART Nº 1/Z.2770 (STORES REF. 27D/2280) DUTCH LACED IN CONJUNCTION WITH ENGINE COVER AND TIED ROUND BASE OF PROPELLER BLADES.

(12) ENGINE COVER PART Nº 1/Z.2769 (STORES REF. 27D/2281) DUTCH LACED UNDERNEATH AND IN CONJUNCTION WITH SPINNER COVER. TAPES WRAPPED ROUND AND TIED WHERE CONVENIENT.

(13) WHEEL COVERS. (STORES REF. 26 BA/13138)

(14) DORSAL TURRET COVER PART Nº 1/Z.2906 (STORES REF. 27D/2282) TAPES TIED UNDERNEATH FUSELAGE.

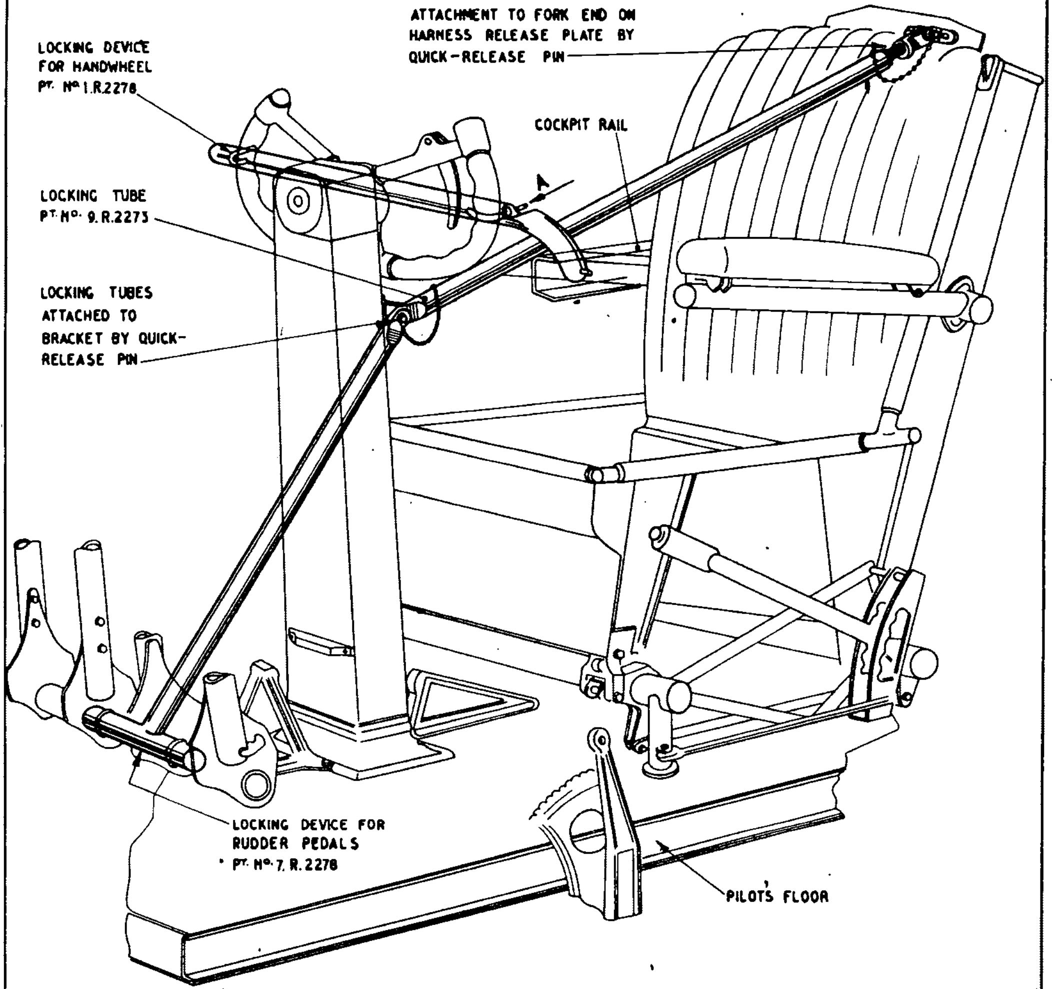
(15) REAR TURRET COVER PART Nº 1/Z.2810 (STORES REF. 27D/2283) DUTCH LACED AT REAR AND UNDERNEATH. TAPES SECURED TO TAIL WHEEL SHOCK ABSORBER STRUT.

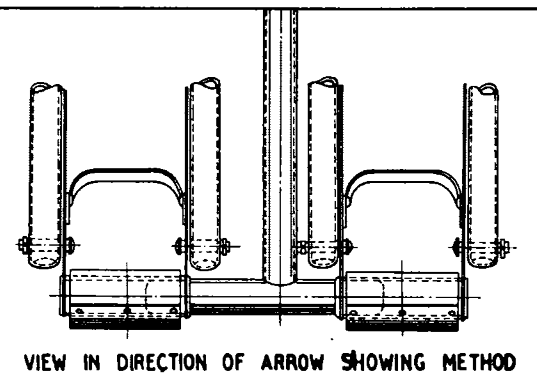
(16) LIFT-THE-DOT FASTENERS.

FIG. 2 **PICKETING AND ARRANGEMENT OF COVERS** FIG. 2

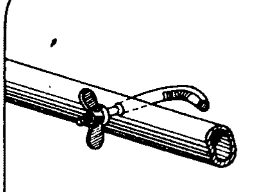
13545/P.L.M./11.44.

This leaf issued with A.L. No. 11 , Feb. 1945





VIEW IN DIRECTION OF ARROW SHOWING METHOD OF LOCKING RUDDER PEDALS



DETAIL IN DIRECTION OF ARROW A

FIG 3 — LOCKING OF FLYING CONTROLS — FIG 3

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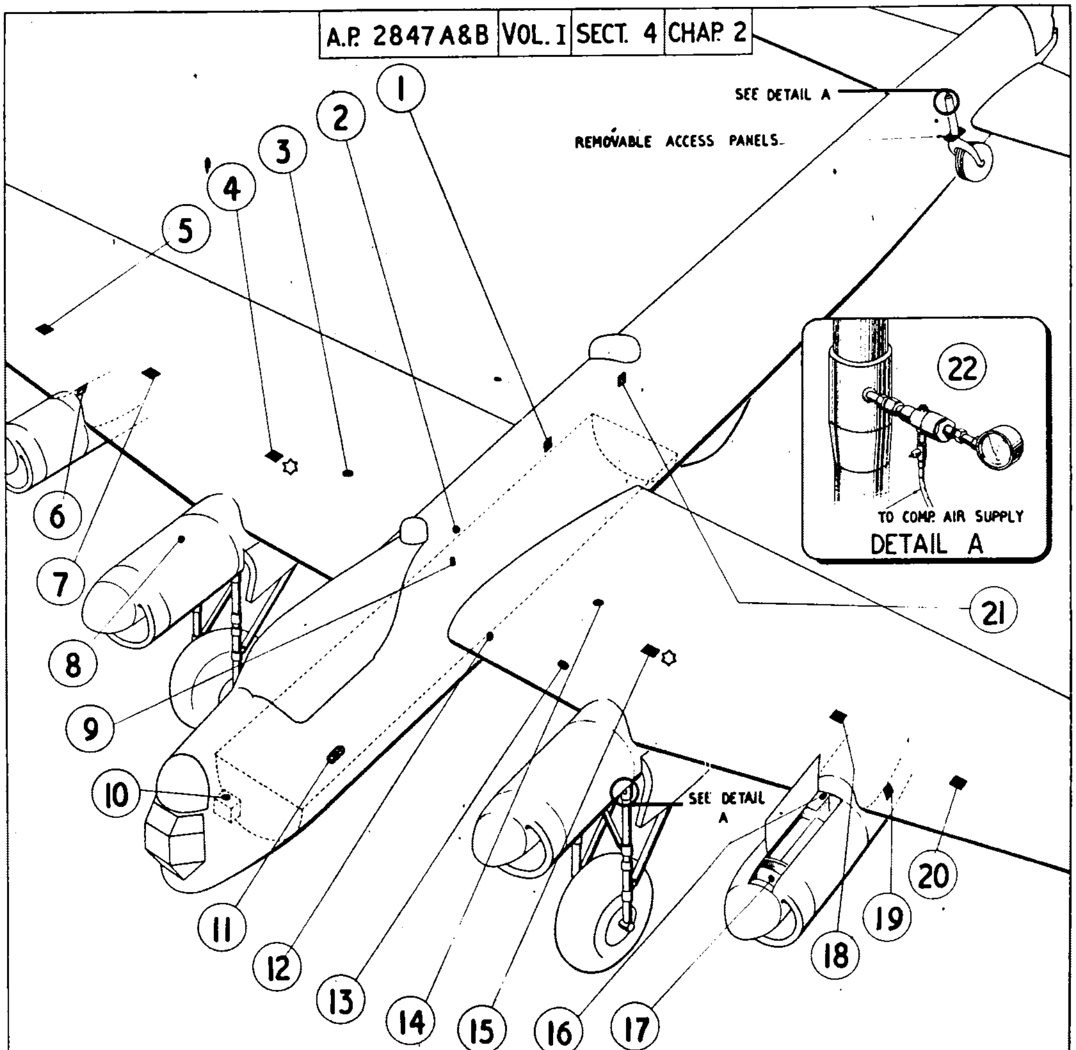


1. ELECTRICAL GROUND SUPPLY SOCKET IN STARBD. SIDE-EXTERNAL ACCESS.
2. NITROGEN CHARGING VALVE IN STARBD. SIDE - EXTERNAL ACCESS.
3. No. 1 FUEL TANK FILLER CAP-TOP SURFACE-STARBD.
4. OIL TANK FILLER CAP FOR STARBD. INBOARD ENGINE - TOP SURFACE.
5. No. 3 FUEL TANK FILLER CAP-TOP SURFACE-STARBD.
6. OIL TANK FILLER CAP FOR STARBD. OUTBOARD ENGINE, ACCESS THROUGH REMOVABLE DOOR IN OUTBOARD FAIRING PANEL.
7. No. 2 FUEL TANK FILLER CAP - TOP SURFACE - STARBD.
8. PNEUMATIC CHARGING POINT ON BRACKET BETWEEN UNDERCARRIAGE BEAMS.
9. HYDRAULIC RESERVOIR FILLER CAP INSIDE THE FUSELAGE AFT OF THE FRONT SPAR.
10. DE-ICING (WINDSCREEN) FILLER CAP ON TANK INSIDE FUSELAGE.
11. ITEM DELETED..

14. EMERGENCY AIR FOR UNDERCARRIAGE AND FLAPS. OXYGEN SYSTEM. CHARGING VALVES IN PORT SIDE - EXTERNAL ACCESS.

13. TAIL TURRET HYDRAULIC HEADER TANK. ACCESS DOOR IN LEADING EDGE FOR TOPPING UP AND INFLATION.

14. No. 1 FUEL TANK FILLER CAP - TOP SURFACE - PORT.
15. OIL TANK FILLER CAP FOR INBOARD PORT ENGINE - TOP SURFACE.
16. INTERCOOLER SYSTEM FILLER CAP (FILL TO EDGE OF CAP.)
17. COOLANT MAIN SYSTEM FILLER CAP. REMOVE ACCESS DOOR (FILL TO EDGE OF CAP)
18. No. 2 FUEL TANK FILLER CAP - TOP SURFACE - PORT.
19. OIL TANK FILLER CAP FOR PORT OUTBOARD ENGINE ACCESS THROUGH REMOVABLE DOOR IN OUTBOARD FAIRING PANEL.
20. No. 3 FUEL TANK FILLER CAP - TOP SURFACE - PORT
21. VACUUM TEST COCK IN STARBOARD SIDE - EXTERNAL ACCESS.
22. INFLATION POINTS FOR THE MAIN WHEEL AND TAIL WHEEL SHOCK-ABSORBER STRUTS.
INFLATION ADAPTOR. STORES REF. 4G/2433.
ACCESS TO TAIL WHEEL INFLATION POINT THROUGH REMOVABLE PANELS IN BOTTOM SURFACE OF THE FUSELAGE.

✡ IMPORTANT CARE SHOULD BE TAKEN NOT TO OVERFILL THESE TANKS.

FIG. 4 **SERVICING POINTS** FIG. 4

(14576) Wt. 23716/G.4376/M.30003. 1,050. 3/45. P.L.H. & CO. LTD. G.943.

CHAPTER 3

GENERAL SERVICING

LIST OF CONTENTS

General Servicing

LIST OF ILLUSTRATIONS

General

1. This chapter describes the servicing operations for certain components, and is intended to implement the Inspection Schedule, A.P.2847A and B, Vol. II, Pt. 2. Servicing notes on the electrical and radio equipment are given in Sect. 6. The ancillary ground equipment required for servicing is listed in the appropriate M leaflet of A.P.2847A and B, Vol. II, Pt. 1, and tools, rigging boards and other special items of equipment are included in the Schedule of Spare Parts, A.P.2847A and B, Vol. III, Pt. 1.

List of references

2. For servicing notes and information on equipment not dealt with in this chapter, reference should be made to the relevant Air Publications, a list of which is given at the beginning of this publication.

Former positions and inspection panels

3. The positions of the fuselage formers and main plane ribs are shown in fig. 5, and the inspection doors and access panels in fig. 4. The layout of the assembly panels and the types of rivets used to secure them are shown in Sect. 5, fig. 4.

Servicing ladder

4. A ladder, Pt. No. 1/U.575 (Stores Ref. 26EA/4274) which can be used as a single ladder or as a step ladder, is provided for servicing operations. When used as a single ladder the two portions are held together by two quick-release pins and two bolts and wing nuts. When used as a step ladder the bolts and wing nuts are removed, the top portion swung down, and a tie cable fitted between the two legs.

Jacking

Method of using jacks

WARNING—

In no circumstances is the aircraft to be jacked for ANY purpose entailing the raising of the main wheel(s) from the ground, in any condition in which the all-up weight exceeds 65,000 lb., with the jacking equipment (see fig. 1) at present available.

5. It is important to ensure that the jacks are correctly positioned and used. The following points should be noted:—

P9866 M04199/G4251 3/46 1050 C & P **Gp. 1**

General Servicing

(i) There are two jacking pad positions in each main plane (*see fig. 1*). Normally the outboard positions are used for complete jacking to give increased stability, unless it is required to retract the undercarriage. The inboard positions are used for undercarriage retraction tests, for jacking one side only, and—in some instances—for salvage operations.

(ii) The telescopic leg is not used (*see fig. 1*). The position of the jack trailing leg is important: when the outboard jacking position is used this leg must be inboard, and when the inboard jacking position is used the leg must be outboard.

(iii) When jacking on one side only, e.g. for the removal of a deflated tyre, the jack body must be suitably tilted (*see fig. 2*) before commencing to lift and the trailing leg must be adjusted throughout the operation.

(iv) When using jacks in pairs the trailing legs must be adjusted to act as struts and not used with loose adjustment.

Jacking complete aircraft

6. The complete aircraft should be jacked as shown in fig. 1. The jacks must be positioned with the plane of the jacking legs parallel to the centre line of the aircraft, and steadying trestle and gantries placed under the outer planes as shown. The main wheels should be chocked and the tail wheel raised before the main jacks are operated.

Jacking for undercarriage retraction tests

7. The method of jacking for undercarriage retraction tests is described in fig. 1.

Jacking for main wheel changing

8. A main wheel can be changed by jacking on one side only, but when this method is used it is important to follow the instructions in fig. 2.

Jacking rear end

9. For the method of jacking the aircraft to remove the tail wheel or to inflate the strut, *see fig. 3*.

Jacking sections of aircraft

10. Instructions for jacking, trestling and slinging the sections of the aircraft are given in Sect. 5.

Lubrication

General

11. The lubrication diagrams are fig. 6 and 7. All ball races are packed with grease on assembly and with the exception of those marked A need periodical inspection. The ball races marked A are sealed and no attention is necessary.

Rigging

General

12. The main plane and tail plane are fixed cantilever structures and can only be adjusted during the assembly of the component sections. Such adjustment may be required when re-assembling with repaired or new sections, and is described in Sect. 5. Apart from this, the only rigging operations are those of checking the fins, the movement of the control surfaces, and the incidence and dihedral of the main plane and tail plane. Instructions are given for checking the mass-balancing of the movable flying control surfaces.

13. The aircraft is illustrated in rigging position in fig. 8, which illustration also indicates the positions of the datum points and the setting boards; rigging instructions are given, in brief, in fig. 9.

Main plane

14. The nominal incidence of the main plane is 4 deg. $\pm$ 15 min., but during initial assembly the port intermediate and outer plane is given an additional incidence of 0 deg. 6 min., and the incidence of the starboard intermediate and outer plane is reduced by 0 deg. 6 min., to prevent the aircraft flying port wing low. The

General Servicing

following tolerances are permitted for incidence variations (i.e., twist) in a main plane:—

(i) The incidence variation on the complete span from tip to tip may not exceed 0 deg. 20 min.

(ii) The incidence variation in the centre section may not exceed 0 deg. 4 min. from end to end.

(iii) The incidence variation in each intermediate and outer plane from rib 1 to the tip may not exceed 0 deg. 8 min.

Tail plane

15. The tail plane incidence is checked as shown in fig. 8 and 9. A tolerance of 0 deg. 15 min. is permissible in the tail plane horizontal datum line.

Fins and rudders

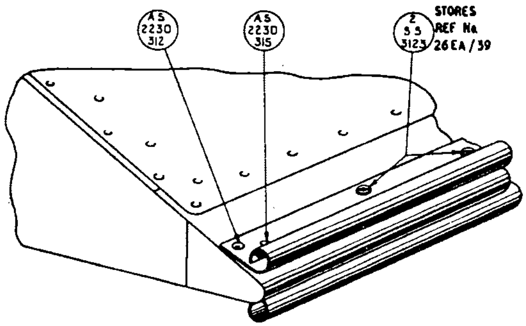
16. The hinge line should be vertical in the lateral plane and have 1 deg. 15 min. forward inclination in the fore-and-aft plane a tolerance of ± 0 deg. 15 min. in each plane being permissible. To check the fins, lower the fuselage rear end 1 deg. 15 min. from the flying position, and proceed as shown in fig. 9. It is important that the rudder trimming tabs are not twisted and that their hinges are so attached to the rudder that the hinge line forms a perfectly straight line parallel to the hinge line of the rudder, and that there is no backlash.

Setting of flying controls

17. ***General.***—Instructions for setting the flying controls are given in fig. 10. Additional explanatory notes are given in the following paragraphs.

18. ***Ailerons.***—The two sections of each aileron should be lined up with their undersurfaces equidistant from the undersurface of the main plane trailing edge. Initially, both ailerons should be set in the same relation to the outer plane and packing up to $\frac{1}{16}$ in. thickness may be used under the aileron hinge brackets to obtain this condition. Further adjustment may be required after flight testing (*see para. 22A*). With the control handwheel central the ailerons should be set with their trailing edges in line with the outer plane trailing edges. The wing tip detachable trailing edge portions can be adjusted by packing, to allow for any slight twist in the ailerons. The friction load in the aileron control circuit must not exceed 10 lb. applied at the root end of the trailing edge of one of the ailerons.

18A. Two one-foot lengths of trailing edge cord (light alloy rolled-edge strip supplied in one-foot lengths, Pt. No. 34/F.5628) are fitted initially on the upper and lower surface at the inboard end of the trailing edge of each aileron (*see also para. 22A*). The aileron balance tab should be fitted with lever, Pt. No. 10/F.5429, having six holes for the attachment of the connecting rod, which is set initially in the third hole from the top.



NOTE:—The two rivets attaching the trimming cords at the inboard end of each aileron are of the solid type, passing through both cords.

Inboard section of aileron trailing edge showing position of trimming cords

19. ***Flaps.***—The flaps are set with 1 in. lead on the port flaps (*see fig. 10*) to minimise drooping when the aircraft is airborne. To check that the starboard flaps close, select FLAPS UP on the hydraulic control and pump with the hand pump. A maximum droop of $\frac{3}{16}$ in to $\frac{1}{4}$ in. is permissible.

20. ***Rudders and elevators.***—The push-pull controls in the fuselage should not normally require further adjustment after the initial setting, but when adjustment is required it can be made at the points indicated in the accompanying sketch, similarly at formers 13 and 22, and at the outboard ends of the push-pull connections in the tail plane. The neutral position distances between the centre line of the

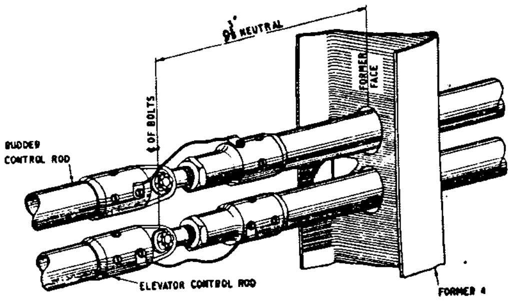
General Servicing

bolts and the former face, at formers 13 and 22 respectively, are:—

Rudder control rod, $5\frac{7}{8}$ in. and $7\frac{25}{32}$ in.

Elevator control rod, $5\frac{3}{16}$ in. and $7\frac{5}{32}$ in.

To adjust, the joint is disconnected, the locknut slackened off and the eyebolt screwed in or out as necessary. An inspection hole in the socket indicates the safe limit to which the eyebolt may be unscrewed.



Setting of fuselage push-pull controls

21. ***Trimming tabs.***—To adjust the aileron trimming tab control cables it is necessary to lower the flaps to gain access to the turnbuckles. A system of colour identification is used to ensure that the elevator trimming tab cables are correctly fitted. The ends of the cables are marked with blue or yellow bands at the turnbuckle joints and at the joints with the chains; the elevator spar and the trimming control mounting bracket are also marked.

22. ***Setting of automatic pilot.***—The setting instructions for the automatic pilot are given in fig. 11. For detailed information regarding the automatic pilot, Mk. VIII, *see* A.P.1469C, Vol. I.

Adjustment after flight testing

22A. After the aircraft has been flight tested any adjustments required should be made in accordance with the following instructions. For convenience, the port wing only is referred to, but the instructions are effective for either side by transposing the words "Port" and "Starboard" when necessary.

(i) The aileron control can be adjusted by three methods:—

(*a*) The ailerons may be set with droop up to a maximum of $\frac{3}{8}$ in.

Note . . . Differential droop up to $\frac{1}{4}$ in. is permissible.

(*b*) The trailing edge cords may be increased from 2 ft. to 3 ft., or 4 ft. maximum.

(*c*) The aileron control becomes progressively lighter as the balance tab connecting rod is moved to a hole nearer the tab to increase its movement. Any suitable hole may be used as required. If it is necessary to use the bottom hole, the distance piece normally fitted in this position should be moved to the top hole.

(ii) If the aircraft flies port wing low and the control wheel cocked to port the ailerons require adjustment.

(*a*) Provided the correction on the manually-operated trimming tab control does not exceed two graduations, a slight adjustment of the aileron balance tabs will be sufficient. The port balance tab should be adjusted "up" two turns of the control rod and the starboard balance tab two turns "down" if the original setting will allow.

(*b*) When the correction on the manually-operated trimming tab control exceeds two graduations, it will be necessary to pack up the starboard aileron; e.g. if the aircraft requires five graduations trim to starboard to fly level, the starboard aileron should be packed up with $\frac{1}{8}$ in. taper packing strips. For a small variation thinner packings will be required. Care must be taken that the hinge arm securing bolts are long enough to pass through the anchor nuts.

(iii) If the aircraft is port wing low with the control wheel central, the cause is an error in wing incidence. The whole of the main plane incidence should be carefully checked to ensure that it is within the permissible tolerances given in para. 14. If it is necessary to alter the intermediate and outer plane incidence relative to that of the centre section, this is done by removing the centre-section-to-intermediate-plane-spar-joint web plates, and, after setting the incidence, fitting new undrilled web plates which are then drilled back from the spar webs.

(iv) If the aircraft flies level with the control wheel cocked to starboard, the aircraft is port wing low on wing incidence and starboard wing low on ailerons, one being counteracted by the other.

General Servicing

(*a*) The wing incidence error should first be corrected, as described in sub-para. (iii).

(*b*) If any correction has been made to the outer plane incidence as a whole, the aircraft should be test flown before any further adjustments are made, as altering the incidence may effect the trim of the ailerons. If necessary, the ailerons may then be adjusted as described in sub-para. (ii).

(v) If the aircraft flies port wing low with the control hand wheel cocked to port, and after trimming the aircraft laterally level by means of the aileron trimming tab control, the hand wheel is cocked to starboard, the cause is port wing low due to wing incidence and port wing low due to ailerons.

(*a*) The wing incidence error should first be corrected, as described in sub-para. (iii).

(*b*) If any correction has been made to the intermediate and outer plane incidence as a whole the aircraft should be test flown again before any further adjustments are made, unless it is considered that the condition of port wing low on ailerons is sufficiently pronounced to justify packing the starboard aileron first.

Mass-balancing

23. ***General.***—The movable control surfaces are mass-balanced to prevent flutter or vibration. Accuracy of balance is vital to the safety of the aircraft, and should be checked as described in the following paragraphs, if it is believed that it may have been affected by repairs or other causes.

24. ***Ailerons.***—Each inboard and outboard portion of the aileron should be balanced separately and each should be nose-heavy. To check that the over-balance is adequate a ¼ lb. weight should be hung at the trailing edge, at rib 10 in the case of the inner portion and at rib 18 on the outer portion. This should be the minimum weight required to balance the half aileron which should be completely free to float. If, when the weight is in position, the half aileron is tail-heavy, additional balance weights (Pt. No. 167/F.5360), should be fitted to the peg provided in the nose until it is balanced. The peg is located in each case at the end where the operating mechanism is attached.

25. ***Elevators.***—Elevators should be checked complete, including the elevator trimming tab and its operating gear, and the elevator balance tab and operating rod, which should be secured in a fore-and-aft position close to the underside of the elevator.

26. Each half of the elevator should be balanced separately, and for this purpose must be mounted on the datum (inboard) hinge and the outboard hinge only, the centre hinge being left free to float. This is necessary to prevent the balance being upset by any slight spring which may be present due to the hinges not being absolutely in line. The mass-balance is corrected by increasing or decreasing the weight carried in the mass-balance tube in the leading edge between the datum hinge and the inner end of the elevator. To open the tube, remove the screw and the plug at the hinge end. The lead weights inside (Pt. No. 16/G.1337) can then be pushed through by inserting a rod in

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General Servicing

the hole at the inner end of the tube. The maximum permissible variations from static balance, in which condition the elevator will float horizontally, are:—

(i) A weight not exceeding ½ lb., when placed on the trailing edge at rib 3 (i.e. at a distance of 37 in. from the hinge centre) suffices to lower the trailing edge to the horizontal.

(ii) The reading of a spring balance at the same position does not exceed 1 lb. to raise the trailing edge to the horizontal.

27 and 28. ***Rudders.***—This information will be issued later.

Engine Installation

Fuel, oil and coolant systems

29. ***Fuel tank servicing cocks.***—A hand-operated stop cock in the delivery line from each fuel tank enables any tank to be isolated for servicing. All the servicing cocks are mounted in the valances of the undercarriage compartments, one in each inboard valance for the No. 1 tanks and those for the No. 2 and No. 3 tanks in the outboard valances. Access panels, secured by screws, are provided inside the undercarriage compartments, and the cocks are so positioned that the panels cannot be replaced unless the cocks are in the OPEN position. The panels are painted red and are marked ACCESS TO SERVICE FUEL COCKS.

30. ***Draining the fuel tanks.***—A draining valve through which, in conjunction with operation of the appropriate servicing cock or cocks (*see* para. 29) any tank, combination of tanks, or the whole fuel system may be drained, is mounted on the front spar in the port inboard nacelle. This valve, which is wire-locked is fitted in the cross-feed line, and when it is required to drain any of the starboard tanks the cross-feed cock in the fuselage must be opened. Before a drain pipe can be attached to the 1¼ in. B.S.P. male connection of the drain valve, a screw cap, secured by a split pin, must be removed. As the use of the relevant Pulsometer pumps is necessary for draining, provision should be made for a ground electric supply to be available. The valve is labelled: OPEN ST'B'D, CLOSED and OPEN PORT, enabling either side of the fuel system to be drained separately. After draining, the drain valve must be returned to CLOSED, and wire-locked, and the cap and split pin replaced.

31. ***Draining the distributor tanks.***—Each distributor tank has two small drain cocks, primarily to enable any accumulation of water to be drawn off, but also to drain the fuel content.

32. ***Cleaning the fuel tanks.***—

(i) Drain the fuel system (*see* para. 30).

(ii) Remove the tank (*see Sect. 5*).

(iii) (*a*) On No. 1 tanks, remove all access doors, sumps, and pipe connections.

(*b*) On No. 2 and 3 tanks, remove the manhole covers only.

Note . . . The No. 2 and 3 tanks, which are the collapsible type, should be handled with special care to avoid creasing or distortion, with possible damage to interior fittings.

(iv) Flush out the interior with filtered petrol by spraying the petrol on the walls of the tank.

(v) Drain off the flushing petrol.

(vi) Clean any fittings removed and refit them to the tank.

(vii) Refit the tank (*see Sect. 5*).

33. ***Draining the oil tanks.***—Each oil tank has a drain cock, which is opened by partly unscrewing the plug in the side. Before draining, connect a suitable hose to the drain cock and open the filler cap.

34. ***Cleaning the oil tanks.***—

(i) Drain (para. 33) and remove (*Sect. 5*) the tank.

(ii) Plug all holes.

(iii) Remove the access door in the tank.

(iv) Wash out the tank by spraying with flushing oil (Stores Ref. 34A/68) and finally spray the sides with petrol.

(v) Drain off the flushing oil and the petrol.

General Servicing

Make sure that the petrol is all cleared away before filling the tank with new oil.

(vi) Refit the access door in the tank and refit the tank (*see Sect. 5*).

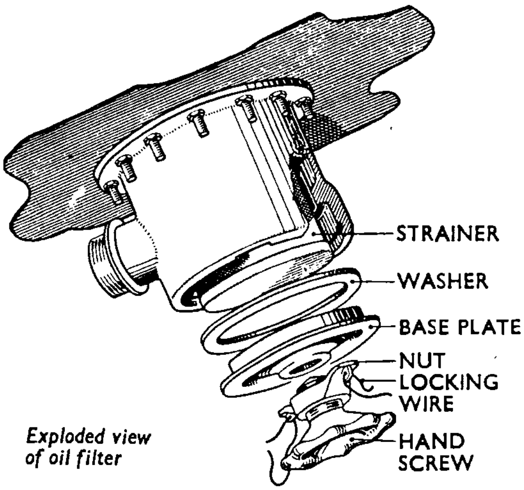
35. ***Cleaning the oil filters.***—To clean the oil filter:—

(i) Remove the locking wire and unscrew the hand screw.

(ii) Turn the special nut through 90 deg. until the arms coincide with the slots in the casing, and remove the hand screw and nut.

(iii) The filter element will now slide out under the pressure of the spring-loaded plunger which descends and seals the oil inlet. Should the element stick, it may be released by grasping the projection at the bottom.

(iv) Clean the inside of the filter and the element with flushing oil (Stores Ref. 34A/68) and finally flush with filtered petrol.



Exploded view of oil filter

36. ***Draining the cooling systems.***—Draining must not be attempted unless the coolant temperature is below 65 deg. C., as the internal pressure caused by a higher temperature makes it unsafe to remove the filler caps or drain plugs. To drain the whole system:—

(i) Remove the filler caps.

(ii) Remove the drain plugs at the bottom of the radiators. (These are accessible through the door in the bottom panel.)

(iii) On either inboard system, open the pet cocks on the cabin-heating radiators and at the end of the bleed connections. The latter are positioned as follows:—

(*a*) For the port system, on a panel in the bomb compartment, on the underside of the main floor just forward of the front spar.

(*b*) For the starboard system, near the Avery couplings between the starboard undercarriage beams.

(iv) Complete the draining of the cabin-heating radiators through the plug in the base.

37. The cabin heating radiator in the fuselage (port inboard system) can be isolated and separately drained if the two stop cocks under the front spar cover are turned OFF. To drain the starboard cabin-heating radiator entails partly draining the whole system, as this radiator cannot be isolated. For detailed notes on the engine cooling systems *see* A.P.2861A, Vol. I.

38. ***Filling the cooling systems.***—The aircraft must be in the tail-down position for filling either the main or intercooler systems. Care must be taken to avoid splashing of coolant, since glycol will damage rubber-covered cables. The procedure is to:—

(i) Check that the drain plugs at the bottom of the radiators are in place and that the drain cock in the base of the coolant pump bowl is closed.

(ii) Unscrew and remove the main header tank filler cap and fill the system until the coolant is level with the lower edge of the filler orifice.

Note . . . It is not necessary to open any vent plugs when filling the outboard systems. On the inboard systems the pet cocks (para. 36, sub-para. (iii) (*a*) and (*b*)) on the cabin heating radiators and on the bleed connections, must be opened. On the port inboard system check that the stop cocks under the front spar cover are open.

General Servicing

(iii) Unscrew and remove the intercooler header tank filler cap and fill the system until the coolant is level with the lower edge of the filler orifice.

(iv) Replace the filler caps and run the engine for a short period at about 1,000 to 1,200 r.p.m. to circulate the coolant and sweep out any small air pockets in the system. Throttle back and switch off before the coolant outlet temperature exceeds 40 deg. C.

(v) Remove the filler caps and, if necessary, add sufficient coolant to restore the levels in the header tanks. Replace and wire-lock the filler caps.

Fuel control cocks

39. ***General.***—The fuel control cocks comprise:—

(i) Four master engine cocks, two on each fuel distributor tank.

(ii) Six ground-servicing cocks, in the valances of the undercarriage compartments. On each inboard nacelle, the inboard valance contains the No. 1 tank cock, and the outboard valance the No. 2 and No. 3 tank cocks.

(iii) One cross-feed cock, on the floor in the fuselage just forward of the front spar.

(iv) One drain cock, on the front spar in the port inboard nacelle.

(v) Two auxiliary fuel system cocks, behind the front spar in the fuselage.

40. Dismantling of the cock valves should be avoided if possible and in any case restricted to the minimum necessary for effective servicing. When any of the valves are dismantled it is most important:—

(i) To ensure complete cleanliness, since the presence of foreign matter will cause permanent loss of seal.

(ii) That the parts be kept in sets, as the internal parts of each valve are matched.

(iii) That the seal on the external end of the spindle is not disturbed.

41. As all these cocks are of similar construction, one only has been illustrated (*see fig. 14*). The following general instructions apply to them all:—

(i) Dismantling and examination:—

(*a*) Examine the exterior for damage and evidence of leakage.

(*b*) Remove all external dirt and dust.

(*c*) Turn the valve into the open position (i.e. with the ports in the body and plug communicating).

(*d*) Remove the cotter pin (*A*) from the control handle or lever using extractor 5376A. Pull off the control. From the cross-feed cock remove the stop collar in like manner.

(*e*) Note the position of the cotter groove(s) in relation to the stops.

(*f*) Secure an assembly fixture—1316/F13 for a master engine cock, 3362/F10 for a service cock or cross-feed cock, 3194/F1 for a drain cock, 2734/F13 for an auxiliary system cock—in a bench vice and place the valve in the fixture. Alternatively, secure the valve in a bench vice, gripping *lightly* by the *hexagons only* (*see fig. 14*).

(*g*) Remove the seal and locking wire. Unscrew the base cap (*G*), using a ring spanner—SF.1129/B for a master cock or auxiliary system cock, SF.1129/C for a service cock, cross-feed cock or drain cock—exerting pressure with the palm of the hand so that the last thread will not suffer damage as the cap comes out.

(*h*) Remove the spring and the thrust member.

(*j*) Take great care in removing the valve plug (*F*). Invert the valve with the open end in the palm of the hand and release the plug by a slight rotation of the spindle (grip the spindle in a fibre-jawed vice, or temporarily attach the handle for this purpose). Lift the body (*B*) clear of the plug and remove the slipper (*E*) from the plug. Examine the plug, wiping the conical surface dry with a clean hand; rag must not be used.

General Servicing

The surface should have a continuous smooth finish free from scratches and the edges of the ports should be free from burrs.

(*k*) Similarly examine and clean the conical surface of the insert in the valve body.

(*l*) Remove the spindle (*C*) by pressing it into the valve body, taking care not to damage the insert. Examine the glands rings (*D*) which should be resilient and show smooth continuous edges.

Note . . . Do not attempt to remove the screw from the centre of the spindle. This screw has been adjusted to maintain the slipper in correct contact with the valve plug with a small amount of backlash to ensure seating of the conical surfaces of the plug and liner. The seal at the external end of the spindle should not be disturbed.

(ii) To renew damaged gland rings on the spindle:—

(*a*) Cut out the old gland ring (*D*) with a knife.

(*b*) With clean petroleum jelly lightly grease a gland assembly tool SF.1112/B, and slide a new gland ring towards the large end. Place the tool over the spindle end and slide the gland into its groove. The concave face of the ring should be next to the sloping wall of the groove.

(iii) To re-assemble the valve:—

(*a*) Place the slipper (*E*) astride the spindle tongues, retaining with clean petroleum jelly. Press the spindle (*C*) by hand into its bearing as far as possible. Grip the small end of the spindle in a fibre-jawed vice and pull the body (*B*) on to the spindle with a semi-rotary movement. Leave the cotter groove in the position noted when dismantling.

(*b*) Clean the tapered bore of the valve with a dry finger and support as for dismantling.

(*c*) Clean the valve plug (*F*) with a dry hand, and, fingering the conical surface as little as possible, drop it into the body so that the "V" groove engages the slipper (and, in the case of the drain cock, so that the ports in the plug agree with the marking on the spindle end).

(*d*) Replace the thrust members and firmly screw home the base cap (*G*). Rewire the cap.

(*e*) Secure the stop collar (when fitted) and control handle or lever.

(*f*) Operate the valve by hand and "feel" that the operation is correct and that the essential backlash is present (*see* Note, para. 41 (i)). Check the alignment of ports.

(*g*) Apply pressure test (*see* para. 42)

42. ***Pressure tests.***—After re-assembly each valve should be pressure-tested with petrol or paraffin for external leakage and for leakage past the valve plug.

(i) External leakage.—With the outlet(s) blanked off and an inlet coupled to a pump giving an output of 15 lb. per sq. in. there should be no leakage from any gland or joint for each operational position of the valve.

(ii) Leakage past valve plug.—To each inlet union in turn, with the valve closed to that union, connect a pump giving an output at 15 lb. per sq. in. Leakage past the valve plug should not exceed 5 drops per minute, after allowing 5 minutes for settling down.

Engine and fuel cock controls

43. ***General.***—The control levers, chains and tie-rods normally need adjustment only after the dismantling of components. The following paragraphs give general instructions for rigging the engine and fuel cock controls. For details of the controls in the power plant *see* A.P.2861A, Vol. I.

44. ***Throttle and propeller controls.***—The vertical position of certain levers (*see fig. 16 and 17*) relate to the aircraft in rigging

General Servicing

position. The front spar web and the engine firewalls also are vertical in this position.

(i) Set the levers on the pilot's control quadrant to the mid-travel position.

(ii) On the inboard engine control boxes on the front spar, set the levers as follows to obtain the mid-travel position (*see fig. 16*):—

Throttle lever 5 deg. forward of vertical

Propeller lever 21 deg. forward of vertical

(iii) On the outboard engine control boxes, set the levers as follows (*see fig. 17*):—

Throttle lever 35 deg. forward of vertical

Propeller lever 50 deg. forward of vertical

(iv) Connect up all chains on the sprockets so that the chain ends are approximately equidistant from the sprockets. Attach the tie-rods and adjusters and take up all slack.

(v) On the inboard and outboard engine firewalls, if the length of the adjustable levers on the upper countershaft has not been disturbed, the existing setting should be retained. Otherwise as a preliminary measure the levers should be adjusted to a length of 3½ in. measured from the centre of the shaft to the centre of the connecting rod attachment.

(vi) On the inboard engine firewalls, set the levers for the rods passing through the wall as follows to obtain the mid-travel position:—

Throttle lever 20 deg. forward of vertical

Propeller lever 2¼ deg. forward of vertical.

(vii) On the outboard engine firewalls set the levers as follows:—

Throttle lever 47 deg. forward of vertical

Propeller lever 33¾ deg. forward of vertical

(viii) Fit the connecting rods between the levers at the front spar and the top countershaft, adjusting the lengths of the rods to suit the positions of the levers as previously set.

(ix) On the lower countershaft on the firewall, set the single lever horizontally for mid-travel position, and fit the connecting rod between the two countershafts, adjusting it to suit the positions of the levers.

(x) Pull the control levers in the cockpit to the fully-back position and set the control levers on the engine against the rear stops.

(xi) Connect the rods between the engine controls and the levers on the countershafts on the firewall (*see fig. 16 and 17*), adjusting the length of the rods as required.

Note . .The double lever on the lower countershaft is shown in the illustrations with the upper arm connected, as required for Merlin 85 engines. The lower arm is required for Merlin 68 engines, when fitted.

(xii) Move the cockpit levers to the fully forward position and check that the levers on the engine are against the forward stops. The levers may be checked at the forward and rear stops by ascertaining that a piece of thin paper placed on the stop is trapped by the lever when the cockpit lever is pushed fully forward or pulled fully backward.

(xiii) Make any adjustments required on the control connections on the engines. (*See* A.P.2861A, Vol. I).

(xiv) If required, adjust the lengths of the levers on the upper countershaft on the firewall and the lengths of the connecting rods between the spar and the firewall.

45. ***Boost cut-out control.***—This control is fitted on all aircraft, but is only connected to Merlin 68 engines. When Merlin 85 engines are fitted the cable is coiled and taped to the firewall. To connect the control, the operating lever in the cockpit and the quadrant on the countershaft at the front spar should be set at mid-travel position, and the chains fitted with the ends approximately equidistant from the sprockets. The quadrant is at mid-position when the centre line of the bolt at its outer edge is 3·96 in. below the lower surface of the skin of the main floor. To adjust the cables,

General Servicing

the lever in the cockpit must be pulled back to the stop, and the cables tensioned by means of the turnbuckles. When the cockpit lever is released, the engine levers must return to the stops, and the cables between the inboard engines and the cable junctions, and between the outboard engines and the springs at nose ribs 4A, must be slack. In this position the springs should be extended to 5·4 in., measured between the centres of the attachment bolts.

46. ***Fuel cock controls.***—To set the fuel cock controls between the levers on the pilot's quadrant and the sprocket assemblies on the front spar, set the levers and the Teleflex connections at mid-position, connect up the chains and tie-rods with the chain ends approximately equidistant from the sprockets, and take up all slack. The setting of the Teleflex controls between the front spar and the fuel cocks is shown in fig. 15. For information regarding Teleflex controls *see* A.P.1464B, Vol. I, Part 5, Sect. 6, Chap. 6 (Old Publication) or A.P.1464D, Vol. I, Part 2, Sect. 2, Chap. 3 (New Publication).

Hydraulic Systems

General

47. Installation diagrams of the general service hydraulic system circuits are given in fig. 18 to 21 inclusive. These diagrams show the identification markings and the pipe part numbers. For the turret services, *see* Sect. 12. In all servicing operations on the hydraulic system absolute cleanliness is essential. Clean fluid only must be used when filling or topping up, and the containers, funnels, etc., used for holding the fluid and for the reception of drained fluid must be scrupulously clean. After a container has been carefully cleaned it should be swilled out with a small quantity of clean fluid, which should then be thrown away.

48. Whenever pipes are disconnected, the unions and pipe ends should be blanked off against entry of dirt, and when drain plugs or other components are removed they must be carefully examined to see that they are free from dirt before being re-assembled. Any length of new pipe or a new coupling should be thoroughly flushed out to ensure freedom from dirt before being fitted.

Filling

49. The following is the procedure for filling the complete circuit:—

(i) Jack the aircraft (*see fig. 1*).

(ii) Fill the hydraulic reservoir with fluid as specified in the Leading Particulars.

(iii) Drain the No. 1 fuel tanks (para. 30).

(iv) Open the jettison door in the No. 1 tank access panels by removing the shearing washers, and allow the jettison pipes to extend.

(v) Seal the supply and return lines by slackening the Avery self-sealing couplings on the stay between each pair of undercarriage support beams.

(vi) Release the hose connections at each general services pump and connect a standard ground test rig, Stores Ref. 4F/172, having a pump of the same type as that on the aircraft (*see* A.P.2306B). Tighten the Avery couplings.

(vii) Set the undercarriage and bomb door controls in the UP position, and the flaps control in the neutral position.

(viii) Commence to fill the system by running the test rig at its lowest speed, at the same time maintaining the fluid level in the reservoir. It is important to screw down the reservoir cap while operating any circuit, and to fill—when necessary—with the test rig stopped.

(ix) Operate the undercarriage circuit at least twelve times to ensure that all air has been expelled.

(x) Operate each of the remaining systems several times to fill completely both sides of the jacks and the jettison system.

(xi) Inflate the hydraulic accumulator to the pressure given in the Leading Particulars.

(xii) Re-pack the jettison pipes as described in para. 61.

General Servicing

Bleeding

50. The system should be bled after any component has been removed or a new length of pipe inserted, and during this operation the aircraft should be jacked. Connect the ground test rig (*see* para. 49 (v) and (vi)).

51. ***To bleed the main wheel and bomb door circuits.***—

(i) Set the main wheel and bomb door control valves in the UP position.

(ii) Disconnect the jack piston rods from the bomb doors, and the operating links from the undercarriage doors.

(iii) Pump with the ground test rig until the jacks are fully closed, then switch off the test rig.

(iv) Slacken off the bleed plugs on the rod side of the piston.

(v) Pump with the aircraft hand pump until air bubbles cease to appear and fluid is ejected.

(vi) Tighten and lock the bleed plugs.

(vii) Top up the reservoir.

(viii) Move the main wheel and bomb door control valves to the DOWN position.

(ix) Repeat (iii) to (vii), noting that the jacks will now fully extend, and slackening the bleed plugs on the piston head side of the jacks.

(x) Reconnect the jack piston rods to the bomb doors, and the operating links to the undercarriage doors.

52. ***To bleed the flap circuit.***—

(i) Move the operating lever on the control valve to the flaps DOWN position.

(ii) Pump with the ground test rig until the stroke is completed and switch off the test rig.

(iii) Slacken off the bleed plugs at the end of the jack into which fluid is being fed.

(iv) Pump with the hand pump until air bubbles cease to appear and fluid is ejected.

(v) Tighten and lock the bleed plugs.

(vi) Move the operating lever on the control valve to the flaps UP position.

(vii) Repeat the procedure, (ii) to (v), this time slackening off the bleed plugs at the opposite end of the jack when the stroke is completed.

Operational tests

53. When the system has been filled and bled it is necessary to test each circuit. Before any operational tests are carried out it is necessary to jack the aircraft and connect the ground test rig (*see* para. 49 (v) and (vi)). No leakage should occur in the delivery pipes under full operational pressure. The circuits should also be tested by the hand pump in conjunction with their respective control valves.

54. ***Main wheel units.***—

(i) To retract, release the spring catch and move the control valve lever to the UP position.

(ii) To lower, move the control valve lever to the DOWN position. When the jacks are fully extended the retracting strut joint should lock in the DOWN position.

55. ***Flaps.***—

(i) To lower, move the operating handle to the DOWN position; when the desired angle is reached, return the handle to the neutral position and the movement of the flaps should stop immediately.

(ii) To raise, move the operating handle on the control valve from the neutral position to the UP position. When the desired angle is reached or the flaps are in the fully UP position return the handle to the neutral position.

56. ***Bomb doors.***—

(i) To lower, move the control valve lever to the DOWN position.

(ii) To raise, move the control lever to the UP position. For the method of adjusting the bomb door jacks, *see* para. 98.

57. ***Fuel jettison system.***—The jettison system should be operated at least once a month to prevent the synthetic rubber rings sticking to the valve piston barrels and spindles. For this purpose, the No. 1 fuel tanks should be empty. If it is desired not to drain the tanks, refer to para. 59.

General Servicing

58. To operate the system, move the lever on the pilot's floor from NORMAL to JETTISON position. Check that the jettison and air valves are now open. Return the lever to NORMAL position and check that the valves have closed (*see* para. 60). After operating the system, re-pack the jettison pipe as described in para. 61.

59. To operate the system without first draining the tanks:—

(i) Detach the shearing washers and allow the jettison pipes to extend.

(ii) Place a 50-gallon container beneath each pipe.

(iii) Check that the accumulator gauge shows not less than 700 lb. per sq. in.: if necessary, operate the hand pump until it does.

(iv) Operating the control quickly, so as to jettison the minimum amount of fuel, move the lever to JETTISON, then return it to NORMAL, at the same time, carefully check the operation of the air inlet valves.

(v) Allow the jettison pipes to dry; then replace the pipes and reset the valves as described in para. 61, using the original shearing washers.

60. If the air inlet valve has stuck in the open position after the jettison system has been tested:—

(i) Ensure that the jettison control handle on the pilot's floor has been returned to NORMAL.

(ii) Open the inspection door in the top skin of the main plane, above the hydraulic pipe connection in the top of the fuel tank, and remove the drilled plug from the jettison system air vent. Connect an air pump or other source of compressed air supply to the ¼ in. B.S.P. female connection exposed by the removal of the plug.

(iii) Apply increasing air pressure until the valve closes. The pressure must not exceed 850 lb. per sq. in.

(iv) Disconnect the air line and replace the drilled plug in the vent.

Note . . . This operation does not ensure that the valve will not stick the next time the jettison system is tested, and it may be necessary to close the valve by this method on each occasion.

Resetting the jettison valve

61. When the fuel jettison system has been operated it is necessary to reset the valve as follows:—

(i) Ensure that the jettison pipe is dry between the double walls, to avoid deterioration due to prolonged contact with fuel. To dry the pipe after it has drained, close and re-open it several times, repeat the process five minutes later, and allow the pipe to dry in the extended position for a further 30 minutes.

(ii) Check that the air vent valve is correctly closed (*see* para. 60).

(iii) See that the jettison lever in the cockpit is in the NORMAL position.

(iv) Have ready a new shearing washer (a spare is stowed inside the hinged door). It is essential that the correct washer, Pt. No. 24/F.4005 (Stores Ref. 26EA/6402) be used.

(v) Pack the jettison pipe as carefully as possible into the pipe casing and swing the door back into place. It should be seen that the opening in the door is concentric with the jettison valve spindle. If it is not (e.g. after a tank has been replaced) the ring on the door should be removed by drilling out the pop rivets which secure it, and a new ring, Pt. No. 6/P.1838 (Stores Ref. 26EA/7413) fitted in the required position. It should be noted that the forward edge of the door must be inset a minimum of $\frac{1}{16}$ in. into the main plane surface.

(vi) Remove the nut at the end of the spindle, allowing the collar to slide off the spindle.

(vii) Place the new shearing washer over the collar and replace the collar and nut on the spindle. Ensure that the washer is concentric with the valve spindle. The nut should be tightened until it is hard against the seat on the spindle.

Note . . . This valve is described and illustrated in A.P.1803, Vol. I.

General Servicing

Faults and their remedies

62. Faulty operation of the hydraulic system may be caused by mechanical defects as well as faults in the system itself. Faults can usually be traced by noting the behaviour of each hydraulic circuit, and this must be done before removing a component from the aircraft. If any circuit responds correctly to both the engine-driven pumps and the hand pump, it follows that the pumps are satisfactory. A study of the diagram of the system (*see Sect. 9*) together with evidence obtained from the working of the system, will usually suffice to locate the fault. A list of likely faults, their causes and the remedial action are given in Table I.

TABLE I

HYDRAULIC SYSTEM FAULT LOCATION AND RECTIFICATION

Symptom	Fault	Probable cause	Remedy
All services inoperative	Loss of pressure	Failure of pump(s)	Fit new pump(s)
All services operative but no pressure shown on gauge	Loss of pressure	Faulty gauge	Fit new gauge
External leakage	Loss of pressure	Faulty connections	Tighten connections and if necessary fit new sealing washers or couplings
Sluggish movements of all services	Internal leakage	Excessive clearance in engine-driven pump(s) allowing fluid to escape from the pressure side to the suction side of the pump(s)	Fit new pump(s)
Sluggish movement of a particular service	Internal leakage	Fluid leakage past glands in control valve	Fit new glands
Sagging of flaps, or lifting when lowered in flight	Internal leakage	Fluid leakage past valve in cut-out	Dismantle valve and inspect for wear. If necessary fit new cut-out
Circuit operating times excessive after bleeding	Internal leakage	Fluid leakage past glands in jacks	Fit new glands
Operating times slow Backlash at flaps Load on hand pump very light and spongy	Air in the system		Bleed the circuit (see para. 50-52)
Increase of load		(i) Mal-alignment of jacks, causing side load on extended piston rod (ii) Mechanical interference between moving parts (iii) Presence of foreign matter between moving parts (iv) Increase of friction due to excessive tightening of glands, etc.	

General Servicing

Servicing of components

63. For the servicing and testing of hydraulic components, *see* A.P.1803, Vol. I.

Cleaning hydraulic fluid filter

64. A high-pressure filter is fitted on the rear face of the front spar on the port side of the fuselage. When it is necessary to clean this filter:—

(i) Relieve all pressure in the system.
(ii) Drain the fluid from the filter by removing the plug at the bottom.
(iii) Unscrew the bottom half of the filter.
(iv) Withdraw the filter element and the by-pass spring.
(v) Unscrew the wing nut at the bottom of the filter element, remove the end cages and take the filter element out of the perforated cylinder.
(vi) Remove the spring clip from the filter element and unroll the element.
(vii) Thoroughly wash the element, also the filter casing and the spring, in filtered petrol.
(viii) Re-roll the element and refit the spring clip.
(ix) Replace the element in the perforated cylinder, and refit the end cages and wing nut.
(x) Screw in the drain plug two or three threads.
(xi) Replace the filter and by-pass spring, checking by feel that the spindle of the wing nut is located in the drain plug.
(xii) Screw together the halves of the filter.
(xiii) Tighten the drain plug.

Alighting Gear

General

65. The main wheel units and the tail wheel must be kept clean and free from mud, particularly at the knee joints on the retracting struts. In wet weather this joint should be cleared of mud and dirt and lubricated after each flight. When the main wheel units are down and the aircraft is resting on the wheels, jury struts, Pt. No. 1/U.631 (Stores Ref. 26EA/10206) must be fitted between the top joint of the shock-absorber strut and the joint at the centre of the retracting strut. These will enable towing or servicing to be done without any danger of inadvertent retraction of the main wheel units.

Main wheel units

66. ***General.***—The main wheel unit is illustrated in Sect. 7, Chap. 5, the hydraulic operating and emergency lowering systems are shown in fig. 18 and 21, and the method of setting the undercarriage doors is described in para. 82.

67. The alignment of the retracting struts in the DOWN position, with fluid pressure applied to the jacks at the cutting-out pressure of the system, is so adjusted that the hinge pin of the knuckle joint is not more than 0·20 in. below, or 0·10 in. above, a line joining the hinge pins at each end of the strut. The amount is checked by means of a thread stretched between the hinge pins.

68. ***Removal of wheel.***—To remove a main wheel, the aircraft should be jacked as shown and described in fig. 2. When the aircraft is in this position:—

(i) Disconnect the pneumatic brake pipe at the bottom of the flexible tubing.
(ii) Support the wheel with blocks of wood.
(iii) Remove the setscrew in the locking plate which locks the stud (*fig. 25, item N1*), and remove the plate.
(iv) Unscrew the stud (*N1*) and remove the bolt and saddle washers.
(v) Lower the wheel and axle, and remove the packing blocks from the ends of the axle.
(vi) Remove the six nuts and bolts securing either brake shoe carrier to the axle, and pull off the carrier.
(vii) Drive out the axle, with the remaining carrier attached, from the wheel hub.

Note . . . The inlet ports of the brake cooling vanes must be on the port side—this is a point to be kept in mind when re-fitting a main wheel. The inlet ports, being larger than the outlet ports, are easily distinguishable.

General Servicing

69. ***Removing and refitting tyre.***—The procedure is described in A.P.2337, Vol. I.

Main wheel shock absorber struts

70. ***General.***—The main wheel shock-absorber struts are illustrated in fig. 25. For the method of filling the struts with fluid, *see* para. 73 and 77, and for inflating the struts, *see* para. 74. The fluid to be used is D.T.D.44D (Stores Ref. 34A/43 and 141).

71. ***Inflation adaptor.***—The standard inflation adaptor, (Stores Ref. 4G/2433), can be used.

72. ***Fluid level check.***—The level should not be checked immediately after landing or taxying. To check the level proceed as follows:—

(i) With the aircraft standing on its wheels, remove the dust cap from the inflation valve, and fit the inflation adaptor (*see Sect. 4, Chap. 2, fig. 4*).

(ii) Allow air to escape gradually by screwing up the gauge head and slowly unscrewing the air release screw until the struts are fully compressed.

(iii) If, in the final stage of compression, a spray of fluid and air is blown off, the fluid level is correct, and the strut may be re-inflated (*see* para. 74).

(iv) If only air is blown off, the level requires topping up (*see* para. 73).

73. ***Topping up with fluid.***—If the fluid level needs topping up (para. 72):—

(i) With the aircraft standing on its wheels and the shock absorbers fully closed connect the inflation valve to a component test rig, using an inflation adaptor.

(ii) Pump fluid into the strut until the pressure begins to rise rapidly. Do not allow the pressure to exceed 2,325 lb. per sq. in.

(iii) Slowly release the pressure by screwing up the adaptor gauge head and unscrewing the release screw, and make the check indicated in para. 72 (iii). If necessary, pump in more fluid and repeat the pressure releasing operation until a spray of fluid and air is blown off.

(iv) Disconnect the test rig and connect the adaptor to an air pump.

(v) Inflate to the correct pressure at full extension (*see* Leading Particulars).

(vi) Remove the air pump and inflation adaptor and replace the inflation valve dust cap.

74. ***Inflation pressure check.***—To check the pressure proceed as follows, with the aircraft standing on the ground:—

(i) Remove the dust cap from the inflation valve, connect the inflation adaptor (*see Sect. 4, Chap. 2, fig. 4*) and test the air pressure in the struts.

(ii) Measure the extension of the strut and compare with the dimension given in the table (*see fig. 23*).

(iii) If the pressure is below the minimum given for the corresponding dimension close the inflation valve, remove the dust cap from the end of the adaptor and attach an air pump. Re-open the inflation valve and inflate the struts, checking the dimension at intervals, until the pressure and extension are within the limits given in the table.

(iv) Close the inflation valve, disconnect the adaptor and replace the dust cap on the inflation valve.

75. ***Deflating.***—To deflate the strut, remove the dust cap and fit an inflation adaptor. Release the pressure by screwing up the gauge head and unscrewing the air release screw.

76. ***Dismantling.***—

WARNING—

On no account should any bolts or connections etc. be removed without first deflating the struts. Failure to observe this precaution may result in a serious accident.

Dismantling should only be necessary after a long period of service or after accidental damage. The following is the sequence of operations involved in dismantling a strut (*see fig. 25*) which has been removed from the aircraft:—

(i) Deflate the struts (*see* para. 75).

General Servicing

(ii) Unscrew the balance pipe union nuts, disconnect the bracing and separate the struts.

(iii) Unlock and remove the inflation valve (*O*) and the balance pipe connection (*G1*)

(iv) Unscrew the ferrules from the two screwed rods (*S1*) and remove the two setscrews to free the end fitting (*G*) and inner cylinder assembly from the main outer tube.

(v) Withdraw the shock-absorber assembly, together with the lower sliding member (*M*) from the top of the main outer tube. Slide down the distance piece (*K*) until the locking screw (*R1*) is accessible through the clearance hole in the sleeve. Remove the locking screw.

(vi) Unscrew the lower sliding member (*M*), then remove the locking pin and unscrew the stop nut (*Z1*) to free the fitting (*V1*).

(vii) Remove the screw securing the fluid cylinder to the piston rod (*Y1*), unscrew the cylinder from the piston rod and remove the cylinder. Unscrew the damping valve assembly (*H1*) from the end of the air chamber (*H*), using spanner S.T.205.

(viii) Slide the damping valve assembly (*H1*) off the piston rod (*Y1*) and unscrew the cover plate of the valve assembly to free the valve.

(ix) Unlock and unscrew the gland nut (*Q1*) using spanner S.T.699.

(x) Remove the spacer rings and gland ring (*J*).

(xi) Remove the circlip locking end cap (*W1*) and unscrew the end cap, using spanner S.T.252.

(xii) Unlock and remove the grease nipples and studs from the attachment sleeves (*A1*) and (*B1*), and unscrew sleeve (*B1*) toward the bottom of the main outer tube. Withdraw the sleeves (*A1*) and (*B1*) and unscrew them from each other.

(xiii) The bronze liner (*L1*) is not to be removed from the tube (*A*). If necessary, a new tube (*A*) complete with liner (*L1*) must be fitted.

77. ***Filling and inflating.***—When, after complete dismantling, the strut requires filling with fluid, the following instructions must be carefully carried out for each strut separately (*see fig. 25*).

(i) With the fluid cylinder and air chamber sub-assembly complete, the balance pipe connection and inflation valve fitted, insert the strut upright in test cage type J.3163, set the sliding member within the limits of its travel, and attach a component test rig to the balance pipe connection.

(ii) Pump in fluid until the pressure rises rapidly. It must not exceed 2,325 lb. per sq. in.

(iii) Allow fluid and air to drain from the unit by gently operating the test rig control valve.

(iv) Repeat operations (ii) and (iii) until a flow of fluid only is obtained, and test to 2,325 lb. per sq. in.

(v) Fully compress the strut, allowing all surplus fluid to drain completely.

(vi) Keeping the strut fully compressed, inflate to 50 lb. per sq. in. Disconnect the pump and depress the valve, thus blowing off any surplus fluid.

(vii) Complete the reassembly of the strut, taking care not to lose any fluid, and then re-inflate to 50 lb. per sq. in.

(viii) Apply the check described in para. 72.

(ix) Finally, after filling both struts, connect the bracing and the balance pipe, and inflate both struts through either inflation valve to the correct pressure at full free extension (*see* Leading Particulars).

78. ***Testing.***—With the unit deflated, connect a component test rig through the inflation adaptor, and pump in fluid to a pressure of 2,325 lb. per sq. in. This pressure should be maintained. Any fall in pressure unaccompanied by visible leakage at the sealing washer under the inflation valve will be due to leakage:—

(i) At the fitting (*L*). Leakage will be visible on removal of the end cap (*G*).

(ii) At the gland ring (*J*). Fluid may eventually appear at the bottom of the main outer tube (*A*).

General Servicing

79. ***Leakage of fluid or loss of pressure.***—

(i) If leakage occurs round the sealing washer under the inflation valve, tighten the valve body. If this is ineffective, deflate the strut, remove the valve and renew the washer.

(ii) If leakage occurs from the inflation valve itself, deflate the strut and renew the complete inflation valve unit.

(iii) Should leakage occur from the sealing washer under the stack pipe (*L*), deflate the unit, remove the stack pipe and renew the washer.

(iv) If leakage of fluid or loss of pressure occurs and cannot be traced to the inflation valve or sealing washer, deflate the strut and then dismantle (*see* para. 76 (i) to (v)). If fluid is found in the lower sliding member (*M*), leakage from the sealing washer (*X1*) is indicated. To remedy this, it will probably be necessary to renew the sealing washer. Proceed as in para. 76 (v) to (vii).

(v) If no leakage is apparent from the sealing washer (*X1*) continue dismantling as in para. 76 (vi) to (vii) and (ix). Then tighten the gland nut (*Q1*), using spanner S.T.699, and if this is ineffective renew the gland.

Adjustment of main wheel units

80. ***UP and DOWN latches.***—The arrangement of these latches is shown in fig. 24. They are set correctly before leaving the manufacturers and should need no adjustment. If, however, the unit is damaged or new retracting struts are fitted, the latches may be re-set by means of the adjustable side stays (*C*). These should be so adjusted that the lever (*K*) will contact the stop (*M*) when the upper and lower portions of the strut are truly in line. It is important that when the unit is locked in the "up" position, the "up" latch (*J*) is forced back $\frac{1}{32}$ in. to ensure a positive bearing on the "up" catch tube. This condition can be obtained by means of the two turnbuckles at each end of the catch. Also it is important that a clearance of $\frac{1}{8}$ in. be maintained between the top of the catch tube and the latch (*J*).

81. ***Hydraulic jacks.***—If adjustment is required, refer to fig. 24, and:—

(i) Remove the bolt (*H*).

(ii) With fluid pressure applied to the jack at the cutting-out pressure of the system, adjust the jack piston rod fork-end until the bolt (*H*) can just be refitted without straining the retracting strut.

(iii) Unscrew the fork-end an additional half-turn and refit and lock the bolt (*H*) (the additional half-turn is to ensure that the jack piston will not bottom before the latches (*E*) are fully engaged).

Method of setting main wheel unit doors

82.

(i) Jack the aircraft and chock the tail wheel (*see fig. 1*).

(ii) Remove both the pins securing the adjustable ends of the arms to the rotating pins on the doors.

(iii) Retract the main wheels.

(iv) Push one of the doors into the closed position and adjust the adjustable end of the arm until the door is held in the closed position by the arm when the pin is fitted.

(v) Repeat this procedure with the opposite door.

(vi) Lower the wheels and fit the pins to the rotating pins on both doors.

(vii) Raise the wheels and check that the doors close correctly.

Tail wheel unit

83. ***General.***—The tail wheel is illustrated in fig. 26. For the method of topping up and inflating the strut, *see* para. 86, 87 and 88. The fluid to be used is D.T.D.44D (Stores Ref. 34A/43 and 141).

84. ***Removing tail wheel.***—To remove the tail wheel refer to fig. 26 and:—

(i) Jack the aircraft (*see fig. 3*).

General Servicing

(ii) Remove the two bolts (*E1*) to free the axle (*F1*).

(iii) Fit plug, Pt. No. S.T.530, into the axle. Fit tube, Pt. No. S.T.531, over the plug, and drive the axle from the wheel.

85. ***Removing and refitting tyre.***—The procedure is described in A.P.2337, Vol. I.

Tail wheel shock-absorber strut

86. ***Fluid level check.***—The level should not be checked immediately after landing or taxying. To check the level:—

(i) With the aircraft standing on its wheels remove the inflation valve dust cap and fit a standard inflation adaptor.

(ii) Allow air to escape gradually until the unit is fully compressed.

(iii) If at the final stage of compression a spray of fluid and air is blown off, the fluid level is correct and the tail may then be jacked and the strut reinflated (*see* para. 88) to the correct pressure at full free extension (*see* Leading Particulars).

(iv) If air only is blown off, the fluid level requires topping up (*see* para. 87).

87. ***Topping up with fluid.***—

(i) With the shock absorber fully compressed and having removed the dust cap from the inflation valve, connect, through a standard adaptor, a component test rig.

(ii) Pump fluid into the shock absorber until the pressure begins to rise rapidly. Do not allow the pressure to exceed 1,200 lb. per sq. in.

(iii) Slowly release the pressure by screwing up the adaptor gauge head and unscrewing the release screw, and allow the shock absorber to compress fully.

(iv) Disconnect the rig from the inflation adaptor and connect an air supply.

(v) Jack the tail and inflate to the correct pressure at full extension (*see* Leading Particulars).

(vi) Disconnect the air supply, remove the inflation adaptor, and replace the inflation valve dust cap.

88. ***Inflation pressure check.***—The strut inflation pressure should be checked with the aircraft standing on the ground:—

(i) Remove the dust cap from the inflation valve, connect a standard inflation adaptor, and check the air pressure in the strut.

(ii) Measure the extension of the strut and check it against the dimension given in the table (*see* fig. 23). If the pressure is within the limits given, the strut is serviceable.

(iii) If the pressure is below the minimum for the dimension concerned:—

(*a*) Close the inflation valve, remove the dust cap from the end of the adaptor and connect an air supply. Re-open the inflation valve and inflate the strut until the pressure and extension are within the limits given in the table.

(*b*) Jack the aircraft until the strut is fully extended. The pressure in the strut in this condition must be that given in the Leading Particulars. If it is not, the fluid content is insufficient and the unit must be partly dismantled and refilled with fluid (*see* para. 93).

89. ***Deflating.***—To deflate the strut, fit a standard adaptor to the inflation valve and release the pressure by screwing up the gauge head and unscrewing the air release screw.

90. ***Dismantling.***—

WARNING.—

On no account should any bolts, connections, etc., be removed before the strut is deflated. Failure to observe this precaution may result in a serious accident.

To dismantle the tail wheel strut refer to fig. 26 and proceed as follows:—

(i) Remove the complete unit (*see* Sect. 5).

(ii) Deflate the strut (*see* para. 89).

(iii) Remove the wheel and axle (*see* para. 84, sub-para. (ii) and (iii)).

(iv) Remove the set-screws (*B*) and the inflation valve (*M1*). This will release

General Servicing

the main outer tube (*M*) which must then be drawn down from the top of the strut to expose the dowels (*C*).

(v) Extract the dowels (*C*), remove the end fitting (*A*) and then slide the main outer tube (*M*) from the top of the strut.

(vi) Using tool S.T.721, unscrew the ferrules (*X*) from the screwed rods securing fork (*W*) into the bottom of the lower sliding tube (*L*) or (*N1*). Extract the rods.

(vii) Extract the wheel fork assembly from the tube (*L*) or (*N1*). This will free the retaining plate (*T*), and, in the case of tube (*L*), liner (*R*). The air cylinder (*F*), together with the diaphragm and cam (*G1*) assembly, can then be pushed down through the lower sliding member and extracted from the bottom.

(viii) Remove the locking grub screw and, using spanner S.T.781, unscrew the gland nut (*G*); remove the distance ring (*H*), gland ring (*J*), and spacer (*L1*).

(ix) Using spanner S.T.719, unscrew the retaining nut (*K*) to free the top cam (*J1*).

(x) Remove the four set-screws (*H1*) to free the cam (*G1*) and the diaphragm sub-assembly from the end of the air cylinder (*F*).

(xi) Remove the nut from the bolt (*Q*) to free the cover plate, diaphragm gland ring and damping valve (*N*).

(xii) Remove the locking circlip and unscrew gland nut (*B1*) with spanner S.T.252 if it is required to renew ring (*A1*).

(xiii) Remove the 10 set-screws (*Y1*) to release the end ring (*V*) from the sleeve (*S*).

Note:—The sleeve (*S*) must not be removed from the bottom of the main outer tube.

91. ***Re-assembling.***—In general, re-assembly is a reversal of the dismantling procedure, but as the unit must be filled with fluid during assembly the following instructions should be observed:—

(i) Rebuild the air cylinder (*F*) with diaphragm assembly and cam (*G1*).

Note: When a Brico R.143 ring (*O*) is fitted in place of an S.P.593/8 ring, the fitted gap is to be adjusted, by filing, to 0·006 in.—0·010 in.

(ii) Fit the cam (*J1*) into the lower sliding member (*L*) or (*N1*), taking care to position the key (*K1*) correctly and securing the cam in position with the nut (*K*). When the lower sliding tube (*L*) is used the liner (*R*) must be inserted into (*L*) at this stage.

(iii) Using the sleeve S.T.857, insert the air cylinder assembly into the lower sliding tube from the bottom, and fit the retaining plate (T).

(iv) Build up the wheel fork assembly complete with gland (*A1*) and gland nut (*B1*), insert into the bottom of the lower sliding tube and refit the screwed rods and ferrules (*X*).

(v) Fit the spacer (*L1*), gland (*J*), distance ring (*H*) and gland nut (*G*) over the air cylinder (*F*) (using sleeve S.T.528 when fitting the gland ring), but do not at this stage insert these members into the lower sliding tube.

(vi) Fit the inflation valve (*M1*) into the air cylinder and carry out the filling instructions contained in para. 92, sub-para. (i) to (v).

(vii) Enter the lower sliding member assembly into the bottom of the main outer tube (*M*).

(viii) Replace the end fitting (*A*) over the top of cylinder (*F*), the main outer tube being drawn down sufficiently to enable the dowels (*C*) to be replaced. Then slide the tube (*M*) up over the end fitting (*A*) until the set screws (*B*) can be replaced.

(ix) Carry out the instructions contained in para. 92, sub-para. (vi) to (viii), to complete the filling and inflating procedure. Refit the wheel and axle into the fork.

92. ***Filling and inflating.***—

(i) With the strut assembled as instructed in para. 91, sub-para. (i) to (vi), and the unit upright and fully extended, connect a standard inflation adaptor to the inflation valve (*M1*) and pump in fluid until it completely fills the lower sliding member and overflows from the top edge.

General Servicing

(ii) Unscrew the inflation valve and fit sealing plug S.T.784 in its place.

(iii) With the gland housing still full of fluid and the unit fully extended, insert the spacer (*L1*) and gland ring (*J*), using sleeve S.T.720 to facilitate fitting of the gland ring.

Note:—While pressing the gland ring down into position, fluid must be released past the gland ring by the careful use of a smooth wooden or metal spoon.

(iv) Refit the distance ring (*H*) and the gland nut (*G*), using spanner S.T.781 to tighten the gland nut. Replace the gland nut locking grub screw.

(v) Complete the re-assembly of the strut as described in para. 91, sub-para. (vii) and (viii).

(vi) Remove the sealing plug S.T.784, and fully compress the strut. Refit the inflation valve, attach the adaptor and pump in fluid to extend the strut.

(vii) Extend and compress the strut by alternately pumping in fluid and operating the inflation valve until bubble-free fluid is expelled from the inflation valve during compression. Then disconnect the fluid pump and connect an air line to the inflation adaptor.

(viii) Inflate to the correct pressure at full free extension (*see* Leading Particulars). Close the inflation valve and remove the air line and inflation adaptor. Replace the inflation valve dust cap.

93. ***Testing.***—With the unit deflated, connect a component test rig through a standard inflation adaptor, and pump in fluid to a pressure of 1,200 lb. per sq. in. This pressure should be maintained.

94. ***Leakage of fluid or loss of pressure.***—

(i) Leakage of fluid may occur at the following points:—

(*a*) At the gland ring (*A1*). Leakage at this point will eventually cause fluid to appear at the junction of the lower sliding member (*L*) and the wheel fork (*W*).

(*b*) At the gland ring (*J*). Fluid will eventually appear at either the top or bottom ends of the main outer tube (*M*).

In both cases the unit must be dismantled and the affected ring renewed. At the same time any metal parts in sliding contact should be examined for scoring or other damage.

(ii) Loss of air pressure may occur with or without external indication.

(*a*) Loss of pressure can occur through failure of the inflation valve (*M1*) or the sealing washer under the valve, both of which can be tested externally. Renewal of the core of the inflation valve or renewal of the sealing washer will be necessary.

Note:—When fitting a new inflation valve core, care must be taken that the correct type of core, i.e. the one bearing a star on the end of the valve pin, is used.

(*b*) Loss of pressure can also occur past the head of the stack pipe (*E*), which will not be apparent externally, but will be visible in the counter bore at the head of cylinder (*F*) when fitting (*A*) has been removed. This can only be removed immediately if the stack pipe is of the hexagon-headed screwed-in type, when the sealing washer under the head can be renewed. If leakage is experienced past the head of the soldered-in type of stack pipe the complete air cylinder (*F*) must be renewed.

Miscellaneous

Propeller feathering tests

95. When propeller feathering tests are to be made on the ground, an external battery must be used. It is essential that this be fully charged, to avoid damage to the switch solenoids.

General Servicing

Vacuum system test cock

96. A test cock is fitted in the vacuum pipe extending aft on the starboard side of the fuselage (*see Sect. 4, Chap. 2, fig. 4, and Sect. 11*). This cock enables an external suction pump to be connected when it is required to test the rear section of the vacuum system. The external-access door to the cock is located on the starboard side just aft of the bomb compartment.

Draining A.S.I. system

97. The drains in the A.S.I. system consist of short vertical lengths of pipe, sealed at the lower end. To drain the system these drain pipes are disconnected and removed and any water shaken out. For the location of the drains, *see* the relevant illustration in Sect. 11.

Landing lamp adjustment

98. For instructions on making adjustments, and for other servicing notes, refer to A.P.1095A, Vol. I.

Method of adjusting the bomb doors

99.

(i) Drain the bomb door circuit.

(ii) Disconnect the four jacks at their lower pins.

(iii) Fully close jack by hand.

(iv) Close each door in turn and hold it flush with the fuselage to ascertain the adjustment required for each jack.

(v) Slacken the locknut, screw the eye-bolt in or out, to shorten or lengthen the jack, as required, and tighten the locknut.

(vi) Lower the doors, then extend the jacks and connect to the doors.

(vii) To check the adjustment, close each door in turn, then close both together. They should meet evenly along the whole length of the joint. Any sag should not exceed $\frac{3}{8}$ in.

(viii) Sagging in excess of $\frac{3}{8}$ in. may be remedied by closing the door which sags slightly inside the skin line and closing the other door slightly outside the skin line.

Hand de-icing pump

100. The hand pumps for windscreen and air bomber's window de-icing require to be primed if they have been drained in the course of servicing or from any other cause.

Fixed aerial

101. It is important, when replacing or repairing the main fixed aerials, that the insulator immediately forward of the fin is fitted with a $\frac{3}{32}$ in. dia. aluminium rivet instead of the standard split-pin. This is to provide a weak link in the aerial and so prevent damage by over-tensioning.

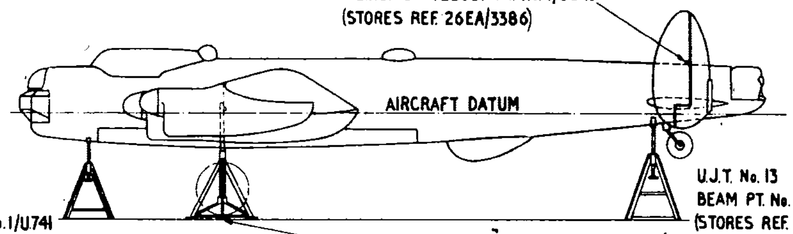
Swinging D.R. compass

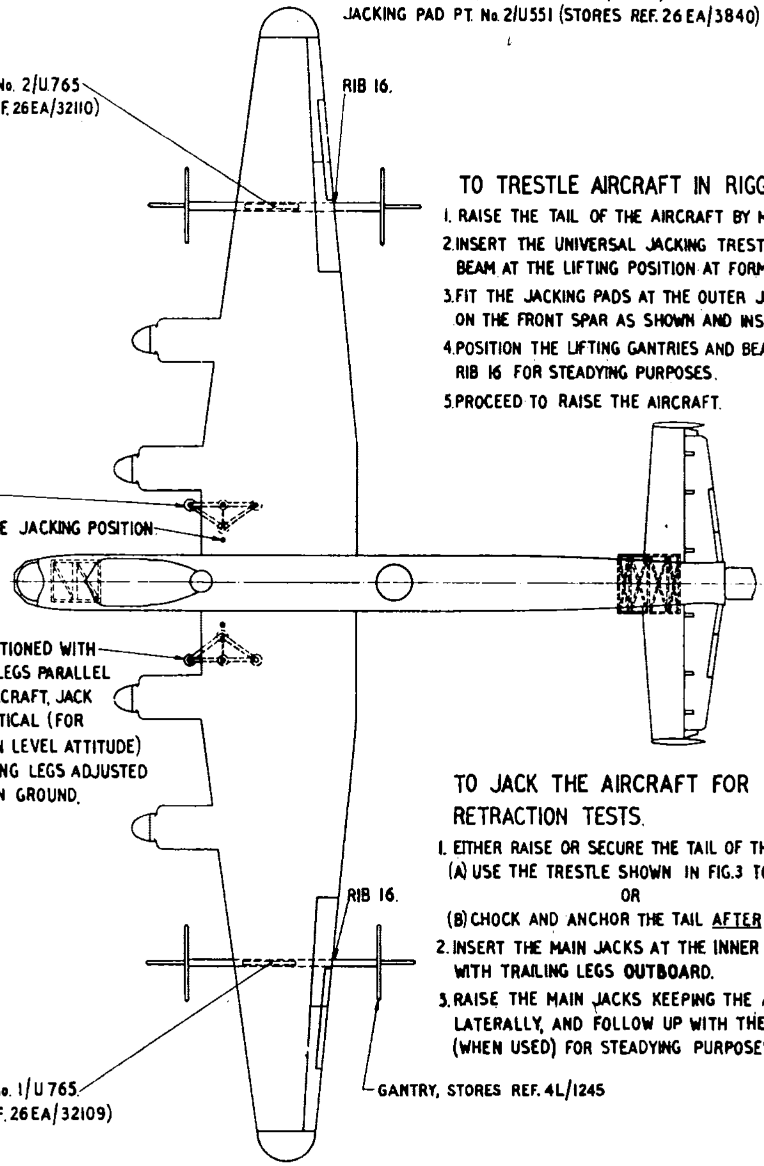
102. When swinging the D.R. compass the entrance door must be closed.

Sanitary closet

103. It is important that the sewage should always be covered with liquid; if necessary add water occasionally. When cleaning the closet the sewage container can be removed by means of a wire handle attached to it. It should then be emptied and swilled out. Before recharging the closet the "Elsanol" chemical should be well stirred. One pint of the chemical should be then added to $\frac{1}{2}/\frac{3}{4}$ gall. of water and well mixed. Care should be taken to see that the chemical is not exposed to naked light.

P7879 M /G829 7/45 1050 C & P Gp. 1





TO TRESTLE AIRCRAFT IN RIGGING ATTITUDE.

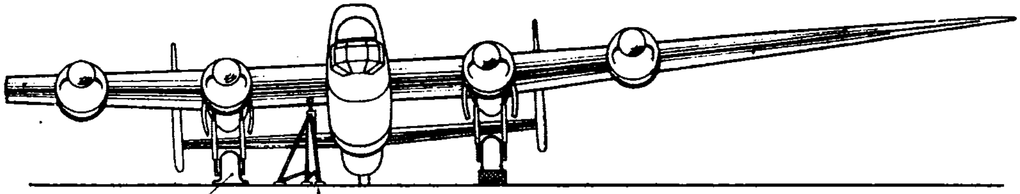
1. RAISE THE TAIL OF THE AIRCRAFT BY MEANS OF THE SLING.
2. INSERT THE UNIVERSAL JACKING TRESTLE AND THE SPECIAL BEAM AT THE LIFTING POSITION AT FORMER 35.
3. FIT THE JACKING PADS AT THE OUTER JACKING POSITIONS ON THE FRONT SPAR AS SHOWN AND INSERT THE MAIN JACKS.
4. POSITION THE LIFTING GANTRIES AND BEAMS AT MAIN PLANE RIB 16 FOR STEADYING PURPOSES.
5. PROCEED TO RAISE THE AIRCRAFT.

TO JACK THE AIRCRAFT FOR UNDERCARRIAGE RETRACTION TESTS.

1. EITHER RAISE OR SECURE THE TAIL OF THE AIRCRAFT AS FOLLOWS:-
   (A) USE THE TRESTLE SHOWN IN FIG. 3 TO RAISE THE TAIL.
   OR
   (B) CHOCK AND ANCHOR THE TAIL <u>AFTER</u> JACKING.
2. INSERT THE MAIN JACKS AT THE INNER JACKING POSITIONS WITH TRAILING LEGS **OUTBOARD**.
3. RAISE THE MAIN JACKS KEEPING THE AIRCRAFT LEVEL LATERALLY, AND FOLLOW UP WITH THE TAIL TRESTLE (WHEN USED) FOR STEADYING PURPOSES.

FIG. 1 — JACKING COMPLETE AIRCRAFT — FIG. 1

PP3596 M G4897 3/45 1050. C & P Gp. 959 (4)



TO JACK THE AIRCRAFT WHEN ONE MAIN WHEEL TYRE IS DEFLATED

1. CHOCK OR ANCHOR THE TAIL WHEEL AND CHOCK THE MAIN WHEEL ON THE SIDE OPPOSITE THE DEFLATED TYRE
2. RAISE THE HINGED LEADING EDGE AND FIT A JACKING PAD AT THE INNER JACKING POSITION.
3. PLACE A JACK IN A FULLY TILTED ATTITUDE BELOW THE JACKING PAD WITH THE LOAD LEGS PARALLEL TO A LINE JOINING THE CENTRES OF THE TAIL WHEEL AND THE MAIN WHEEL ON THE OPPOSITE SIDE TO THE JACK (15° APPROX TO THE ℄ OF THE AIRCRAFT)
4. RAISE THE JACK UNTIL THE WHEEL IS CLEAR OF THE GROUND KEEPING THE TRAILING LEG ADJUSTED TO SUPPORT THE JACK THROUGHOUT THE OPERATION.

IMPORTANT

THESE INSTRUCTIONS SHOULD BE FOLLOWED CAREFULLY OR DAMAGE TO JACK MAY RESULT

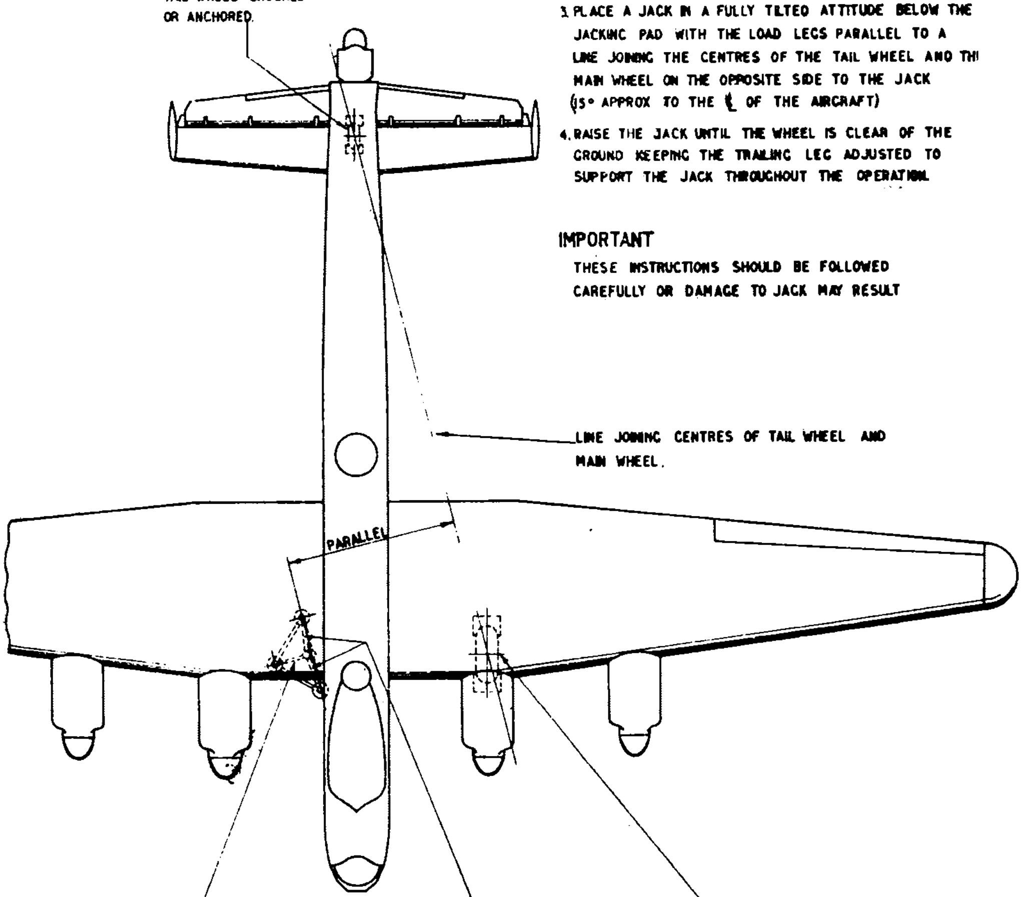


FIG. 2 JACKING ONE MAIN WHEEL FIG. 2

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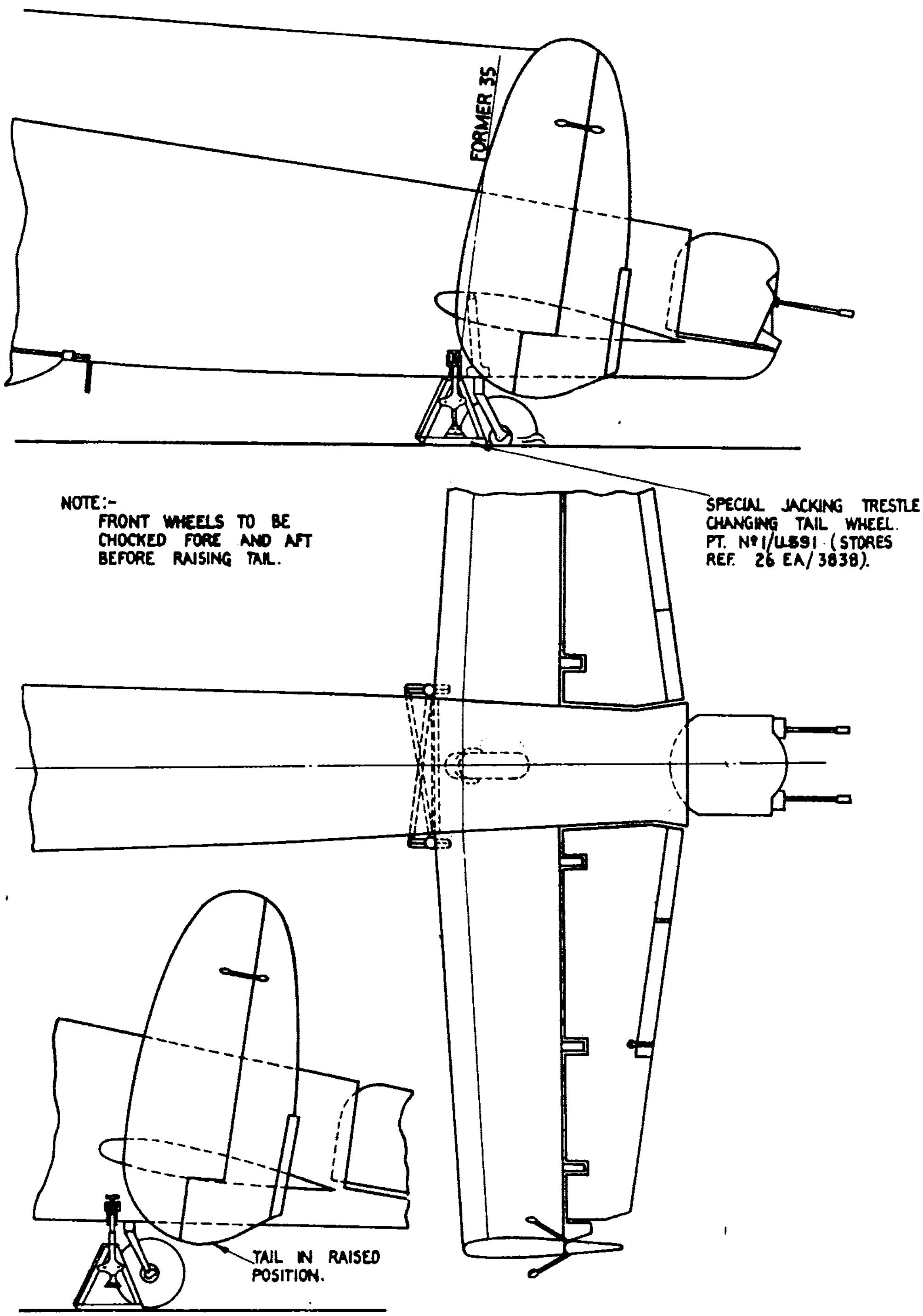

FIG. 3 JACKING FOR REMOVAL OF TAIL WHEEL. FIG. 3

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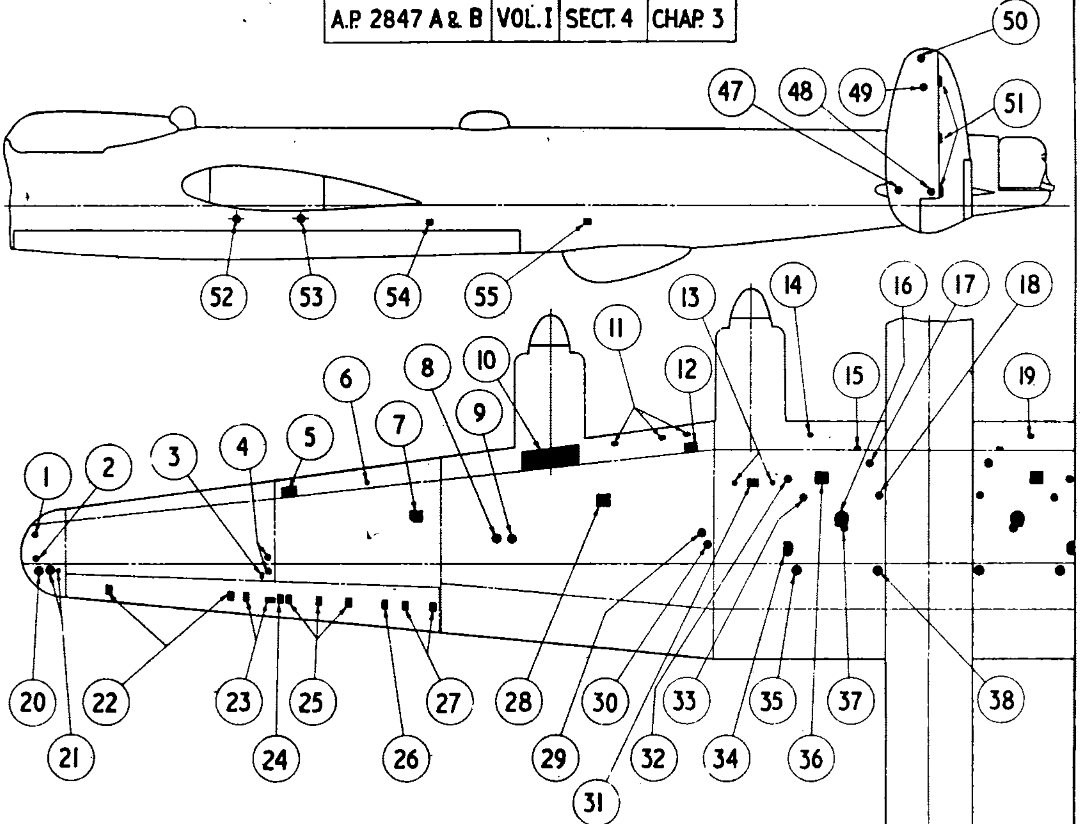
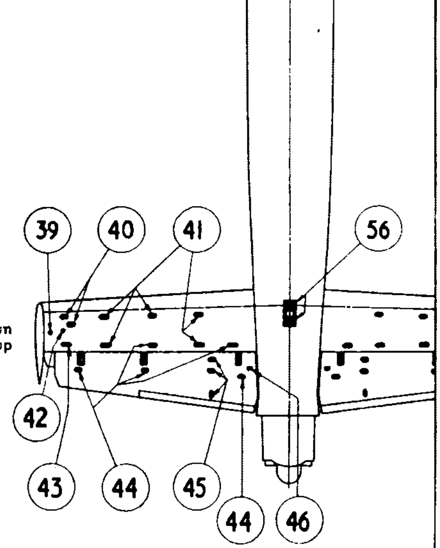




MAIN PLANE AND TAIL UNIT PANELS

1. Navigation lamp terminals
2. Formation lamp terminals
3. Aileron rocking lever—top
4. Aileron control
5. Mooring ring—outer
6. Landing lamp terminals
7. No. 3 tank fuel filler—top
8. No. 3 tank fuel gauge—top
9. No. 3 tank sump
10. Engine controls
11. Engine control cables
12. Mooring ring—inner
13. Undercarriage up switch
14. Header tank—rear turret hydraulic system—top
15. Jacking pads
16. Jettison pipe valve cover
17. Auxiliary fuel pipe coupling—top
18. Hydraulic connection—top
19. Cabin heating
20. Formation lamp terminals
21. Tip assembly joint
22. Aileron hinge
23. Aileron control
24. Aileron hinge
25. Aileron trimmer fairlead
26. Aileron hinge
27. Aileron trimmer fairlead
28. No. 2 tank fuel filler—top
29. No. 2 tank fuel gauge—top
30. No. 2 tank sump
31. Oil filler—top
32. No. 1 tank air vent—top
33. No. 1 tank fuel gauge—top
34. No. 1 tank sump
35. Aileron control
36. No. 1 tank fuel filler
37. Jettison pipe connection—top
38. Aileron control
39. Rudder connecting rod
40. Rudder controls
41. Fairlead
42. Rudder controls—top and bottom
43. Rudder trimming tab control—top
44. Elevator hinge bolts
45. Elevator trimming tab control
46. Torque tube coupling
47. Connecting bolts
48. Rudder trimming tab and connecting bolts
49. Aerial tension spring
50. Aerial pulley
51. Rudder hinge cuffs

FUSELAGE PANELS

52. Emergency air and oxygen charging valves—port side
53. Hydraulic reservoir filler cap—starboard side
54. Electrical ground supply socket—starboard side
55. Vacuum test cock—starboard side
56. Tailwheel strut—bottom

Note.—All panels are situated on underside unless otherwise stated.

FIG. 4 — ACCESS & INSPECTION PANELS — FIG. 4

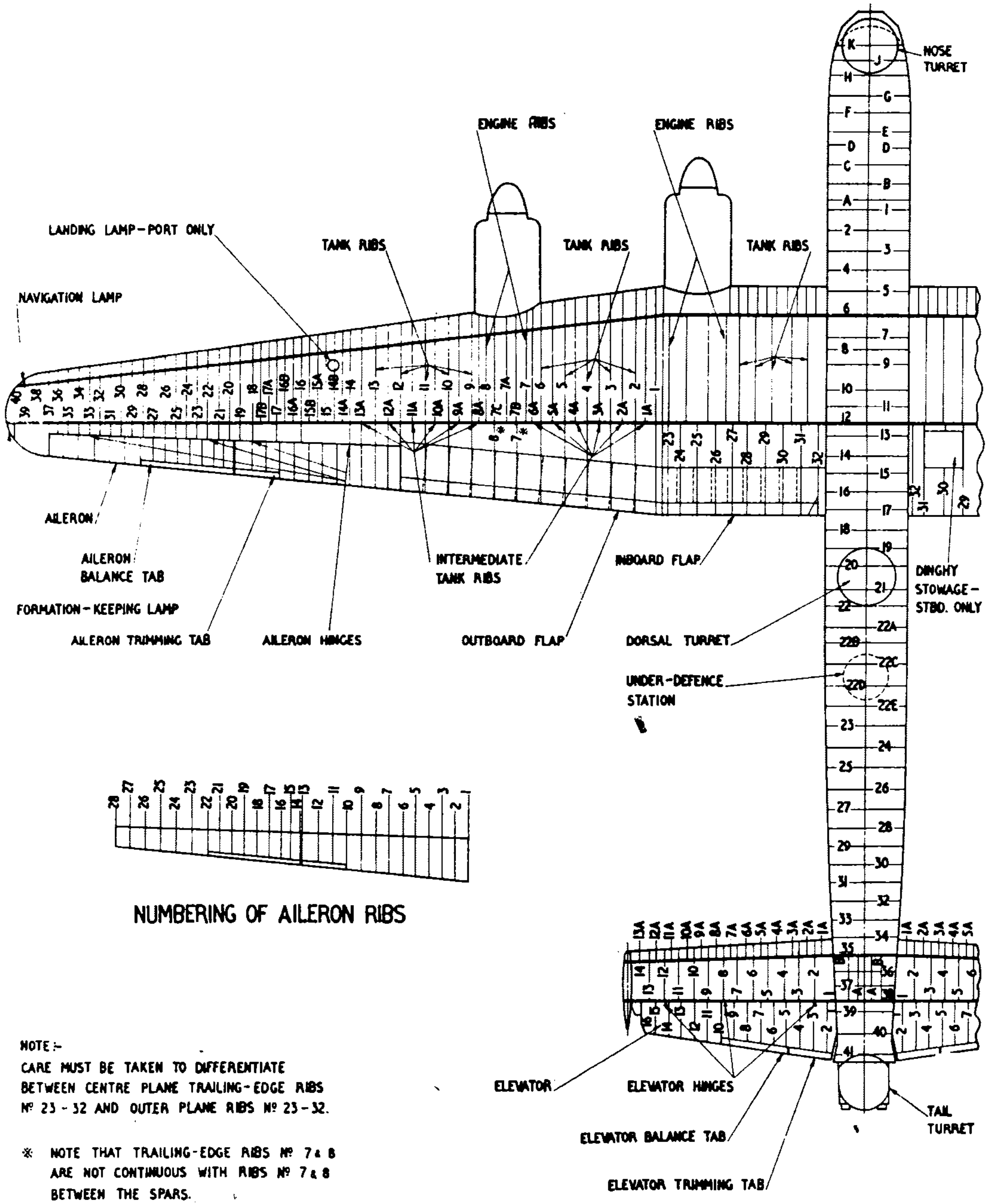
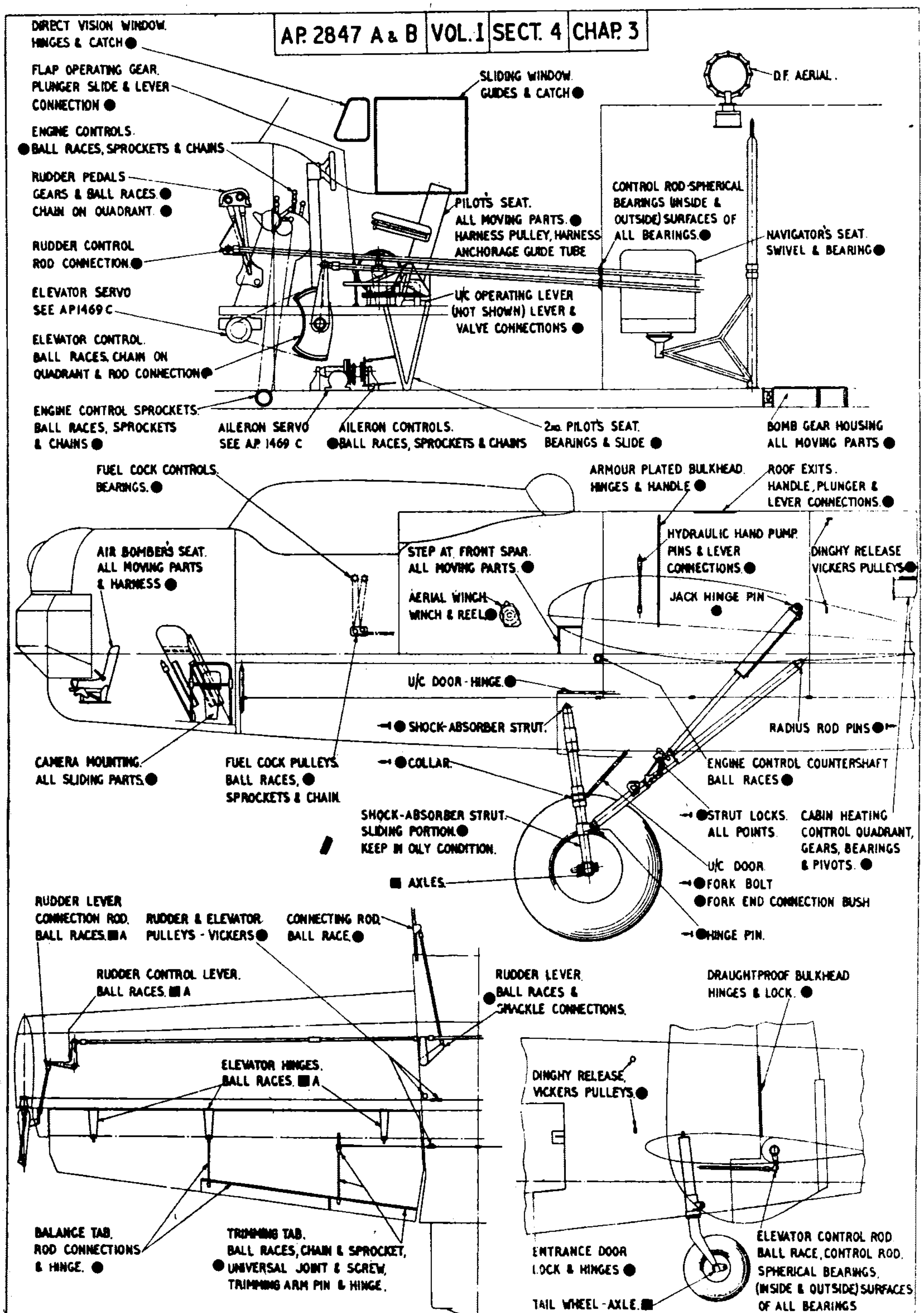


FIG. 5 — FORMER AND RIB POSITIONS

PP3387 M IG3530 12/44 1050 C & P Gp. 959(4)



FOR KEY TO SYMBOLS SEE FIG. 7

FIG. 6 **LUBRICATION DIAGRAM - FUSELAGE-TAIL UNIT** FIG. 6

REPRINT PP.3387 M /G3530 1/45 1050 C & P Gp. 959(4)

This leaf issued with A.L. No. 9, November 1944

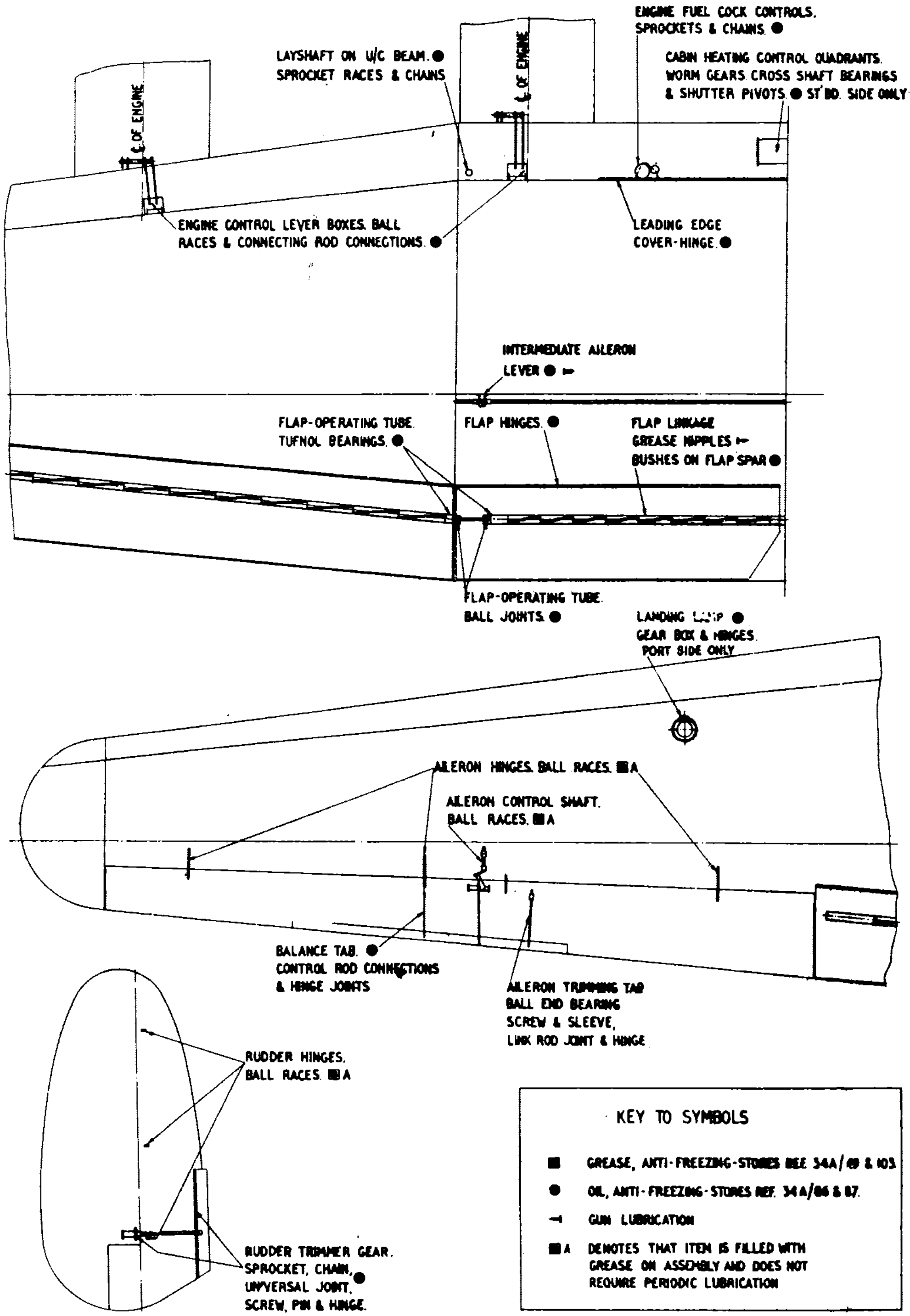
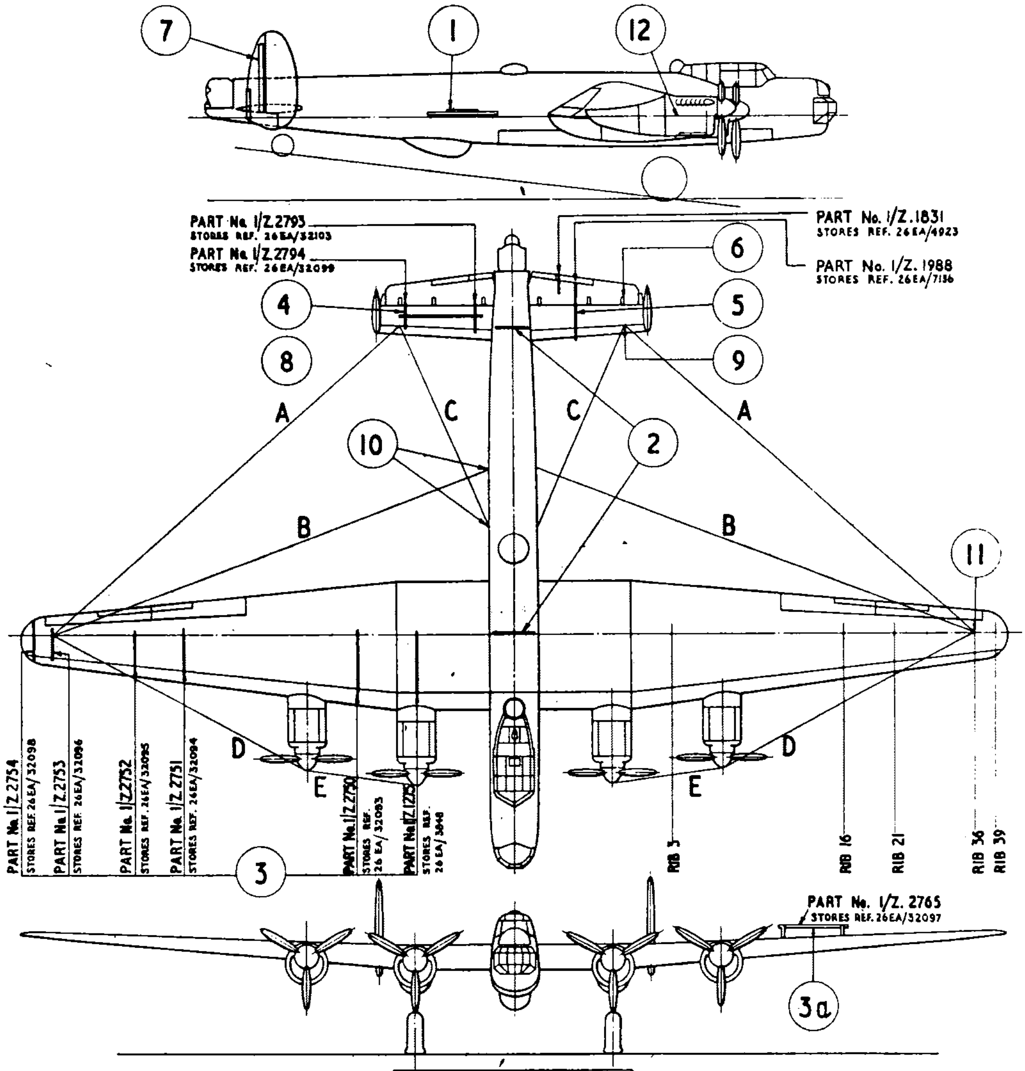
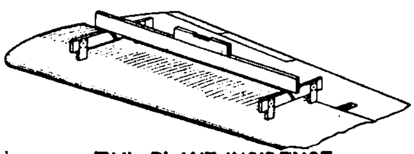


FIG. 7 **LUBRICATION DIAGRAM - MAINPLANE & RUDDER** FIG. 7

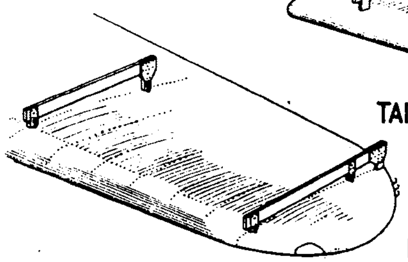
REPRINT PP3387 M /G3530 1/45 1050 C & P Gp. 959(4)



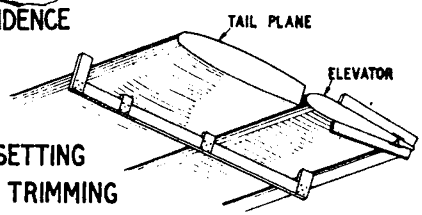
FOR REFERENCES, SEE FIG. 9



TAIL PLANE INCIDENCE CHECK



MAIN PLANE INCIDENCE CHECK



METHOD OF SETTING ELEVATOR AND TRIMMING AND BALANCE TABS

FIG. 8

RIGGING INSTRUCTIONS (I)

FIG. 8

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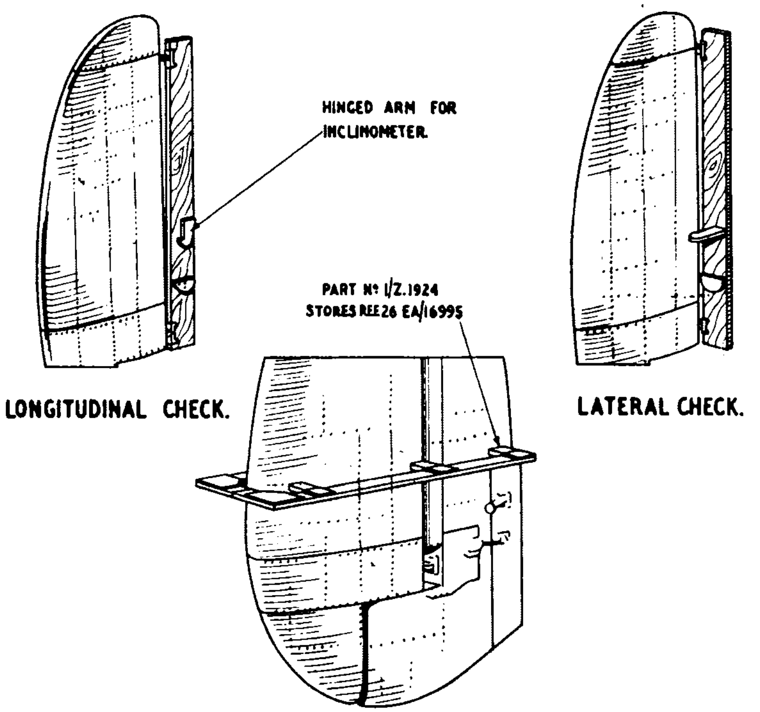


METHOD OF SETTING RUDDER IN CONTINUITY WITH FIN.

1. To level the aircraft longitudinally, fit pegs, Part No. 1/Z.1353, Stores ref. 26 EA/4316, into the two rear jacking points. Place straight edge, Part No. 1/Z.1427, Stores ref. 26 EA/4319 across the pegs and check with inclinometer.

2. To level the aircraft transversely, place straight edges, Part No. 1/Z.1422 and 1/Z.1421, Stores Ref. 26 EA/4318 and 26 EA/4317 across the datum blocks attached to each side of formers 12 and 35 respectively inside the fuselage and check with inclinometer.

3. Check mainplane incidence by means of Incidence Jigs shown on Fig. 8 at ribs 39, 36, 21, 16 and 3 and at ℄ of inboard engine.

3a. Check mainplane dihedral by means of Check Board, Part No. 1/Z.2765, Stores Ref. 26EA/32097 placed on top surface of rear spar.

4. To check tail plane incidence place Incidence Jigs, Part No. 1/Z.2794 and 1/Z.2793, Stores Ref. 26 EA/32098 and 26 EA/32103 on tail plane ribs No. 11 and 3 respectively. Check incidence and horizontal level by means of an inclinometer.

5. To set elevator, use the Setting Board, Part No. 1/Z.1988, Stores Ref. 26EA/7136 at tail plane rib No. 6. To set the elevator trimmer, place the Setting Boards, Part No. 1/Z.1931, Stores Ref. 26 EA/4923 on each side of the elevator, and set the trimming tab midway between the boards.

6. On the assembly of the tailplane to the aircraft, the elevator hinge brackets must be aligned right through the aircraft. This should be carried out by means of a length of twine through the bolt holes. The hinge brackets should be shimmed if necessary for alignment.

7. Check the verticality of the fins by means of the Checking Board, Part No. 1/Z.1896, Stores Ref. 26 EA/17477. Fin post inclines forward 1deg. 15min. ± 30min. For lateral check ± 15min., turn the board through 90 deg. (see above). To set the rudder in continuity with the fin, use Setting Boards, Part No. 1/Z.1924, Stores Ref. 26 EA/16995.

8. Check dimensions as follows:-
   - Distances A to be equal within 1½ in.
   - Distances B to be equal within 1 in.
   - Distances C to be equal within ½ in.
   - Distances D to be equal within ½ in.
   - Distances E to be equal within ½ in.

9. Rigging datum on front spar at tailplane rib No. 12

10. Two rear jacking points in fuselage longeron

11. Rigging datum, centre of rear slinging socket, mainplane rib No. 36.

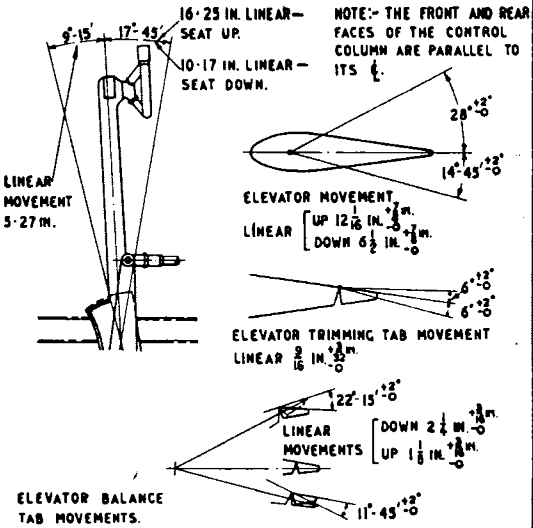
12. C.G. origin, centre of hole, rear jacking point in fuselage front centre section.

● The notes on this diagram relate also to Fig. No. 8, Stores References where quoted are Air Ministry Stores Reference numbers.

FIG. 9 — RIGGING INSTRUCTIONS (2) — FIG. 9

REPRINT PP3977 M /G2030 9/45 1050 C & P Gp. 959(4)

CONTROL	ADJUSTMENT



ELEVATOR

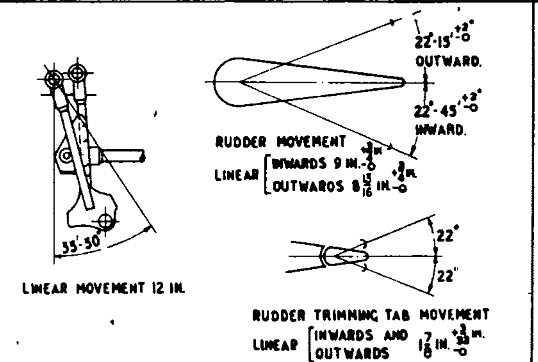
Lock the control column in the neutral position. Check the setting of the elevators with setting boards (see fig. 8). To adjust the push-pull controls, see para. 20.

Trimming tab

Lock the control column in the neutral position. Set the trailing edge of the tab in line with the trailing edge of the elevator, with the cockpit indicator reading 0 deg. To set the tab, adjust the turnbuckle in the fuselage just aft of the tail plane rear spar and on the port side of the fuselage between formers 30 and 31.

Balance Tab

Lock the elevator control in the neutral position. Set the trailing edge of the tab in line with the trailing edge of the elevator.



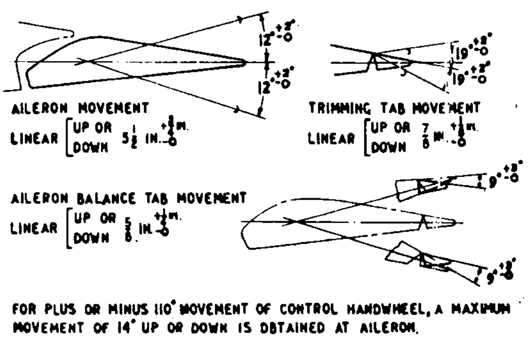
RUDDER

Lock the rudder control pedals in the neutral position and fit setting board (see fig. 9). For adjustment of push-pull controls, see para. 20.

Note: **The linear measurement is taken immediately above the trimming tab.**

Trimming Tab

Lock the rudder control pedals in the neutral position. Set the trimming tab in line with the rudder, with the cockpit indicator reading 0 deg. To set the tab, adjust the turnbuckles between formers 30 and 31 on the port side of the fuselage. Further adjustment may be made if required at the turnbuckles between the tail plane spars, one at the centre of the fuselage and one between tail plane ribs 12 and 13 on each side.



AILERON

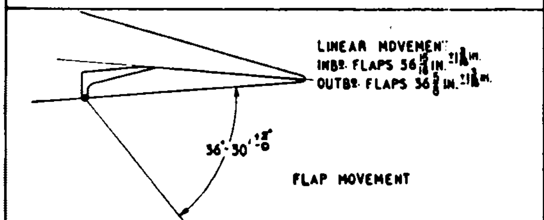
Lock the aileron control central and rig the ailerons with their trailing edges in line with the main plane trailing edges. Line up the two sections of each aileron with their undersurfaces equidistant from the undersurface of the main plane trailing edge. Turnbuckles are provided on the port side of the fuselage, just forward of the front spar. For complete setting instructions, see text of this chapter.

Trimming Tab

Lock the aileron control in the neutral position and set trailing edge of tab in line with trailing edge of aileron, with the cockpit indicator reading 0 deg. To adjust, lower the flaps to gain access to the cables. When the tab is in the mid position, the turnbuckles on the starboard forward cable should be equidistant between the fairlead on the bridge bracket and rib 32, and the turnbuckle on the aft cable equidistant between the fairlead and rib 25. On the port side the positions are reversed.

Balance Tab

Lock the aileron control in the neutral position. Set the trailing edge of the tab in line with the trailing edge of the aileron. (Initial setting only, see text).

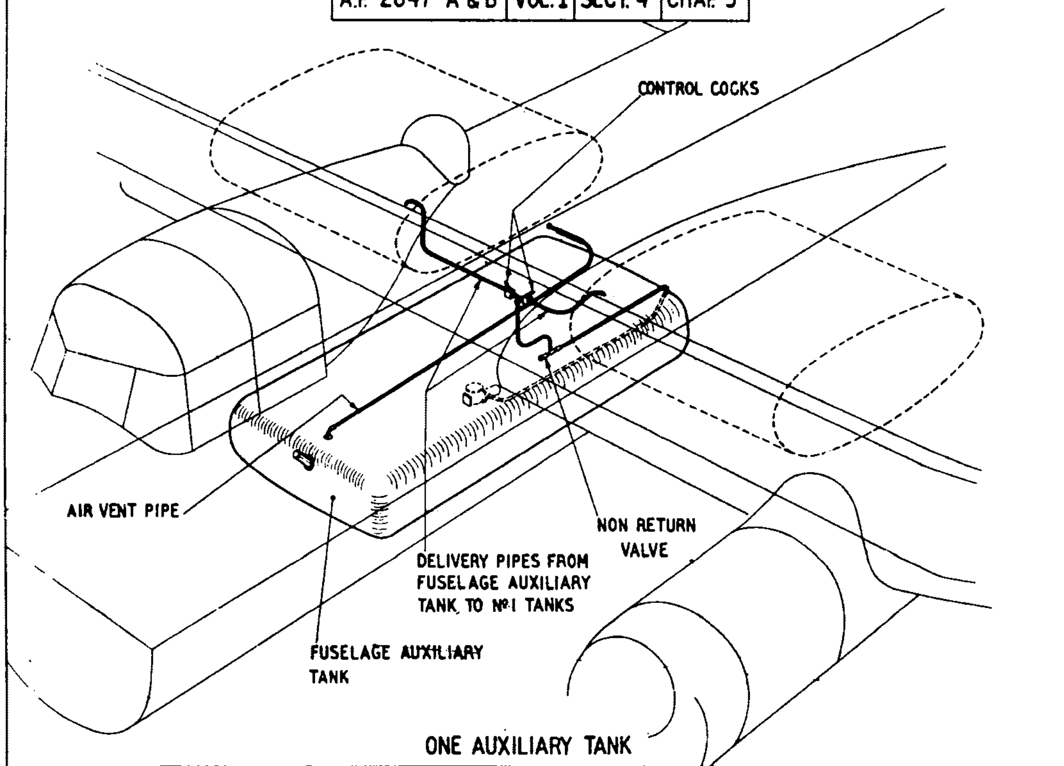


FLAPS

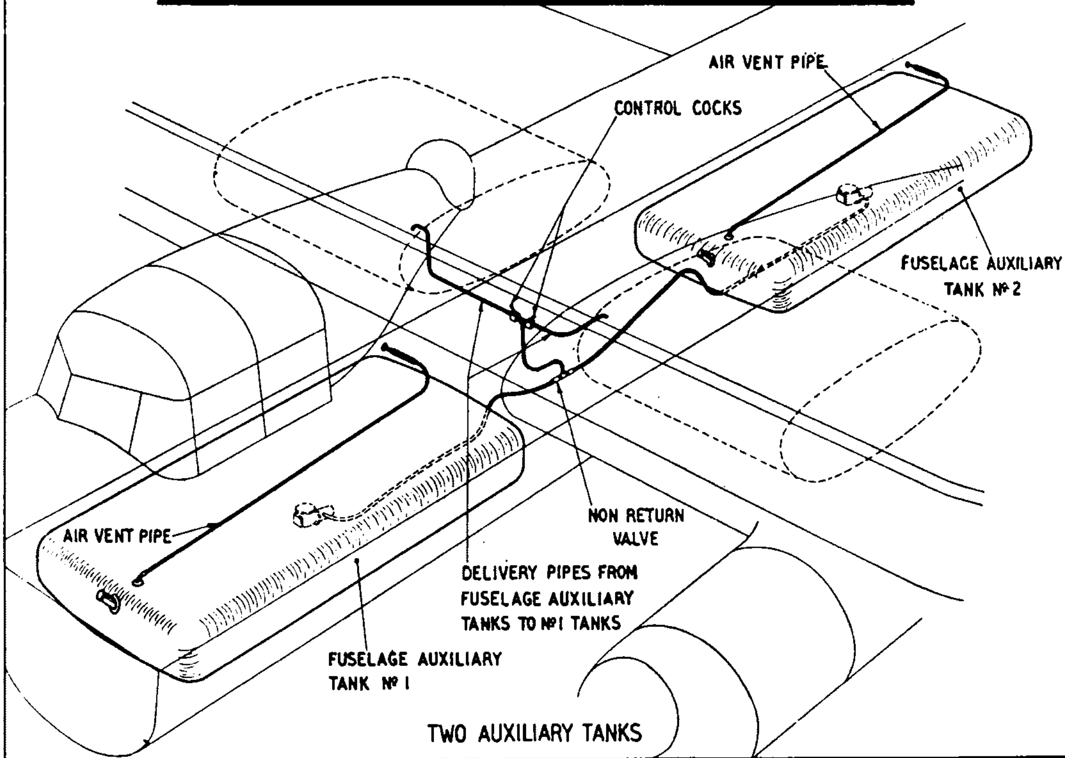
Set the flaps to close completely, then allow to droop 1 in. Adjust the interconnection links at the port end of the jack piston rod until the port flaps just touch the trailing edge while the starboard flaps are maintained at 1 in. droop.

FIG. 10 — RIGGING CONTROL SURFACES — FIG. 10

PP3977 M /G2030 8/45 1050 C & P Gp. 959 (4)



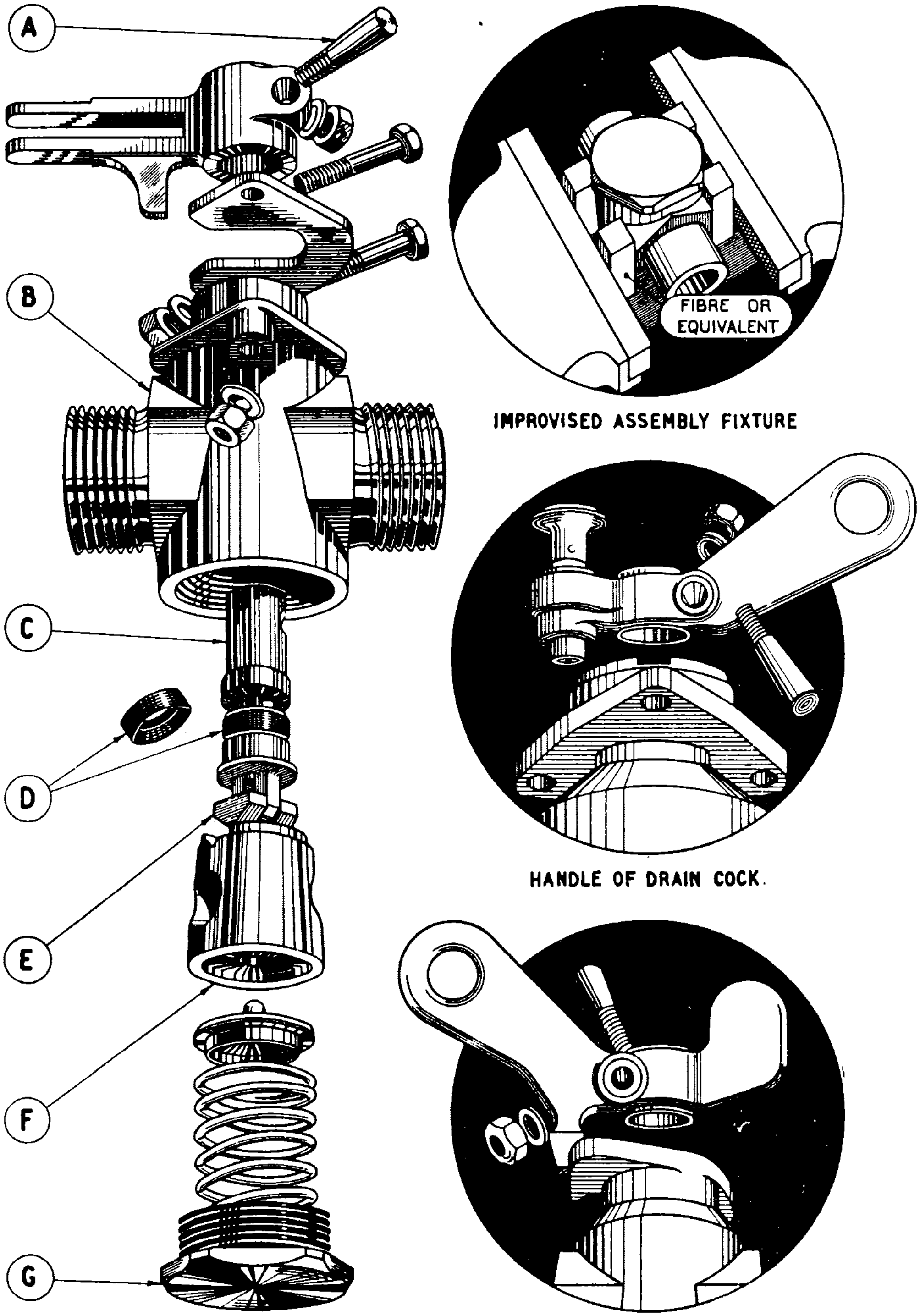
ONE AUXILIARY TANK



TWO AUXILIARY TANKS

FIG. 13 AUXILIARY FUEL SYSTEM FIG. 13

PP3387 M /G3530 12/44 1050 C & P Gp. 959 (4)



MASTER ENGINE COCK. HANDLE OF COCK FOR AUXILIARY FUEL SYSTEM

FIG. 14 TYPICAL FUEL COCK DETAILS. FIG. 14.

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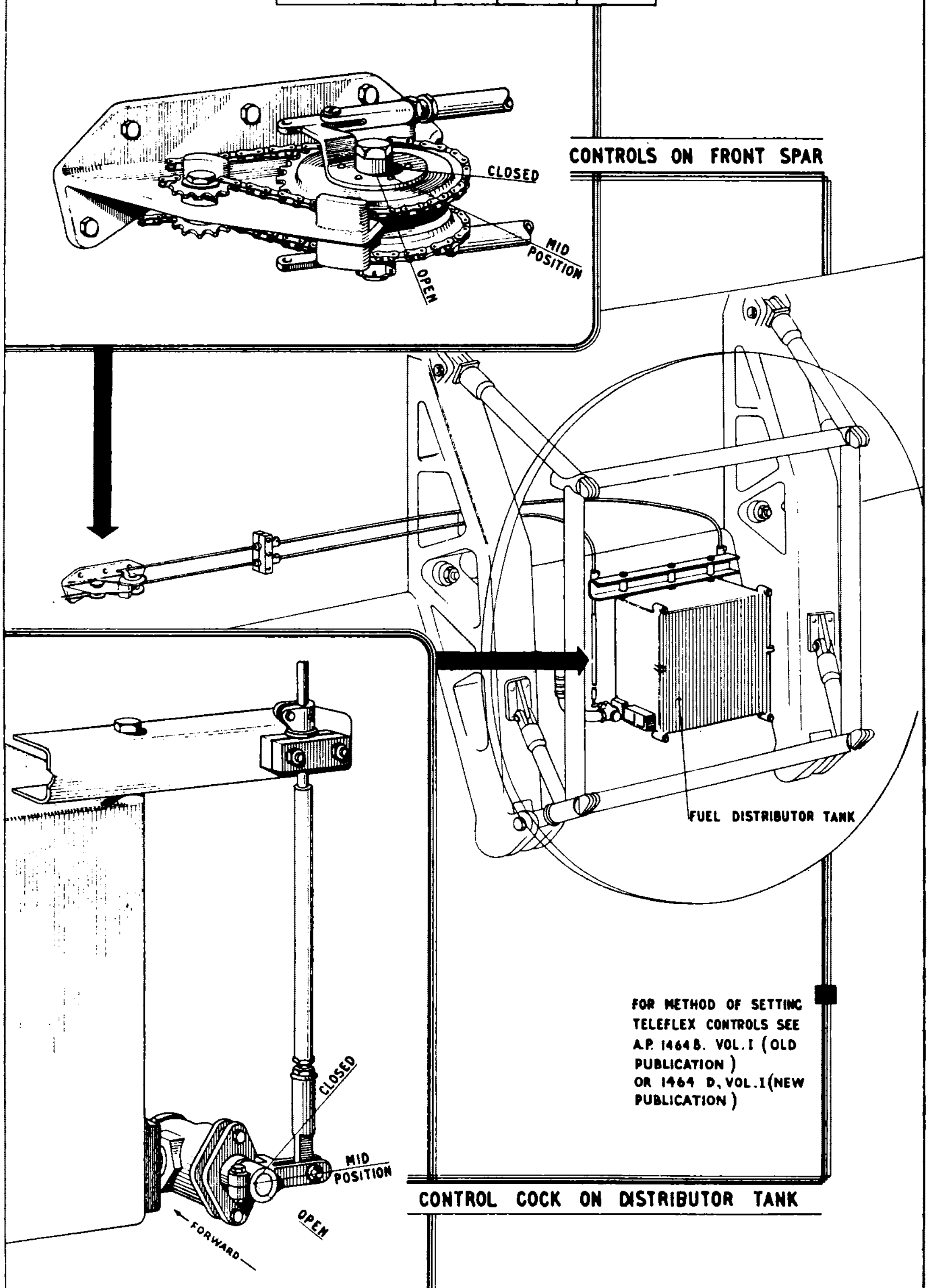
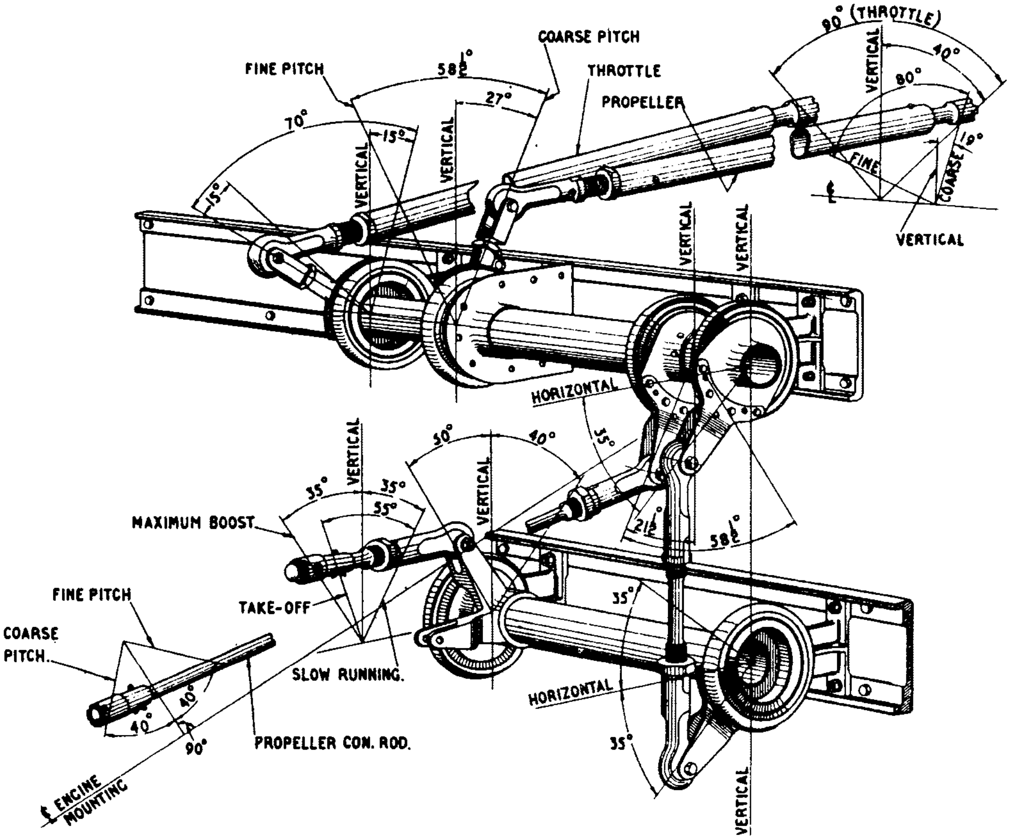


FIG. 15 SETTING OF FUEL COCK CONTROLS FIG. 15

PP3387 M /G3530 12/44 1050 C&P Gp. 959 (4)



NOTE:– THE PROPELLER IS SHOWN IN COARSE PITCH POSITION.

THE THROTTLE IS SHOWN IN MAXIMUM BOOST.

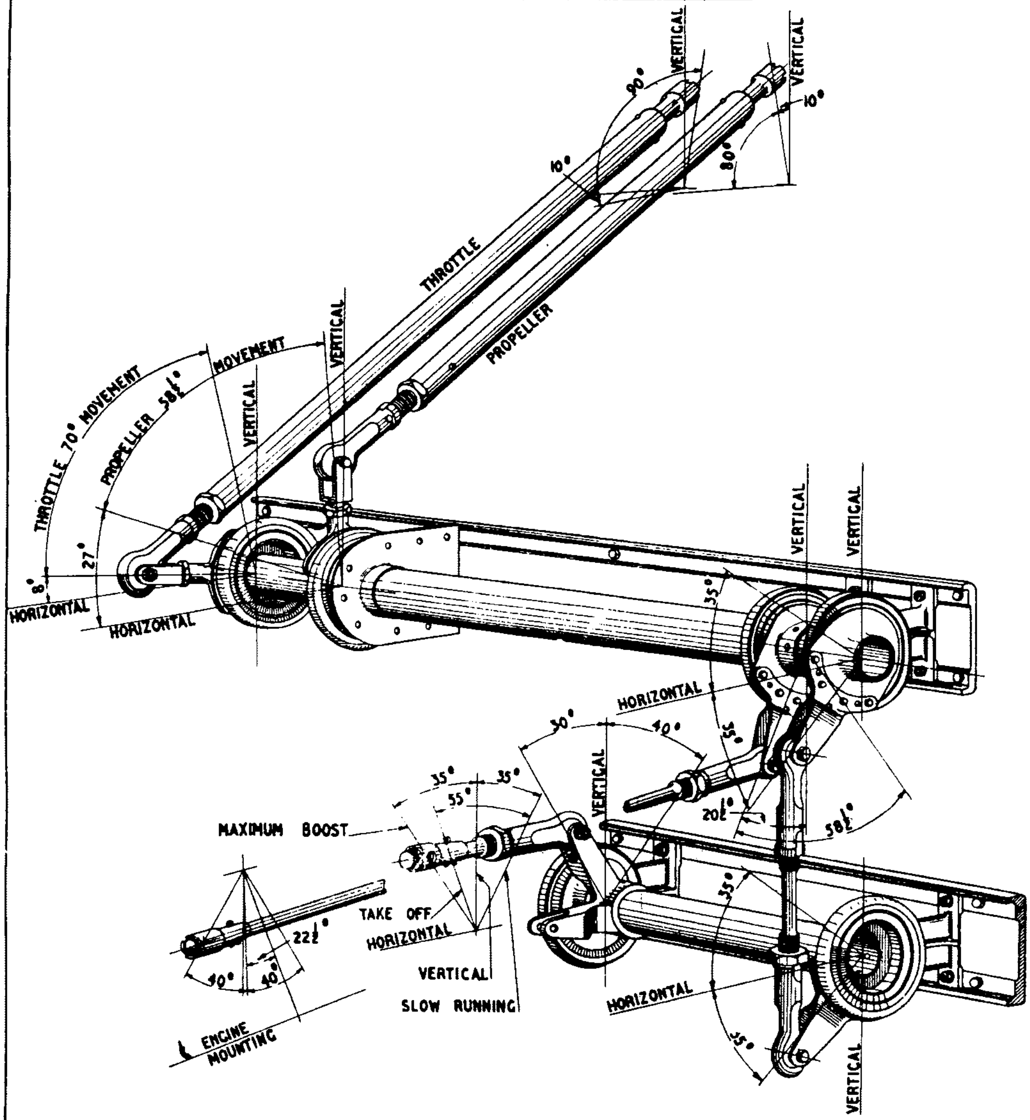
THE THEORETICAL ANGULAR MOVEMENTS FOR THROTTLE AND PROPELLER AT CONTROL BOXES ON SPAR FACE ARE 100° AND 90° RESPECTIVELY. 10° HAS BEEN DEDUCTED FROM EACH TO ALLOW FOR BACKLASH AND LOST MOTION. ANY NECESSARY CORRECTIONS THAT MAY BE REQUIRED MAY BE OBTAINED BY ADJUSTING LEVERS ON FIREWALL UPPER C/SHAFT ASSEMBLY ALONG WITH LENGTHS OF CON-RODS BETWEEN SPAR AND FIREWALL.

THE VERTICAL AND HORIZONTAL DATUM LINES ARE SHOWN WITH THE AIRCRAFT IN THE RIGGING POSITION.

FIG. 16 ENGINE CONTROLS SETTING – INBOARD FIG. 16

REPRINT PP3387 M /G3530 1/45 1050 C & P Gp. 959(4)

This leaf issued with A.L. No. 9, November 1944



NOTE:- THE PROPELLER IS SHOWN IN COARSE PITCH POSITION.

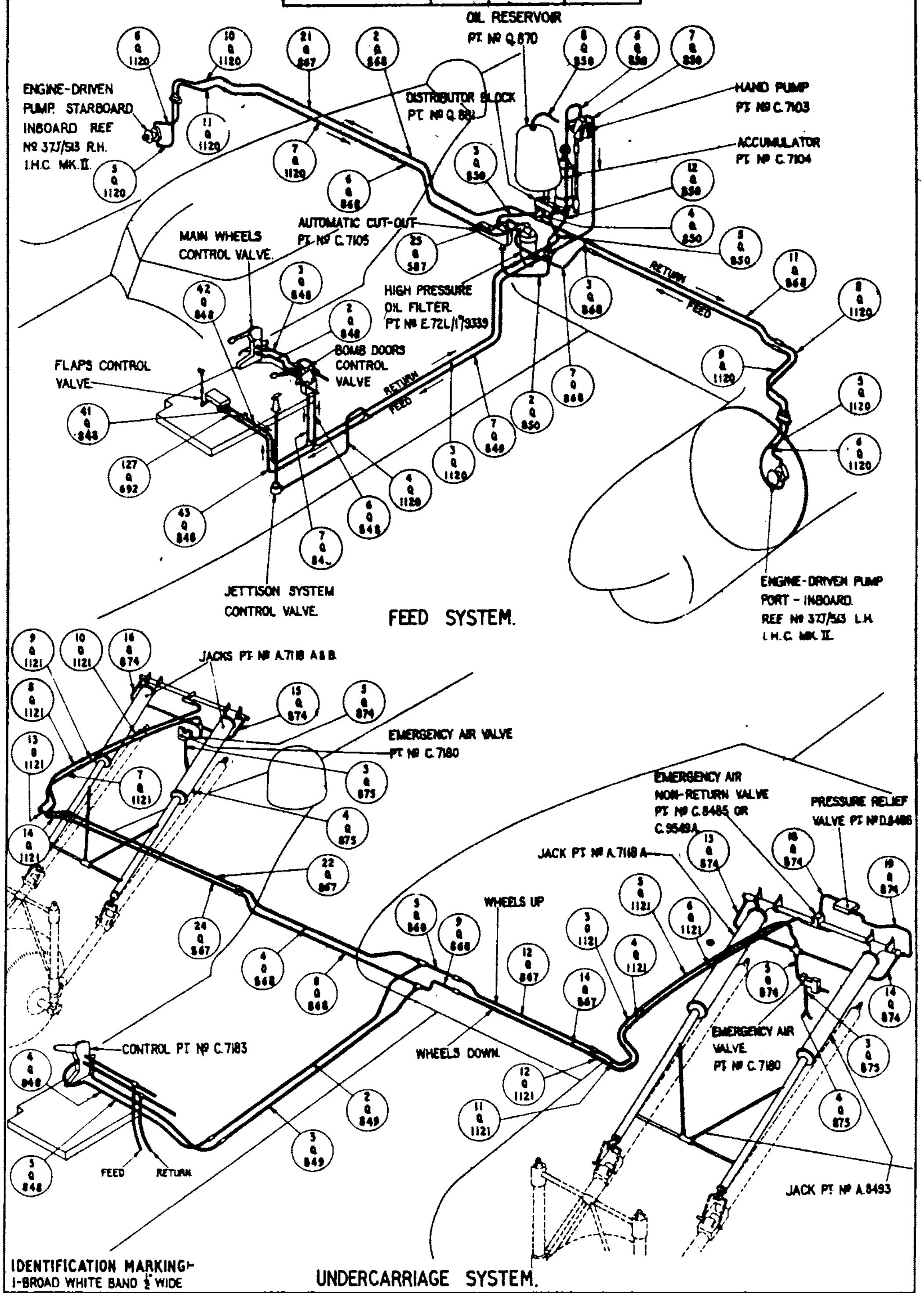
THE THROTTLE IS SHOWN IN MAXIMUM BOOST.

THE THEORETICAL ANGULAR MOVEMENTS FOR THROTTLE AND PROPELLER AT CONTROL BOXES ON SPAR FACE ARE 100° AND 90° RESPECTIVELY. 10° HAS BEEN DEDUCTED FROM EACH TO ALLOW FOR BACKLASH AND LOST MOTION. ANY NECESSARY CORRECTIONS THAT MAY BE REQUIRED MAY BE OBTAINED BY ADJUSTING LEVERS ON FIREWALL UPPER C/SHAFT ASSEMBLY ALONG WITH CON-RODS BETWEEN SPAR AND FIREWALL.

THE VERTICAL AND HORIZONTAL DATUM LINES ARE SHOWN WITH THE AIRCRAFT IN THE RIGGING POSITION.

FIG. 17 — ENGINE CONTROLS SETTING - OUTBOARD — FIG. 17

REPRINT PP3387 M /G3530 1/45 1050 C & P Gp. 959(4)



IDENTIFICATION MARKING:- 1-BROAD WHITE BAND ½" WIDE

FIG. 18

HYDRAULICS – FEED & UNDERCARRIAGE SYSTEMS.

FIG. 18

REPRINT PP3387 M /G3530 1/45 1050 C & P Gp. 959(4)

This leaf issued with A.L. No. 9, Nov. 1944

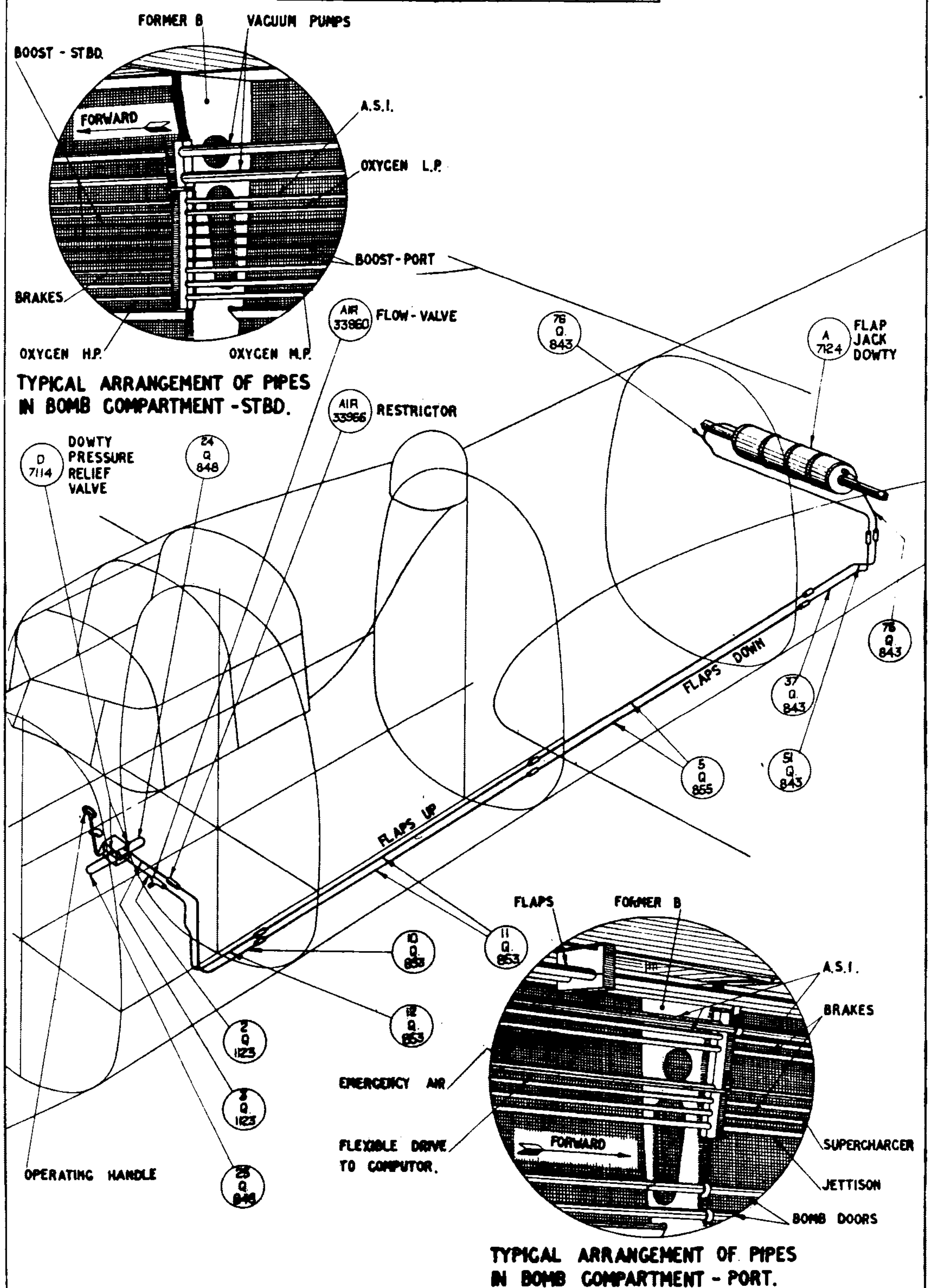
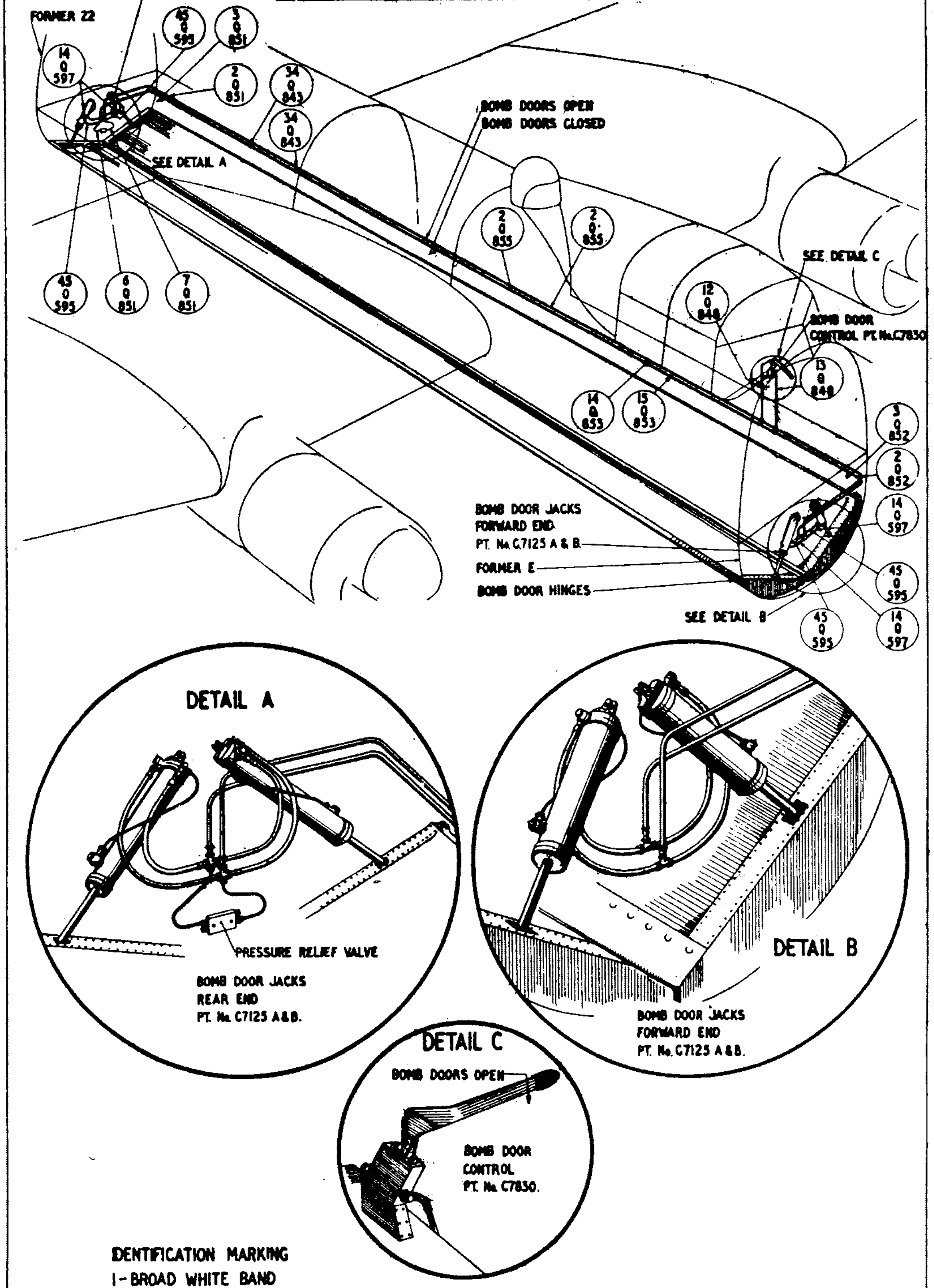


FIG. 19 **HYDRAULIC SYSTEM - FLAPS** FIG. 19

PP3387 M /G3530 12/44 1050 C&P Gp. 959 (4)



IDENTIFICATION MARKING
1 - BROAD WHITE BAND

FIG. 20 — HYDRAULIC SYSTEM - BOMB DOORS — FIG. 20

REPRINT PP3387 M JG3530 1/45 1050 C & P Gp. 959(4)

FIG. 21

EMERGENCY AIR SYSTEM

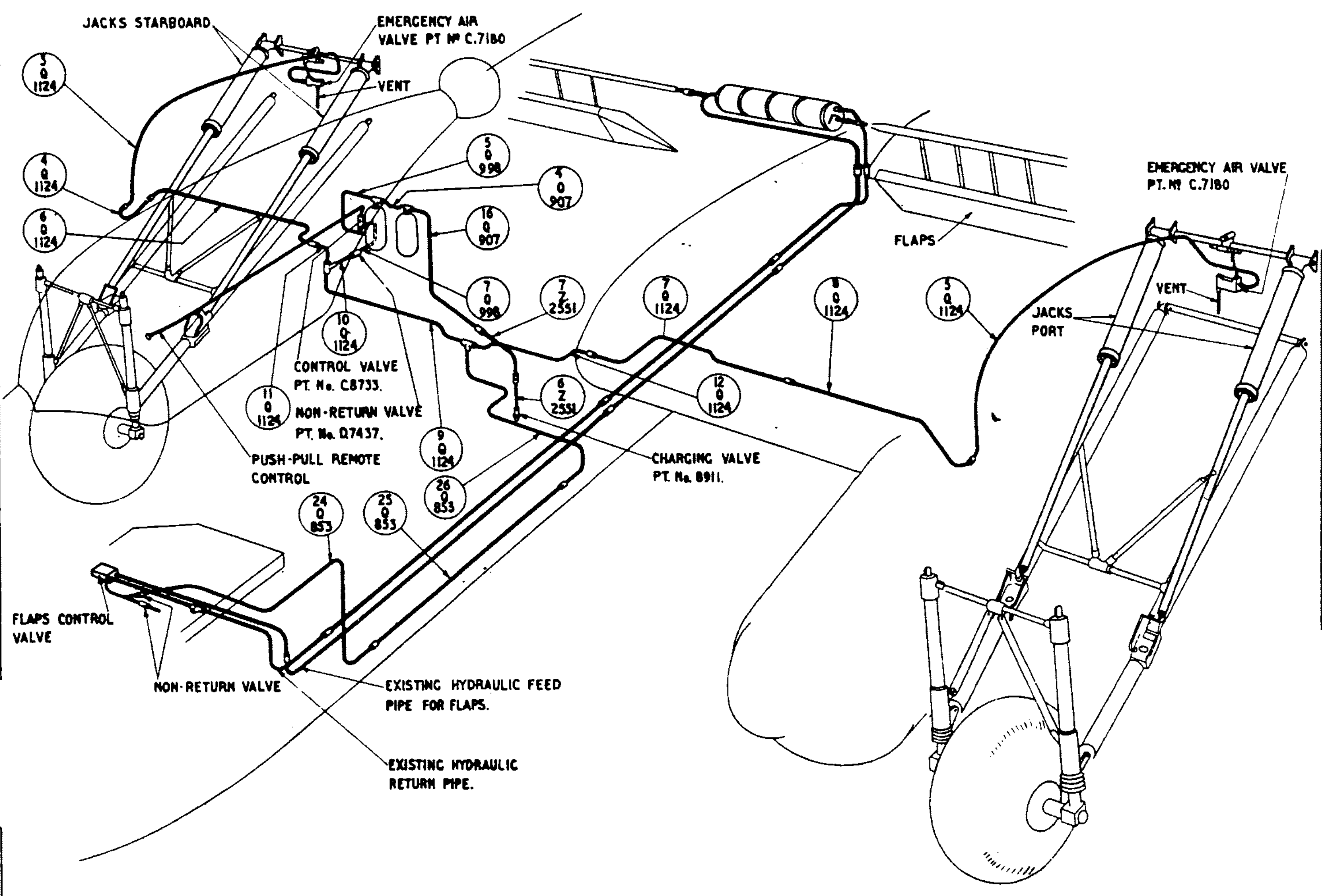


FIG. 21

REPRINT P3596 M /G.497 4/45 1050 C & P Gp. 959(4)

FIG. 22

PNEUMATIC SYSTEM

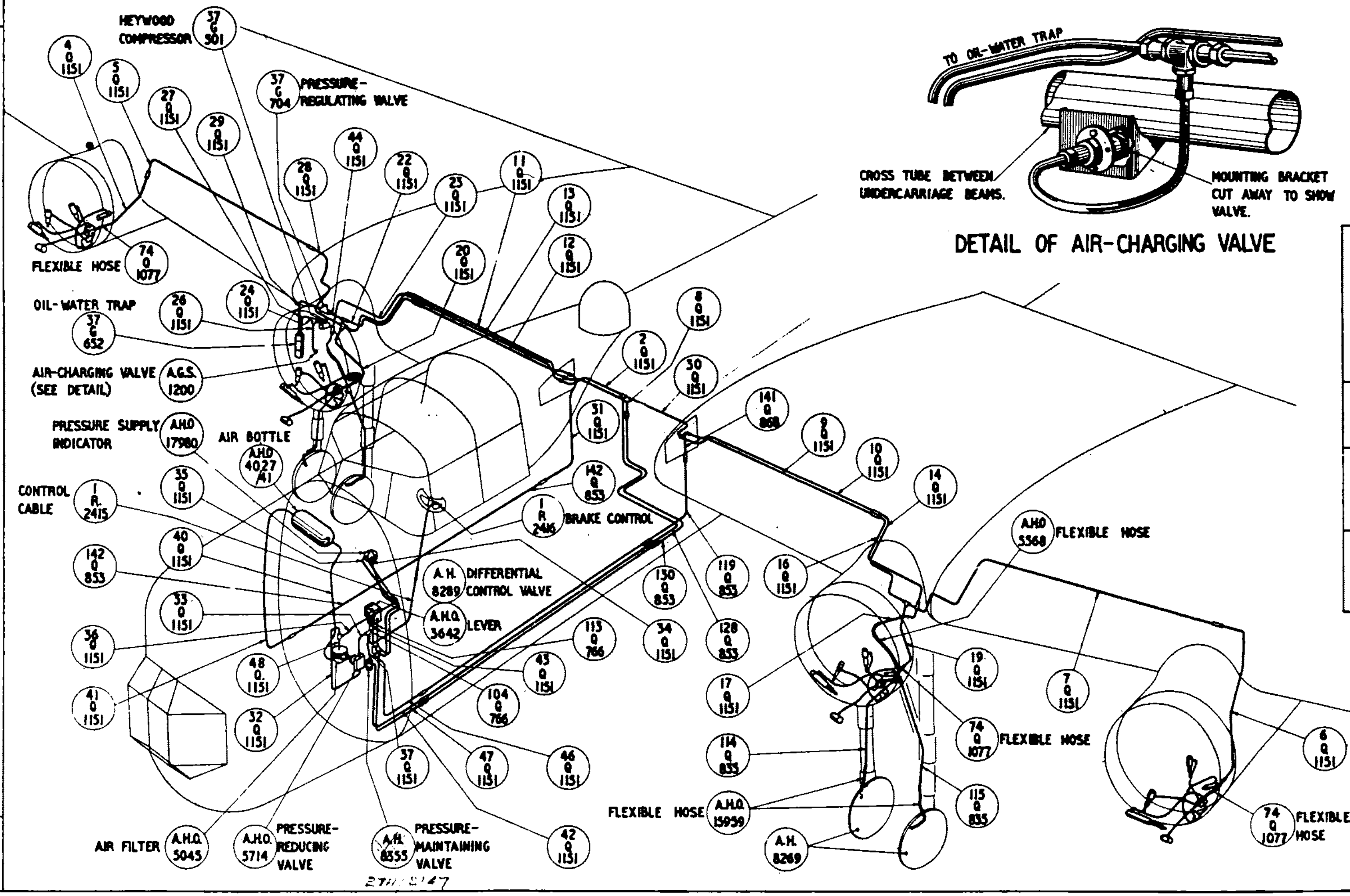


FIG. 22

This leaf issued with A.L. No. 19 , May 1945

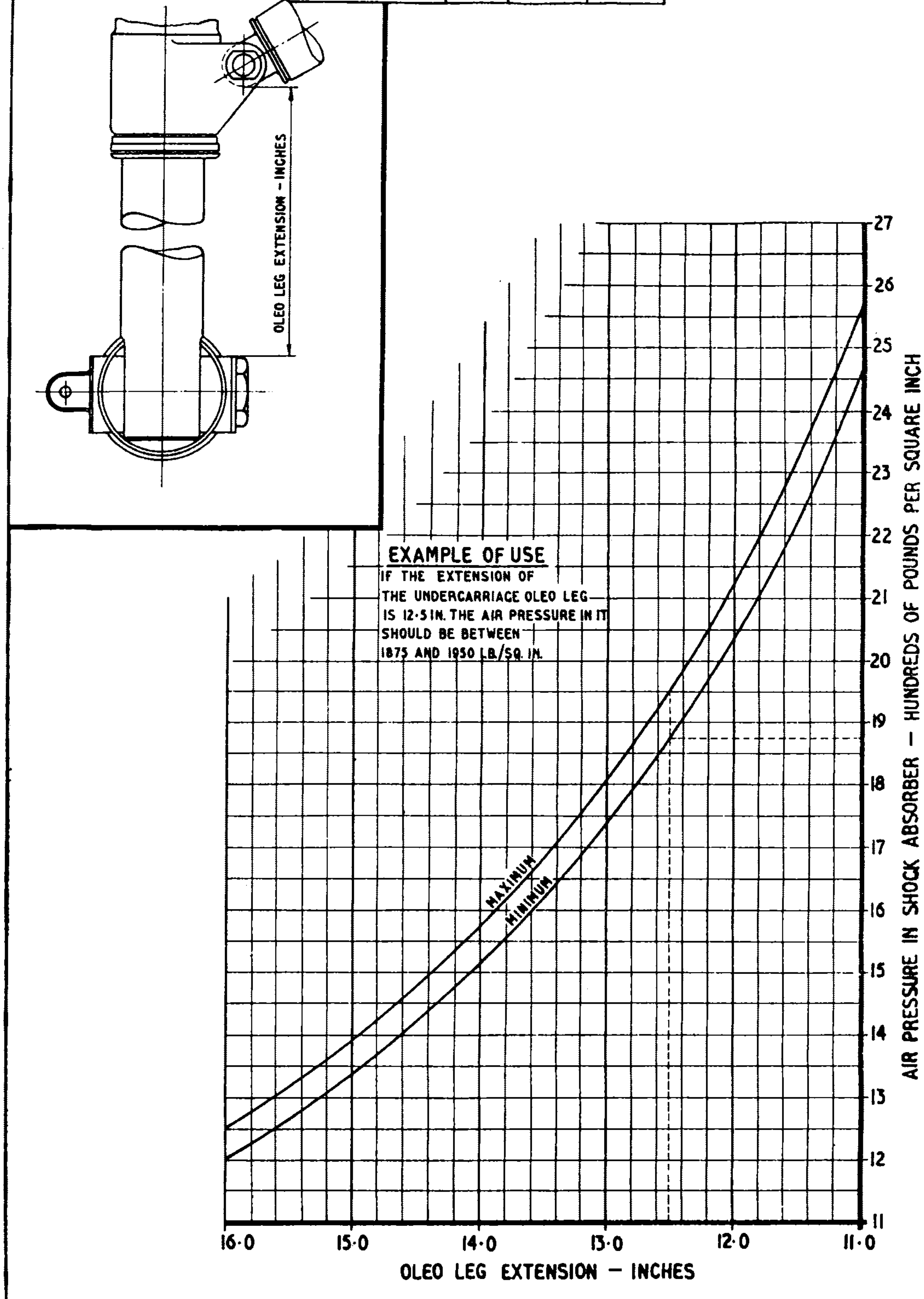


FIG. 23 — MAIN WHEEL STRUT INFLATION DIAGRAM — FIG. 23

PP3776 M /G830 6/45 1050 C & P Gp. 959 (4)

This leaf issued with A.L. No. 19 . May 1945

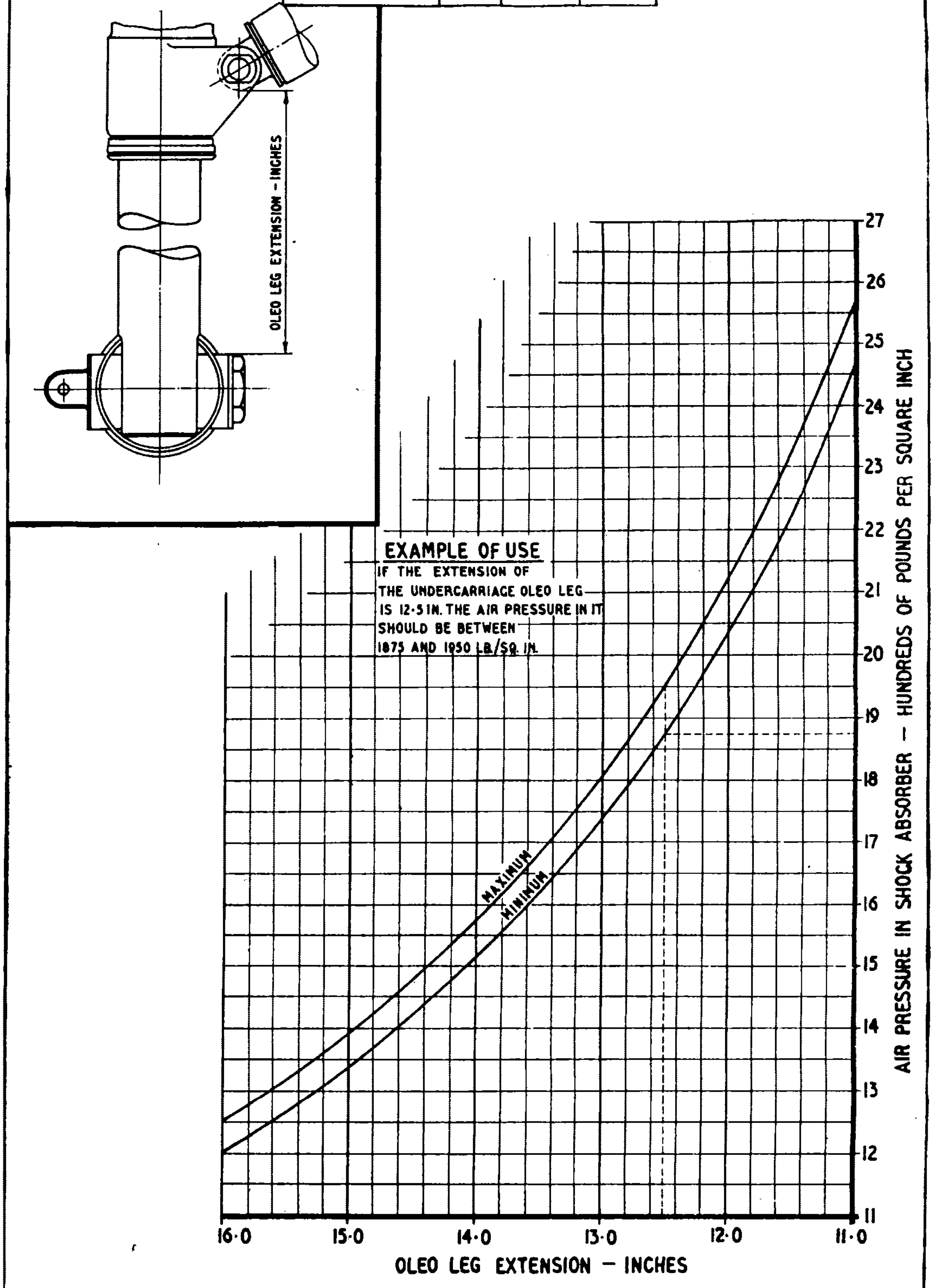


FIG. 23 **MAIN WHEEL STRUT INFLATION DIAGRAM** FIG. 23

PP3776 M /G830 6/45 1050 C&P Gp. 959 (4)

TAIL WHEEL LOAD UNDER 7,800 LB.
INFLATION PRESSURE LEG FULLY EXTENDED 650 - 700 LB./SQ.IN.

TAIL WHEEL LOAD 7,800 - 8,500 LB.
INFLATION PRESSURE LEG FULLY EXTENDED 725 - 775 LB./SQ. IN.

EXAMPLE OF USE
IF THE EXTENSION OF THE TAIL WHEEL STRUT (I.E. X IN.) IS 2·5 IN. AND THE TAIL WHEEL LOAD IS UNDER 7,800 LB. THE AIR PRESSURE IN THE LEG SHOULD BE BETWEEN 1,000 AND 1,077 LB./SQ. IN.

LEG FULLY EXTENDED 4·92 IN.

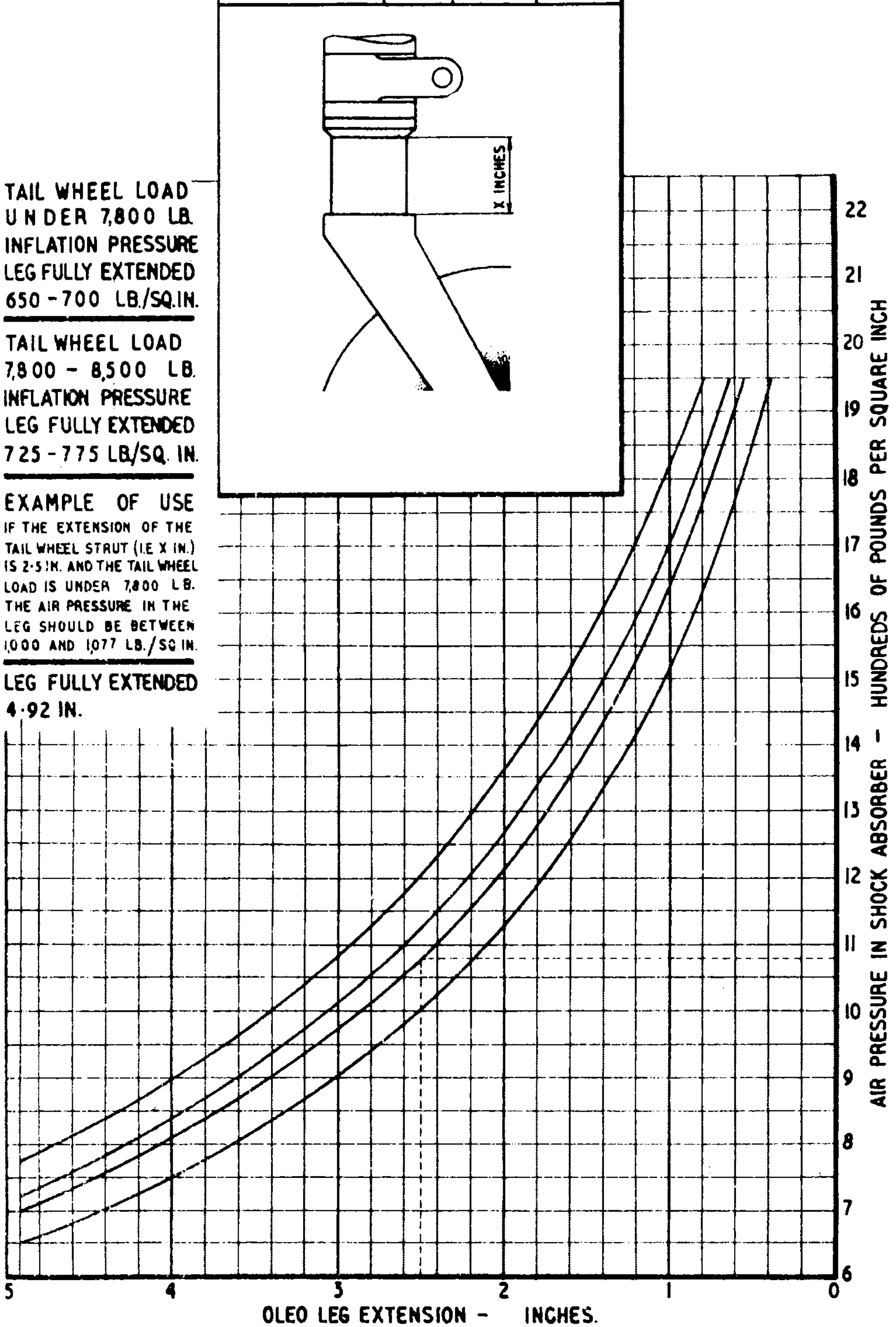


FIG. 23A TAIL WHEEL STRUT INFLATION DIAGRAM FIG. 23A

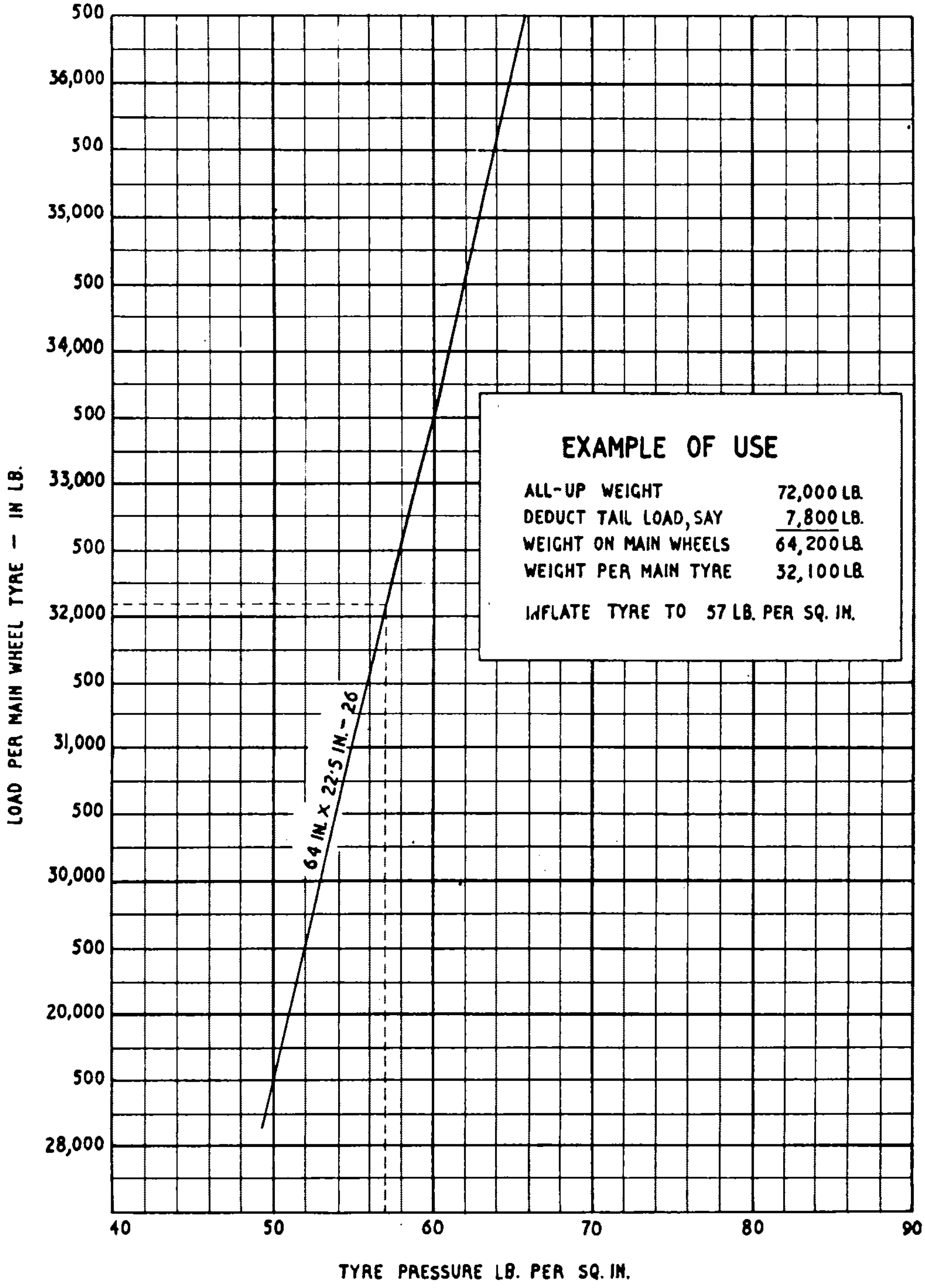
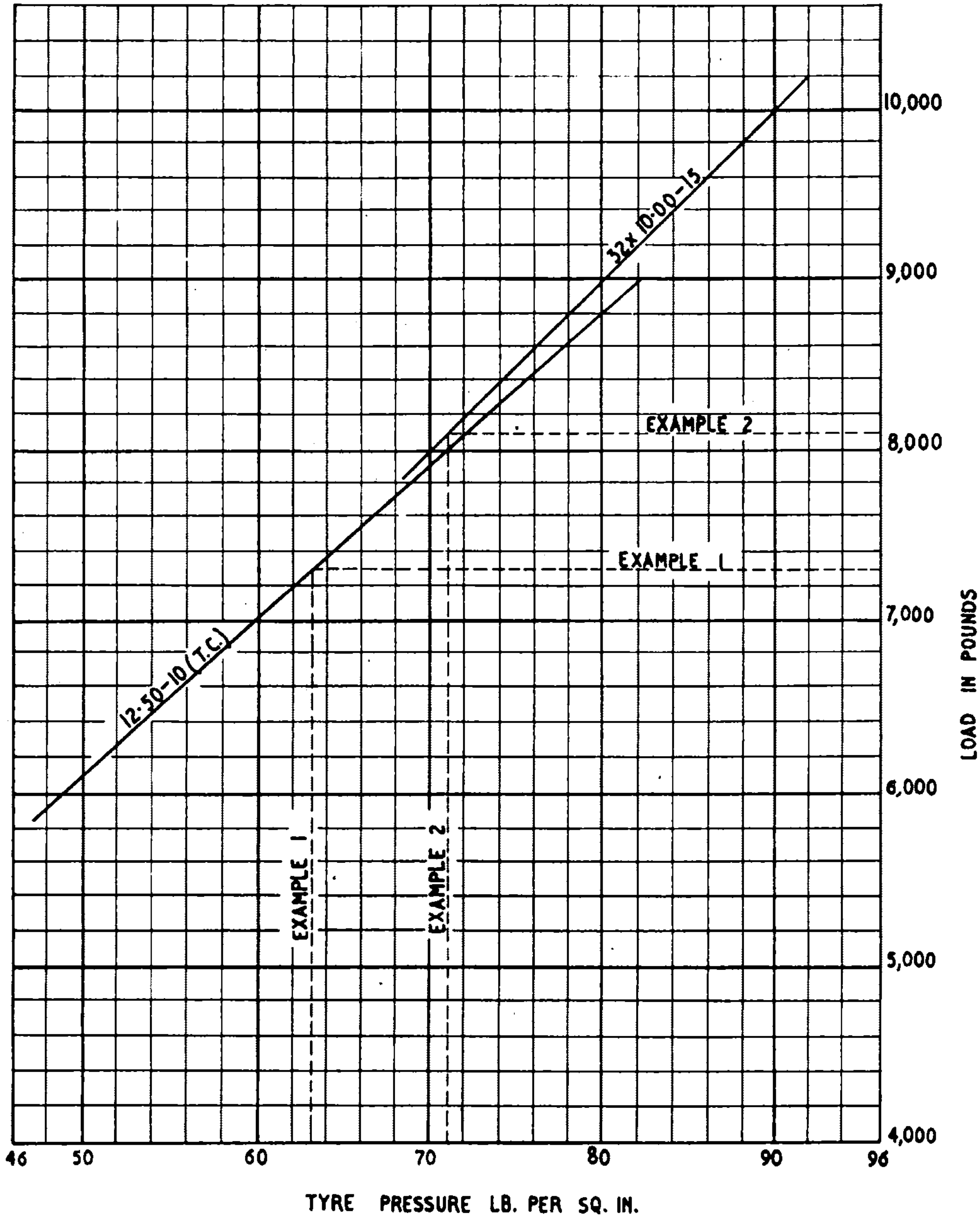


FIG. 23B **MAIN WHEEL TYRE INFLATION** FIG. 23B

PP4297 M /G4252 2/46 1050 C & P Gp. 959 (4)



EXAMPLES OF USE

1. TWIN-CONTACT TYRE : NX. R.30 (12·50 IN.– 10 IN.)
   TAIL WHEEL LOAD 7,300 LB., TYRE PRESSURE 63 LB. PER SQ. IN.
2. NORMAL SECTION TYRE: FF, ER 17-N (32 IN. x 10·00 IN.- 15 IN.)
   TAIL WHEEL LOAD 8,100 LB., TYRE PRESS. 71 LB. PER SQ. IN.

FIG. 23C — TAIL WHEEL TYRE INFLATION — FIG. 23C

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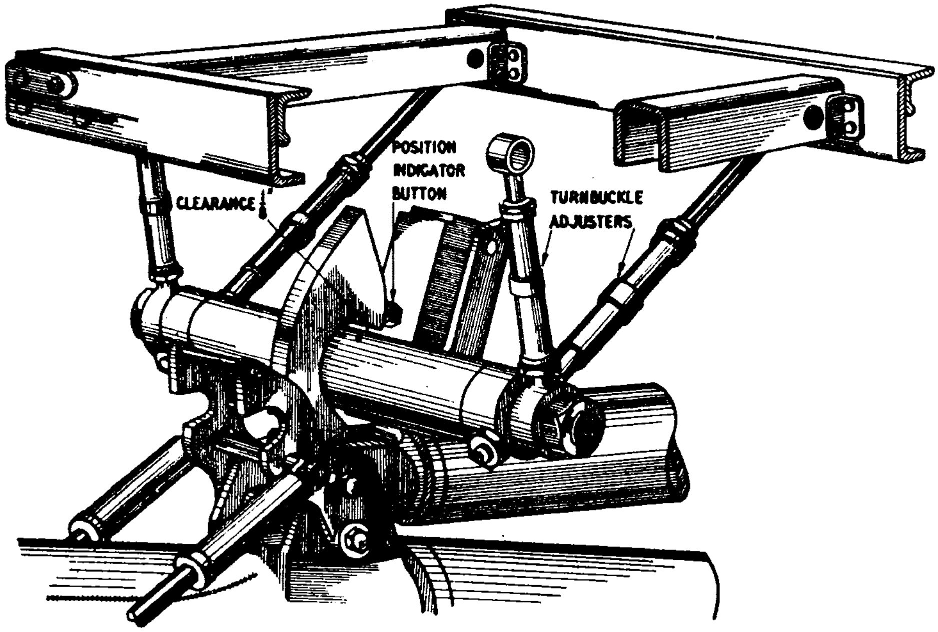
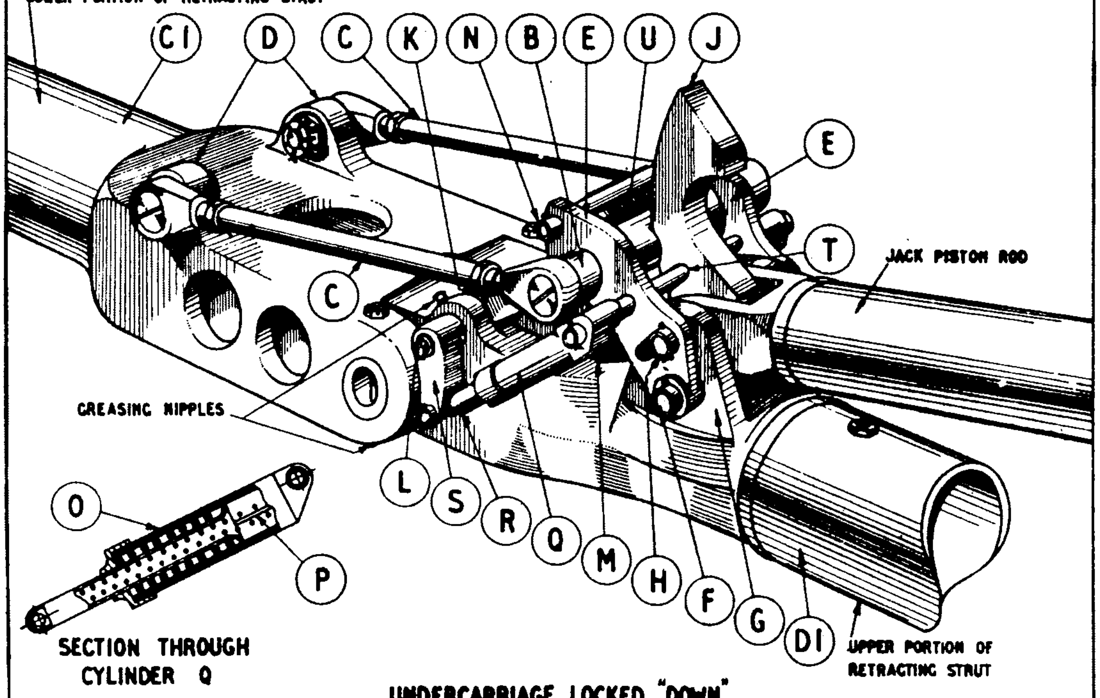


UNDERCARRIAGE LOCKED "UP"



SECTION THROUGH CYLINDER Q

UNDERCARRIAGE LOCKED "DOWN"

FIG. 24 RETRACTING STRUT LOCKING MECHANISM FIG. 24

REPRINT PP3776 M /G830 6/45 1050 C & P Gp. 959(4)

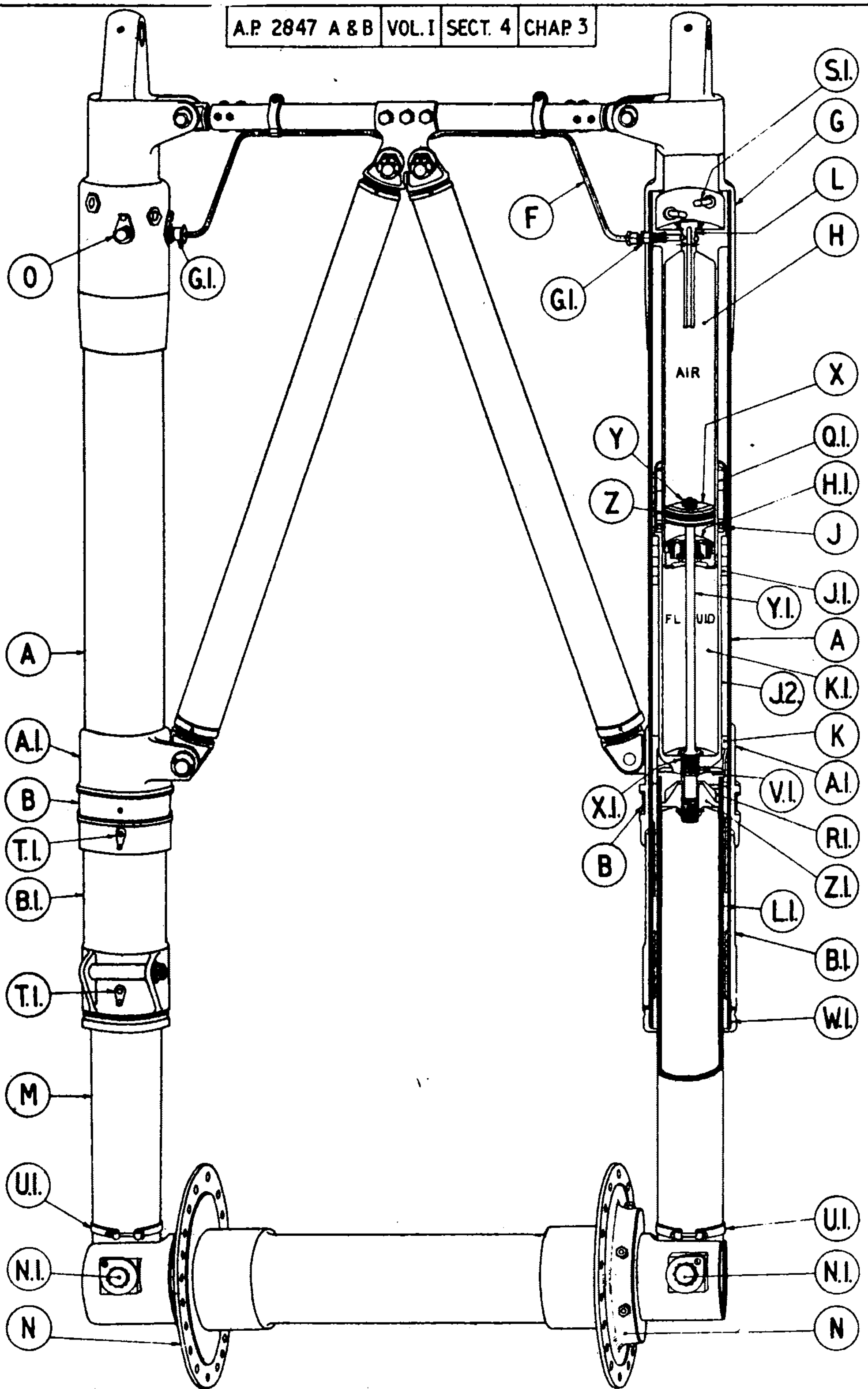


FIG. 25 MAIN WHEEL SHOCK-ABSORBER STRUTS FIG. 25

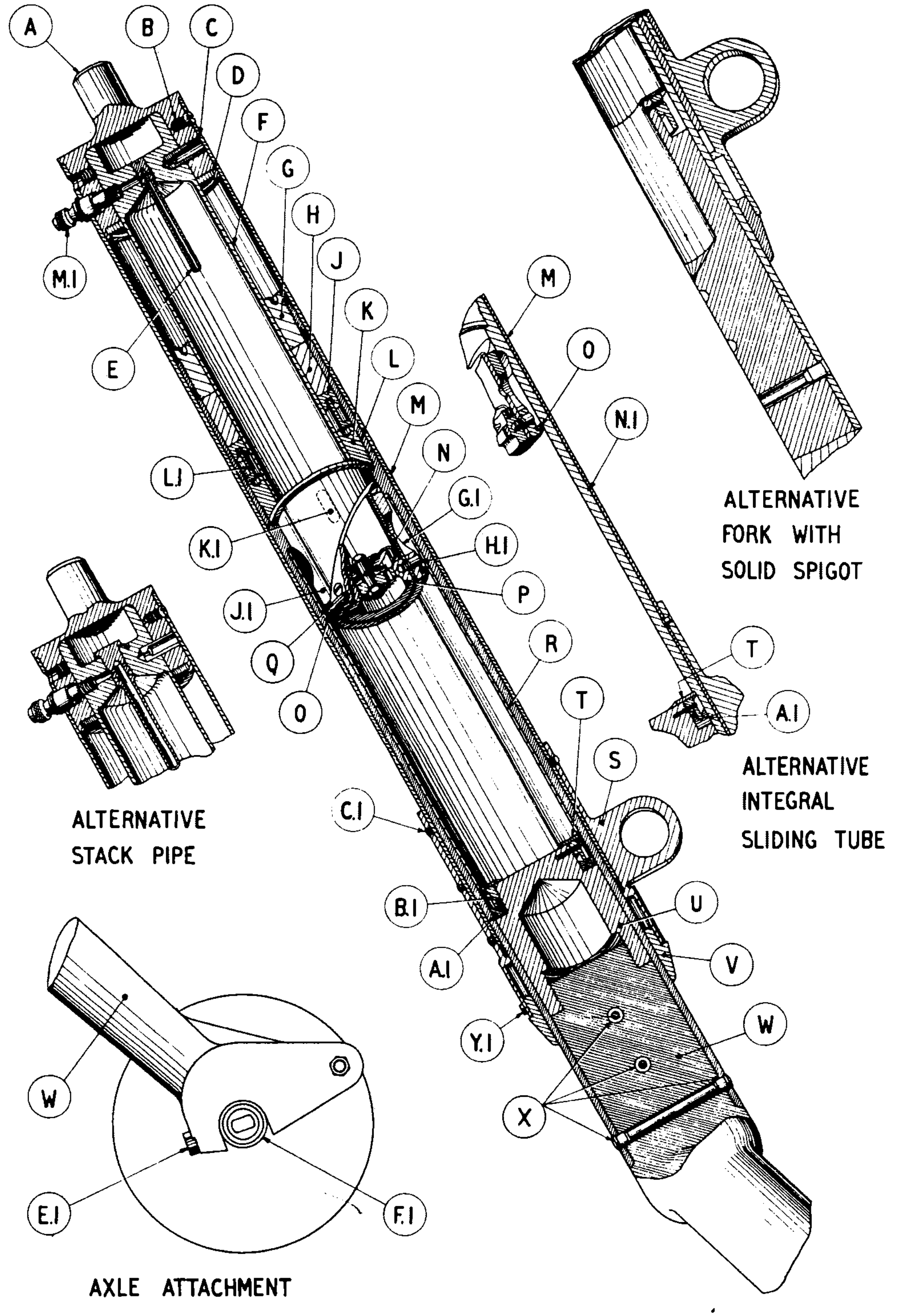


FIG. 26 TAIL WHEEL SHOCK—ABSORBER STRUT FIG. 26

PP3776 M /G830 6/45 1050 C & P Gp. 959 (4)

5

• REMOVAL, ASSEMBLY AND DISMANTLING OPERATIONS

(11065) T14574/G2588 1050 11/44 M20691 C & P 752

SECTION 5

REMOVAL, ASSEMBLY AND DISMANTLING OPERATIONS

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

* *To be issued later*

Introduction

1. This Section consists mainly of illustrations which give, pictorially, a guide to the best methods of removing and assembling the principal components of the aircraft. Removal instructions only are given in most instances, as re-assembly is usually a reversal of the removal operations. Special notes on assembly are included where required, and general instructions in the following paragraphs should always be borne in mind.

2. The numerical sequence of the operations illustrated indicates the recommended order for dismantling, although in some cases it will be obvious that it is not essential to adhere rigidly to the numerical order. Ringed or bracketed key numbers (with the exceptions of the Roman numerals in the key to fig. 1) have a corresponding number in the relevant illustration; key numbers not ringed or bracketed do not have a corresponding number in the relevant illustration, and concern either items regarding which it is necessary to refer to another part of the book (a reference being given), or items which it is not practicable to illustrate.

3. Details of bonding, locking and sealing should be carefully noted when components are dismantled, to enable them to be correctly restored on re-assembly, in addition to the operations illustrated. A description of bonding will be found in Sect. 6.

4. The positions of the trestles under each main component are shown in fig. 3. If the aircraft is to be jacked for assembling a minor component, the method described in Sect. 4, Chap. 3 may be used.

WARNING—

Before carrying out any dismantling operations on the main planes the cable cutters must be disarmed and made safe.

Assembly of complete aircraft

5. The sequence of assembling a complete aircraft is as follows:—

(i) Undercarriage main wheel units to fuselage intermediate centre section (this includes the main plane centre section).

(ii) Fuselage nose to fuselage front centre section (these are rarely separated).

(iii) Rear fuselage, with tail wheel strut, to fuselage rear centre section.

(iv) Rear fuselage assembly to intermediate centre section.

(v) Front fuselage assembly to intermediate centre section.

(vi) Tail plane to fuselage.

(vii) Fins, rudders and elevators to tail plane.

(viii) Centre plane trailing edge portions, including flaps, to centre section.

(ix) Intermediate planes (without trailing edge) to centre plane.

(x) Intermediate plane trailing edge sections, including flaps, to intermediate planes.

(xi) Outer plane sections to intermediate planes.

(xii) Ailerons to main plane.

(xiii) Engine sub-frames and nacelle fairings to main plane.

(xiv) Power plants to engine sub-frame.

6. The main components and the transport joints are illustrated in fig. 1, and notes on the fuselage transport joints are given on the facing page. Trestles and slings are shown in fig. 3.

Dismantling

7. The complete dismantling of an aircraft for packing and transport is done in the reverse order to that given in para. 5. The packing sizes for the components are given in fig. 2.

Removal notes

8. ***Pop-riveted panels.***—Pop rivets securing assembly panels must be drilled out before the panels can be removed. Drill, Pt. No. 1/Z.1473 (Stores Ref. 26EA/3880) should be used for this purpose; it is fitted with a screwdriver end which prevents the special pop rivet from revolving with the drill. The mandrel heads should be punched out of the rivets before the latter are drilled. When replacing the assembly panels they should be riveted with the same type of rivets that were removed. Pop-riveting equipment, Pt. No. 1/Z.1474 (Stores Ref. 26EA/3881) is provided for this purpose. Fig. 4 shows the lay-out of the assembly panels and the types of rivets used.

9. ***Trimming tab cables.***—When disconnecting a cable, a weight should be attached to the end before releasing the cable to prevent it unwinding from the cable drum.

Weatherproofing

10. It is important to ensure that all transport joints are sealed on re-assembly. For details and procedure *see* fig. 5.

This leaf issued with A.L. No. 21, May 1945

TO REMOVE:-	SEE
(1) FUSELAGE NOSE	
(2) FUSELAGE FRONT CENTRE SECTION	KEY TO FIG. 1
(3) CENTRE SECTION FUSELAGE AND MAIN PLANE	
(4) FUSELAGE REAR CENTRE SECTION	KEY TO FIG. 1
(5) FUSELAGE REAR SECTION	KEY TO FIG. 1
(6) NOSE GUN TURRET	SECT. 12
7 DORSAL GUN TURRET (NOT SHOWN.)	SECT. 12
(8) TAIL GUN TURRET	SECT. 12
(9) BOMB DOORS	FIG. 42
(10) POWER PLANTS	FIG. 10
(11) ENGINE SUB-FRAMES INBOARD	FIG. 18 & 19
(12) UNDERCARRIAGE BEAMS	FIG. 22 & 23
(13) MAIN WHEEL DOORS AND VALANCES	FIG. 21
(14) MAIN WHEEL UNITS	FIG. 20
(15) FLAPS - INBOARD	FIG. 26
(16) TRAILING EDGE - CENTRE SECTION	FIG. 28
(17) ENGINE SUB-FRAMES OUTBOARD.	FIG. 17
(18) TRAILING EDGE-INTERMEDIATE PLANE	FIG. 27
(19) FLAPS - OUTBOARD	FIG. 26
(20) INTERMEDIATE PLANES	FIG. 30
(21) AILERONS	FIG. 24 & 25
(22) OUTER PLANES	FIG. 30
(23) ELEVATORS	FIG. 39
(24) RUDDERS	FIG. 37
(25) FINS	FIG. 38
(26) TAIL PLANE	FIG. 40
(27) TAIL WHEEL	FIG. 41

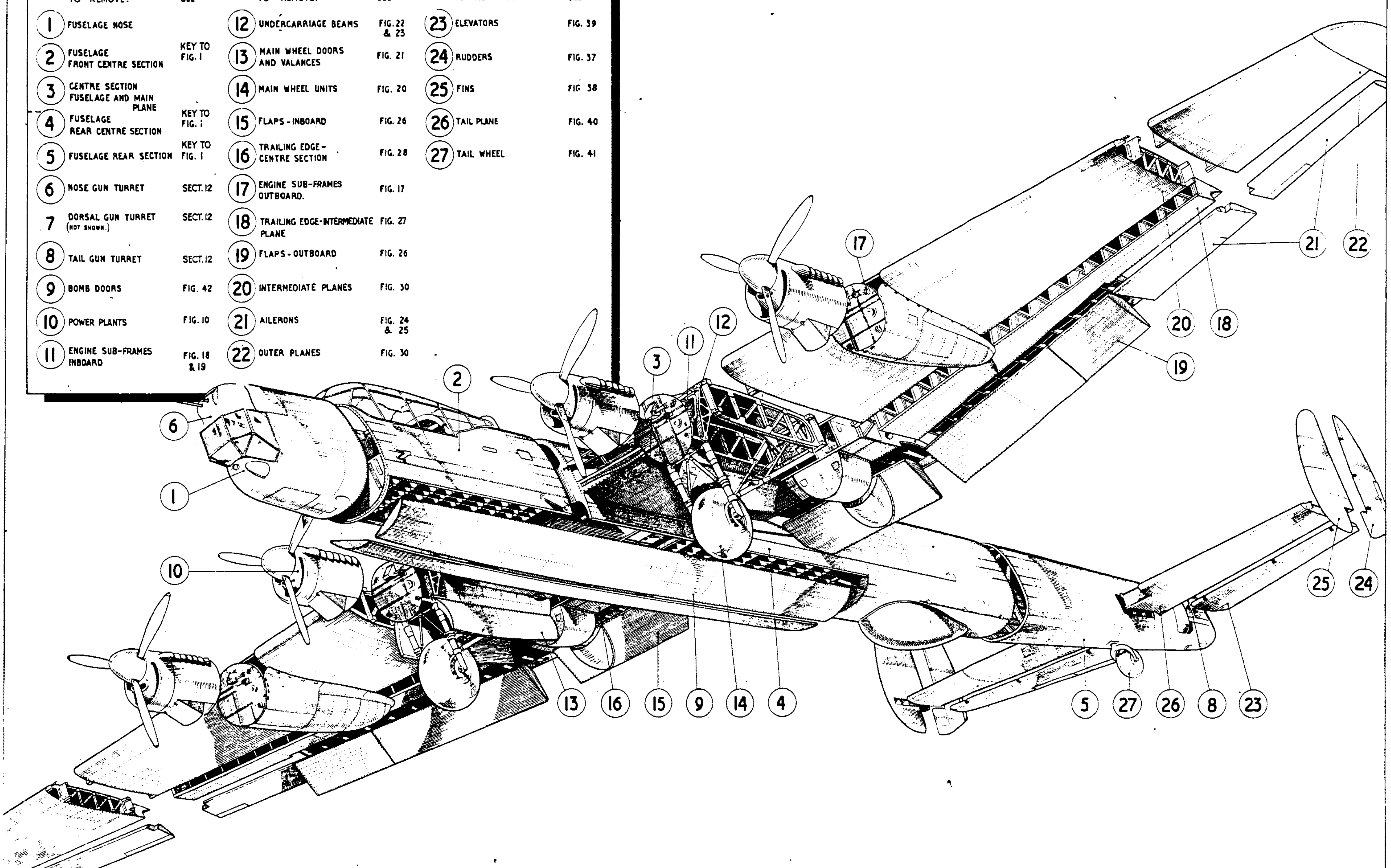


FIG. 1 SECTIONS OF AIRCRAFT FIG. 1

PP3788 M /G847 6/45 1150 C & P Gp. 959 (4)

KEY TO FIG. I

(2) Fusealge front centre section:—

(i) Disconnect rudder and elevator push-pull rods between formers 4 and 5. This necessitates removing socket fork ends from rods.
(ii) Disconnect aileron cables between formers 5 and 6.
(iii) Disconnect all hydraulic, emergency air, vacuum and nitrogen pipes at joint nearest to front spar.
(iv) Disconnect emergency air remote control at bottle aft of front spar.
(v) Disconnect all engine controls and fuel cock tie rods at sprocket boxes on front spar and withdraw through fuselage.
(vi) Disconnect boost cut-out cables at two turnbuckles at front spar and withdraw cables.
(vii) Disconnect cabin heating pipes at joints just outside fuselage on front spar, and at front spar in fuselage, disconnect also in bomb compartment between formers 6 and 7, starboard side, and remove pipes.
(viii) Disconnect all electrical conduits at panel on starboard side between formers 3 and 5 and where necessary withdraw through sides of fuselage.
(ix) Disconnect D.R. compass cables between stringers 2 and 3 at former 6.
(x) Disconnect all other electrical cables at nearest terminal block or junction box.
(xi) Disconnect oxygen pipes between formers 5 and 6 in bomb compartment.
(xii) Disconnect A.S.I. static line between formers 5 and 6, port and starboard sides of bomb compartment.
(xiii) Disconnect vacuum pipe to scanner in rear centre section between formers 4 and 5 in bomb compartment.
(xiv) Disconnect bomb fuzing cable under centre section floor.
(xv) Disconnect aileron trimmer cables at slide under centre-section floor in bomb curtain, starboard side.
(xvi) Disconnect bomb release cables at junction box at front end of bomb compartment, remove troughs and coil cables.
(xvii) Disconnect hydraulic pipes (flap, bomb door, rear turret (F.N. only) and jettison) between formers 5 and 6 in bomb compartment (port side).
(xviii) Disconnect rudder and elevator trimming tab cables inside rear fuselage, release fairleads and withdraw.
(xix) Disconnect glider release cable between formers D and C in bomb compartment.
(xx) Disconnect all pipes at joints on port and starboard spars outside fuselage.
(xxi) Disconnect boost pipes on spars port and starboard, and at joints inside fuselage, disconnect fairleads and withdraw pipes.
(xxii) Disconnect cabin heater by-pass from duct on front spar, starboard side.
(xxiii) Disconnect fuel cross-feed pipe at cock inside cabin, remove fairleads and withdraw pipe.
(xxiv) Remove bolts securing front centre section to centre section.

(4) Fuselage rear centre section:—

(i) Disconnect rudder and elevator push-pull rods between formers 13 and 14 on port side of fuselage.
(ii) Disconnect aileron push-pull rods at rocking lever on rear spar.
(iii) Disconnect all electrical cables at nearest junction box or socket.
(iv) Disconnect D.R. compass cables at former 12.
(v) Disconnect all piped services between formers 11 and 13 on port side of bomb compartment.
(vi) Disconnect turret heater pipes between formers 13 and 14, starboard side of bomb compartment.
(vii) Disconnect ground starter cables between formers 17 and 18, starboard side of bomb compartment, and withdraw through fairleads.
(viii) Disconnect A.S.I. static vent pipe between formers 11 and 12 on starboard side of bomb compartment.
(ix) Disconnect bomb release cables at junction box at front end of bomb compartment, remove troughs and coil cables.
(x) Disconnect vacuum pipe between formers 11 and 12 on starboard side of bomb compartment.
(xi) Remove bolts securing rear centre section to centre section.

(5) Fuselage rear section:—

(i) Disconnect rear turret hydraulic pipes between formers 27 and 28 (applies only to aircraft equipped with F.N. tail turret).
(ii) Disconnect ammunition tracks at former 28.
(iii) Disconnect trimming tab cables opposite fuselage and withdraw through fairleads.
(iv) Disconnect rudder and elevator push-pull rods between formers 27 and 28.
(v) Remove handrail clip at former 27.
(vi) Disconnect intercommunication and fuselage lighting cables at terminal block between formers 27 and 28.
(vii) Disconnect electrical cables at junction box between formers 41 and 42, remove clips and coil cables.
(viii) Disconnect dinghy release.
(ix) Disconnect turret heater pipe.
(x) Remove angle brackets between stringers 10 and 12 at former 27.
(xi) Remove bolts securing rear fuselage to rear centre section.

P7929 M /G846 6/45 8 C&P Gp. 1

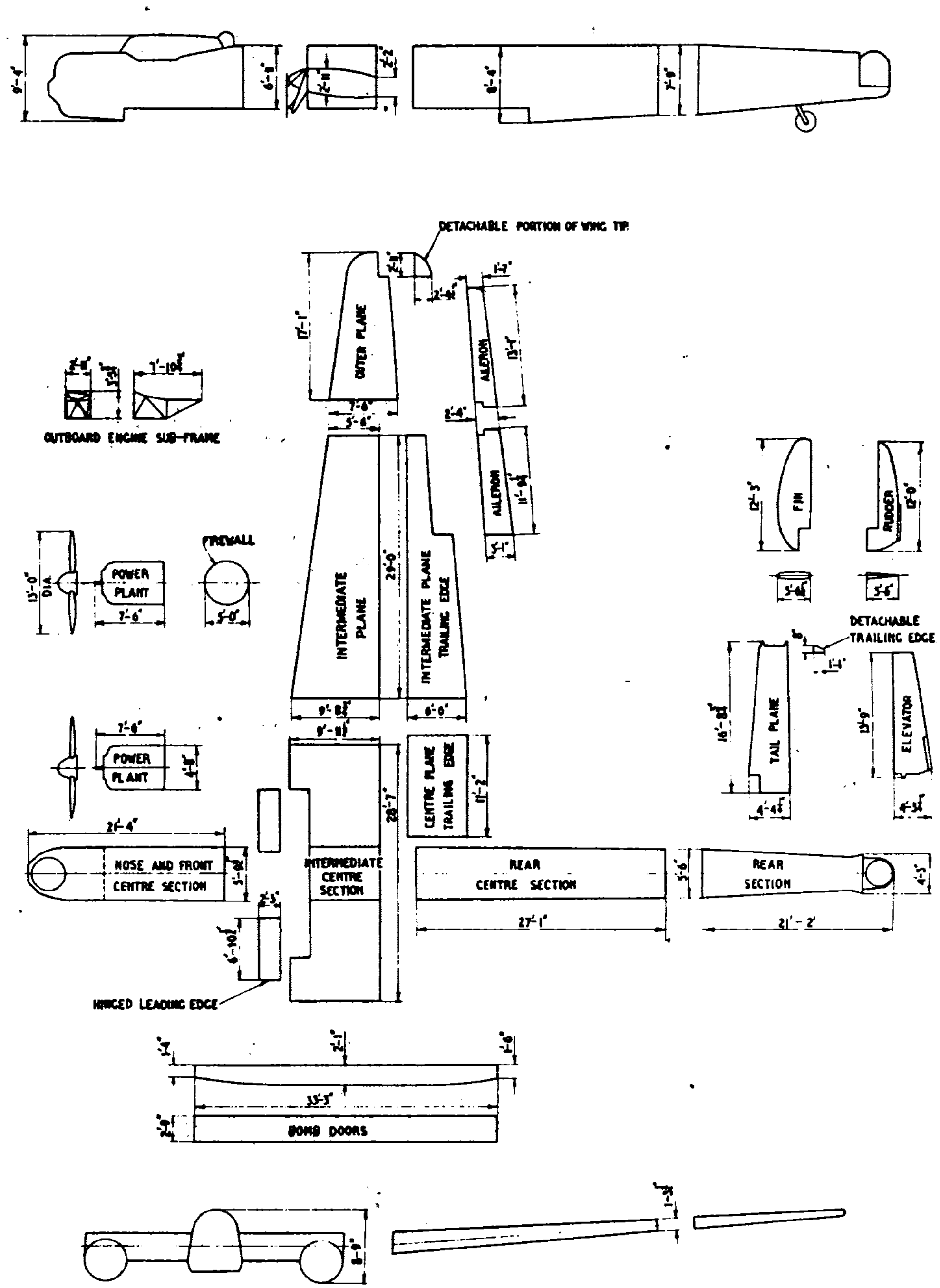
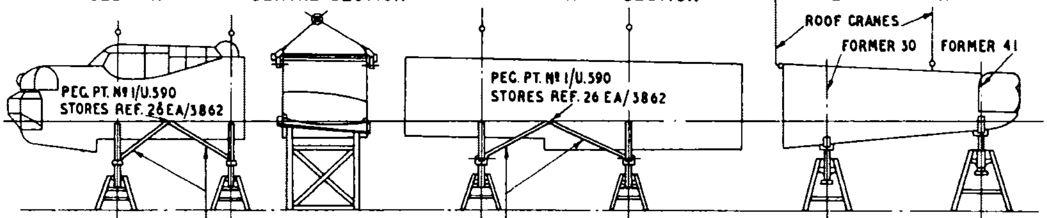


FIG. 2 DIAGRAM OF TRANSPORT SECTIONS FIG. 2

NOSE & FRONT CENTRE SECTION | INTERMEDIATE CENTRE SECTION | REAR CENTRE SECTION | REAR SECTION



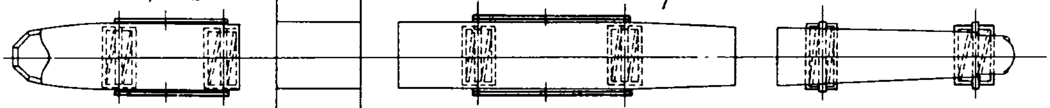
U.J.T. No. 6
FRAME PT. No. 1/U.565
STORES REF. 26 EA/3845
SLING PT. Nº 1/U.568
STORES REF. 26 EA/3847
SUPPORT TUBES
FORWARD AND REAR
PART Nº 1/U.585 & 1/U 586
STORES REF. 26EA/3858
AND 26EA/3859

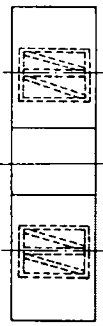
U.J.T. No. 10 A
BEAM PT. Nº 1/U.589
STORES REF. 26 EA/3863
SLING PT. Nº 1/U.552
STORES REF. 26 EA/4256

U.J.T. Nº 6
FRAME PT. Nº 1/U.563
STORES REF. 26 EA/3845
SLING PT. Nº 1/U.568
STORES REF. 26 EA/3847
SUPPORT TUBES
FORWARD AND REAR
PART Nº 1/U 587 AND 1/U 588
STORES REF. 26EA/3860
AND 26EA/3861

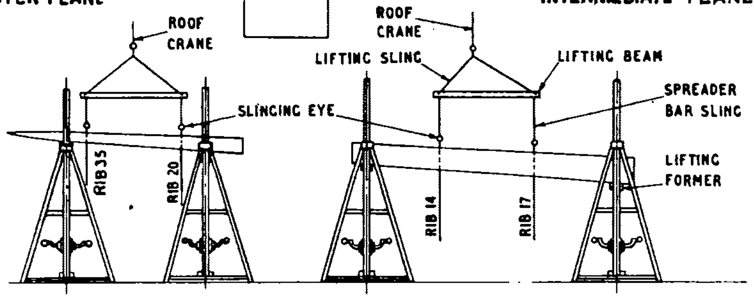
U.J.T. Nº 8
BEAM
PT. Nº 1/U.557
STORES REF.
26 EA/3843
SLINGING-PLATE
PT. Nº 1/U.560
STORES REF.
26 EA/3846

U.J.T. Nº 10
BEAM
PT. Nº 1/U.559
STORES REF.
26 EA/3844
SLINGING EYE BOLT
PT. Nº 1/U.549
STORES REF.
26 EA/3386





OUTER PLANE | INTERMEDIATE PLANE

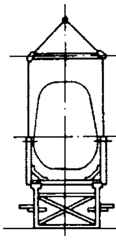


A.M. GANTRY
STORES REF.
4L/1245

A.M. GANTRY
STORES REF.
4L/1245

A.M. GANTRY
STORES REF.
4L/1245

A.M. GANTRY
STORES REF.
4L/1245



TYPICAL FRAME AND SLING MOUNTED ON TRESTLE

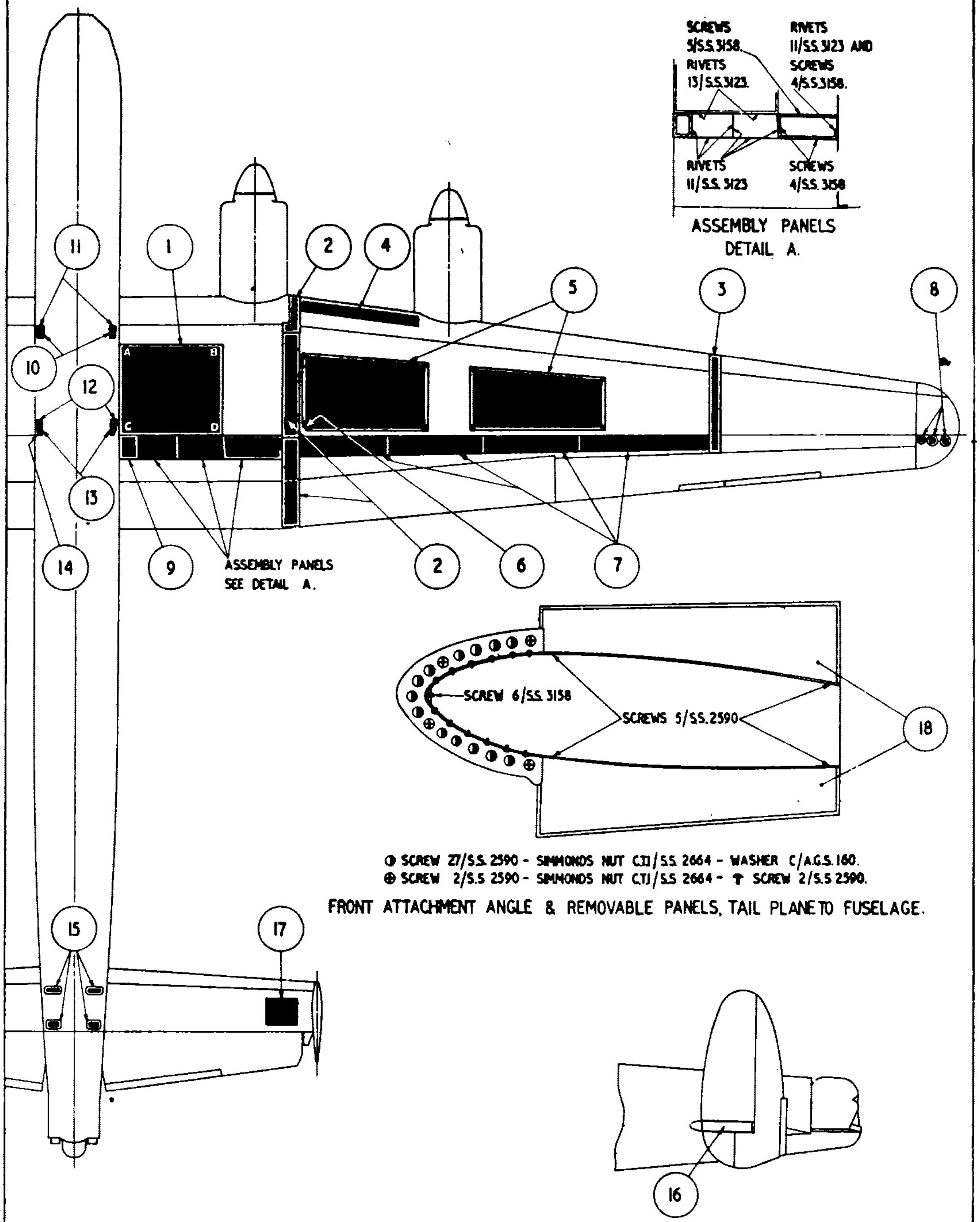
LIFTING SLING
(COMPRISING
SLING, SPREADER
BAR AND SLINGS)
PART Nº 2U/760
STORES REF. 26EA/32089
SLINGING EYE BOLT PT. Nº 4/F4033
STORES REF. 26 EA/4272
LIFTING FORMER - PORT
AT RIB 36 PT. Nº 1/U.767
STORES REF. 26EA/32113
AT RIB 21 PT. Nº 1/U.766
STORES REF. 26 EA/32111
LIFTING FORMER - STARBOARD
AT RIB 36 PT. Nº 2/U.767
STORES REF. 26 EA/32114
AT RIB 21 PT. Nº 2/U.766
STORES REF. 26 EA/32112

LIFTING SLING
(COMPRISING
SLING, SPREADER
BAR AND SLINGS)
PART Nº 1 U/760
STORES REF. 26EA/32088
SLINGING EYE BOLT PT. Nº 4/F4033
STORES REF 26 EA/4272
LIFTING FORMER - PORT
AT RIB 16 PT. Nº 1/U.765
STORES REF. 26 EA/32109
AT RIB 3 PT. Nº 1/U.739
STORES REF. 26 EA/32091
LIFTING FORMER - STARBOARD
AT RIB 16 PT. Nº 2/U.765
STORES REF. 26 EA/32110
AT RIB 3 PT. Nº 2/U.739
STORES REF. 26EA/32108

THE JACKING SHOWN ON THIS DIAGRAM IS ARRANGED AT A HEIGHT THAT WILL ENABLE THE 15-TON HYDRAULIC JACK. (SEE SECT. 4 CHAP. 3 FIG. 1.) TO BE PLACED UNDER THE JACKING PADS WHEN IN THE FULLY RETRACTED POSITION.

FIG. 3 — SLINGING & JACKING SECTIONS OF AIRCRAFT — FIG. 3

PP3454 M /G4037 1/45 1050 C&P Gp. 959 (4)



UNLESS OTHERWISE STATED ALL PANELS ARE ON UNDER SURFACE.

■ DENOTES PANEL IS ATTACHED BY SCREWS.

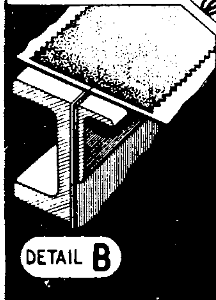
■ DENOTES PANEL IS ATTACHED BY RIVETS.

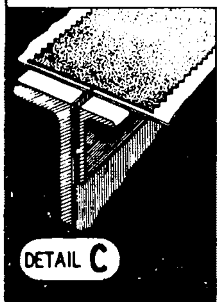
SEE FACING PAGE.

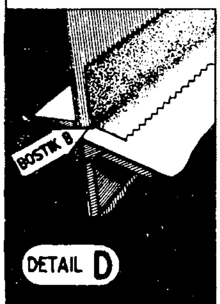
ASSEMBLY PANELS

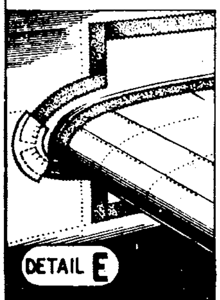
KEY TO FIG. 4

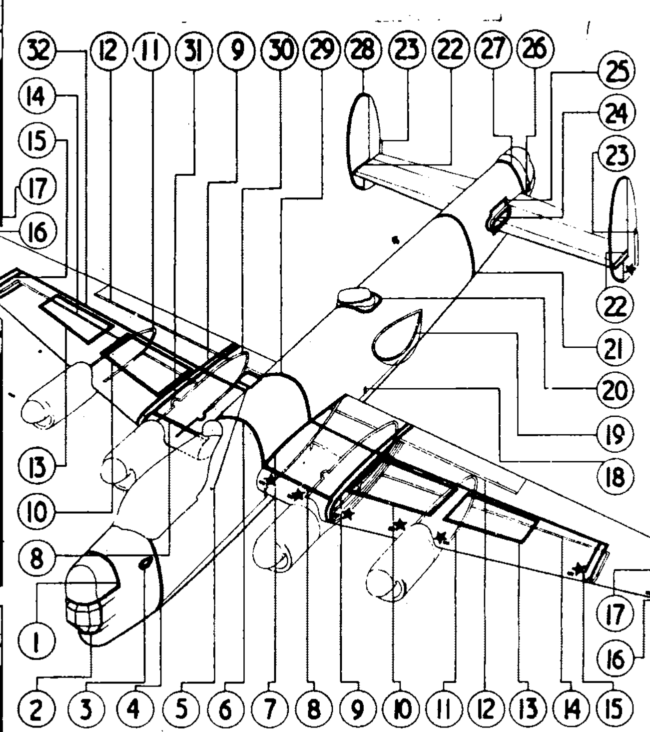
Item	Description	Access	Screws	Rivets	Bolts
1	Assembly panel—	No. 1 fuel tank			
	Excluding corners — Forward edge		231/D.2902		
	Excluding corners — Aft edge		230/D.2902		
	Excluding corners — Inboard edge		1/S.S.3753		
	Excluding corners — Outboard edge		1/S.S.3754		
	Corners — Forward inboard — Front		36/D.4205 (8 off)		
	Corners — Forward inboard — Side		36/D.4205 (8 off)		
	Corners — Forward outboard — Front		36/D.4205 (8 off)		
	Corners — Forward outboard — Side		35/D.4205 (8 off)		
	Corners — Aft inboard — Rear		36/D.4205 (8 off)		
	Corners — Aft inboard — Side		36/D.4205 (7 off)		
	Corners — Aft outboard — Rear (nearest to corner)		35/D.4205 (3 off)		
	Corners — Aft outboard — Rear (remainder)		36/D.4205 (5 off)		
	Corners — Aft outboard — Side		35/D.4205 (7 off)		
	Fit screws in panel until $\frac{1}{4}$ in.—$\frac{3}{8}$ in. proud, apply Heldite to exposed shanks and underside of heads, and tighten				
2	Covers, top and bottom surface	Centre—intermediate plane joint	5/S.S.3158		
3	Covers— Top surface Bottom surface	Intermediate—outer plane joint		 7/S.S.3123	 A.S.1885/1.C
4	Assembly panel— Forward edge Remainder	Engine controls		 7/S.S.3123 6/S.S.3123	
5	Assembly panels, top surface— Panels to frames At each corner except where otherwise indicated	No. 2 and 3 fuel tanks			 A.S.1882/3.E A.S.1882/4.3 (4 off)
6	At corner indicated				A.S.1882/4.3 (8 off)
7	Assembly panels	Trailing edge intermediate plane joint		11/S.S.3123	
8	Access doors	Formation lamp terminals and tip assembly joint	4/S.S.3158		
9	Access panel— Except in transport spar In transport spar	Centre plane—trailing edge joint	 4/S.S.3158 5/S.S.3158		
10	Assembly panels— In cover, skin and intercostal	Transport joint bolts		 10/S.S.3222	
11	Panel and floor skin			9/S.S.3222	
12	Attachment strip and panel			13/S.S.3222	
13	Intercostal, floor skin and panel			10/S.S.3222	
14	Floor skin and panel			9/S.S.3222	
15	Assembly panels, top skin	Control joints	2/S.S.2590		
16	Assembly panel— Panel to ribs Panel to front fin post Panel to rear fin post	Fin—tail plane joint	 A.S./159/408	 10/S.S.3222 11/S.S.3222	
17	Assembly panel	Rudder control lever		10/S.S.3222	
18	Panels, except where otherwise indicated	Tail plane—fuselage joint	26/S.S.2590		

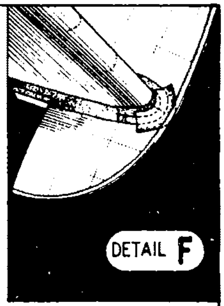


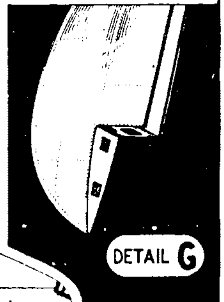


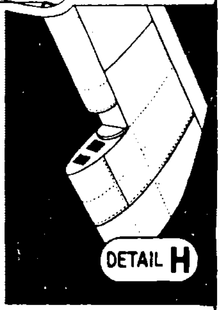


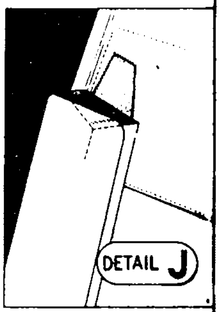


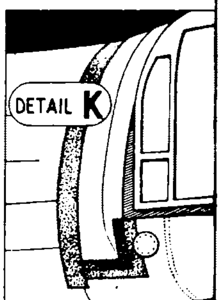












1. 3" TAPE ROUND TURRET DRAUGHTSCREEN
2. 3" TAPE AT AIR BOMBER'S WINDOW
3. MADAPOLLAM PATCH ROUND AERIAL
4. 3" TAPE ROUND TRANSPORT JOINT AT FORMER E. INSERT A BEAD OF BOSTIK B BEFORE BOLTING UP. SEE DETAIL A
5. 3" TAPE ROUND DINGHY STOWAGE COVER
6. 4" TAPE ROUND TRANSPORT JOINT AT FORMER 6. INSERT A BEAD OF BOSTIK B BEFORE BOLTING UP. SEE DETAIL A
7. 4" TAPE AT WING ROOT. INSERT A BEAD OF BOSTIK 'B' BEFORE TAPING. SEE DETAIL D
8. 5" TAPE OVER JOINT AT FRONT SPAR. CUT TAPE AT END OF HINGED LEADING EDGE
9. TAPES ROUND WING GAP FAIRING 3" TAPES ON TOP TO FRONT SPAR 4" TAPES OVER NOSE AND UNDERSIDE
10. 5" TAPES AT No. 2 TANK ACCESS PANEL
11. 4" TAPES ROUND OUTBOARD NACELLE
12. 5" TAPES OVER FLAP HINGE
13. 5" TAPES AT No. 3 TANK ACCESS PANEL
14. 3" TAPES AT UNDERSIDE OF REAR SPAR SEE DETAIL B FOR INNER SECTION. SEE DETAIL C FOR OUTER SECTION
15. 4" TAPES OVER OUTER PLANE JOINT FAIRING
16. 2" TAPE AT NAVIGATION LAMP WINDOW
17. 3" TAPE ROUND FORMATION-KEEPING LAMPS
18. 3" TAPES ON BOMB DOOR CURTAIN JOINTS
19. CUPOLA-TO-FUSELAGE JOINT. TWO MADAPOLLAM PATCHES AT FRONT AND 3" TAPE AT REAR
20. 3" TAPE AT DORSAL TURRET FAIRING
21. 3" TAPE ROUND TRANSPORT JOINT AT FORMER 27. INSERT A BEAD OF BOSTIK B BEFORE BOLTING UP. SEE DETAIL A
22. JOINT TAILPLANE TO FIN. 4" TAPE FROM FRONT TO REAR SPAR TOP AND BOTTOM. DOUBLE 3" TAPES OVER LEADING EDGE AND MADAPOLLAM PATCH AT FRONT SEE DETAIL F
23. SPECIAL PATCHES OVER TOOLING HOLES. SEE DETAIL J
24. 4" TAPE ROUND TAILPLANE ROOT FAIRING. SEE DETAIL E
25. 4" TAPE ON FUSELAGE ROUND TAILPLANE ROOT FAIRING. MADAPOLLAM PATCH AT FRONT. SEE DETAIL E
26. 5" TAPE AT BASE OF TURRET DEFLECTOR. SEE DETAIL K
27. 5" TAPE ROUND JOINT AT TURRET DEFLECTOR AND FUSELAGE. SEE DETAIL K
28. 3" TAPE ROUND LEADING EDGE OF FIN. SEE DETAIL F
29. 4" TAPE AT TRANSPORT JOINT FORMER 12. SEE DETAIL A
30. 4" TAPE ROUND INBOARD NACELLE VALANCE.
31. MADAPOLLAM PATCH 3" WIDE ROUND BLISTER BOTH SIDES OF INBOARD NACELLES
32. 3" TAPE OVER REAR SPAR. SEE DETAIL B FOR CENTRE SECTION, SEE DETAIL C FOR OUTER SECTION

★ SPECIAL COVERS OVER B.B.P. 64/F.4112. ALSO PATCHES OVER TOOLING HOLES. SEE DETAILS G AND H

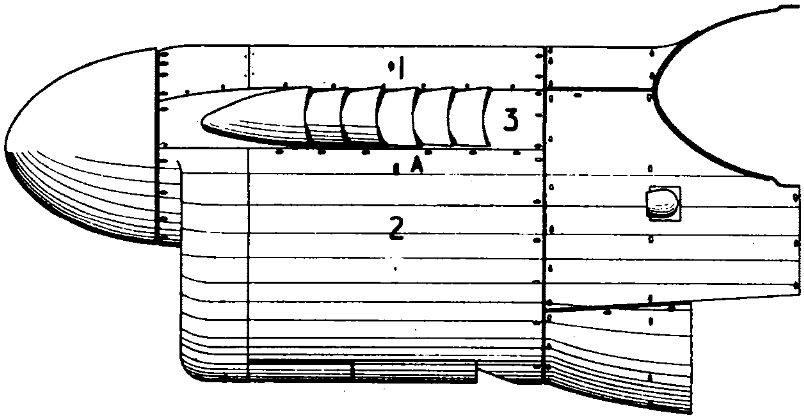
ALL TAPES AND PATCHES (MADAPOLLAM D.T.D. 343) TO HAVE SERRATED EDGES.
METHOD OF TAPING:- APPLY VERY THIN COAT CERRIC D. 3639 ADHESIVE, (STORES REF 33C/683) POSITION TAPE OR PATCH. BRUSH THROUGH WITH EVEN COAT OF ADHESIVE. ALLOW TO DRY FOR 5 MINUTES. APPLY FINAL COAT, ALLOW TO DRY FOR 15 MINUTES AND RECAMOUFLAGE.

WEATHERPROOFING

This leaf issued with A.L. No. 21 , May 1945

COWLINGS FORWARD OF COWLING RING

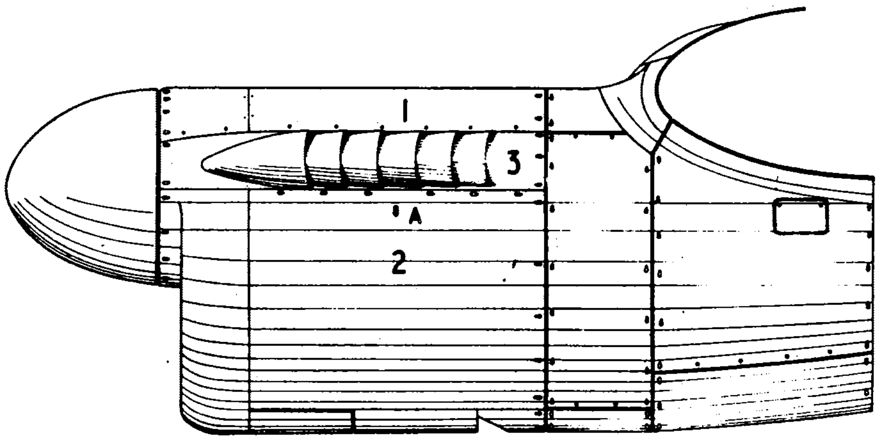
TO DISENGAGE COWLINGS RELEASE DZUS FASTENERS. ON PANELS MARKED 2 ALSO INSERT HOOK ON TOP RUNG OF SERVICE LADDER AT A AND PUSH UP TO RELEASE LOCKING CATCH. PANELS MARKED 1 AND 2 ARE HINGED AND NOT NORMALLY REMOVED. THESE PANELS MUST BE SWUNG OPEN BEFORE EXHAUST PANEL MARKED 3 CAN BE REMOVED.



INBOARD ENGINE

FAIRINGS AFT OF COWLING RING

THESE ARE DISENGAGED BY RELEASING THE DZUS FASTENERS AND MAY BE REMOVED IN ANY ORDER.



OUTBOARD ENGINE

FIG. 6 ENGINE & RADIATOR COWLINGS FIG. 6

PP3788 M /G847 6/45 1050 C & P Gp. 959 (4)

KEY TO FIG. 7

General note

The power plant-changing gantry, Part No. 1/U.746 (Stores Ref. 26EA/32084) is provided for use when a crane is not available. The aircraft must be in the tail-down position. The rear cowling panels must first be removed and a wooden platform, Part No. 1/U.743 (Stores Ref. 26EA/32085), placed in position. The instructions on the labels on the gantry component parts, as well as those given below, must be carefully followed.

Erecting gantry at inboard engine

(1) Remove two plugs from holes in engine rib top booms just forward of rear spar and screw in eyebolts, Part No. 2/U.746.

(2) Through holes in hinged fairing panel (which need not be lifted) remove plugs from top of undercarriage support beams and fit two ball socket brackets, Part No. 11/U.634, using bolts, Part No. 6A1 8L.

(3) Attach rear side members, Part No. 1/U.749, to eyebolts and to operating screw, Part No. 1/U.735.

Note.—Top joint, Part No. 1/U.646, is permanently attached to operating screw.

(4) Fit ball ends of rear side struts, Part No. 1/U.750 and 2/U.750, in ball socket brackets, raise operating screw and secure side struts at top joint. Screw down caps on to ball socket brackets.

(5) Assemble hook, Part No. 6/U.634, link pin, Part No. 7/U.634, and reversible nuts, Part No. 8/U.634, to links, Part No. 3/U.634, and attach links to forward end of top strut, Part No. 1/U.648.

Note.—The recessed ends of the reversible nuts should be on the inner side.

(6) Attach front side struts, Part No. 1/U.751 and 2/U.751, to forward end of top strut.

(7) Place ball ends of front side struts in sockets on rear side struts, and screw down caps.

(8) Raise top strut and secure at top joint with quick-release pin.

For propeller removal

(9) Remove reversible nuts from pin securing hook, fit extension members, Part No. 1/U.752 and 1/U.753 (Stores Ref. 26EA/32086) to pin and replace nuts, turning recessed ends outward. Swing links forward and attach extension members to sleeves on front side struts by quick-release pins.

Erecting gantry at outboard engine

(10) Remove plug forward of rear spar from hole in top boom of centre engine rib and screw in eyebolt, Part No. 3/U.746.

(11) Remove plugs from front spar and screw in two ball sockets, Part No. 10/U.634.

(12) Anchor rear strut, Part No. 1/U.747, at eyebolt by quick-release pin, and fit operating screw, Part No. 1/U.735, to rear strut.

(13) Proceed as from item 4 for inboard engine, after ensuring that struts are correctly adjusted (see labels on struts).

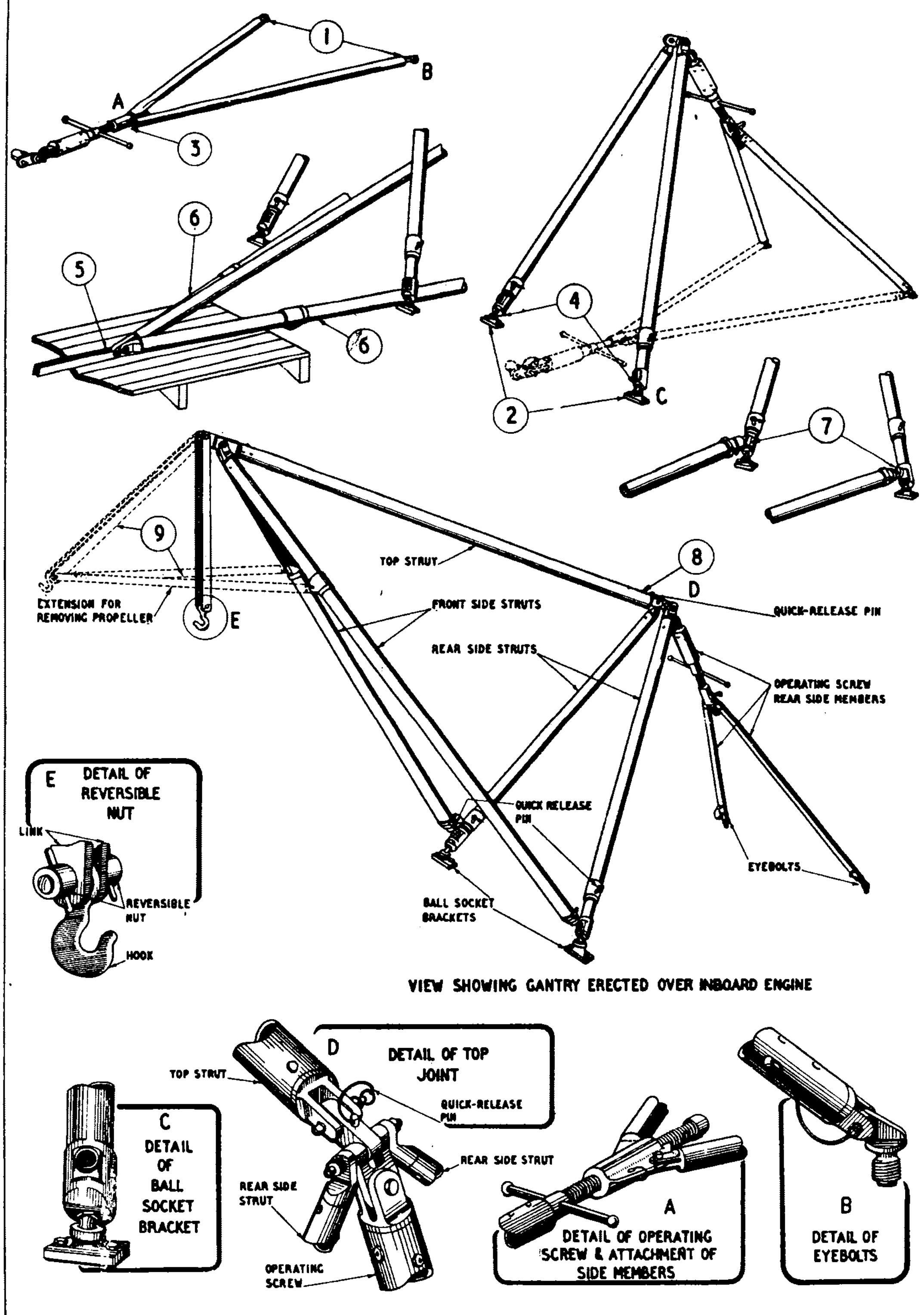


FIG. 7 ERECTING ENGINE-CHANGING GANTRY FIG. 7

PP3589 M /G4663 3/45 1050 C & P Gp. 959 (4)

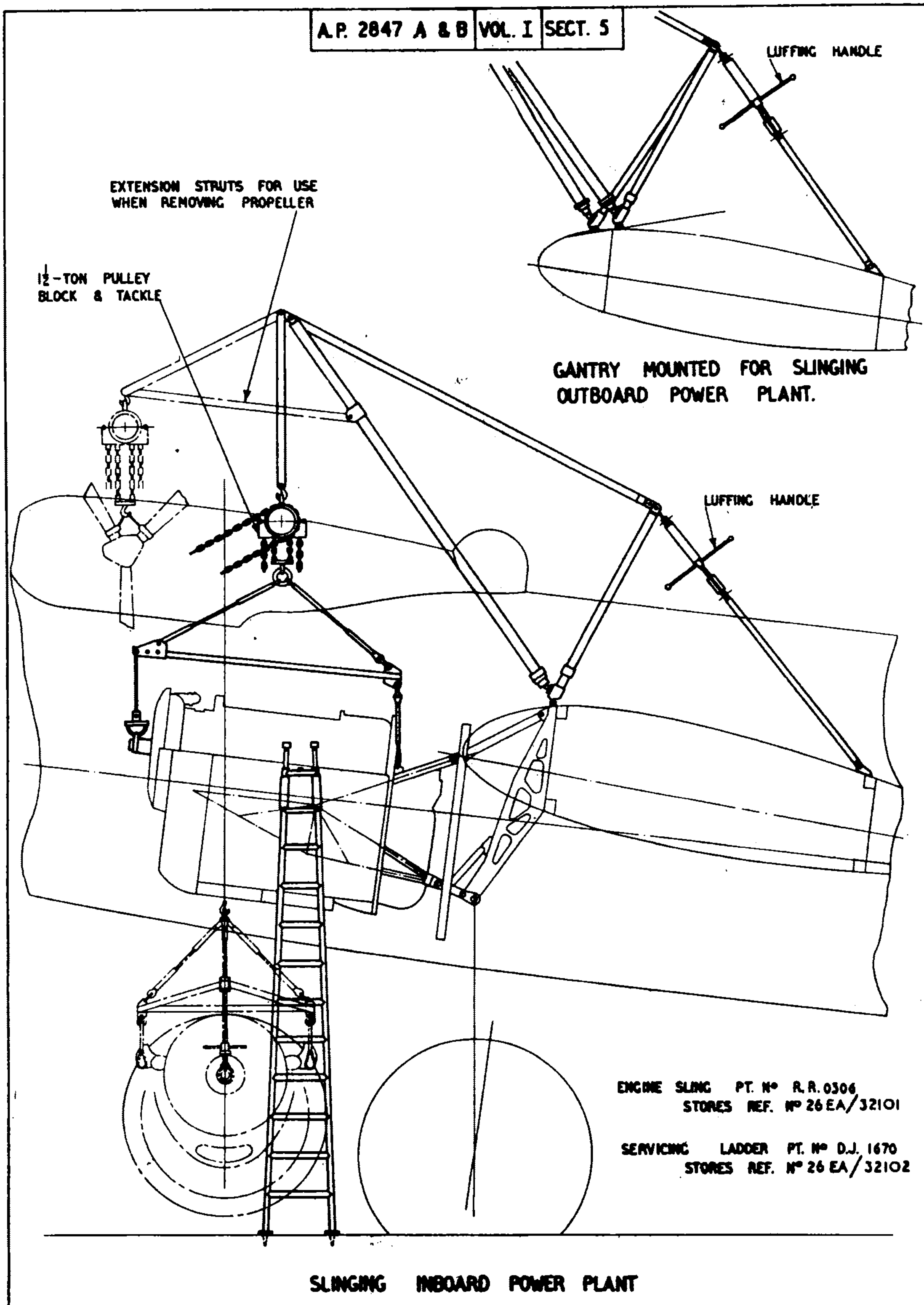


FIG. 8 — POWER PLANT SLINGING — FIG. 8

REPRINT PP3589 M /G4663 4/45 1050 C & P Gp. 959(4)

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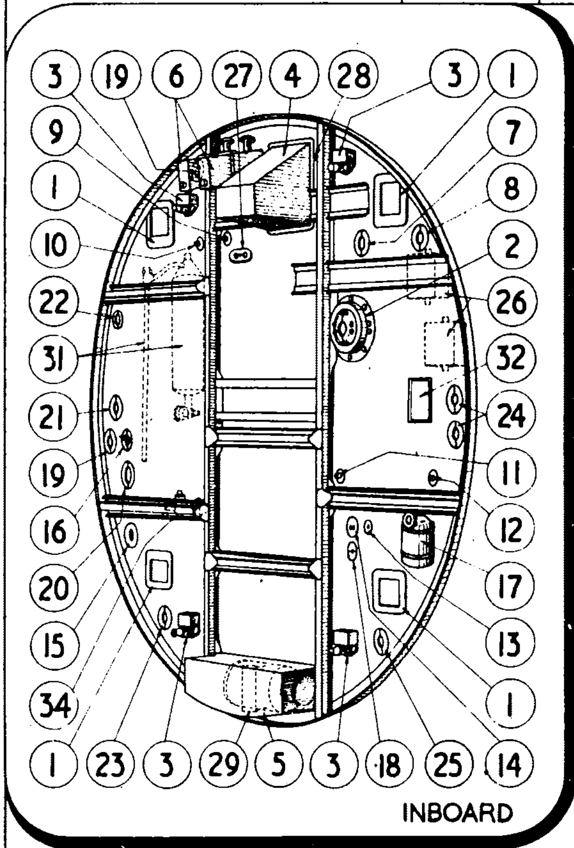


REFERENCES

1. SEALING WASHERS AT CUT-OUTS FOR SUB-FRAME LUGS
2. COVER FOR COUPLING OF ACCESSORY GEARBOX DRIVE
3. FLAME SWITCHES — FOUR ON EACH FIREWALL.
4. COVER FOR ENGINE CONTROL COUNTERSHAFT.
5. OIL-AND-WATER DRAINS TANK
6. OIL SEPARATOR TANKS. TWO ARE ON STARBOARD INBOARD FIREWALL, ONE ON PORT INBOARD FIREWALL, NONE ARE ON OUTBOARD FIREWALLS
7. FAIRLEAD FOR ELECTRICAL SERVICES CABLE
8. FAIRLEAD FOR ENGINE SERVICES CABLE
9. BOOST PIPE CONNECTOR
10. DOPER PIPE CONNECTOR
11. FUEL VENT PIPE CONNECTOR
12. AIR SUPPLY PIPE CONNECTOR
13. FAIRLEAD FOR FUEL FLOWMETER CABLE
14. FAIRLEAD FOR FLAME SW. AND PRESSURE CUT-OUT CABLES
15. FAIRLEAD FOR ENGINE STARTER CABLE
16. FAIRLEAD FOR IGNITION CABLE
17. FUEL FILTER
18. FAIRLEAD FOR ACCESSORY DRAIN — INBOARD FIREWALL
19. FAIRLEAD FOR CABIN HEATER COOLANT PIPES — INBOARD FIREWALL
20. FAIRLEAD FOR OIL* SUPPLY PIPE
21. FAIRLEAD FOR OIL RETURN PIPE
22. FAIRLEAD FOR OIL VENT PIPE
23. FAIRLEAD FOR FIRE EXTINGUISHER PIPE — ONE BOTTLE SYSTEM
24. FAIRLEADS FOR FIRE EXTINGUISHER PIPES — TWO BOTTLE SYSTEM
25. FAIRLEAD FOR FEATHERING UNIT SUPPLY PIPE
26. FUEL PUMP SUPPRESSORS — INBOARD FIREWALL
27. FAIRLEAD FOR OIL SEPARATOR PIPES — INBOARD FIREWALL
28. FAIRLEAD FOR BOOST CUT-OUT CABLE
29. FEATHERING PUMP ON AFT FACE OF FIREWALL
30. DOPER VALVE ON AFT FACE OF OUTBOARD FIREWALL
31. OIL-AND-WATER TRAP ON AFT FACE OF PORT INBOARD FIREWALL
32. NOMENCLATURE CARD HOLDER
33. DELAY ACTION SWITCH ON AFT FACE OF OUTBOARD FIREWALL
34. REGULATOR VALVE ON AFT FACE OF STARBOARD INBOARD FIREWALL.

REMOVAL INSTRUCTIONS

INBOARD FIREWALLS ONLY

DISCONNECT ACCESSORY DRAINPIPE AT T-PIECE AFT OF FIREWALL
DISCONNECT PIPES TO OIL SEPARATOR TANKS AT AUXILIARY GEARBOX
DISCONNECT PIPE TO OIL-WATER TRAP AT T-PIECE, AND DELIVERY PIPE TO PRESSURE-REGULATING VALVE AT FIREWALL. UNCLIP PIPES
REMOVE PULSOMETER PUMP. (SEE FIG. 14)
DISCONNECT BOOST AND DOPER PIPES AT UNIONS, AND UNCLIP FROM REAR FACE OF FIREWALL

OUTBOARD FIREWALLS ONLY

DISCONNECT ELECTRICAL CABLES GOING AFT AT TERMINAL BLOCKS ON REAR FACE OF FIREWALL.
DISCONNECT BOOST PIPE AT UNION, AND FUEL SUPPLY PIPE TO DOPER VALVE AT T-PIECE, AND UNCLIP PIPES FROM REAR FACE OF FIREWALL

INBOARD AND OUTBOARD FIREWALLS

REMOVE ALL SPLIT FAIRLEADS IN ORDER THAT PIPES AND CABLES CAN BE WITHDRAWN THROUGH FIREWALL
DISCONNECT AIR SUPPLY PIPE AT UNION ON AFT FACE OF FIREWALL, AND UNCLIP
THE OIL TANK BEING EMPTY, DISCONNECT THE PIPE FROM THE OIL TANK TO THE FEATHERING PUMP AT THE PUMP, AND REMOVE PUMP
REMOVE CONTROL COVER FROM FIREWALL AND DISCONNECT ENGINE CONTROL RODS AT TURNBUCKLES
UNCLIP IGNITION CABLES FROM AFT FACE OF FIREWALL
DISCONNECT FUEL VENT PIPE AT UNION ON AFT FACE OF FIREWALL
DISCONNECT PIPE TO FUEL FILTER AT CONNECTION ON AFT FACE OF FIREWALL
REMOVE SEALING WASHERS AT CUT-OUTS FOR SUB-FRAME LUGS
UNBOLT AND REMOVE CLIPS SECURING FIREWALL TO SUB-FRAME
HOLDING FIREWALL SECURELT, DRAW FORWARD OFF SUB-FRAME LUGS ALLOWING ALL PIPES AND CABLES TO PASS THROUGH FIREWALL

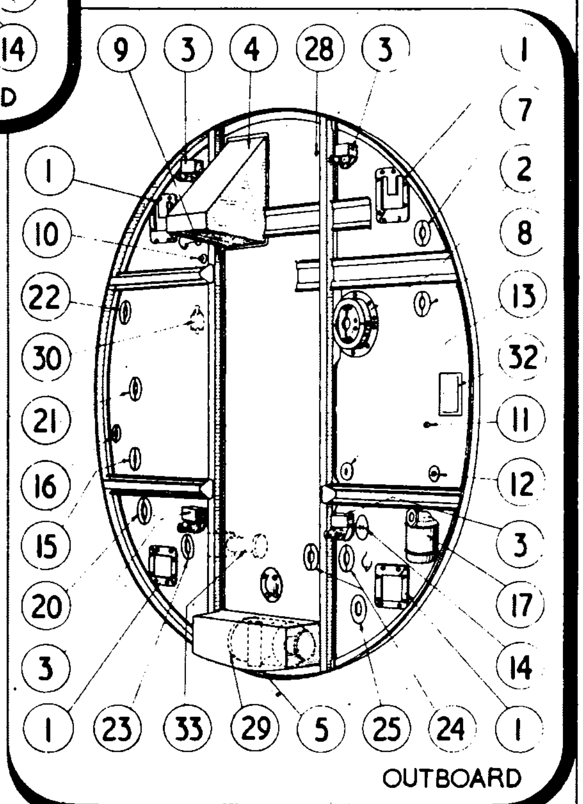
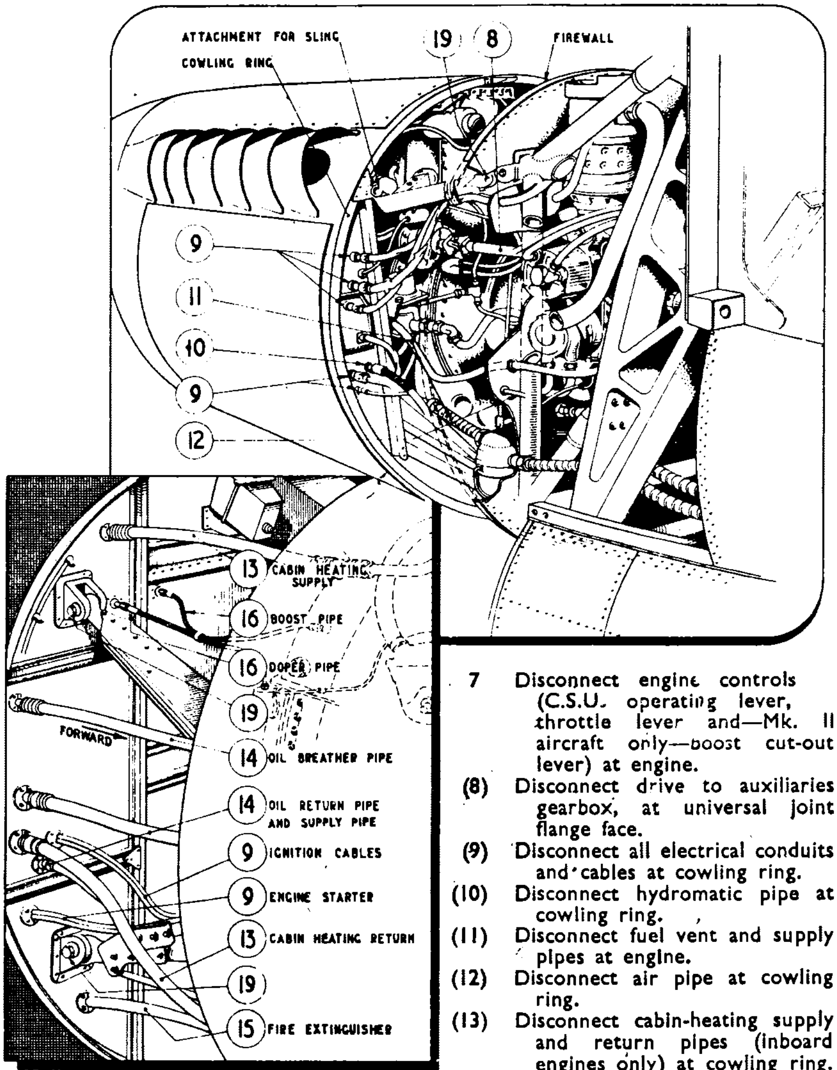


FIG. 9 — FIREWALL DETAILS — FIG. 9



1 Remove panels between cowling ring and firewall.
2 Remove fairing panels aft of firewall.
3 Erect gantry (see fig. 7), if no crane is available.
4 Remove propeller (see fig. 7 and 8, and A.P.1538D).
5 Ensure that master engine cock is in *off* position.
6 Drain oil from tank by removing drain plug and opening filler.
7 Disconnect engine controls (C.S.U. operating lever, throttle lever and—Mk. II aircraft only—boost cut-out lever) at engine.
(8) Disconnect drive to auxiliaries gearbox, at universal joint flange face.
(9) Disconnect all electrical conduits and cables at cowling ring.
(10) Disconnect hydromatic pipe at cowling ring.
(11) Disconnect fuel vent and supply pipes at engine.
(12) Disconnect air pipe at cowling ring.
(13) Disconnect cabin-heating supply and return pipes (inboard engines only) at cowling ring.
(14) Disconnect oil breather, supply, and return pipes at cowling ring.
(15) Disconnect fire extinguisher pipe(s)—one, Mk. I aircraft; two, Mk. II aircraft.
(16) Disconnect boost and doper pipes at engine.
17 Disconnect pipe to drain tank at bottom of firewall. Remove tank.
18 Attach slings (see fig. 8).
(19) Take weight and remove bolts securing engine mounting to sub-frame.

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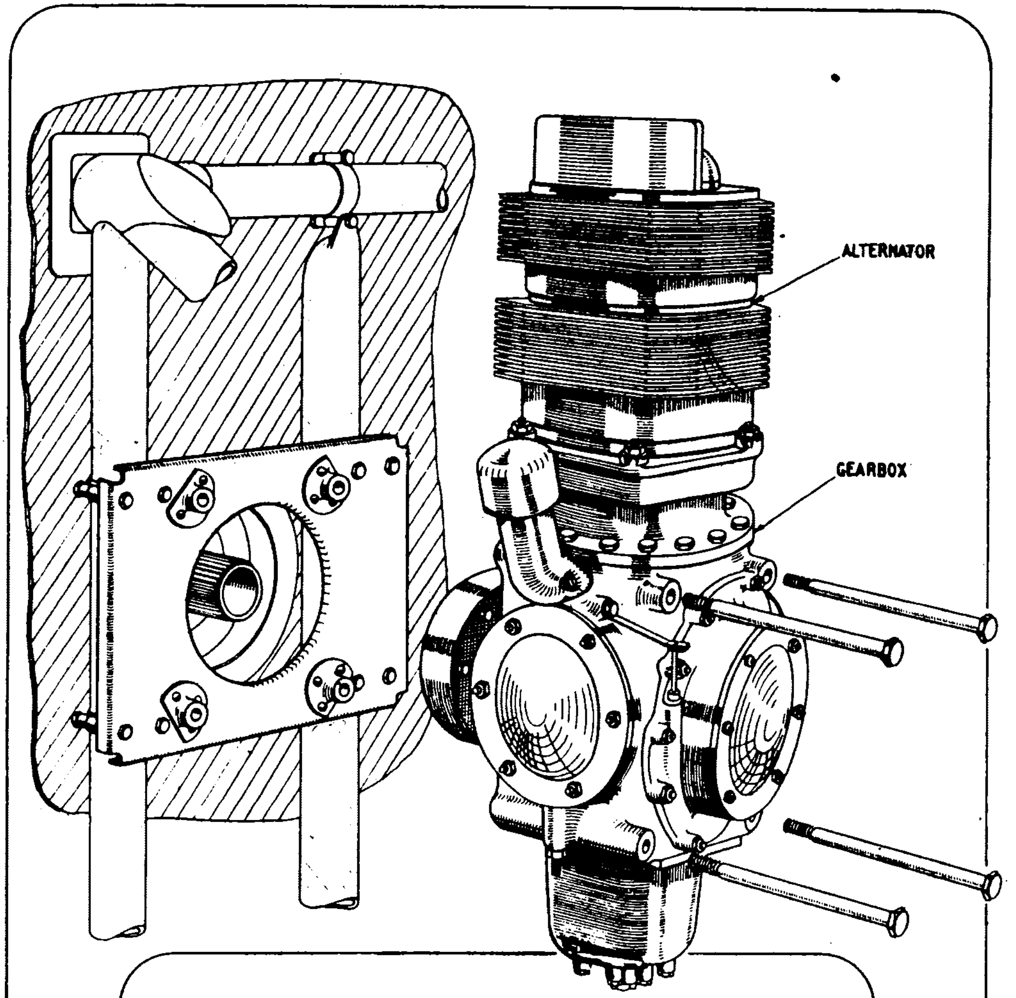

KEY TO FIG. 11

1. REMOVE FAIRING PANELS (SEE FIG. 6)
2. DISCONNECT LEADS AT TOP OF ALTERNATOR
3. REMOVE ATTACHMENT BOLT NUTS BEHIND MOUNTING PLATE ON ENGINE SUB-FRAME
4. WITHDRAW GEARBOX, COMPLETE WITH ALTERNATOR, FROM MOUNTING

FIG. 11 OUTBOARD AUXILIARY GEARBOX FIG. 11

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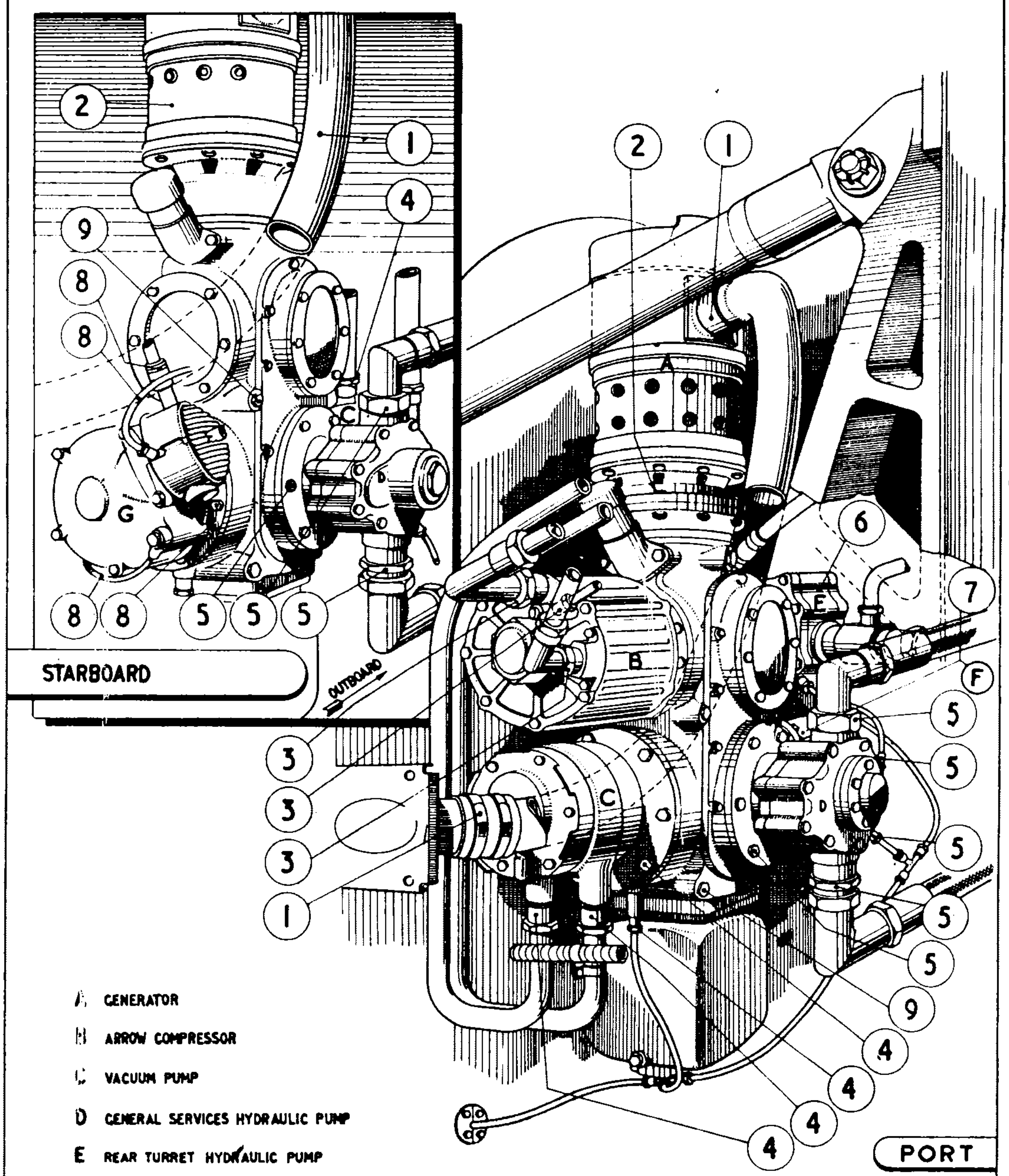


A GENERATOR
B ARROW COMPRESSOR
C VACUUM PUMP
D GENERAL SERVICES HYDRAULIC PUMP
E REAR TURRET HYDRAULIC PUMP
F VACUUM PUMP
G HEYWOOD COMPRESSOR

* FOR METHOD OF REMOVAL SEE FIG. 13

FIG. 12 INBOARD GEARBOXES & AUXILIARIES (1) FIG. 12

PP4029 M /G2287 9/45 1050 C&P Gp. 959 (4)

REMOVAL INSTRUCTIONS

(1) Remove clips securing cooling pipe to generator.

(2) Remove bolts securing generator to gearbox.

(3) Disconnect pipes at Arrow compressor and remove bolts securing compressor to gearbox.

(4) Disconnect pipes at vacuum pump and remove bolts securing pump to gearbox.

(5) Disconnect pipes at general services hydraulic pump and remove bolts securing pump to gearbox.

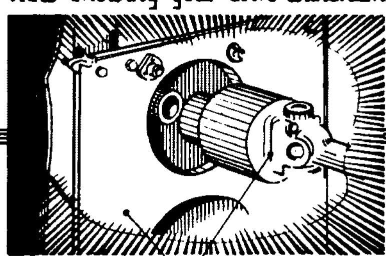
(6) Disconnect pipes at rear turret pump and remove bolts securing pump to gearbox.

(7) Disconnect pipes at vacuum pump and remove bolts securing pump to gearbox.

(8) Disconnect pipes at Heywood compressor and remove bolts securing compressor to gearbox.

(9) Remove four bolts securing gearbox to mounting, slide off gearbox drive (see detail below) and lower from machine.

View showing gear drive withdrawn



Mounting Plate. Drive from gearbox.

FIG. 13 **INBOARD GEARBOXES AND AUXILIARIES (2)** FIG. 13

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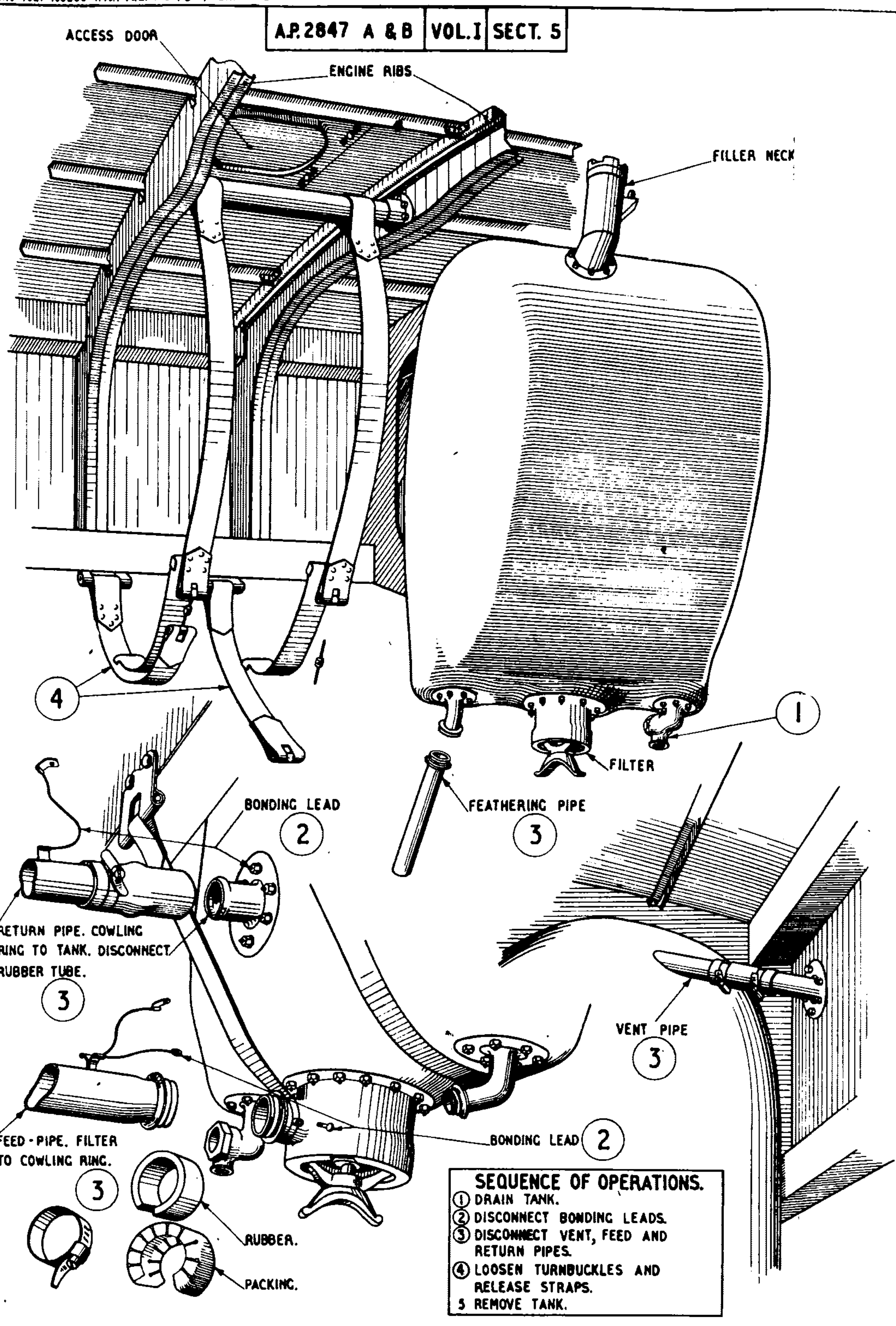
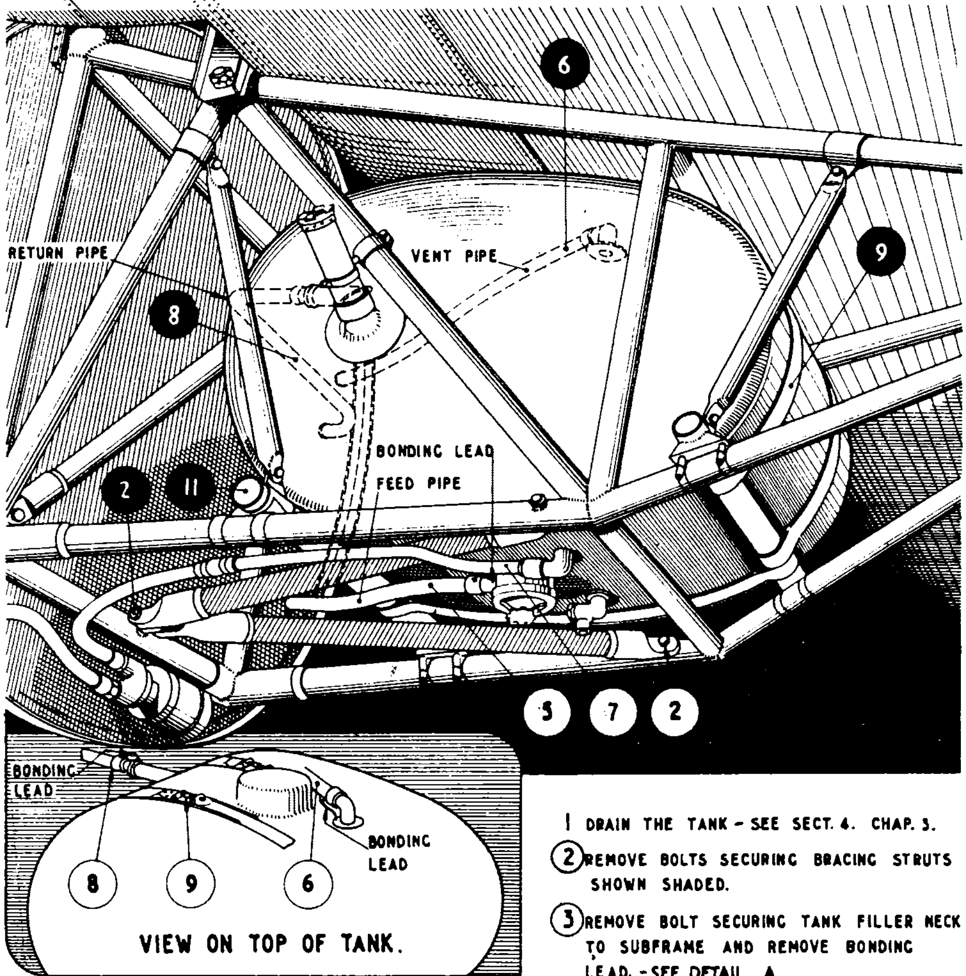


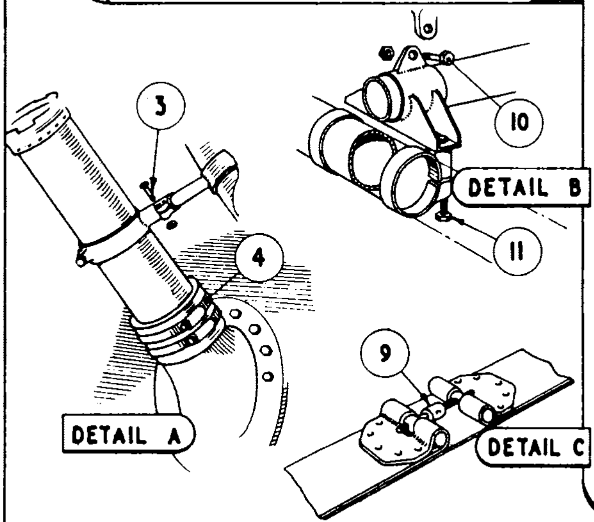
SEQUENCE OF OPERATIONS.

1. DRAIN TANK.
2. DISCONNECT BONDING LEADS.
3. DISCONNECT VENT, FEED AND RETURN PIPES.
4. LOOSEN TURNBUCKLES AND RELEASE STRAPS.
5. REMOVE TANK.

FIG. 15 — **INBOARD OIL TANK** — FIG. 15

PP3454 M /G4037 1/45 1050 C&P Gp. 959 (4)





1 DRAIN THE TANK - SEE SECT. 4. CHAP. 3.

(2) REMOVE BOLTS SECURING BRACING STRUTS SHOWN SHADED.

(3) REMOVE BOLT SECURING TANK FILLER NECK TO SUBFRAME AND REMOVE BONDING LEAD. - SEE DETAIL A

(4) REMOVE FILLER NECK BY SLACKENING OFF CLIPS AT BASE. - SEE DETAIL A

(5) DISCONNECT FEED PIPE FROM TANK.

(6) DISCONNECT VENT PIPE FROM TANK.

(7) DISCONNECT FEATHERING PIPE FROM TANK.

(8) DISCONNECT RETURN PIPE FROM TANK.

(9) DISCONNECT TANK STRAPS ON TOP OF TANK - SEE DETAIL C.

(10) REMOVE BOLTS SECURING BRACING STRUTS TO TANK CROSS MEMBER - SEE DETAIL B.

(11) REMOVE BOLTS SECURING CROSS MEMBER TO SUBFRAME - SEE DETAIL B.

12 LOWER TANK THROUGH BOTTOM OF SUBFRAME.

FIG. 16 OUTBOARD OIL TANK FIG. 16

OUTBOARD ENGINE SUB-FRAME

1 REMOVE POWER PLANT (SEE FIG. 10)

2 REMOVE NACELLE FAIRINGS AS FOLLOWS :-
(a) RELEASE DZUS FASTENERS AND REMOVE PANELS 1, 2 & 3.
(b) UNBOLT SUB-FRAME ATTACHMENT BRACKETS INSIDE FORWARD EDGE OF REAR FAIRING AND REMOVE FAIRING BY RELEASING DZUS FASTENERS

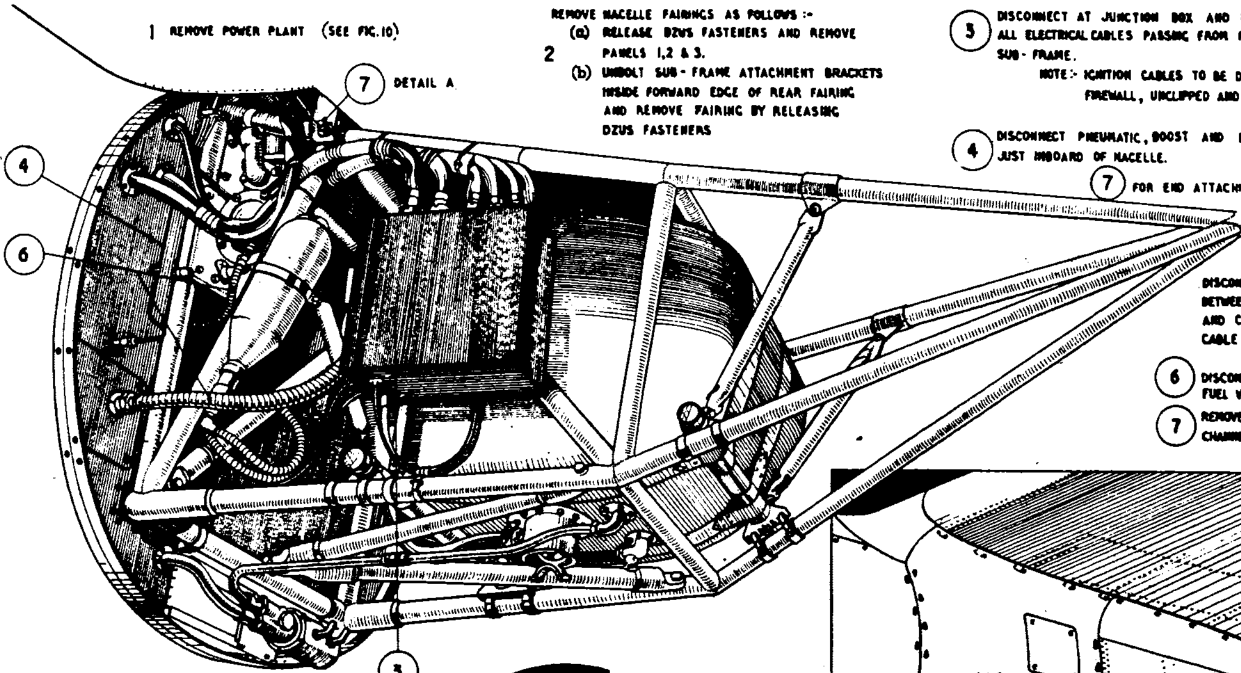
3 DISCONNECT AT JUNCTION BOX AND UNCLIP FROM SUB-FRAME ALL ELECTRICAL CABLES PASSING FROM FRONT SPAR INTO SUB-FRAME.
NOTE:- IGNITION CABLES TO BE DISCONNECTED AT FIREWALL, UNCLIPPED AND COILED AT THE SPAR.

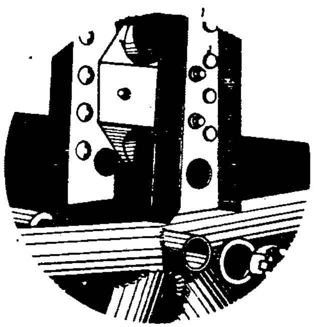
4 DISCONNECT PNEUMATIC, BOOST AND DOPER PIPES AT UNIONS JUST INBOARD OF NACELLE.

5 DISCONNECT ENGINE CONTROL RODS BETWEEN FRONT SPAR AND FIREWALL AND COIL BOOST CUT-OUT CONTROL CABLE IN LEADING EDGE.

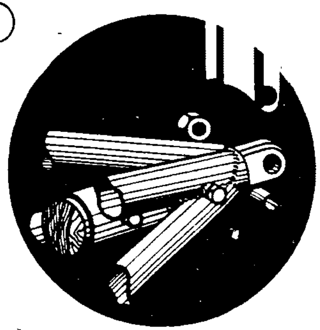
6 DISCONNECT FUEL SUPPLY PIPE AND FUEL VENT PIPE.

7 REMOVE BOLTS SECURING SUB-FRAME TO CHANNELS (SEE DETAILS A & B.)

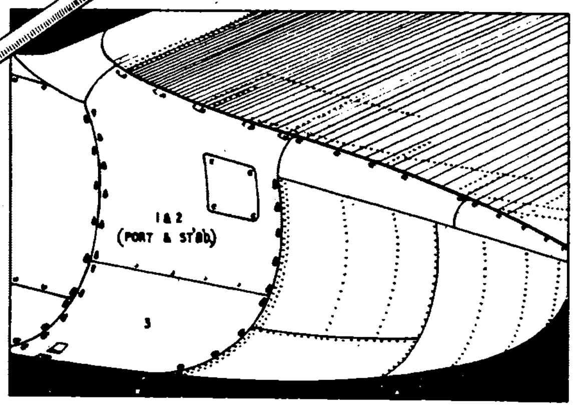




DETAIL A



DETAIL B



DETAILS OF REAR NACELLE FAIRINGS.

NOTE:- ON REPLACEMENT THE INBOARD FRONT SPAR ATTACHMENT BOLT MUST BE INSERTED FROM INSIDE THE SUB-FRAME.

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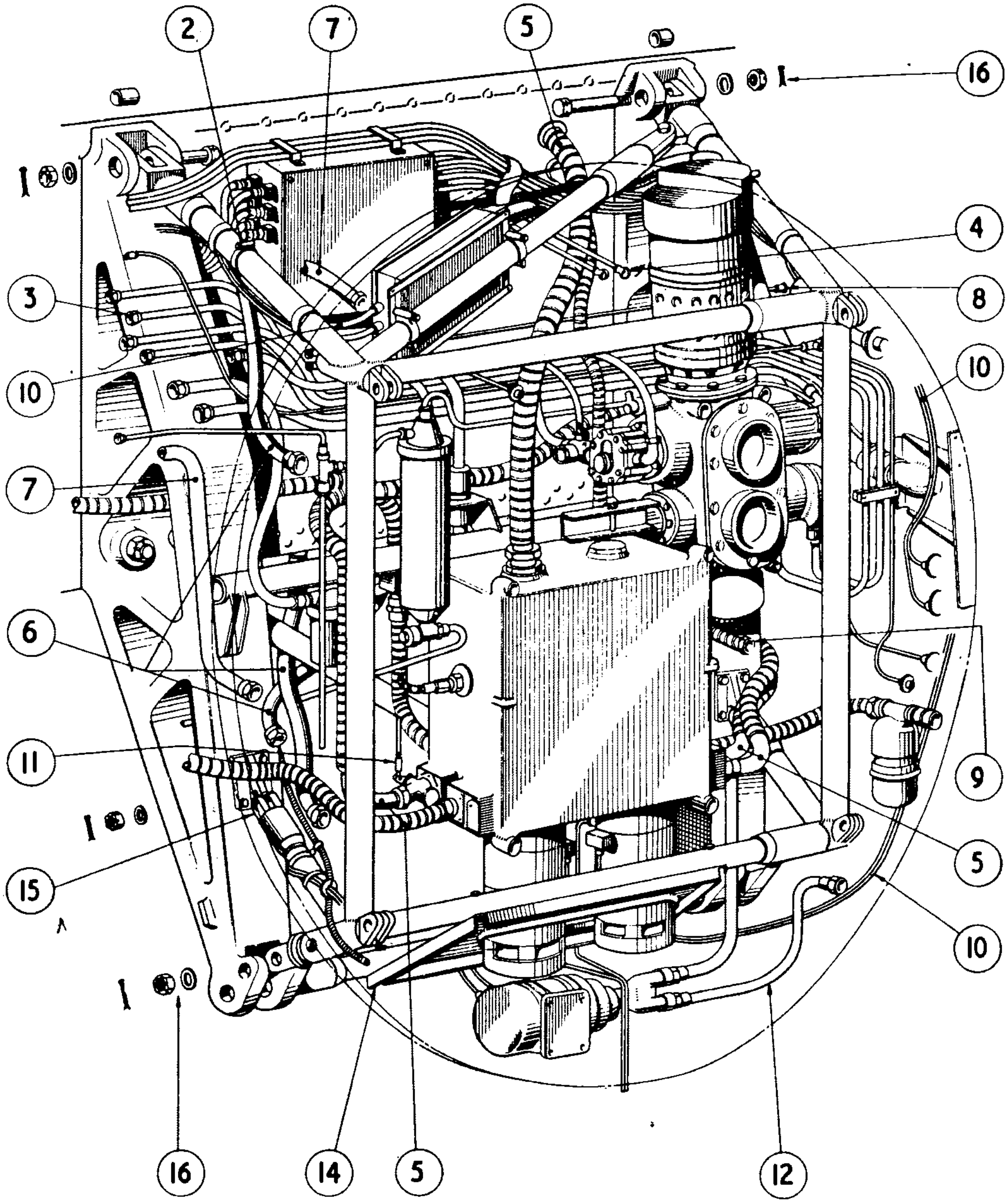
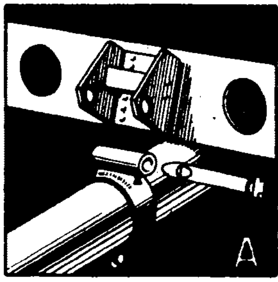


FOR REFERENCES AND DETAILS, SEE FIG. 19.

FIG. 18 INBOARD ENGINE SUB-FRAME (1) FIG. 18



1 Remove power plant (see fig. 10).
(2) Remove quick-release pins securing hinged top panel to sub-frame (see detail A).
(3) Disconnect hydraulic and other pipe services at nearest joint in nacelle.
(4) Disconnect engine control rods at countershaft on firewall.
(5) Disconnect fuel pipes at distributor tank.
(6) Disconnect oil pipes at tank or front spar.
(7) Disconnect cabin heating pipes at firewall.
(8) Disconnect boost pipe at aft face of firewall.
(9) Disconnect fuel vapour vent pipe at firewall.
(10) Disconnect electrical services at junction box or firewall as necessary. Remove clips securing electrical services to sub-frame.
(11) Disconnect fuel cock control cables at distributor tank.
(12) Disconnect feathering pipe at firewall.
(13) Disconnect boost cut-out control cable by detaching fairlead, and slacken Vickers pulley. Withdraw cable through firewall, coil and tie.
(14) Remove bracing plate from underside of sub-frame.
(15) Remove bolts securing bracing struts to undercarriage beams.
(16) Support sub-frame, remove split-pins, nuts and washers from attachment bolts (4). Remove bolts, noting distance tube at each joint (detail B shows arrangement of bottom joint).

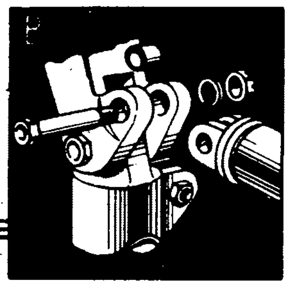


FIG. 19 INBOARD ENGINE SUB-FRAME. (2) FIG. 19

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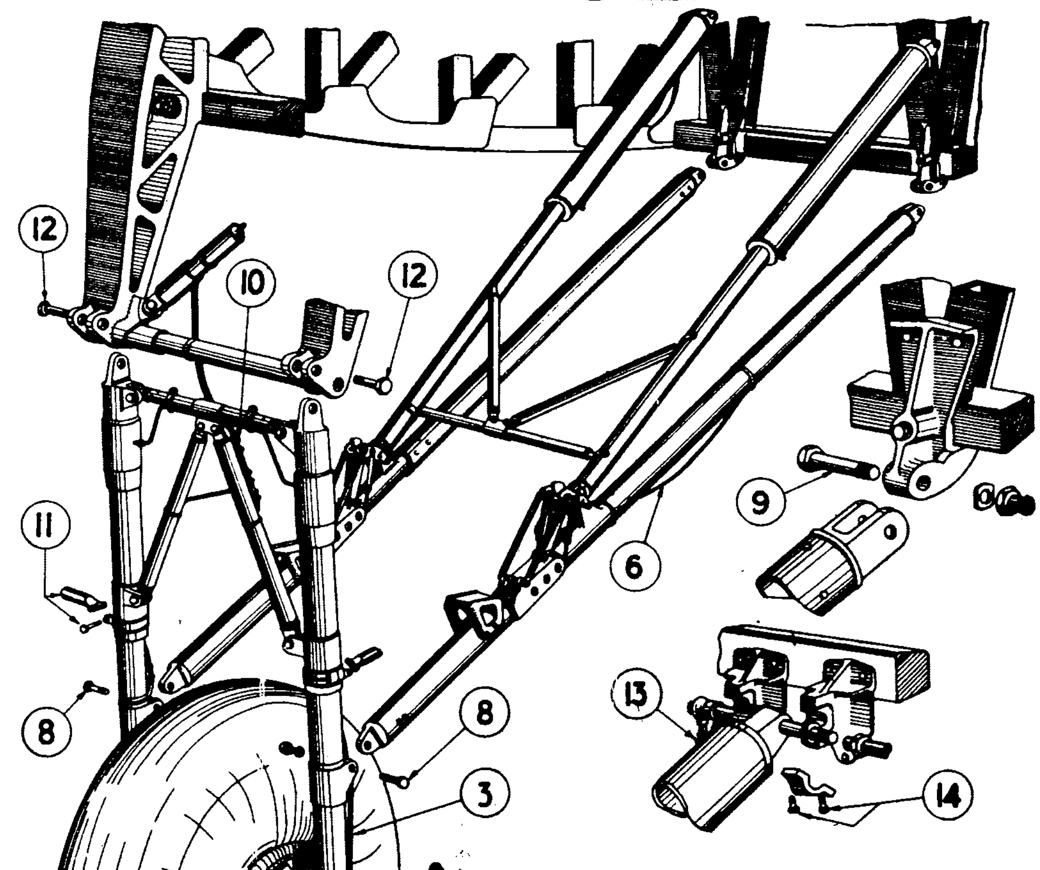

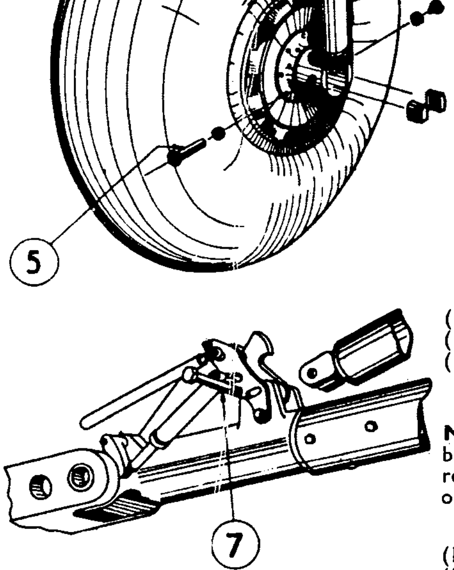

1 Jack aircraft (see Sect. 4, Chap. 3) with wheel about 2 in. off ground.
2 Deflate shock-absorbers (see Sect. 4. Chap. 3).
(3) Disconnect brake pipe at bottom end of flexible tube.
4 Support wheel with blocks.
(5) Remove eye-bolts, saddle washers, and packing pieces securing axle to shock-absorber struts. Lower wheel.
(6) Disconnect electrical cables at terminal blocks at knee joints and unclip from radius rods.
(7) Disconnect jack piston rods.
(8) Remove bolts securing lower radius rods to shock-absorber struts.
(9) Remove bolts securing upper end of radius rods.
(10) Disconnect brake pipes.
(11) Disconnect door-operating links.
(12) Remove bolts at top of shock-absorber struts (the horizontal strut must be supported until the bolts can be replaced).

Note . . . The inlet ports of the brake cooling vanes must be on the port side, which is a point to be kept in mind when re-fitting a main wheel. The inlet ports, being larger than the outlet ports, are easily distinguishable.

TO REMOVE JACKS

(13) Disconnect hydraulic pipes.
(14) Remove bolts securing caps to brackets.

FIG. 20 MAIN WHEEL UNIT FIG. 20

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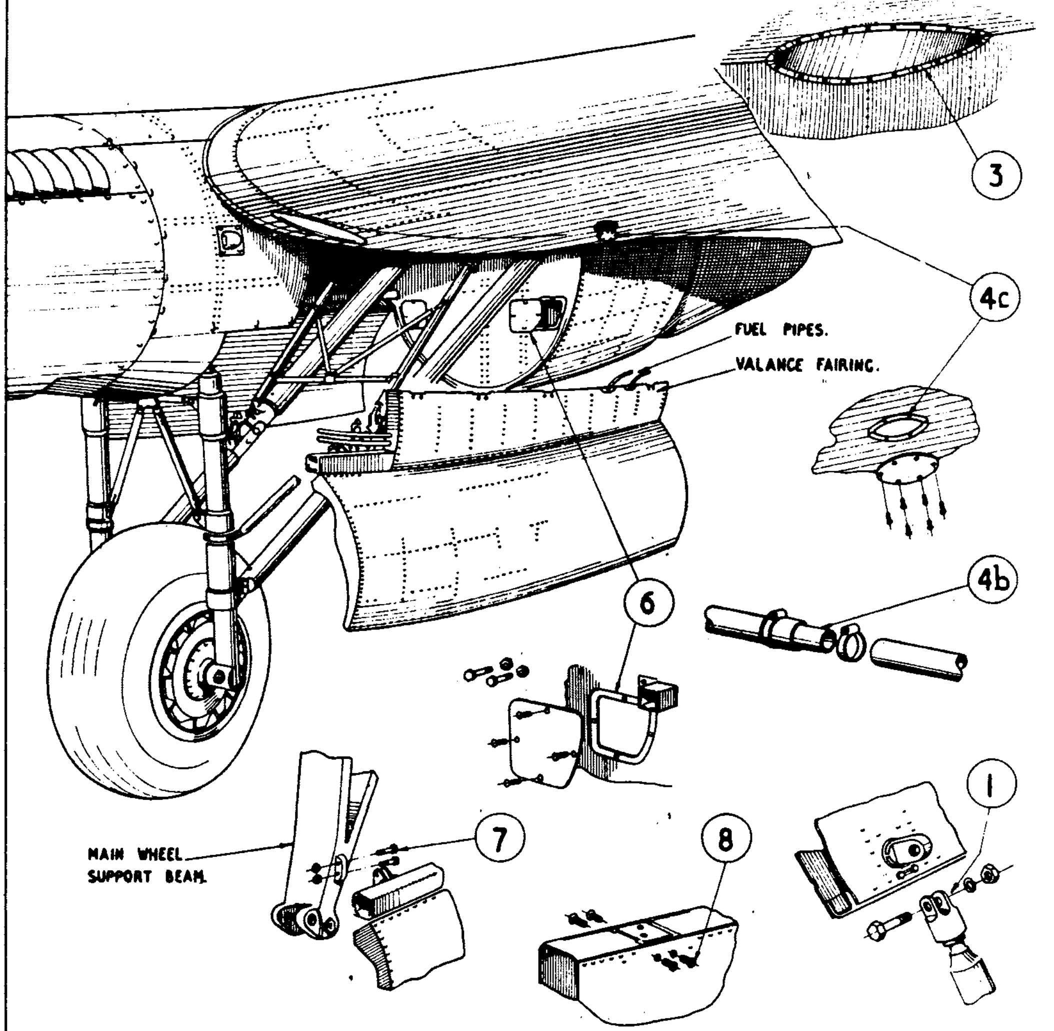

(1) REMOVE THE BOLT SECURING THE DOOR OPERATING LINK TO THE ROTATING PIN IN THE LOWER EDGE OF THE DOOR.

2. DRAIN THE FUEL TANKS ON THE SIDE OF THE AIRCRAFT FROM WHICH THE VALANCE IS TO BE REMOVED (SEE SECT. 4 CHAP. 3)

(3) REMOVE THE FAIRING OVER THE FUEL PIPES AT THE MAIN PLANE AND VALANCE JOINT.

(4) DISCONNECT THE FUEL PIPES AT THE REAR OF THE VALANCE:—
   (a) INBOARD VALANCE – UNCOUPLE THE FUEL PIPE AT No. 1 TANK SUMP.
   (b) OUTBOARD VALANCE – DISCONNECT THE PIPE TO No. 3 TANK AT THE JOINT
   (c) REMOVE THE ACCESS PANEL IN THE UNDERSIDE OF THE MAIN PLANE AND UNCOUPLE THE PIPE AT No. 2 TANK SUMP.

5. DISCONNECT THE FUEL PIPES AT THE DISTRIBUTOR TANK ON THE FIREWALL.

(6) REMOVE THE INSPECTION DOOR IN THE FACE OF THE REAR FAIRING BULKHEAD AND REMOVE THE BOLTS SECURING THE DOOR RAIL TO THE REAR FAIRING.

(7) REMOVE THE TWO BOLTS SECURING THE FRONT END OF THE DOOR RAIL TO THE MAIN WHEEL SUPPORT BEAM.

(8) SUPPORT THE DOOR AND REMOVE THE SCREWS SECURING THE TOP OF THE VALANCE TO THE UNDERSIDE OF THE MAIN PLANE. THESE SCREWS ARE ON EACH SIDE OF THE TOP EDGE OF THE VALANCE.

9. LOWER THE DOOR AND VALANCE FROM THE AIRCRAFT, TOGETHER WITH THE LENGTHS OF FUEL PIPING.

FIG. 21	MAIN WHEEL DOOR AND VALANCE FAIRING	FIG. 21

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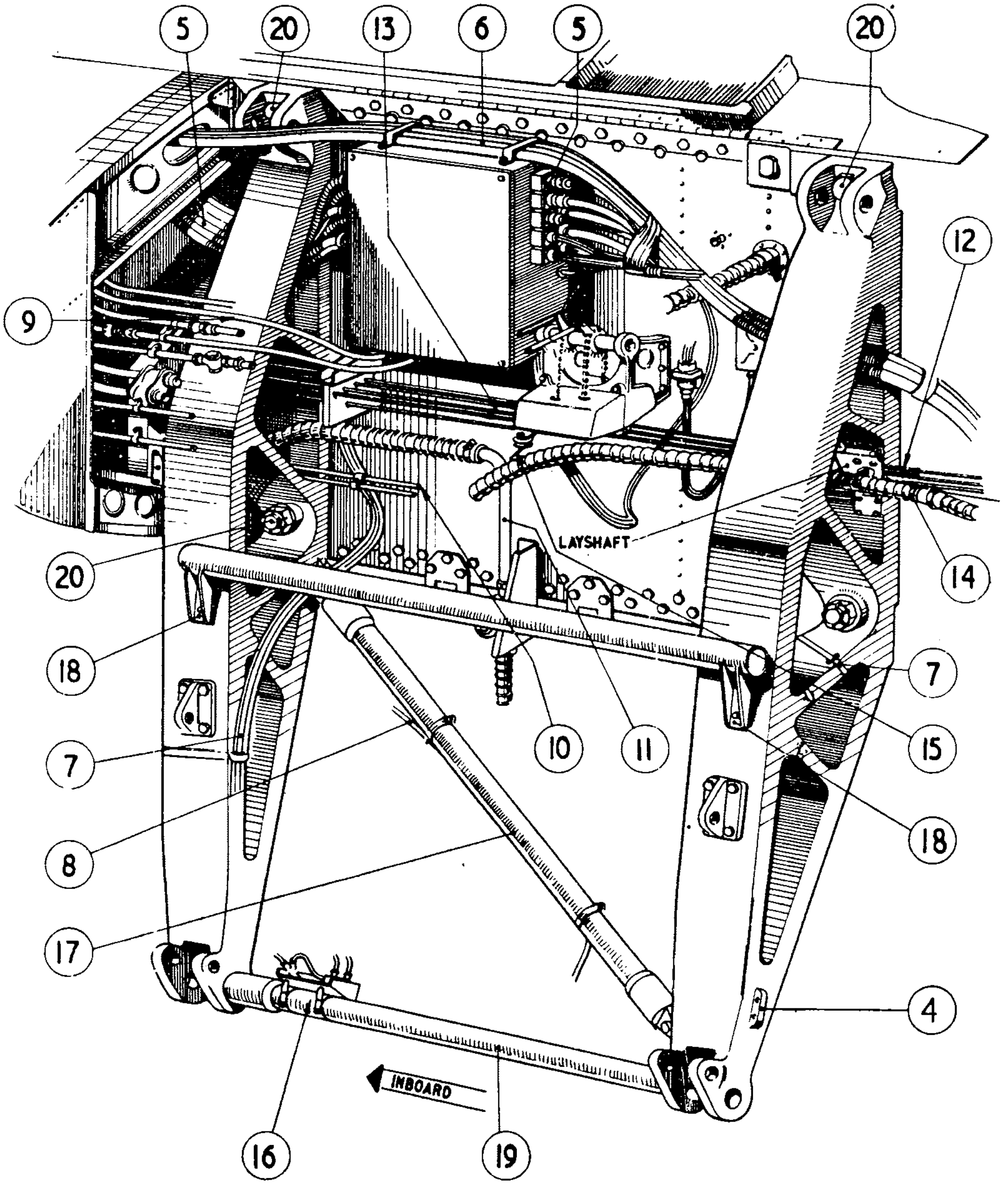

FIG. 22 UNDERCARRIAGE BEAMS (I) FIG. 22

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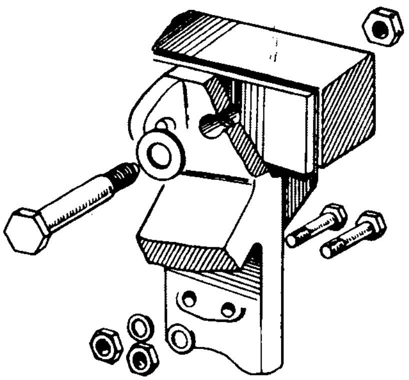
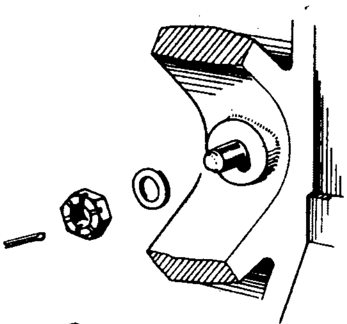
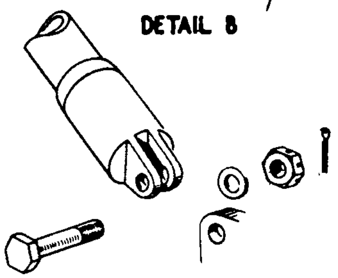


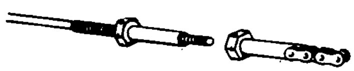
DETAIL A



DETAIL B



DETAIL C



DETAIL D

1 Remove power plant (see fig. 10)

2 Remove sub-frame (see fig. 18 and 19)

3 Remove main wheel unit (see fig. 20)

(4) Remove bolts securing main wheel door hinge beam to support beam (see also fig. 21)

(5) Disconnect electrical conduits at junction box on front spar and withdraw through beam.

(6) Disconnect electrical conduits at junction box on outboard sub-frame and withdraw through tube in leading edge and through beam.

(7) Remove clips securing electrical cables to beam.

(8) Remove clips securing pipe to diagonal strut.

(9) Disconnect hydraulic pipes at joints near beam.

(10) Disconnect fuel cock controls at connector block on front spar.

(11) Disconnect fuel cross-feed pipe at drain cock and withdraw through beam.

(12) Disconnect engine control rods at each side of layshaft (see detail D) and remove bolts securing layshaft to beam.

(13) Disconnect engine control rods at sprocket box between beams and at front spar (in fuselage) and withdraw through beam.

(14) Disconnect fuel feed pipe and withdraw through beam.

(15) Disconnect boost cut-out cable at junction of inboard and outboard cables and withdraw through beams.

(16) Disconnect all pipes at Ki-gass bracket.

(17) Remove bolts securing diagonal strut to beams (see detail C).

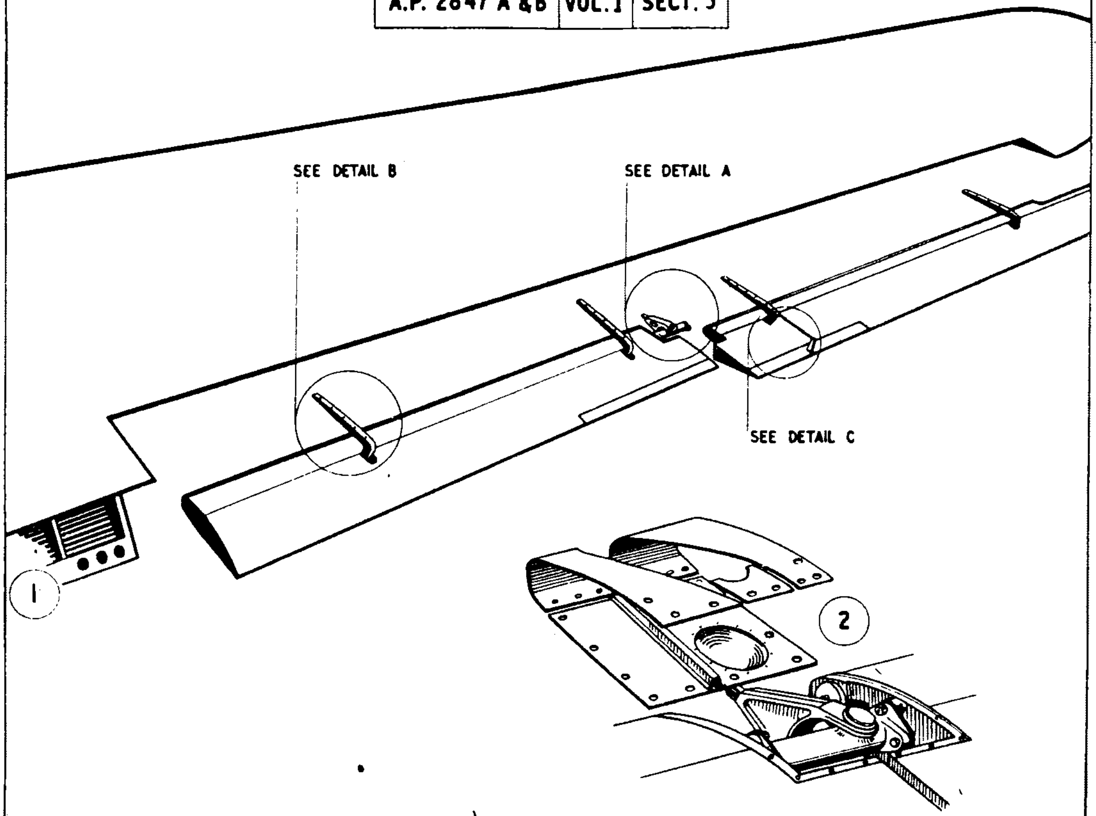
(18) Remove bolts securing cross-member to beams.

(19) Remove lower bracing strut.

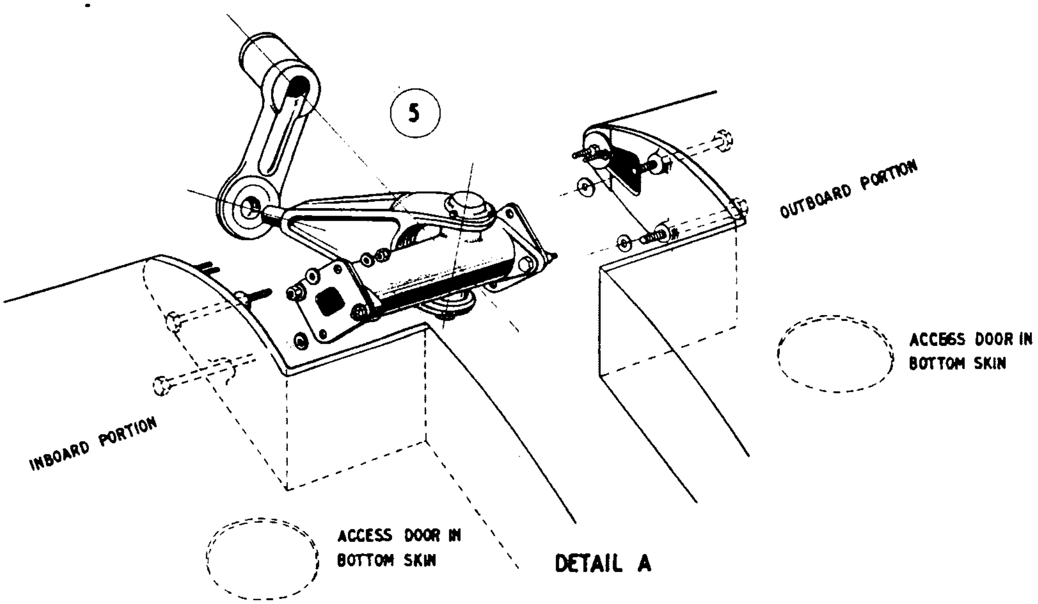
(20) Remove top attachment bolts (see detail A), and nuts from bottom attachment studs (see detail B). Lower beams from spar.

FIG. 23 — UNDERCARRIAGE BEAMS (2) — FIG. 23

PP3788 M /G847 6/45 1050 C & P Gp. 959 (4)



DETACHABLE COVER AT JOINT

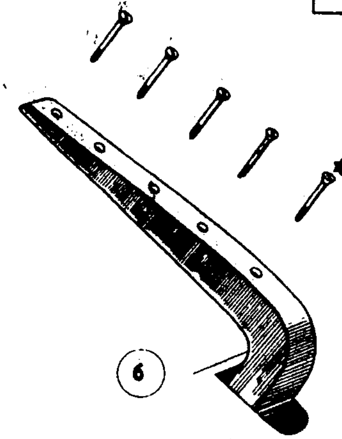


DETAIL A

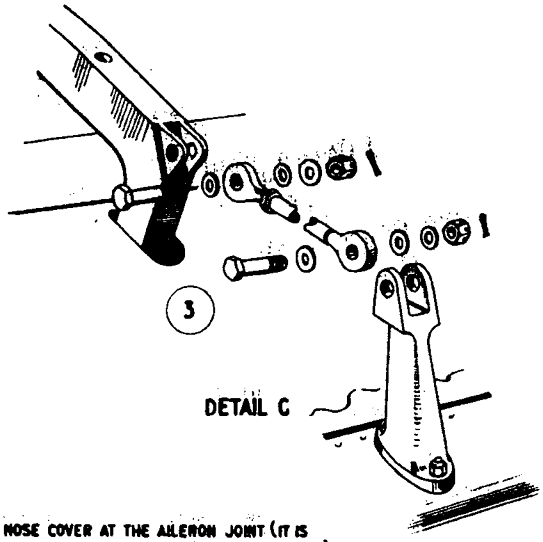
FIG. 24

AILERON (1)

FIG. 24



DETAIL B

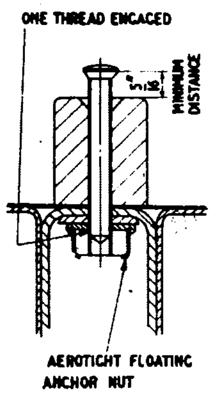


DETAIL C

1. LOWER THE FLAPS.
2. REMOVE THE DETACHABLE NOSE COVER AT THE AILERON JOINT (IT IS NECESSARY TO ELEVATE THE AILERON WHEN REMOVING THE UPPER COVER.)
3. REMOVE THE BALANCE TAB OPERATING ROD BY DISCONNECTING AT THE AILERON HINGE AND LEVER.
4. DISCONNECT THE AILERON TRIMMING TAB OPERATING CABLES AT THE TURNBUCKLES. RELEASE THE FAIRLEADS AND WITHDRAW THE CABLES FROM THE INNER AND OUTER TRAILING EDGES. SEE FIG. 28
5. REMOVE THE FULCRUM FORGING AND OPERATING LEVER. ACCESS TO THE BOLT HEADS SECURING THE FULCRUM TO THE AILERON NOSE FORGINGS IS THROUGH THE DETACHABLE DOORS IN THE BOTTOM SKIN OF THE AILERON. WITHDRAW THESE BOLTS AND LOWER THE FULCRUM AND LEVER.
6. SUPPORT THE INBOARD AND OUTBOARD PORTIONS OF THE AILERON. REMOVE THE SECURING BOLTS FROM THE HINGE BRACKETS AND RELEASE THE BONDING CONNECTION AT THE TRAILING EDGE RIB 14. REMOVE THE TWO PARTS OF THE AILERON.

NOTE:-
WHEN RE-ASSEMBLING THE AILERON OPERATING GEAR IT IS ESSENTIAL TO ENSURE THAT THE CENTRE LINE OF THE TORQUE TUBE IS IN LINE WITH THE INTERSECTING POINT OF THE CENTRE LINES OF THE FULCRUM FORGING AND THE BOLT ATTACHING THE OPERATING FORK TO THE FULCRUM. LATERAL ADJUSTMENT OF THE FULCRUM FORGING CAN BE MADE BY BUILDING UP OR REDUCING THE LAMINATED PACKING WASHERS ON THE BOLTS SECURING IT TO THE NOSE FORGING.

✱ THIS BOLT MAY BE SHORTENED TO CLEAR THE SHROUD IF NECESSARY, BUT MUST PROJECT THROUGH ANCHOR NUT.



INSPECTION OF AILERON HINGE ARM BOLTS.

METHOD OF DETERMINING THE SAFETY AND ENGAGEMENT OF AILERON HINGE ARM BOLTS ON THE FINAL ASSEMBLY OF THE HINGE ARMS TO THE TRAILING EDGES AFTER ALL ADJUSTMENTS HAVE BEEN MADE IN FITTING THE AILERON.

(i) PLACE THE BOLT IN THE HOLE AND PRESS IT DOWN TO THE ANCHOR NUT.
(ii) TURN THE BOLT ROUND ONCE TO ENGAGE ONE THREAD.
(iii) LIFT THE BOLT TO CHECK ENGAGEMENT OF THREAD AND TO DRAW THE ANCHOR NUT UP TO ITS CASE.
(iv) MEASURE THE DISTANCE FROM THE TOP OF THE C'SINK. ON THE BOLT TO THE TOP OF THE C'SINK. IN THE HOLE (SEE SKETCH).
IF THIS DISTANCE IS LESS THAN $\frac{3}{16}$" A LONGER BOLT IS NECESSARY TO ENSURE SAFETY.

NOTE:-
$\frac{3}{16}$" IS APPROX. LENGTH OF THREAD ON CROSS SECTION OF NUT.

FIG. 25 — AILERON (2) — FIG. 25

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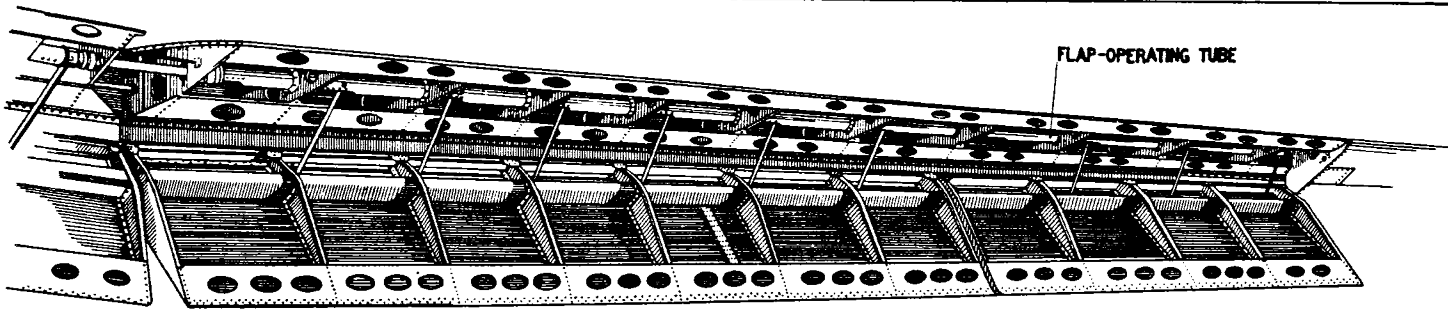
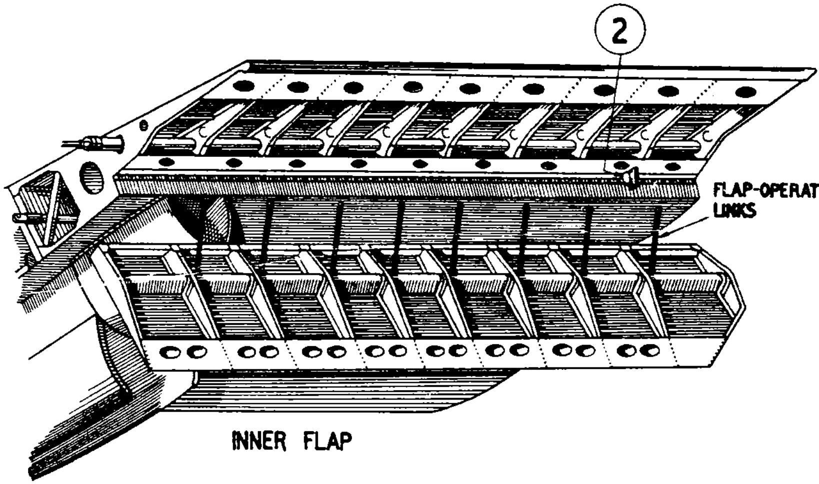
FIG. 26

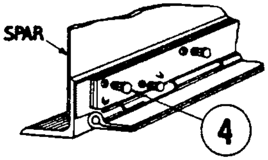
INNER AND OUTER FLAPS

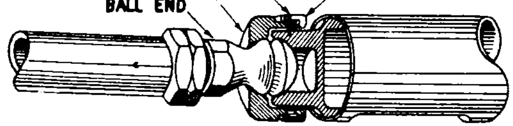


OUTER FLAP

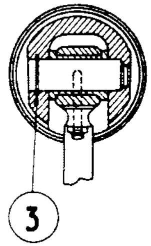


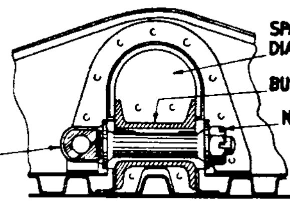
INNER FLAP





DETAIL OF UNIVERSAL JOINT





DETAIL OF LINK CONNECTION AT FLAP SPAR

1 LOWER FLAPS

(2) DISCONNECT OPERATING ROD BETWEEN TRANSMITTER AND FLAP (PORT INNER FLAP ONLY)

(3) DISCONNECT LINKS AT FLAP-OPERATING TUBE AS FOLLOWS: REMOVE CIRCLIPS, USING CIRCLIP PLIERS. SCREW A ¼ IN. B.S.F. BOLT INTO END OF PIN AND WITHDRAW PIN.

(4) REMOVE BOLTS SECURING FLAP HINGE TO MAIN PLANE FALSE SPAR.

5 LOWER FLAP FROM MAIN PLANE.

FIG. 26

P.3589 M /G4663 3/45 1050 C & P Gp. 959

FIG. 27

TRAILING EDGE-INTERMEDIATE PLANE

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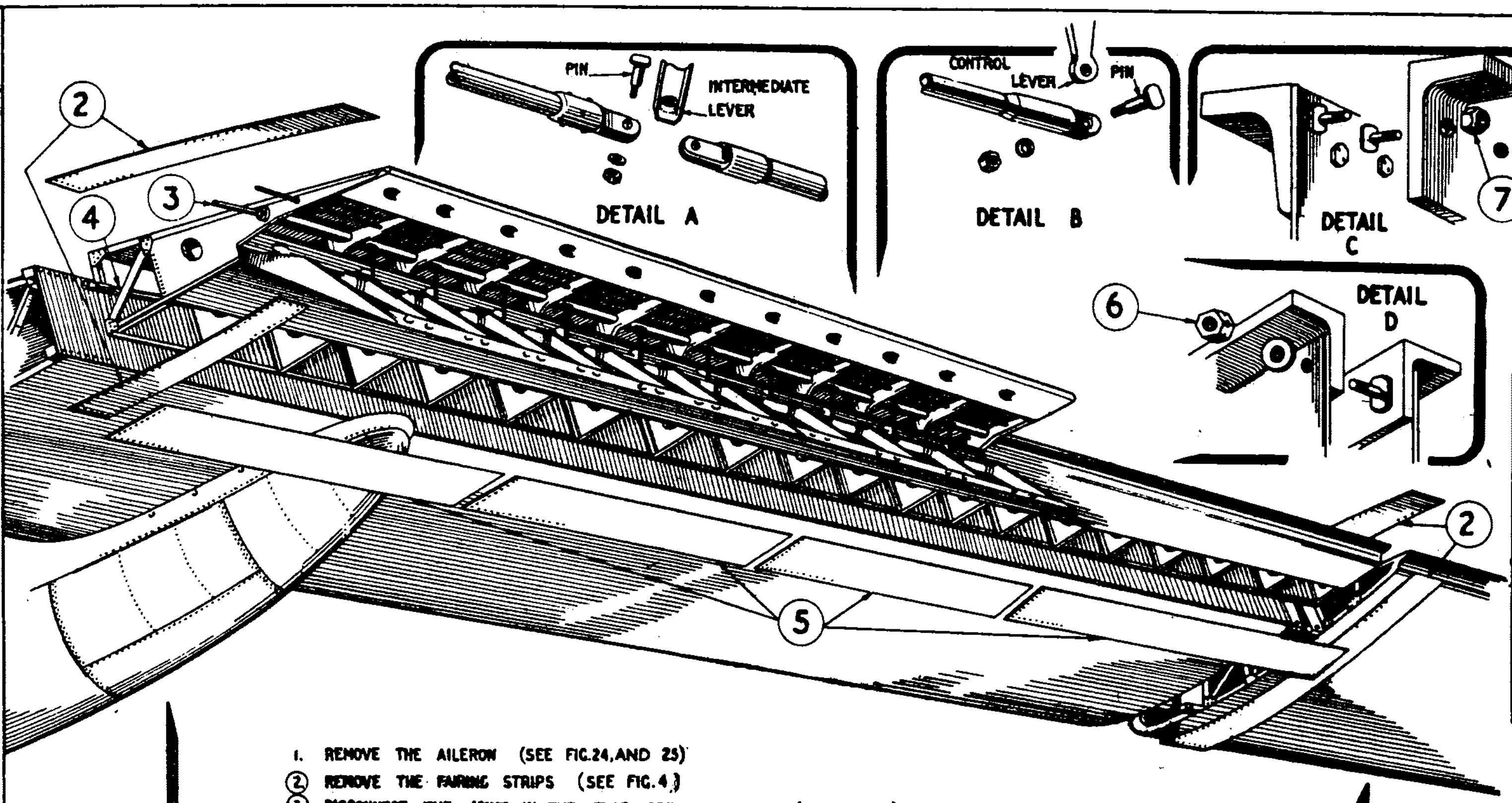

1. REMOVE THE AILERON (SEE FIG.24,AND 25)
2. REMOVE THE FAIRING STRIPS (SEE FIG.4)
3. DISCONNECT THE JOINT IN THE FLAP-OPERATING TUBE (SEE FIG.26)
4. DISCONNECT THE AILERON CONTROL ROD & REMOVE THE BOLT AT THE OUTBOARD END JOINT WITH AILERON LEVER (SEE DETAILS A & B)
5. REMOVE THE ACCESS PANELS ON THE UNDERSIDE OF THE PLANE (SEE FIG. 4)
6. REMOVE THE NUTS FROM THE STUDS WHICH SECURE RIBS 18 & 19 (SEE DETAIL D).
7. SUPPORT THE TRAILING EDGE & REMOVE THE NUTS FROM THE STUDS ATTACHING THE TRAILING EDGE TO THE REAR SPAR (SEE DETAIL C) DRAW THE TRAILING EDGE FROM THE STUDS & LOWER IT FROM THE PLANE.

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KEY TO FIG. 28

To remove trailing edge from main plane:—

(1) Remove top and bottom trailing edge fairing strips along fuselage side and trailing edge.

(2) Remove flap jack covers in fuselage, just aft of rear spar. (See fig. 43).

(3) Support flaps and disconnect flap-operating tube at flap jack. (See fig. 43.)

(4) Lower flaps fully.

(5) Remove top and bottom fairing strips between centre and intermediate plane trailing edges.

(6) Disconnect joint in flap-operating tube at junction of centre plane and intermediate plane.

(7) Remove access doors in bulkhead at rear end of main wheel compartment and remove bolts securing rear ends of main wheel door hinge beams.

(8) Support rear fixed section of inboard nacelle and remove screws securing it to underside of main plane trailing edge.

(9) Remove assembly panels on underside of trailing-edge section, just aft of rear spar (see fig. 4).

(10) Disconnect flap indicator electric cable (port side only).

(11) Disconnect dinghy manual release cable and electrical release cable (starboard only).

(12) Disconnect aileron operating push-pull rod at intermediate lever on outer end of centre plane rear spar, and at joint inside inboard end of trailing edge. (See details A & B.)

(13) Disconnect aileron trimming tab operating cables at turnbuckles, release fairleads and withdraw cables from inboard trailing edge. (See details C & D.)

(14) Support trailing edge and remove nuts securing trailing-edge spar to rear spar of centre plane. (See detail E.)

(15) Carefully draw trailing edge aft from centre plane and then lower outer end so that trailing edge can be drawn outward to clear projection of aileron push-pull control rod.

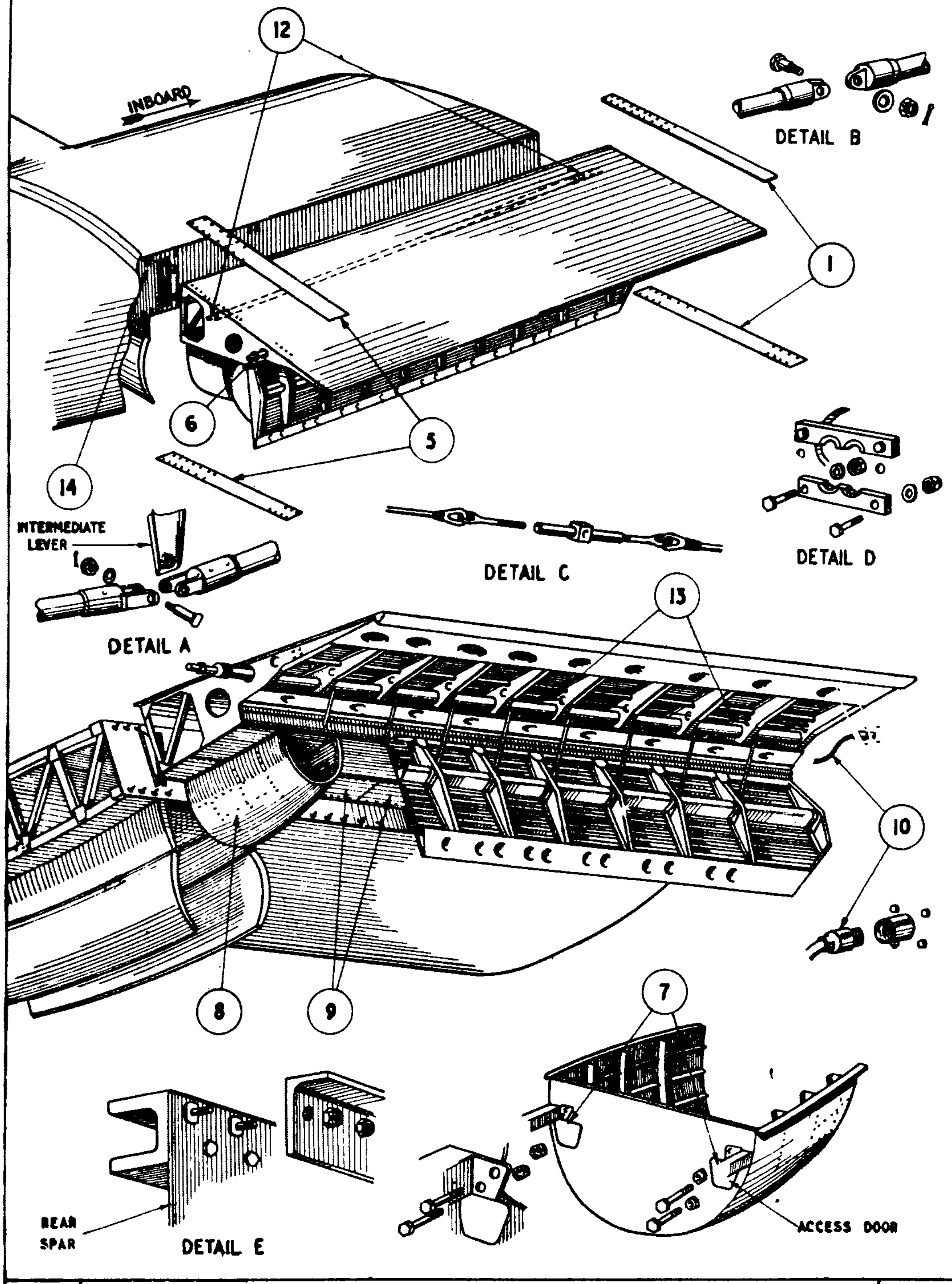

FIG. 28 TRAILING EDGE - CENTRE PLANE FIG. 28

PP3589 M /G4663 3/45 1050 C&P Gp. 959 (4)

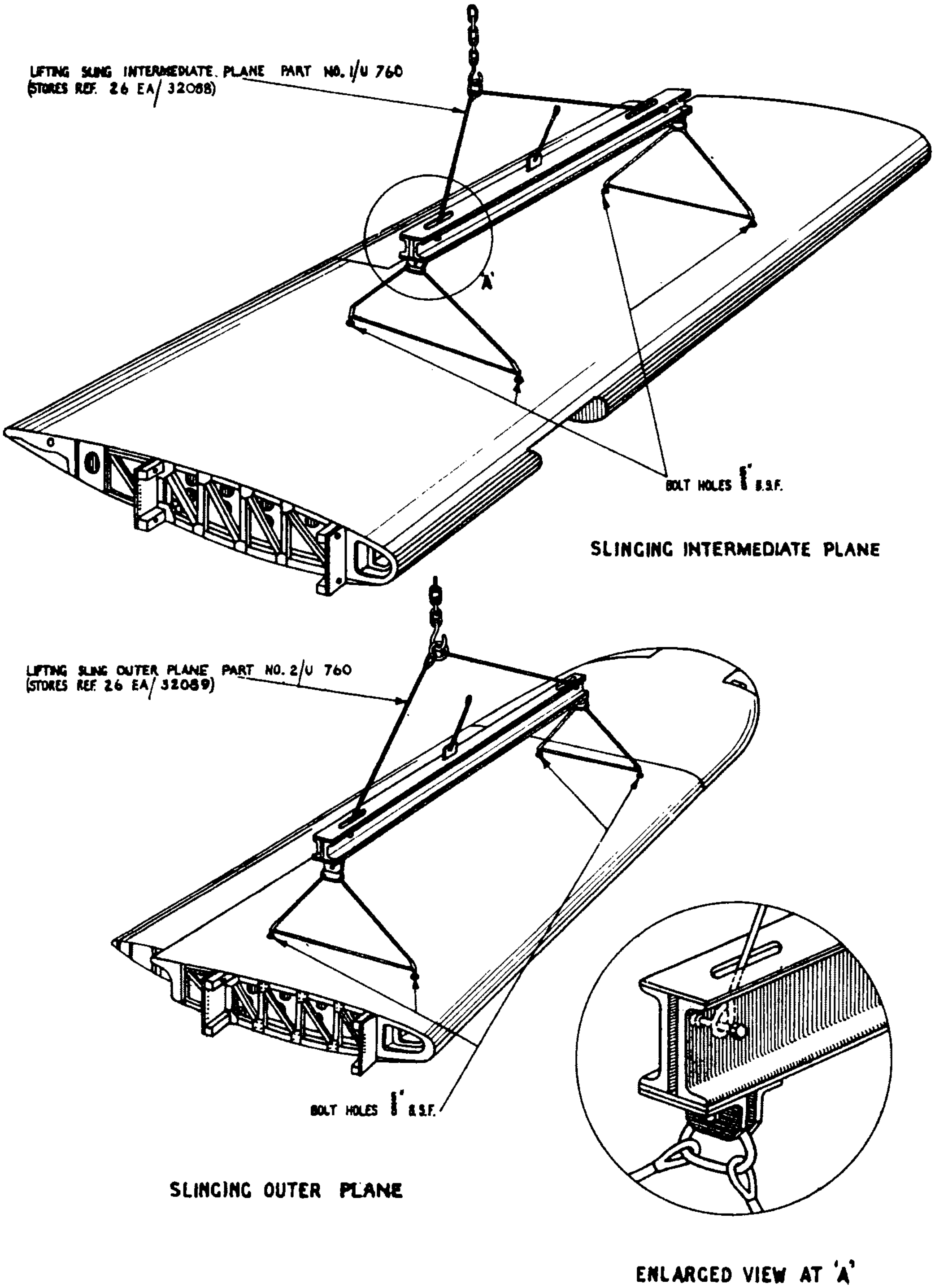

FIG. 29 — SLINGING INTERMEDIATE AND OUTER PLANES — FIG. 29

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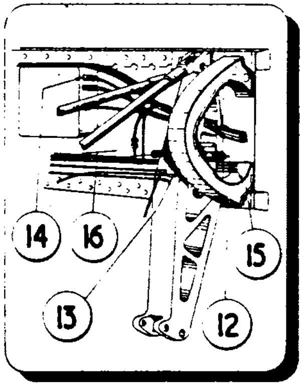
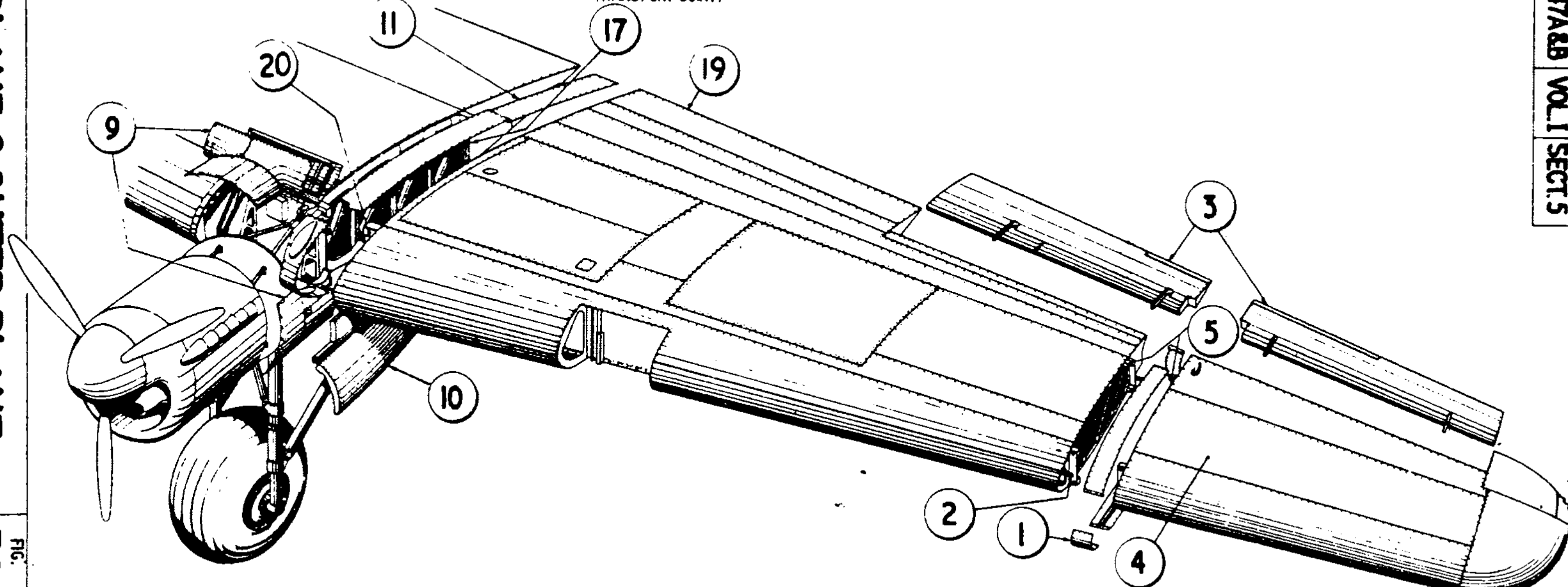
INTERMEDIATE PLANE & OUTER PLANE



① REMOVE JOINT COVER PLATES AT JUNCTION OF INTERMEDIATE PLANE & OUTER PLANE. - SEE FIG.4
② DISCONNECT ELECTRICAL CABLE TO NAVIGATION & RESIN LAMPS.
③ DISCONNECT AND REMOVE AILERON OPERATING GEAR, ALSO INBOARD & OUTBOARD PORTIONS OF AILERON - SEE FIG.24.
④ SLING OUTER PLANE FROM A CRANE - SEE FIG. 29.
⑤ REMOVE SPLIT PINS, UNSCREW NUTS & DRIVE OUT BOOM JOINT PINS - REMOVE JOINT PLATE - SEE FIG. 33.
6. LOWER THE OUTER PLANE.
7. REMOVE OUTBOARD POWER PLANT - SEE FIG. 10.
8. REMOVE OUTBOARD ENGINE SUB - FRAME - SEE FIG. 17.
⑨ REMOVE INBOARD ENGINE FAIRING PANELS BETWEEN FIREWALL & FRONT SPAR.
⑩ REMOVE OUTBOARD UNDERCARRIAGE DOOR & VALANCE FAIRING - SEE FIG. 21.
⑪ REMOVE TRANSPORT JOINT COVER PANELS AT JUNCTION OF CENTRE SECTION & INTERMEDIATE PLANE.- SEE FIG.4
⑫ DISCONNECT FUEL SUPPLY PIPE TO OUTBOARD ENGINE AT TRANSPORT JOINT.
⑬ DISCONNECT PNEUMATIC BOOST & DOPER PIPES AT TRANSPORT JOINT.
⑭ DISCONNECT ALL ELECTRICAL CONDUITS GOING OUTBOARD, AT THE JUNCTION BOX MOUNTED BETWEEN THE U/C. BEAMS ON FRONT SPAR.
⑮ DISCONNECT OUTBOARD ENGINE CONTROL RODS AT TURNBUCKLES.
⑯ DISCONNECT OUTBOARD ENGINE BOOST CABLE AT THIMBLE ON FRONT SPAR BETWEEN U/C. BEAMS, WITHDRAW & COIL.
⑰ REMOVE SPLIT PIN & DISCONNECT AILERON PUSH-PULL CONTROL ROD AT INTERMEDIATE LEVER ON CENTRE SECTION REAR SPAR.
18. DISCONNECT FLAP OPERATING TUBE - SEE FIG. 26.
⑲ SLING INTERMEDIATE PLANE FROM A CRANE - SEE FIG. 29.
⑳ REMOVE SPLIT PINS, UNSCREW NUTS & DRIVE OUT BOOM JOINT PINS - REMOVE JOINT PLATE - SEE FIG. 31 & 32
21 LOWER INTERMEDIATE PLANE FROM AIRCRAFT.



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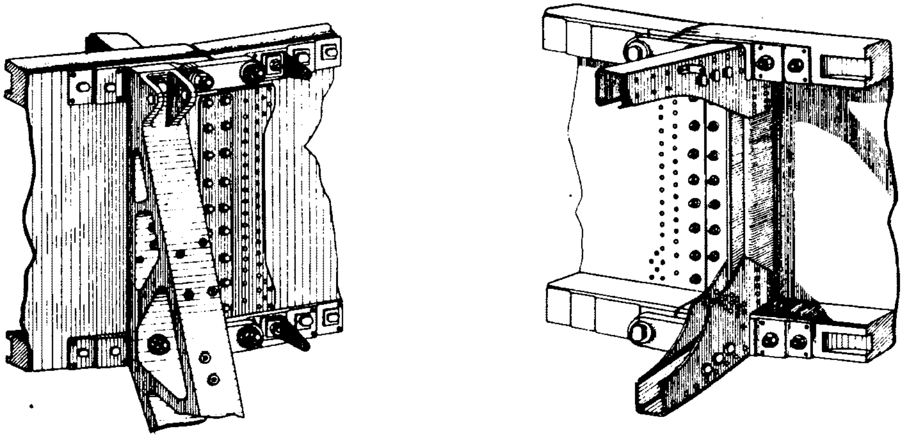

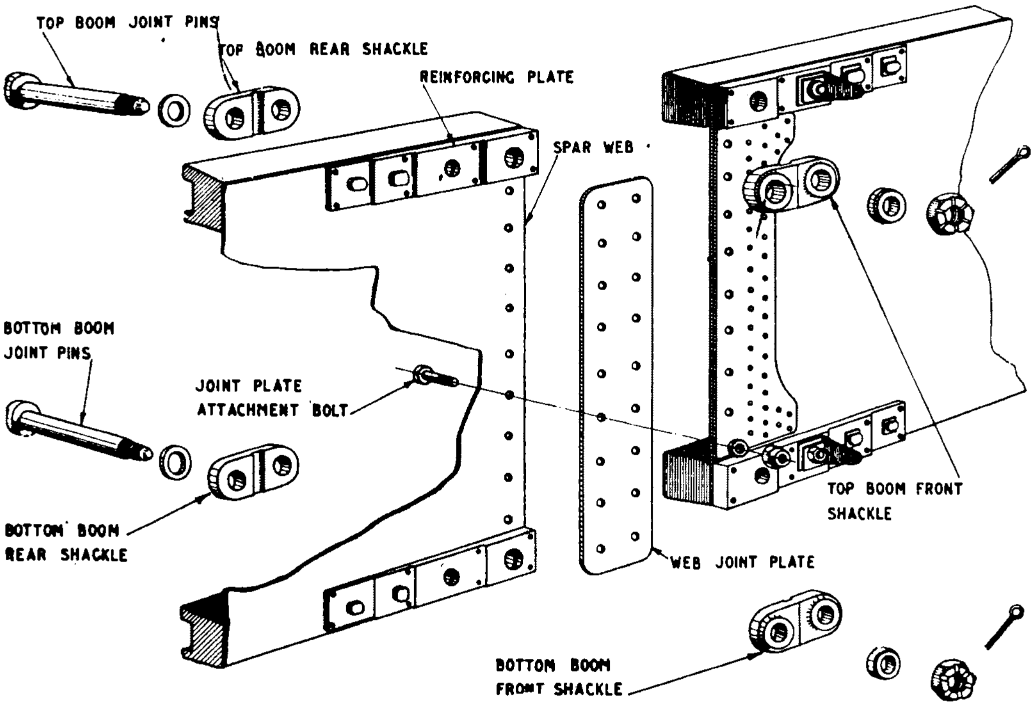

NOTE:-
USE SPANNERS PT. No 1.Z.2877 (STORES REF. 26EA/32635) FOR NUTS ON JOINT PINS.

FIG. 31

DETAIL OF FRONT SPAR JOINT
INTERMEDIATE PLANE TO CENTRE PLANE.

FIG. 31

PP4029 M /G2287 10/45 1050 C&P Gp. 959 (4)

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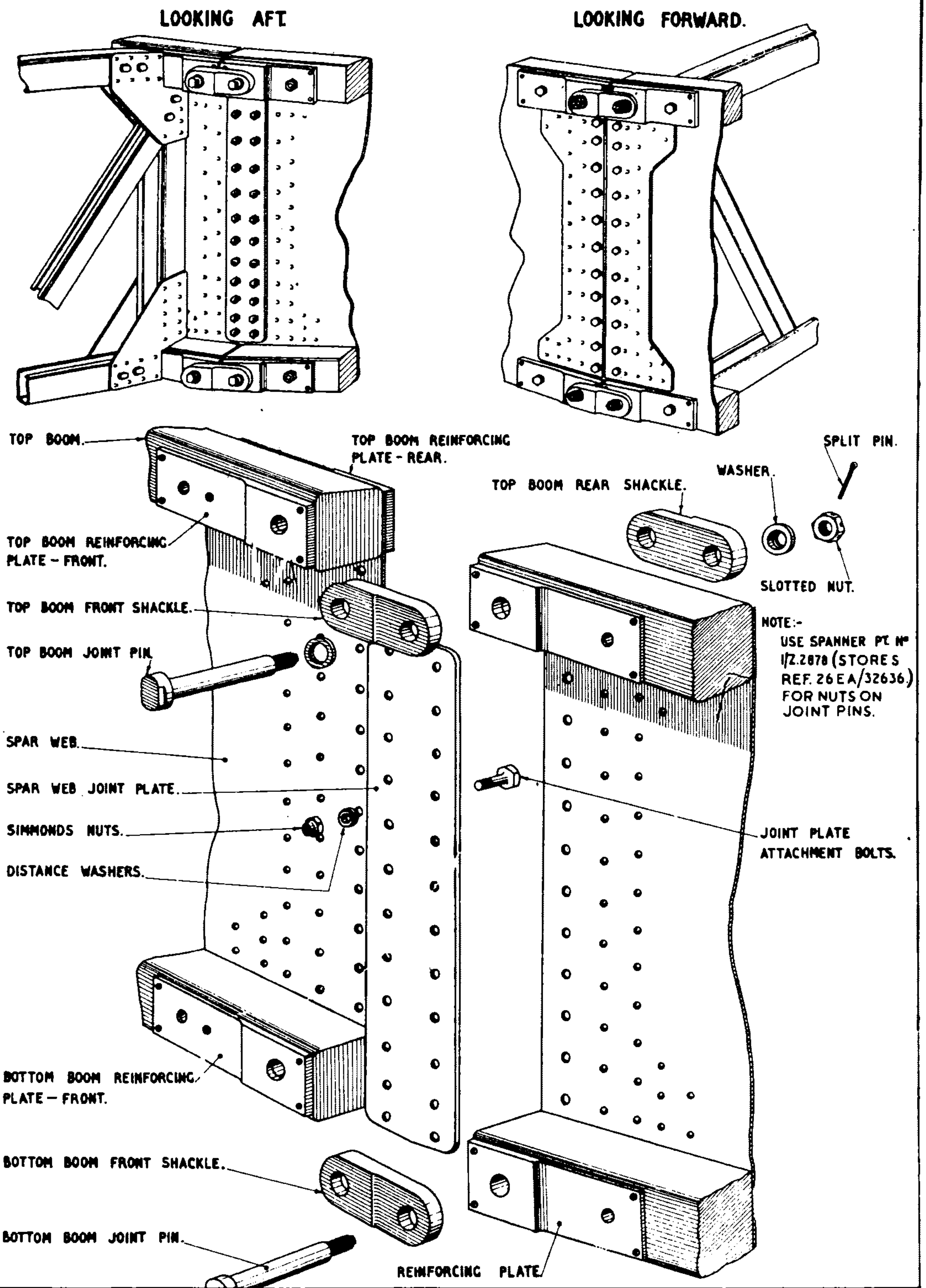
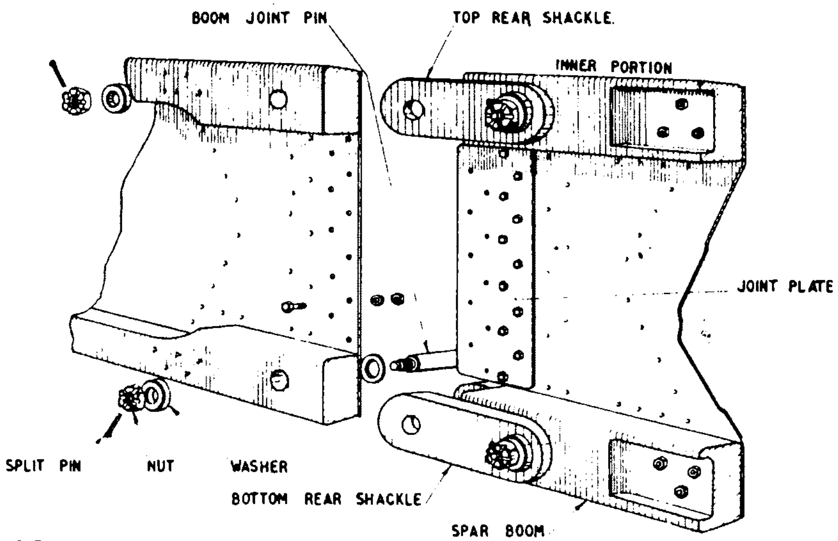


FIG. 32

DETAIL OF REAR SPAR JOINT.
INTERMEDIATE PLANE TO CENTRE PLANE.

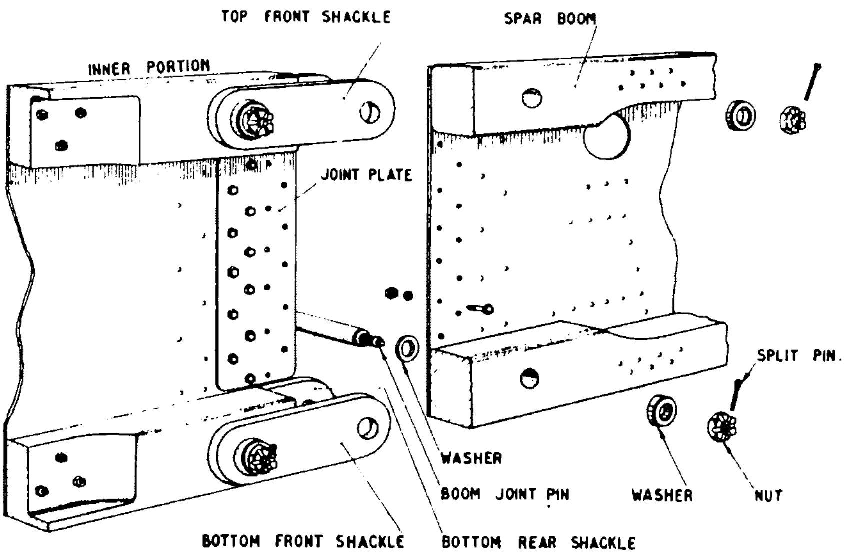
FIG. 32

PP4029 M /G2286 9/45 1050 C & P Gp. 959 (4)



NOTE:—
USE SPANNER PT. Nº 1/Z 2502 (STORES REF. 26 EA/16997) FOR NUTS ON JOINT PINS.

VIEW ON FRONT SPAR JOINT LOOKING FORWARD



NOTE:—
USE SPANNER PT. Nº 1/Z.2501 (STORES REF. 26 EA/16996) FOR NUTS ON JOINT PINS.

VIEW ON REAR SPAR JOINT LOOKING AFT.

FIG. 33

FRONT AND REAR SPAR JOINTS
OUTER PLANE TO INTERMEDIATE PLANE.

FIG. 33

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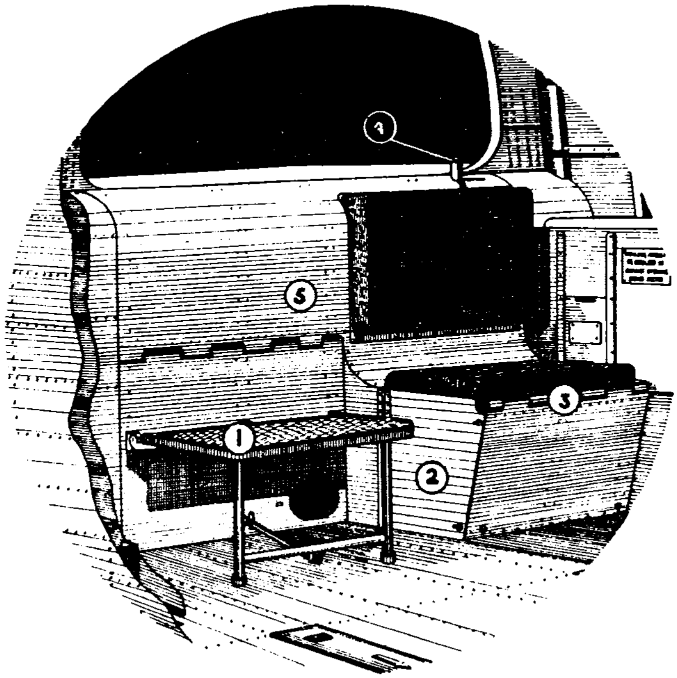
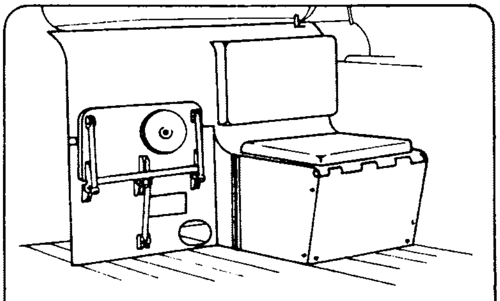
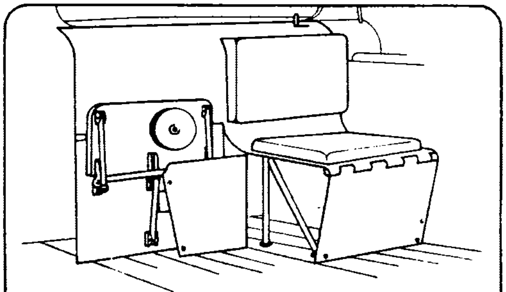
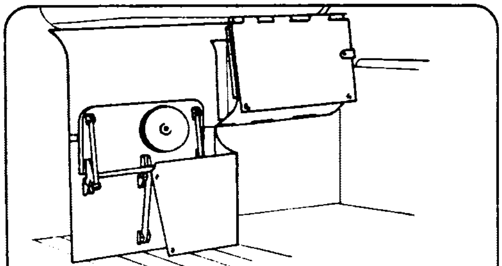




1 FOLD UP THE STEP.

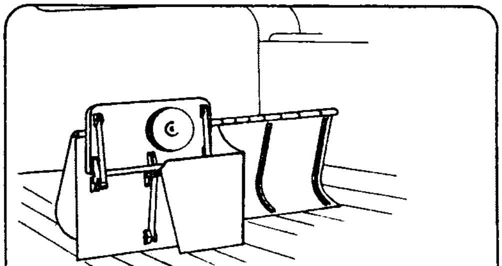


2 RELEASE THE TWO FASTENERS ON THE SEAT SIDE PANEL AND FOLD SIDE PANEL BACK.



3 RELEASE THE TWO FASTENERS AT THE BOTTOM OF THE SEAT FRONT PANEL. FOLD THE SEAT UP AND THE FRONT PANEL DOWN. SECURE WITH THE STRAP ATTACHED.

4 PULL THE PROJECTING HANDLE OF THE SECURING BOLT TOWARDS THE PORT SIDE. THE BOLT MUST BE HELD BACK.



5 LIFT THE COVER TO RELEASE THE FLOOR PEGS AND DRAW IT FORWARD FROM THE SPAR. FOLD THE UPPER PORTION OF THE COVER BACKWARD AND DOWN TO THE FLOOR.

6 TO REMOVE EITHER PORT OR STARBOARD SIDE PANELS RELEASE TOP FASTENERS AND LIFT FROM THE FLOOR.

FIG. 34 — FRONT SPAR COVER — FIG. 34

PP3589 M /G4663 3·45 1050 C&P Gp. 959 (4)

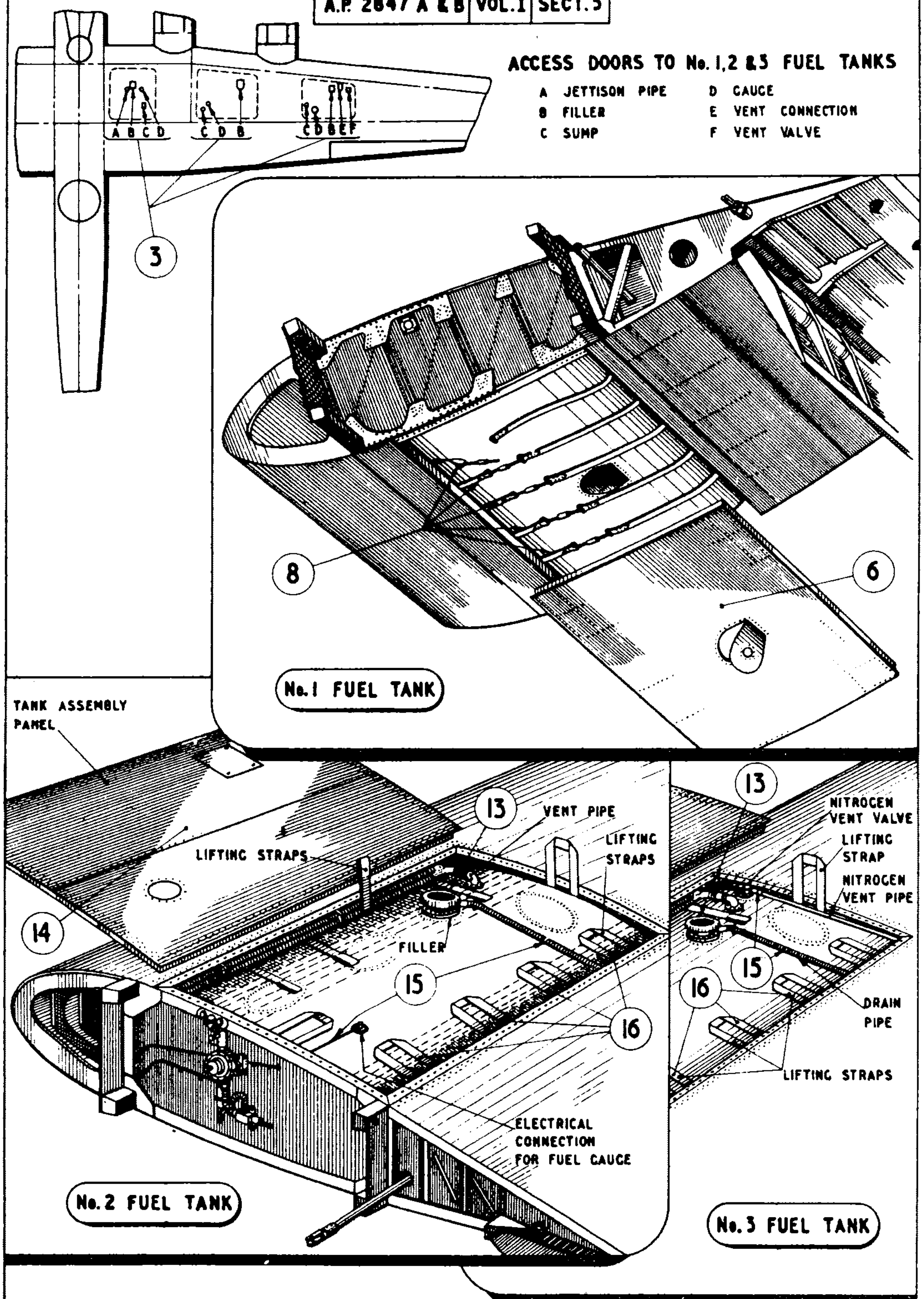


FIG. 35

FUEL TANKS (1)

FIG. 35

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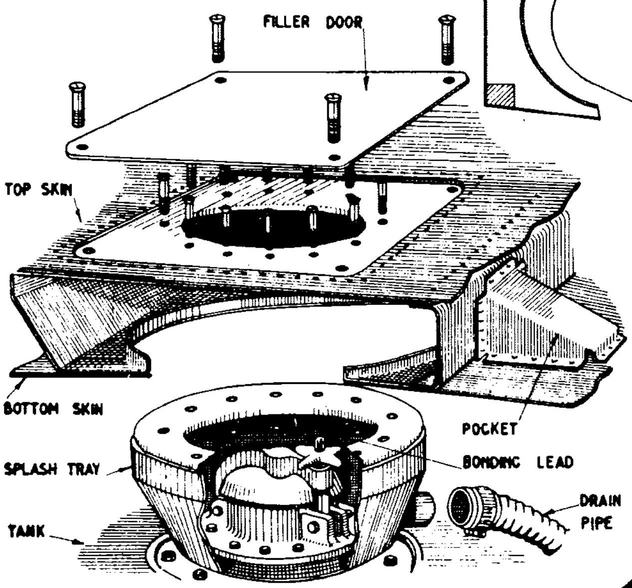
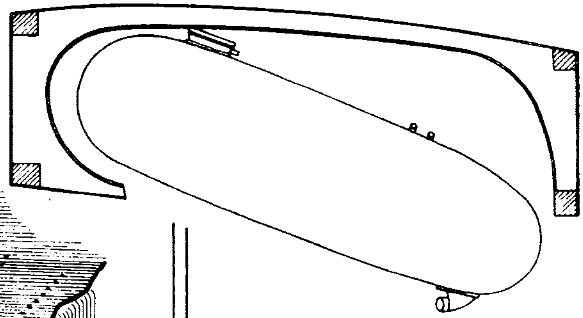
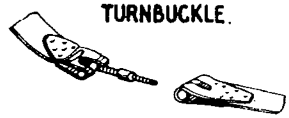
DETAIL OF TANK FILLER
(No 2 AND 3 TANKS)





DETAIL 'A'.
LOWERING OF No I TANK

DETAIL OF TURNBUCKLE.



TANK No I

1 PLACE A SUITABLE PLATFORM BENEATH THE ASSEMBLY PANEL IN THE MAIN PLANE

2 DRAIN OR PARTLY DRAIN THE FUEL SYSTEM AS REQUIRED (SEE SECT. 4 CHAP. 3)

(3) REMOVE ACCESS DOORS IN UPPER SURFACE OF PLANE AND REMOVE FILLER CAP ASSEMBLY LEAVING SPLASH TRAY IN POSITION.

4 DISCONNECT ALL PIPES AND ELECTRICAL LEADS AT THE TOP OF THE TANK

5 REMOVE THE NUT FROM THE END OF THE SPINDLE SECURING THE JETTISON PIPE DOOR TO THE UNDERSIDE OF THE MAIN PLANE

(6) REMOVE THE TANK ASSEMBLY PANEL FROM THE UNDERSIDE OF THE MAIN PLANE

7 DISCONNECT THE DELIVERY PIPE AT THE CONNECTION TO THE TANK.

(8) SUPPORT THE TANK AND UNSCREW THE TURNBUCKLE OF EACH STRAP.

9 LOWER THE REAR END OF THE TANK AND WITHDRAW IT FROM THE MAIN PLANE (SEE DETAIL 'A')

TANKS No 2 & 3

10 DRAIN OR PARTLY DRAIN FUEL SYSTEM AS REQUIRED (SEE SECT. 4 CHAP. 3)

11 TAKE THE WEIGHT OF THE OUTBOARD ENGINE BY SLINGING OR TRESTLING.

12 REMOVE THE ACCESS DOOR UNDER THE MAIN PLANE AND DISCONNECT THE DELIVERY PIPE FROM THE TANK.

(13) REMOVE THE SCREWS SECURING THE SPLASH TRAY TO THE ACCESS PANEL AT THE FILLER CAP. NOTE THAT THE BONDING LEAD MUST BE RECONNECTED ON RE-ASSEMBLY.

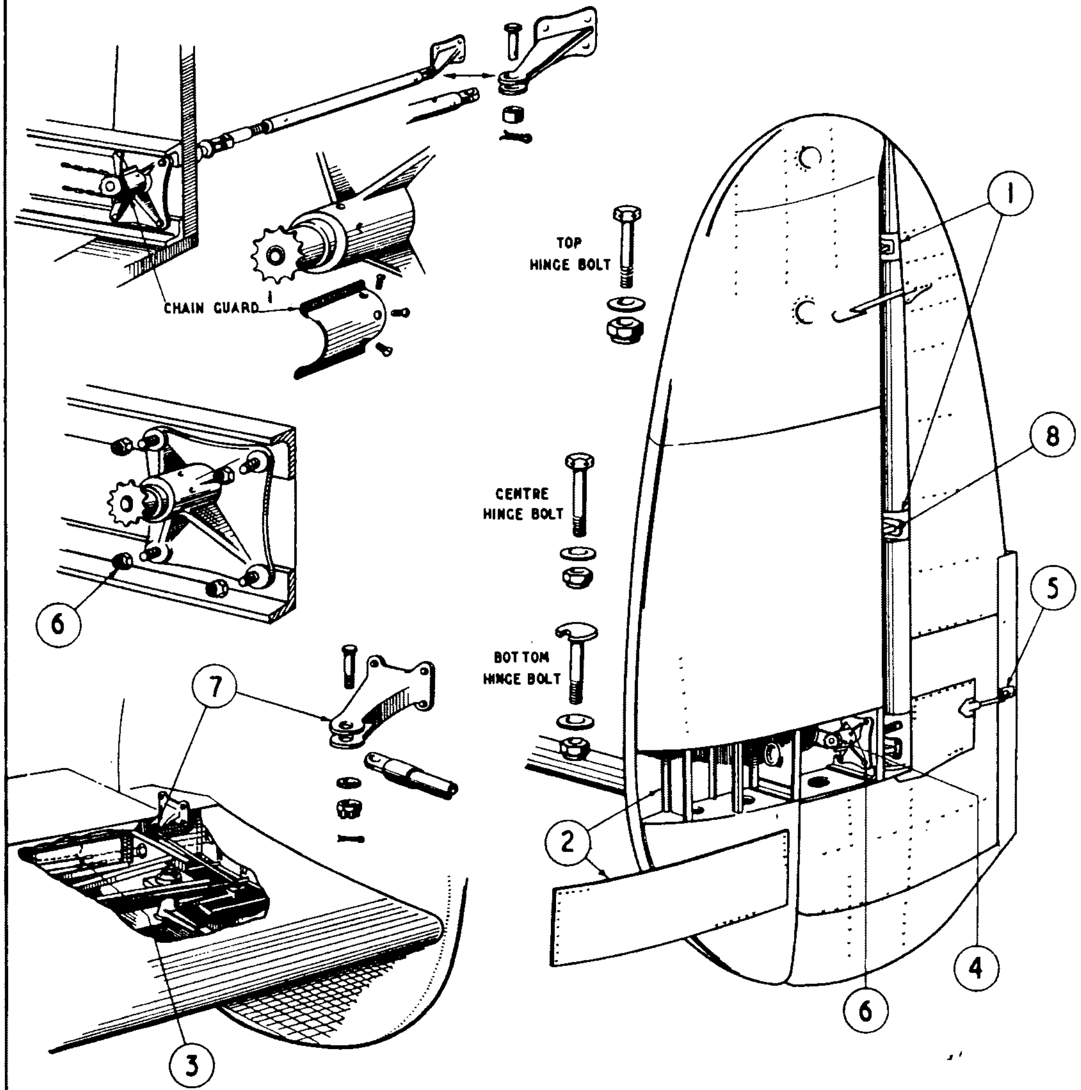
(14) REMOVE THE SCREWS SECURING THE TANK ASSEMBLY PANEL AND LIFT AWAY THE PANEL. WHEN REPLACING A PANEL FIT AT LEAST TWO SCREWS AT DIAGONALLY OPPOSITE CORNERS AND CHECK ALIGNMENT OF SCREW HOLES. IF NECESSARY RAISE OR LOWER THE ENGINE TO ENABLE THE SCREWS TO BE FITTED.

(15) DISCONNECT ALL PIPES AND ELECTRICAL LEADS AT THE TOP OF THE TANK.

(16) LIFT THE TANKS BY MEANS OF THE STRAPS AND REMOVE WITH GREAT CARE.

FIG. 36 — FUEL TANKS (2) — FIG. 36

PP3454 M /G4037 1/45 1050 C & P Gp. 959 (4)



(1) REMOVE THE THREE HINGE INSPECTION COVERS AT THE NOSE OF THE RUDDER.

(2) REMOVE THE ACCESS PANEL ON THE OUTER FACE OF THE FIN BY REMOVING THE RIVETS - SEE FIG.4

(3) REMOVE THE ACCESS DOOR IN THE UPPER SURFACE OF THE TAILPLANE OUTER END.

(4) DISCONNECT THE RUDDER TRIMMING TAB OPERATING CABLE, DETACH THE GUARD AND REMOVE THE CHAIN FROM THE SPROCKET IN THE FIN.

(5) DISCONNECT THE TRIMMING TAB OPERATING ROD AT THE TAB, UNSCREW AND REMOVE. (THE SPROCKET MUST BE PREVENTED FROM TURNING WHILE THE ROD IS UNSCREWED)

(6) REMOVE THE NUTS SECURING THE SPROCKET BEARING HOUSING TO THE OUTER END OF THE TAILPLANE REAR SPAR, AND WITHDRAW THE HOUSING COMPLETE WITH THE UNIVERSAL JOINT AND THE SCREWED FORK-END

(7) REMOVE THE BOLT SECURING THE RUDDER ACTUATING LEVER TO THE CONNECTING ROD IN THE TAILPLANE.

(8) SUPPORT THE RUDDER, REMOVE THE THREE HINGE BOLTS AND LOWER THE RUDDER FROM THE FIN.

FIG. 37 — **RUDDER** — FIG. 37

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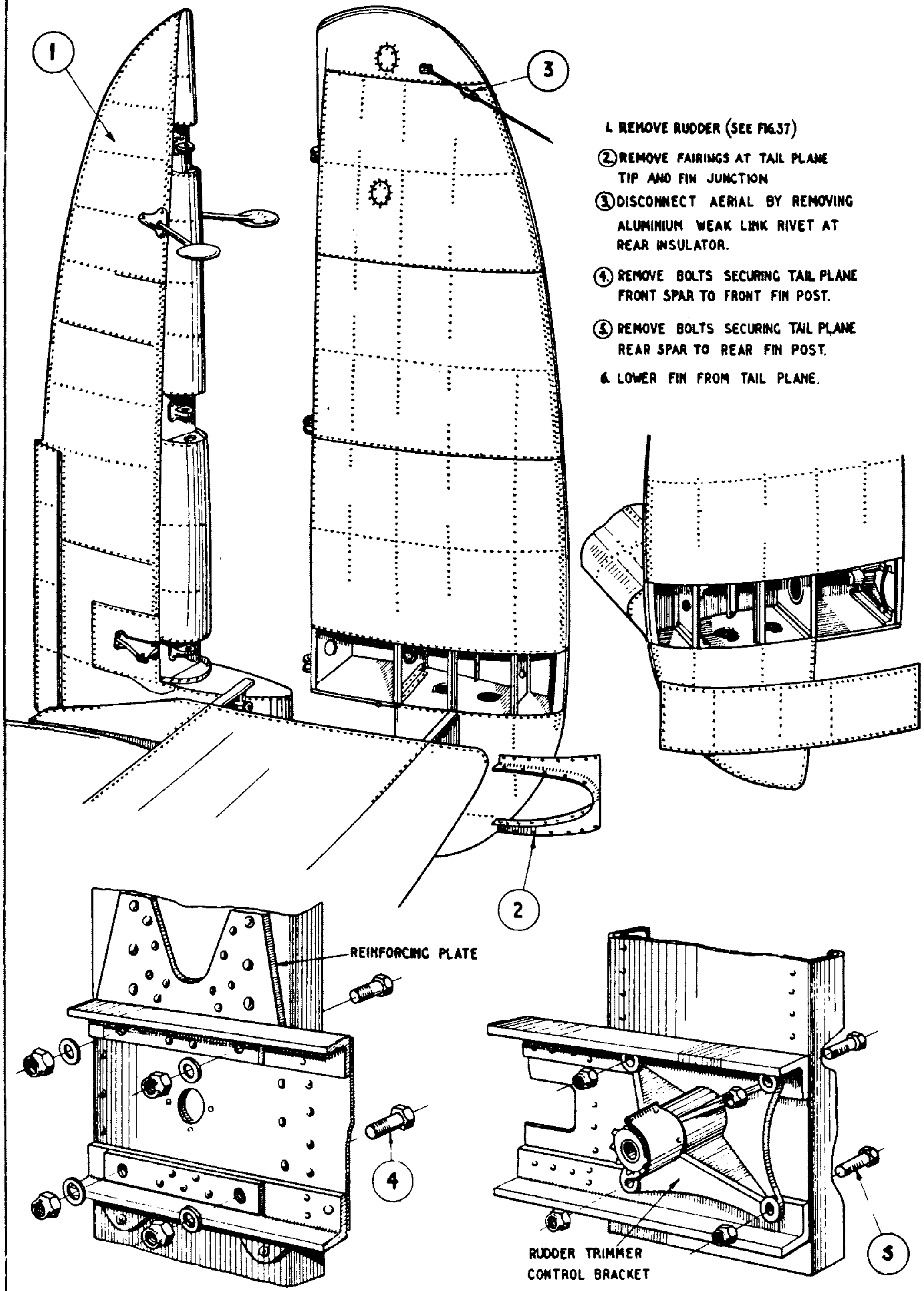

FIG 38 — FIN — FIG 38

PP3589 M /G4663 3/45 1050 C&P Gp. 959 (4)

KEY TO FIG. 39

(1) Disconnect elevator control rod at torque shaft lever

(2) Remove bonding lead from torque shaft

(3) Disconnect coupling at each side of elevator torque shaft and remove centre portion of shaft

(4) Disconnect elevator trimming tab cable turnbuckle at centre of fuselage behind rear spar

5 Disconnect elevator trimming tab cables at turnbuckles forward of tail plane front spar

(6) Remove Vickers pulleys mounted at former 39

(7) Remove fairlead in fuselage side and pass cables through opening

(8) Remove access doors on top and bottom surfaces

(9) Remove three taper pins securing outer ends of elevator torque shaft to inner end of elevator spars and draw ends of torque shaft into fuselage

(10) Remove access doors in bottom surface of elevator just aft of hinges

(11) Support elevator, remove split pins and nuts from hinge bolts and draw elevator from tail plane

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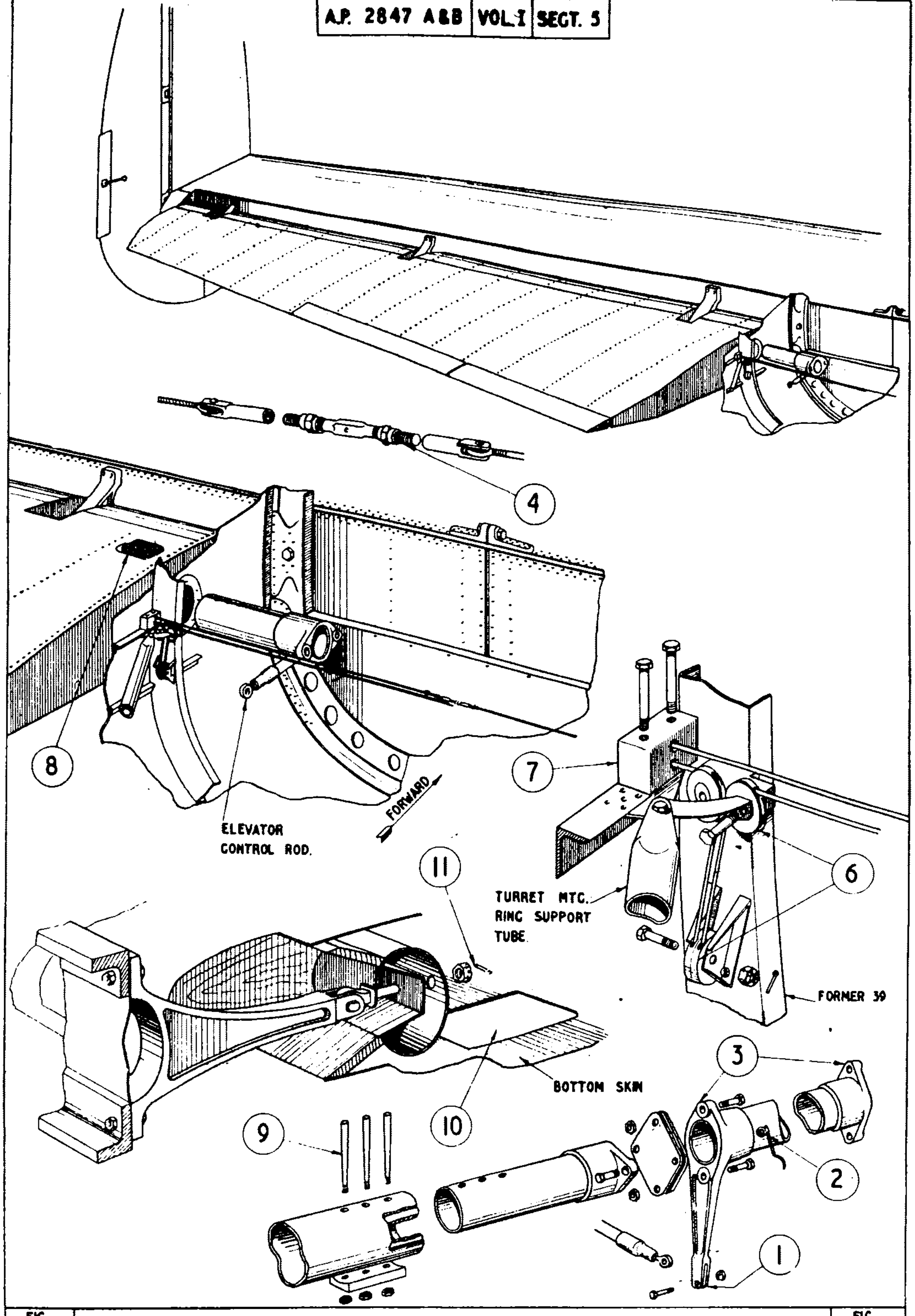

FIG. 39 **ELEVATOR** FIG. 39

REPRINT PP3589 M /G4663 4/45 1050 C & P Gp. 959(4)

KEY TO FIG. 40

Trestle rear end of fusélage and:—

(1) Remove all tail plane root fairings (see fig. 4).

(2) Disconnect aerial at top of each fin by removing aluminium "weak link" rivet at rear insulator.

(3) Disconnect aerial (if fitted) from tail plane.

(4) Disconnect elevator control rod at torque shaft lever.

(5) Disconnect couplings at each end of elevator torque shaft.

(6) Remove three taper pins securing outer ends of elevator shaft to inner ends of elevator spars on side of fuselage, and draw ends of torque shaft into fuselage.

(7) Remove bolts securing walkway across top of tail plane in centre of fuselage and securing walkway in rear end of fuselage to angle brackets on tail plane rear spar.

(8) Remove four inspection panels on top surface of tail plane inside fuselage.

(9) Disconnect and remove rod connecting rudder push-pull controls in fuselage to lever between tail plane spars.

(10) Disconnect starboard rudder push-pull control at lever between tail plane spars in fuselage.

(11) Tie elevator and rudder trimming tab cables with string at control box in pilot's cockpit to prevent cables unwrapping over sides of drum.

(12) Disconnect elevator and rudder trimming tab control cables at turnbuckles on port side of fuselage forward of tail plane front spar.

(13) Remove fairleads on fuselage formers between turnbuckles and tail plane rear spar.

(14) Remove four Vickers pulleys between tail plane spars and draw rudder trimming tab cables into tail plane.

(15) Disconnect rudder trimming tab cable turnbuckle at centre of fuselage between tail plane spars.

(16) Disconnect elevator trimming tab cable turnbuckle at centre of fuselage aft of tail plane rear spar.

(17) Remove four Vickers pulleys at first former aft of tail plane rear spar and remove fairlead on each side of fuselage.

(18) Withdraw cables leading forward and pass them through sides of fuselage.

(19) Remove four bolts securing draught-proof plate to rear spar of tail plane.

(20) Detach canvas bulkhead below front spar of tail plane and remove fastener studs from spar.

(21) Remove eight bolts securing tail wheel strut anchorage plate on top of tail plane.

(22) Remove fibre packing blocks positioned between ends of fuselage formers, and at top and bottom skin of tail plane.

(23) Support tail plane at each side of fuselage on suitable trestles.

(24) Remove attachment bolts at top and bottom joints at centre of tail plane.

(25) Remove main attachment bolts securing tail plane front and rear spars to fuselage formers 35 and 38. Unscrew rear spar bolt bushes until flush with former. Withdraw tail plane horizontally from each side of fuselage. Care must be taken not to damage fuselage formers and trimming tab cables.

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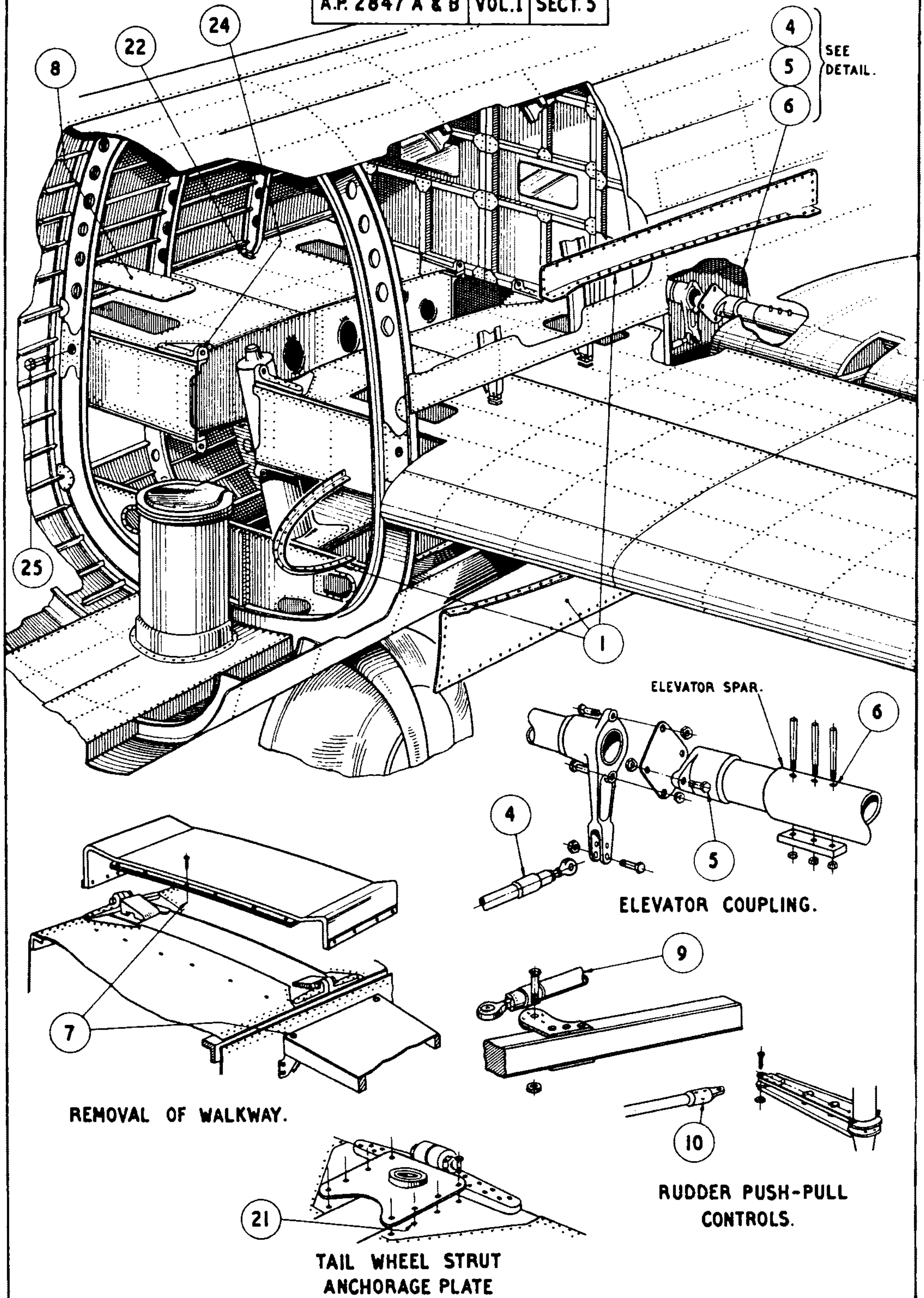
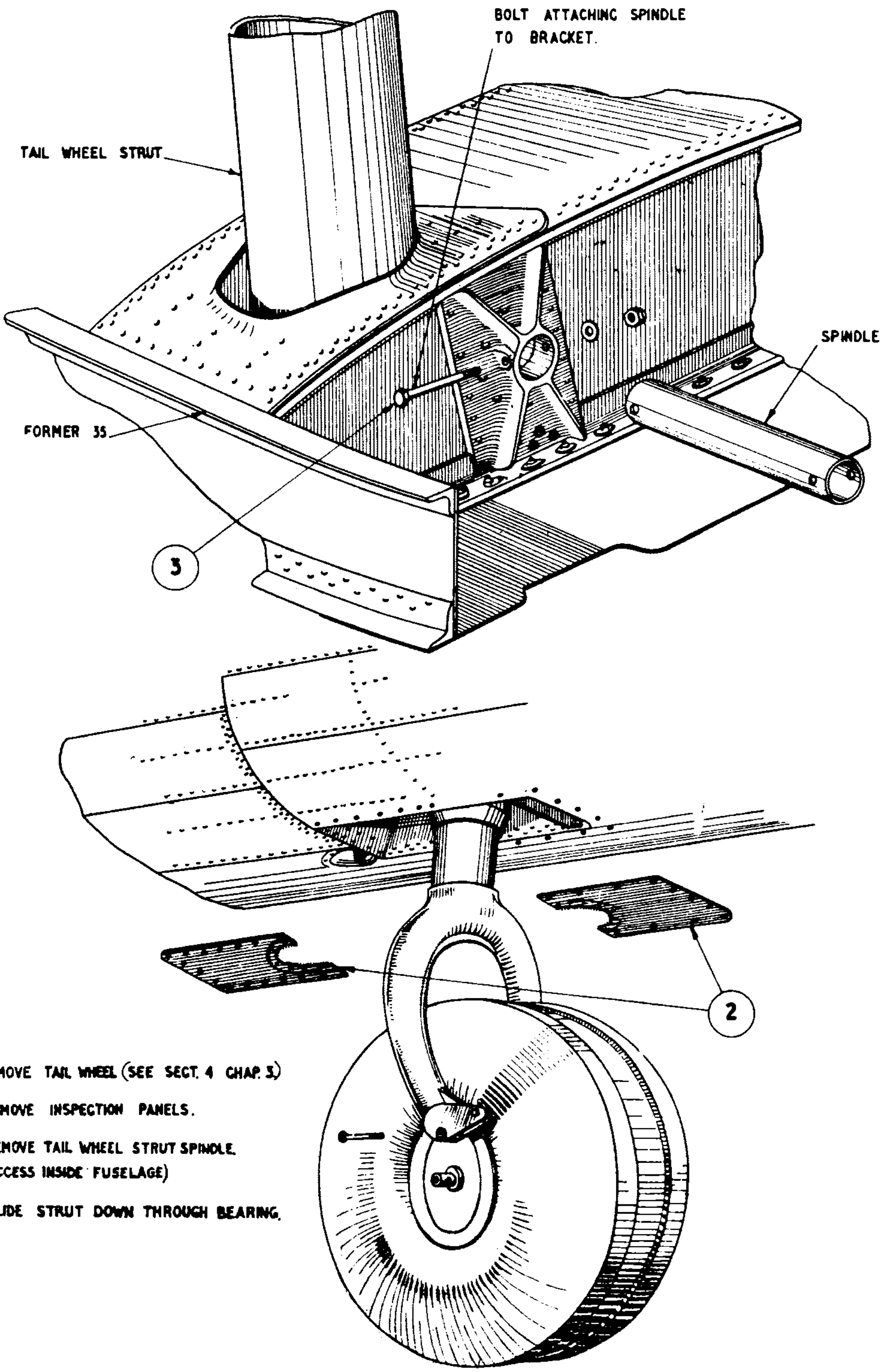


FIG. 40 — TAIL UNIT — FIG. 40

PP3589 M /G4663 3/45 1050 C&P Gp. 959 (4)



1. REMOVE TAIL WHEEL (SEE SECT. 4 CHAP. 3)
2. REMOVE INSPECTION PANELS.
3. REMOVE TAIL WHEEL STRUT SPINDLE. (ACCESS INSIDE FUSELAGE)
4. SLIDE STRUT DOWN THROUGH BEARING.

FIG. 41 — TAIL WHEEL STRUT — FIG. 41

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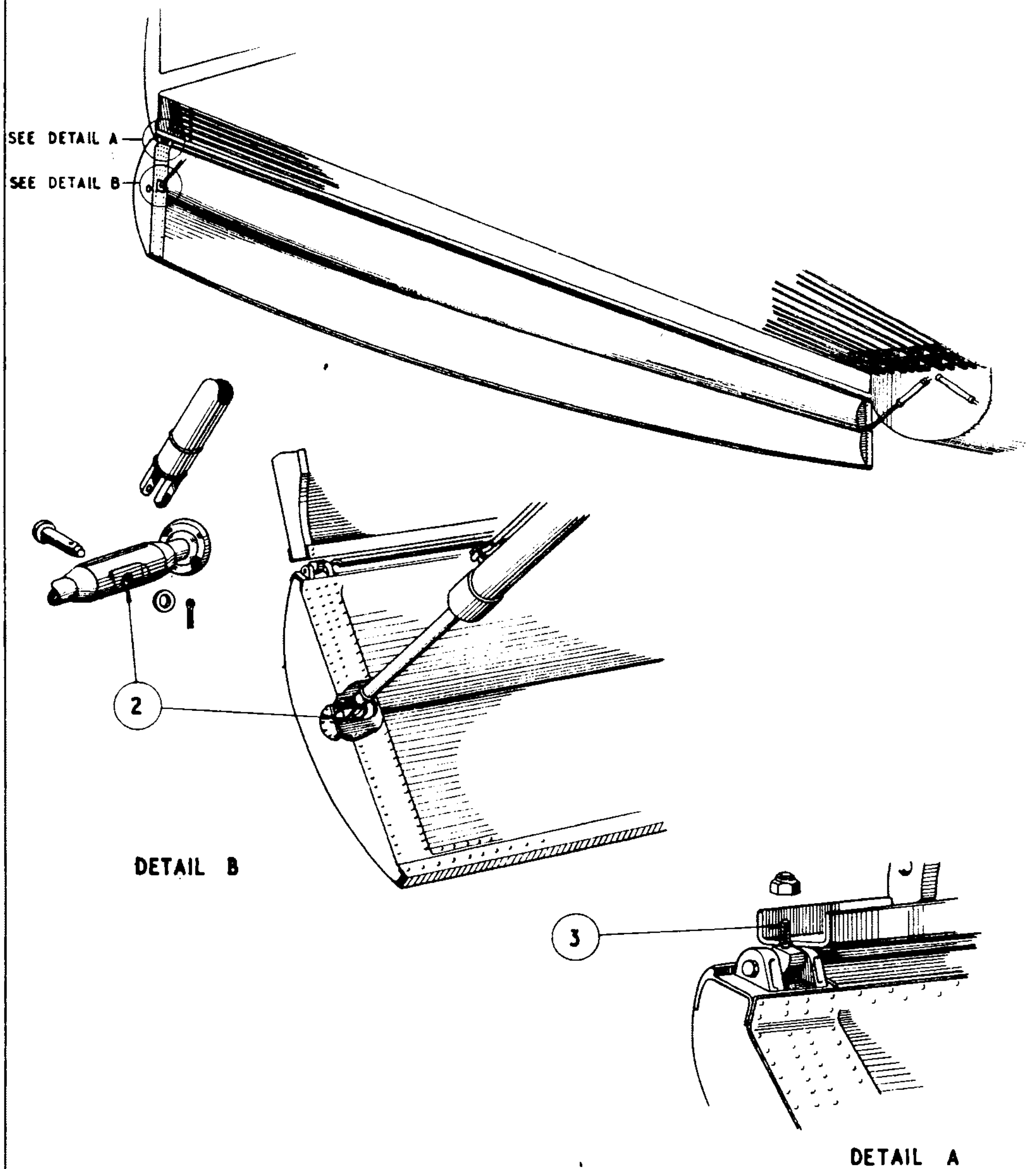


TO REMOVE THE BOMB DOORS PROCEED AS FOLLOWS:-

1 OPEN THE BOMB DOORS BY SETTING THE LEVER BY THE PILOT'S SEAT TO "OPEN."

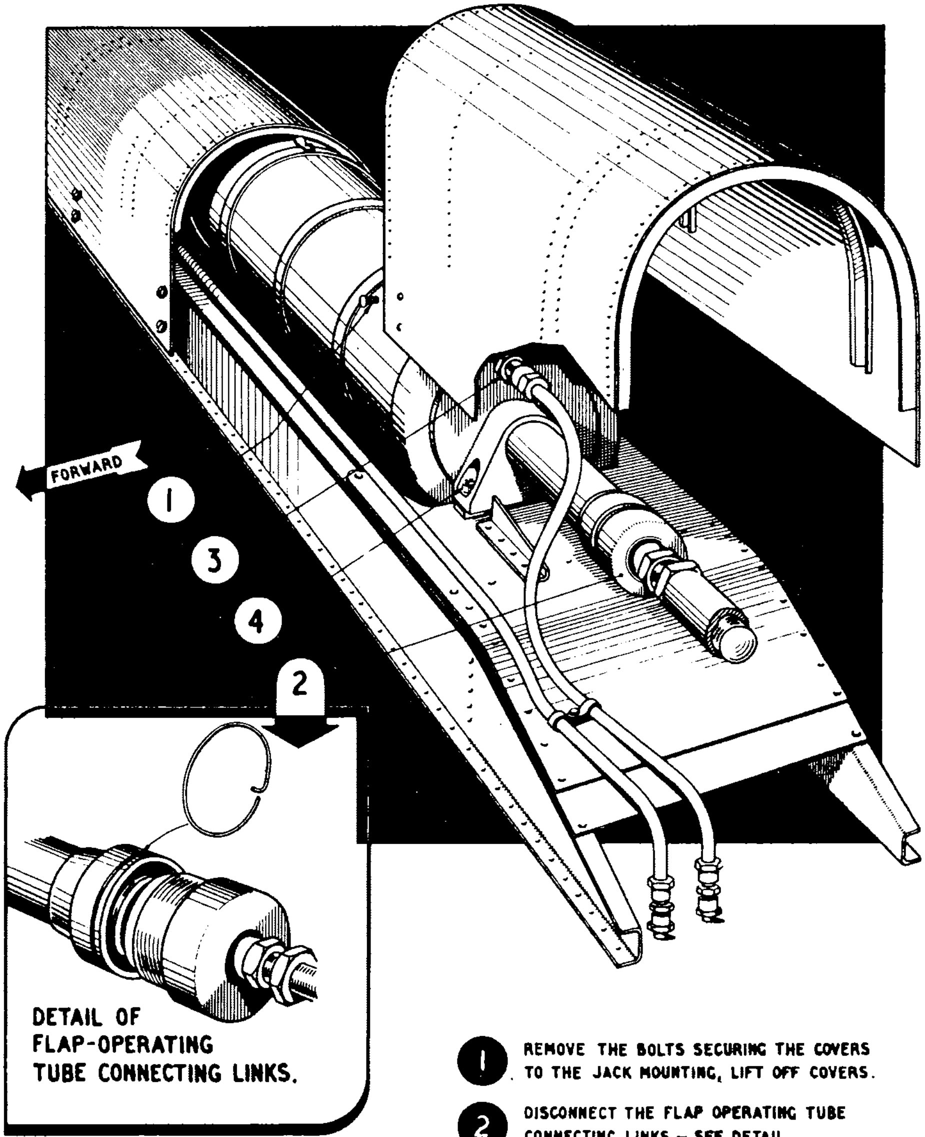
(2) WITHDRAW THE PIN AT THE LOWER END OF THE HYDRAULIC JACKS AT EACH END OF THE DOORS.

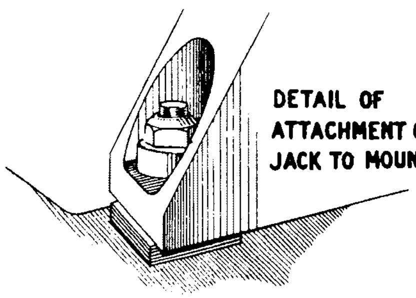
(3) SUPPORT THE BOMB DOOR AND REMOVE THE SIMMONDS NUTS FROM THE TOP HINGE EYEBOLTS SECURING THE BOMB DOOR TO THE FUSELAGE RAIL.

NOTE:- DO NOT TRY TO REMOVE THE HINGE PINS WITH THE DOOR IN POSITION.

FIG. 42 — BOMB DOORS — FIG. 42

PP3454 M /G4037 1/45 1050 C&P Gp. 959 (4)





DETAIL OF
ATTACHMENT OF
JACK TO MOUNTING.

1. REMOVE THE BOLTS SECURING THE COVERS TO THE JACK MOUNTING, LIFT OFF COVERS.
2. DISCONNECT THE FLAP OPERATING TUBE CONNECTING LINKS – SEE DETAIL.
3. DISCONNECT THE PIPE CONNECTIONS AT EACH END OF THE JACK.
4. REMOVE FOUR NUTS SECURING THE ENDS OF THE JACK TO THE MOUNTING – SEE DETAIL.
5. RAISE THE JACK AND REMOVE FROM MOUNTING.

FIG. 43 — FLAP HYDRAULIC JACK — FIG. 43

ELECTRICAL AND RADIO WIRING AND SERVICING 6

(11065) T14574/G2588 1050 11/44 M20691 C & P 752

CHAPTER I

ELECTRICAL SERVICES

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

Introduction

1. This chapter contains descriptive notes on the functioning of the various circuits, and servicing details for certain items of equipment. With the exception of the main power supply equipment, servicing information is confined to those items of a non-standard nature; details of the servicing of standard items of equipment will be found in the relevant Air Publication, reference to which is made in the appropriate paragraphs. A diagram of the main sections of the wiring, together with panels and distribution boxes, faces the last page of the text, and is followed by a series of wiring diagrams which cater for the various electrical services in the aircraft.

Routing charts

2. The wiring diagrams referred to in para. 1 are known as Routing Charts, and are laid out in tabular form; the first column on the left-hand side contains the circuit title, and subsequent columns denote the distribution box (D.B.), panel or items of equipment where "break points" or connections occur in the circuit.

3. Although all possible points for circuit connections are given at the head of each column, it does not follow that cables, shown diagrammatically as passing through a column, do so physically unless there is a connection point for the cable in that column. Those columns marked "Con. ref." contain the conduit reference and, where applicable, the plug or socket pin designation.

4. All routing charts, with the exception of those bearing annotations to the contrary, denote the modification state of the aircraft at the date of issue of this chapter. The introduction of class 4B modifications has necessitated a number of additional routing charts; these can be identified by a note, referring to the Mod. No., on the diagrams concerned.

Power supply

5. During flight the power for the 24-volt d.c. electrical services is provided (before Mod. 1430) by two 6 Kilowatt shunt-wound generators, mounted one on the auxiliary gearbox of each inboard engine, or (after Mod. 1430) by four 6 Kilowatt generators, one on each engine. The generators also charge the four 12-volt, 40 ampere hour, lead acid accumulators which are connected in series-parallel. The accumulators are situated in the fuselage just aft of the front spar.

Electrical Services

6. Control of the generator voltage at varying engine speeds is achieved by voltage regulators, Type 23, on each generator power panel; a master regulator, Type 32, on power panel 3P, ensures stable parallel operation of the Type 23 voltage regulators and maintains a controlled voltage at the bus-bars in panel 3P. A voltmeter on 1 DB indicates the voltage at the bus-bar. Details of the controlling equipment used in the generator circuits are given in para. 11 to 18.

Installation details

7. *General.* — The installation consists primarily of panels and distribution boxes. The wiring between these panels or boxes is enclosed by polyvinyl sheathing which constitutes a conduit. Attached to the ends of the cables, at the extremities of each conduit, are sockets which fit into plugs built in the panels or distribution boxes. All multi-pole plugs and sockets are designed to prevent incorrect mating, thus avoiding accidental cross-connections or short-circuits. A junction box labelled JB A serves as a main junction box for all cables entering or leaving the bomb compartment.

8. *Wiring system.* — To exclude dampness and to ensure a good installation, the wiring between the distribution boxes 1 DB and 2 DB, on the starboard side of the fuselage, has been enclosed in a trough. A single-pole earth return wiring system is employed, the negative connections for each circuit being secured to, and making contact with, the airframe structure. These earth points may be readily identified by their coating of blue paint.

9. *Distribution boxes.*—With the exception of those fuses contained in the bomb aimer's starboard panel and on the generator power panels 2P and 3P, the distribution boxes 1 DB, 2 DB and 3 DB contain the main fuses for the various services. Details of the fuses and the circuits they protect will be found in para. 26 under the heading Main Distribution. Under this heading will also be found details of the radial feeders and circuit-breakers.

10. *Panels.* — Service panels, used for control and inter-connection purposes, are located at convenient points in the aircraft. They are illustrated in fig. 1 of this chapter; their designation is given in the following table:—

- Bomb aimer's starboard panel
- Bomb aimer's port panel
- Flight engineer's No. 2 panel—forward—(Mod. 1447)
- Flight engineer's No. 1 panel—(aft)
- Generator control port panel—2P
- Generator control starboard panel—3P
- Engine services panels:—
  - Port inner—4P
  - Starboard inner—5P
  - Port outer—6P
  - Starboard outer—7P
- Rear fuselage connecting panel—8P

Generator controls

11. *General.* — The incoming generator positive cables at panels 2P and 3P are connected to the current coil (terminal 1) of their appropriate Type 23 voltage regulators. The shunt field cables are connected, via their circuit-breakers on 1 DB, to the carbon piles (terminal 3) of their respective voltage regulators. The negative cables are connected to an earth terminal on the aircraft structure.

12. From the Type 23 voltage regulators, the outgoing generator positive cables are connected to the junction of the voltage and current coils (terminal 1) of their respective cut-outs, Type J, the purpose of which is to control the action of the operating and retaining coils of their associated circuit-breakers, Type D. These circuit-breakers have their main contacts connected in series with the generator positive line, and by the use of a bi-metallic strip, which carries the main contacts, they provide overload protection for the generators.

13. In the event of overload the generator affected will be disconnected from the main bus-bar, but the retaining coil of the circuit-breaker will still have its armature held in by the open-circuited voltage of the generator. Under these conditions the appropriate re-setting push switch on 1 DB will have to be operated before the generator can again be brought into circuit. These push switches are

Electrical Services

in series with the operating and retaining coils of their associated circuit-breakers and are normally closed. The push-to-break action of the switch releases the spring-loaded armature of the circuit-breaker operating and retaining coils, so that when the push switch is released and returned to its normal and closed position, the circuit-breaker is automatically closed and the generator is again connected to the bus-bar.

14. The generators can be switched out of circuit by operating the field circuit-breakers on 1 DB, which also protect the field circuit from damage due to heavy current. After being tripped, these circuit-breakers must be closed manually.

15. ***Emergency switch.*** — This switch, situated on 1 DB, is required only when it is necessary to run the generators without the aircraft accumulators in circuit, or in the event of an open-circuit developing in the small centre switch of the Ground/Flight switch. For normal operation the emergency switch should be in the OFF position.

16. ***Ground/Flight switch.*** — This switch, sometimes known as the aircraft master switch, is mounted on the generator starboard panel 3P and provides the master control for all the electrical services. When the switch is in the GROUND position, the aircraft accumulators are disconnected and the electrical services are connected to the external supply (or ground starter) socket. When the switch is in the FLIGHT position the aircraft accumulators are connected, via the master regulator series coil, to the main bus-bar, and they are charged automatically during flight. The Ground/Flight switch should always be placed to the GROUND position when the aircraft is not required for flight.

17. ***Accumulators.*** — The accumulators should be checked before flight for security of mounting and cleanliness and security of connections. If, for any reason, it should become necessary to disconnect them, the Ground/Flight switch should be placed to the GROUND position; the positive side of the inter-connecting cables should first be removed to avoid the possibility of sparking and consequent explosion, which might occur if the accumulators were accidentally short-circuited by the aircraft structure.

18. ***Accumulator cut-out.*** — The closing voltage of the Type J cut-outs should be checked from an independent source of supply, in series with a rheostat. They should be tested on a gradually rising voltage and their contacts should close at 26·5 to 27 volts. Adjustment is made by rotating the nut on the armature, and between each test the applied voltage should be reduced to zero.

Voltage regulators, Type 23

19. ***Testing in aircraft.*** — When testing the Type 23 voltage regulators in the aircraft the following procedure should be adopted:—

(1) Disconnect and stow the leads to the aircraft accumulators.

(2) Place a short-circuiting strip between terminals 3 and 4 of the master regulator.

(3) Place the EMERGENCY switch to the ON position, and ensure that the generator field circuit-breakers are closed.

(4) Place the Ground/Flight switch to the GROUND position.

(5) Connect a testmeter, Type D, or a voltmeter of known accuracy, between terminal 2 of the appropriate cut-out, Type J, and earth.

(6) Check each regulator in turn by running each engine at 2,000 r.p.m., and note that the line voltage of the regulator under test is maintained at 24 volts when two generators are used or at 22 volts when four generators are used.

(7) By means of the trimmer resistance on the voltage regulator carefully adjust the voltage to 22 or 24 volts.

(8) Range the engine from 2,000 to 3,000 r.p.m., and ensure that the voltage is maintained within $\pm$ 0·5 volts.

(9) At the conclusion of the tests, remove the shorting link between terminals 3 and 4 of the master regulator.

Electrical Services

Master regulator, Type 32

20. ***General.*** — Because of the steep falling voltage characteristic between no load and full load of the Type 23 regulators, the variation in line voltage is too wide for use on aircraft without some means of correction. The master regulator, Type 32, has been introduced for this purpose. The principle of operation of this regulator is the reverse of the normal regulator, in that when the operating coil is not energised, the carbon pile is in a de-compressed state and its resistance is at the maximum. The nett effect of this is to maintain the line voltage of the system at 28 volts.

21. ***Setting the master regulator.*** — The setting of this regulator should be checked only after ensuring the satisfactory operation of the Type 23 regulators. The method of setting is as follows:—

(1) Check the mechanical setting of the regulator by pushing home the RESET device, and ensure that the white arrow on the pointer coincides with the mark on the fixed scale. Adjustment can be made if necessary by holding down the reset knob, releasing the pile locking screw, and turning the pile adjusting ferrule until the white marks are in line. Ensure that the pile locking screw is tightened after this operation.

(2) Connect the testmeter, Type D, between terminal 2 of the master regulator and earth.

(3) With all generator field circuit-breakers closed, the Ground/Flight switch in the GROUND position, and the emergency switch on, run the engines to 2,000 r.p.m.

(4) Carefully adjust the voltage to 28 volts by means of the trimmer resistance in the base of the regulator.

(5) Range the engines from 2,000 r.p.m. to 3,000 r.p.m., and check that the voltage remains steady at 28 volts.

Checking circulating current

22. To check the complete system for balance carry out the following procedure:—

(1) Aircraft fitted with two generators (before Mod. 1430):

(a) Place an insulating strip between the main contacts of one of the circuit-breakers, Type D, and connect a 20-0-20 ammeter between terminals No. 1 and No. 2 of this circuit-breaker.

(b) Run the inboard engines at 2,000 r.p.m., and check the circulating current between the two generators. The ammeter reading should be between 0 and ± 10 amp. Slight adjustment can, if necessary, be obtained by means of the trimmer resistance on one of the voltage regulators, Type 23.

(2) Aircraft fitted with four generators (after Mod. 1430):

(a) Place an insulating strip between the contacts of the No. 1 (port outer) circuit-breaker, Type D, and connect a 20-0-20 ammeter between terminals No. 1 and No. 2 of this circuit-breaker.

(b) Using the No. 1 (port outer) engine as master, run the engines in pairs at 2,000 r.p.m., and check the circulating current between each pair of generators. The ammeter reading should be between 0 and ± 10 amp. Slight adjustment can, if necessary, be obtained by means of the trimmer resistance on the No. 2, No. 3 or No. 4 voltage regulators, Type 23. The No. 1 voltage regulator which is being used in this test as a master must not be adjusted.

23. At the satisfactory conclusion of these tests, ensure that all shorting and insulation strips are removed, and connect the aircraft accumulator cables to their respective accumulator terminals. In the event of failure to achieve satisfactory performance, the components should be removed from the aircraft and bench tested. Full details of the equipment used in the power supply circuits are contained in A.P.1095C, Vol. I, which also contains instructions for bench-testing of components.

Main distribution

24. ***General.*** — The combined output of the generators is fed via terminal block No. 70 to the positive bus-bar in panel 3P, and thence to eleven 45 amp. Type A circuit-breakers,

Electrical Services

also contained in panel 3P. Protection against overload is provided by a thermal strip in each circuit-breaker, which causes the tripping of the main contacts. In the event of a circuit-breaker tripping, it can (after allowing an interval for cooling) be re-set by depressing its push-button. Two Type B circuit-breakers, situated in panel 3P, are directly connected to the main supply at T.B.70 to provide the main feeds for the mid-upper and nose turrets. They embody a thermal overload release and under normal conditions operate on the electro-magnetic principle. Their operating coils are controlled by START-STOP push buttons situated adjacent to or on the turrets whose supply they control. Further details of these and the rear turret circuit-breakers will be found in para. 92 under the heading Turret supplies.

25. ***Circuit-breakers and feeders.***—With the exception of the rear turret ammunition assister supply, each Type A circuit-breaker controls groups of fuses in 1 DB, 2 DB, 3 DB and bomb aimer's starboard panel. The circuit-breakers can be identified by their labels; their designation and the fusebanks they feed are given in the accompanying table.

Circuit-breaker (panel 3P)		Fusebank supplied	Fuse location
1DB	1	AA1 to AA8 BB1 to BB8	1DB
	2	CC1 to CC8 DD1 to DD4	
	3	DD5 to DD8 EE1 to EE8	
	4	FF1 to FF8 GG1 to GG4	
	5	GG5 to GG8 HH1 to HH4	
2DB	1	JJ1 to JJ8 KK1 to KK8 LL1 to LL4	2DB
	2	LL5 to LL8 MM1 to MM8 NN1 to NN8	
B.A. panel	1	RR1 to RR8	Bomb aimer's panel
	2	SS1 to SS8	
3DB	1	TT1 to TT8 UU1 to UU8	3DB

Note . . . The circuit-breaker on 3P labelled "Rear Turret" feeds the rear turret ammunition assister panels, and an additional circuit-breaker on panel 2P controls the rear turret supply.

26. ***Table of fuses.***—Details of the fuses with their identification, rating and service are given in the following table:—

	Fuse No.	Rating (amp.)	Service
Fusebox AA in 1DB	1	5	Fire extinguisher warning P.O.
	2	5	Fuel flowmeter P.O.
	3	10	D.R. compass
	4	5	Oil temperature P.O.
	5	—	
	6	10	Undercarriage indicator
	7	5	Radiator temperature P.O.
	8	5	Fuel contents (port)
Fusebox BB in 1DB	1	5	Oil pressure indicator P.O. Fuel pressure indicator P.O.
		5	Fuel contents—L.R. tank
	2	20	Fuel pump No. 2 (port)
	3	5	G.P.I. and A.M.U.
	4	20	Radar supply
	5	5	Coolant loss P.O. (Mod. 1750)
	6	5	A.M.I. (Mod. 1703)
	7	5	Radiator flap control P.O.
	8		

Electrical Services

	Fuse No.	Rating (amp.)	Service
Fusebox CC in IDB	1	5	Fire extinguisher warning P.I.
	2	5	Fuel flowmeter P.I.
	3	5	Radiator temperature P.I.
	4	25	Transmitters, Type F and Z
	5	5	Oil temperature P.I.
	6	5	Oil pressure indicator P.I. Fuel pressure indicator P.I.
	7	20	Fuel pump No. 1 (port)
	8	—	
Fusebox DD in IDB	1	10	Heated pressure head
	2	—	
	3	5	Coolant loss P.I. (Mod. 1750)
	4	5	Radiator flap control P.I.
	5	5	Fire extinguisher warning S.I.
	6	5	Fuel flowmeter S.I.
	7	5	Radiator temperature S.I.
	8	5	Oil temperature S.I.
Fusebox EE in IDB	1	5	Interior lighting—general
	2	5	Oil pressure indicator S.I. Fuel pressure indicator S.I.
	3	20	Fuel pump No. 1 (starboard)
	4	20	R.3090 supply
	5	20	Radar supply
	6	5	Coolant loss S.I. (Mod. 1750)
	7	5	Coolant loss S.O.
	8	5	Radiator flap control S.I.
Fusebox FF in IDB	1	5	Fire extinguisher warning S.O.
	2	5	Flowmeter S.O.
	3	5	Oil dilution
	4	5	Oil temperature S.O.
	5	5	Oil pressure indicator S.O. Fuel pressure indicator S.O.
	6	5	Fuel contents (starboard)
	7	20	Fuel pump No. 2 (starboard)
	8	—	
Fusebox GG in IDB	1	20	T.1154/R.1155 L.T. power unit
	2	40	T.1154 H.T. power unit
	3	5	Radiator temperature S.O.
	4	5	Radiator flap control S.O.
	5	20	Radar supply
	6	5	Interior lighting—general
	7	—	
	8	40	Radar supply (Mod. 1736 only)
Fusebox HH in IDB	1	20	Long range fuel tanks—aft
	2	20	Long range fuel tanks—forward
	3	5	Wing flap indicator
	4	—	
Fusebox JJ in 2DB	1	20	Beam approach
	2	10	Tank bay fire extinguishers
	3	—	
	4	5	Auto pilot control
	5	5	Call lamps
	6	20	Fire extinguisher crash switch
	7	10	Fire extinguisher P.O.
	8	10	Fire extinguisher P.I.

Electrical Services

	Fuse No.	Rating (amp.)	Service
Fusebox KK* in 2DB	1	10	Propeller feathering P.O.
	2	10	Propeller feathering P.I.
	3	—	
	4	—	
	5	25	Exterior lamps master switch
	6	5	Interior lighting—pilot's cockpit
	7	5	Booster coils
	8	5	Slow-running cut-off P.O.
Fusebox LL in 2DB	1	5	Slow running cut-off P.I.
	2	—	
	3	—	
	4	—	
	5	5	Slow running cut-off S.I.
	6	5	Slow running cut-off S.O.
	7	20	Tank bay—fire extinguishers
	8	10	Tank bay—fire extinguishers
Fusebox MM in 2DB	1	10	Engine starting
	2	10	Propeller feathering S.I.
	3	10	Propeller feathering S.O.
	4	10	Fire extinguishers S.I.
	5	10	Fire extinguishers S.O.
	6	5	Air cleaner control
	7	5	Interior lighting—pilot's cockpit
	8	5	Hot and cold air intake control
Fusebox NN in 2DB	1	5	Supercharger warning
	2	20	Engine priming
	3	10	Windscreen wiper
	4	—	
	5	—	
	6	—	
	7	—	
	8	20	Landing lamp filament *
Fusebox PP in 2DB	1	5	Resin lamps
	2	5	Identification lamps } * See fuse KK5
	3	5	Navigation lamps } * See fuse KK5
	4	5	Landing lamp motor } * See fuse KK5
Fusebox RR on bomb aimer's starboard panel	1	20	Nose fuzing
	2	20	Tail fuzing
	3	5	Distributor heating
	4	5	Bomb slip heating
	5	10	Camera heater
	6	5	Bomb sight computor
	7	20	Flare chute, Mk. III
	8	10	Camera supply
Fusebox SS in bomb aimer's starboard panel	1	5	Bomb sight head
	2	5	Interior lighting—general
	3	10	Heated clothing socket
	4	20	Dinghy release
	5	—	
	6	—	
	7	—	
	8	—	

* This fuse supplies fuses NN8 and PP1 to PP4

Electrical Services

	Fuse No.	Rating (amp.)	Service
Fusebox TT in 3DB	1	5	Interior lighting—general
	2	—	
	3	20	Rear turret supply
	4	—	
	5	20	Scanner unit heater
	6	—	
	7	—	
	8	—	
Fusebox VV in panel 3P	1	5	Voltmeter
	2	5	Motor generator No. 1 (Mod. 1430)
	3	5	Motor generator No. 2 (Mod. 1430)
	4	5	Mid-upper turret circuit-breaker coil
	5	5	Nose turret circuit-breaker coil
	6	5	Power failure warning lamp S.O. (Mod. 1430)
	7	5	Power failure warning lamp S.I.
	8	5	Londex relay supply S.I.
Fusebox WW in panel 2P	1	5	Power failure warning lamp P.O. (Mod. 1430)
	2	5	Power failure warning lamp P.I.
	3	5	Londex relay supply P.I.
	4	5	Londex relay supply P.O. (Mod. 1430)
Fusebox XX in panel 3P	1	20	Supercharger relay S.O.
	2	20	Supercharger relay S.I. (Mod. 1281)
	3	20	Supercharger relay P.I.
	4	20	Supercharger relay P.O.
Fusebox YY in panel 3P	1	5	Londex relay supply S.O. (Mod. 1430)
	2	5	Generator controls S.O. (Mod. 1811)
	3	5	Generator controls S.I. (Mod. 1811)
	4	—	
Fusebox ZZ in panel 2P	1	5	Generator controls P.O. (Mod. 1811)
	2	5	Generator controls P.I. (Mod. 1811)
	3	—	
	4	—	

Mod. 1447—Introduction of flight engineer's No. 2 panel

27. ***General.*** — The introduction of this Class 4B modification changes the position and wiring of certain items of equipment. These changes consist mainly of transferring a number of components, originally on the flight engineer's (or air observer's) panel to the flight engineer's forward panel No. 2. In order to clarify the text the paragraphs dealing with these circuits cater for the inclusion of this modification.

28. ***Circuits affected.*** — Details of the changes can be verified by reference to the diagrams of the circuits concerned; in most instances an additional diagram with the fig. suffix "a" has been included. The following circuits are affected:—

- Fuel pumps (main and auxiliary)
- Radiator temperature indicators
- Oil temperature indicators
- Fuel flowmeters
- Fuel pressure warning
- Radiator flap controls
- Interior lighting with pilot's U/V lamps
- Heated pressure head.

Engine starting and propeller feathering

29. ***General.*** — A solenoid switch in panel 3P, acting as a master relay, controls the supply to the main contacts of the starter and feathering relays in the respective engine service panels,

Electrical Services

and so controls the associated starter or feathering motors. It is brought into operation by the closing of any one of the engine starting or propeller feathering push switches.

30. ***Engine starting.*** — The coils of the four starter relays are fed from fuse MM1 in 2 DB via four double-pole push switches on the pilot's instrument panel. The push switches are connected in such a manner as to provide separate control for each relay.

31. ***Propeller feathering.*** — The energisation of the coils of the four feathering relays, each fed from its associated fuse in 2 DB, is controlled by four push switches on the pilot's instrument panel. After being manually operated these push switches are automatically held in the closed position, by the action of a solenoid integral with each switch, until the propeller reaches the fully feathered position.

32. At this juncture a pressure switch, actuated by oil pressure in the propeller pump line, open-circuits the switch solenoid and cuts off the supply to the coil of the feathering relay concerned, thus cutting off the supply to the feathering pump motor. To unfeather the propeller the associated push switch must be held manually in the closed position, since the retaining coil circuit will have been open-circuited by the action of the pressure switch when feathering.

33. ***Servicing.*** — Servicing of the engine starting and propeller feathering motors is restricted to a routine inspection of brush gear and commutator. Carbon or copper dust deposits should be removed by means of compressed air. The relays should be examined at intervals for pitting of contacts and security of connections and contact assembly. The motors and relays should be removed from the aircraft, at the periods stated in the maintenance schedule, and bench tested. Details of these tests are contained in A.P.1095C, Vol. II Part 3.

Ignition booster coils

34. Four booster coils, one on each engine diaphragm, are controlled by four push switches on the pilot's instrument panel. The booster coils are used, when starting, to provide H.T. supply to the distributor rotor of the right-hand magneto of each engine. A full description of these coils will be found in A.P.1374E, Vol. I.

Coolant loss warning

35. Warning of coolant low level is given by the fire warning lamps on the pilot's instrument panel, and takes the form of a flashing signal. The circuit for each engine is self-contained and consists of a tank unit, flasher motor and three relays. A micro switch operated by the throttle lever acts as a control switch.

36. Under normal conditions the tank unit electrode is immersed in the coolant and so maintains a circuit through the coil of a relay (Stores Ref. 5C/3820), keeping the relay contacts, and consequently the flasher motor circuit, open. When the coolant falls below a safe level the electrode is no longer immersed and the circuit of the relay coil is broken, causing the relay contacts to close. This action completes the circuit to the flasher motor and at the same time energises the coil of a Waymouth relay via the normally closed contacts of a relay, Type P2.

37. The closing of the Waymouth relay contacts completes the circuit to the associated warning lamp until the pilot (having pulled back the throttle lever) closes the feathering switch. This action energises the coil of the relay, Type P2, the contacts of which open and render the complete circuit inoperative.

Engine fire extinguishers

38. ***General.*** — In the event of an outbreak of fire in any of the engines during flight, the fire extinguisher system can be brought into operation manually by closing the push switches on the pilot's instrument panel, or automatically by closing the propeller feathering switch. In the event of a crash landing the system is brought into operation if the impact is sufficient to trip the inertia or "crash" switch. Warning of fire is given by the red light in the propeller feathering switch.

39. Eight cylinders or bottles, containing methyl bromide, are fitted, two to each engine, in cradles aft of the firewall. Each engine

Electrical Services

system consists of four interlinked circuits, namely, detector or fire warning, feathering switch, push switch and inertia switch.

40. ***Fire warning.*** — Each fire warning circuit contains six flame switches, four at suitable positions on the forward face of the firewall and one at each side of the engine about half way forward. The switch contacts are normally held in the open position by the action of a spring-loaded rod, which is retained in the "compressed" position by means of a fusible head.

41. In the event of fire, a temperature of 200 deg. C or over will operate the switch by melting the fusible joint and so releasing the spring-loaded rod. As soon as the switch contacts have closed, the relay on the associated engine relay panel will close and complete the circuit to the appropriate fire warning lamp; at the same time two other contacts on this relay close that portion of the circuit between terminal S on the propeller feathering switch and the air intake "bottle" in readiness for the completion of that circuit when the pilot closes the feathering switch.

42. ***Operation of extinguishers.*** — As soon as the feathering switch closes, one "bottle" will discharge its contents into the carburettor air intake. At the same time a delayed action switch on the relay panel is put into operation; this will cause the remaining "bottle" to discharge its contents into the engine spray piping 20 seconds later.

43. Instantaneous discharge of all "bottles" can be obtained by closing the four push switches, guarded against accidental operation by red hinged covers, on the pilot's panel.

44. In the event of a crash landing where the inertia switch has been "tripped" by the impact, all containers will operate immediately. The inertia switch is situated in the nose of the aircraft.

45. ***Testing.*** — It is important that these circuits be tested regularly in accordance with a procedure similar to that laid down in A.P.1095A, Vol. I, Sect. 6, Chap. 8. Before any tests are made, care should be taken to ensure that the sockets on the methyl bromide "bottles" have been withdrawn and the supply leads to the cartridges of the delayed action switches disconnected. At the satisfactory conclusion of the tests ensure that the flame switch heads are tight and locked, the sockets refitted to the bottles, the delayed action switches re-connected, and the inertia switch re-set.

Oil temperature indicators

46. Four indicators on the flight engineer's No. 2 (forward) panel register the temperature of the engine oil. Each indicator is connected to its appropriate resistance unit which is inserted in a pocket in the engine oil pipe line. Any change in the temperature of the oil automatically changes the value of the resistance unit and this change is transmitted to the indicator.

Radiator temperature indicators

47. The resistance element for each indicator is installed in the thermometer pocket of its appropriate coolant header tank. The four indicators are on the flight engineer's No. 2 (forward) panel. The principle of operation is similar to that given in paragraph 42. A full description of these instruments is contained in A.P.1275A, Vol. I, Sect. 4, Chap. 1.

Hot and cold air control

48. A hinged flap in the air intake duct of each engine provides for the intake of hot or cold air. The flap is actuated by a pneumatic ram which is controlled by an electrically-operated valve. All four valve solenoids are controlled by a single switch on the pilot's instrument panel.

Air cleaner control

49. Four filters, one in each engine air intake duct, are normally at the IN (filtered air) position when the aircraft is on the ground and during take-off. They are automatically switched to the OUT position by means of micro switches on the undercarriage when the wheels are retracted, or can be operated to the OUT position by means of the manual switch on the pilot's panel when the aircraft has cleared the area of grit and dust associated with ground running and take-off.

Electrical Services

Slow running cut-off control

50. A slow-running cut-off is provided on each engine. They are normally in the OFF (engine running) position and are operated to the ON (engine cut-off) position by the action of electrically-operated valves in the pneumatic system. The solenoids are controlled by toggle switches on the pilot's instrument panel.

Radiator flap controls

51. ***Temperature control.*** — The radiator flaps are opened and closed by pneumatic rams, the movement of which is effected by the action of electrically-operated valves. Under normal flying conditions the flaps are automatically controlled by their associated thermostatic switches, one of which is fitted to each engine. These switches are actuated by changes of temperature acting on a metallic phial inserted in the coolant header tank. The phial is connected to the switch by a capillary tube.

52. ***Thermostatic switches.*** — The operation of the switches should be checked by observed reactions on coolant temperature during test and operational flying. A switch suspected of inaccurate control should be tested in accordance with the instructions given in A.P.2861A, Vol. I, Sect. 2, but no attempt should be made to adjust the switch setting without special equipment. Details of the switches are contained in A.P.1275A, Vol. I, Sect. 11, Chap. 1.

53. ***Manual control.*** — In some instances it is necessary to override the automatic action of the thermostatic switches in order to have the flaps fully open. This can be achieved by closing the manual control switches on the flight engineer's No. 2 (forward) panel. This method is normally employed to maintain low engine temperature prior to take-off.

54. ***Testing.*** — Four push switches, one on each engine diaphragm, are used for testing the operation of the flaps when the aircraft is on the ground. These push switches are connected in parallel with the manual control and thermostatic switches. The flaps should open when their associated push switches are operated and should return to the closed position when the push switches are released.

Fuel flowmeters

55. Two dual type indicators, on the flight engineer's No. 2 (forward) panel, indicate fuel consumption and record "gallons gone." The indicator counters are actuated by an electrical pulse from their respective transmitters in the fuel line of each engine. When the flowmeters are not in use or in the event of failure of the electrical supply, an electrically-operated fuel valve by-passes the transmitter and ensures a continuous supply of fuel to the engine. This valve is of the normally open type and closes when the circuit to its solenoid is completed. Each flowmeter has its own control switch adjacent to its associated indicators. Visual indication that the flowmeters are in operation is given by four lamps on the panel.

56. ***Testing.*** — To test the flowmeter circuits, ensure that the indicators register "zero", and with the engines running, switch on the flowmeters. The indicator lamps should then light, and the indicators should commence to indicate "gallons gone" as the fuel is used. At the conclusion of the test, place the control switches to the OFF position and re-set the indicators to zero.

Fuel pressure warning

57. Indications of engine fuel pressure are given by four lamps, on the flight engineer's No. 2 (forward) panel, to which the four engine fuel pressure switches are connected. Low fuel pressure for any one engine is indicated by the relevant warning light.

Oil pressure indicators

58. Four Desynn type indicators on the pilot's instrument panel are directly connected to their associated transmitters in the engine oil system. The transmitter pressure chamber is connected, by means of a flexible pipe, to the delivery side of the engine-driven oil pump.

Oil dilution

59. Four electrically-operated valves are fitted, one to each engine. Each valve solenoid

Electrical Services

is selected by its appropriate selector switch on the flight engineer's No. 1 (aft) panel, and the operation of the valves is effected by the closing of the push switch on the same panel as the selector switches.

Engine priming

60. Two motor-driven centrifugal pumps are situated one on each inboard engine firewall. They deliver fuel under pressure to the four electrically-operated valves, one for each engine. The motors are controlled by a selector switch, and the valves by four push switches, all of which are on the pilot's instrument panel. Visual indication of the operation of either pump is given by lamps adjacent to the control switch.

61. During the period that the pumps are running, any desired quantity of fuel can be injected into the induction manifold of each engine by the operation of the appropriate push switch. When the priming pumps are switched on, and until a priming valve is opened, fuel will flow round the idling circuit of the pumps.

Supercharger controls

62. On Mk. II aircraft the change from M.S. to F.S. gear is accomplished by the action of electro-hydraulic valve units, one of which is fitted to each engine. On Mk. I aircraft the hydraulic valve units are operated by pneumatic rams which incorporate electrically-operated valves.

63. In each instance the valve solenoids and consequently the valves themselves are controlled, via four relays in panel 3P, by the switch labelled SUPERCHARGER on the pilot's instrument panel. When this switch is in the AUTO position the supercharger gear change takes place automatically as soon as the aircraft reaches the height at which the altitude switch is set to close. The altitude switch is in series with the positive line to the supercharger switch.

64. Four red lamps adjacent to the supercharger switch indicate that the superchargers are in F.S. gear. On Mk. II aircraft the lamps are brought into circuit by the action of contacts inside the electro-hydraulic valve units. On Mk. I aircraft they are brought into circuit by micro switches adjacent to the electro-pneumatic valves.

Fuel contents gauges

65. Six Desynn type indicators on the flight engineer's No. 1 (aft) panel indicate the quantity of fuel in the port and starboard fuel tanks. The indicators are connected to their respective tank transmitters one in each of the No. 1, 2 and 3 port and starboard tanks. A lever attached to a float operates each transmitter and so indicates the level of fuel in terms of gallons.

Undercarriage position indicator

66. ***General.*** — An indicator on the pilot's instrument panel shows, by means of red and green lamps, the position of the main undercarriage retracting units. The circuits are brought into operation by the action of micro switches on the respective up locks and down locks. The operation of the indicator should be interpreted in the following manner:—

(1) No lights—Undercarriage fully retracted and locked.

(2) Red lights—Undercarriage unlocked.

(3) Green lights—Undercarriage locked down.

Full details of the operation of the micro switches are contained in A.P.1095A, Vol. I, Sect. 1, Chap. 7, A brief outline of the equipment is given in the following paragraphs.

67. ***Audible warning.*** — Two micro switches, one on each inboard engine throttle control, are set to operate a warning horn when the throttle levers are pulled back to approximately one-third of the open position, under all conditions other than undercarriage down and locked, i.e., green lights. A push switch, adjacent to the warning horn on the port side of the cockpit, is provided to test the audible warning circuit.

68. ***Visual warning.*** — A red warning lamp adjacent to the push switch and connected in parallel with the horn gives visual indication of the circuit operation should the horn fail,

Electrical Services

or if it cannot be heard due to unusually noisy conditions.

69. ***Testing.*** — The micro switches and warning devices should be checked for correct functioning, during retraction tests on the undercarriage, at the periods stated in the servicing schedule. The down and locked condition of the undercarriage should be checked before each flight by observing that the green indicator lamps light when the aircraft Ground/Flight switch is put to the FLIGHT position.

Engine speed indicators

70. Four r.p.m. generators, one on each engine, develop 3-phase alternating current at a frequency proportional to the speed of the engines. This 3-phase three wire output from each generator is fed to the engine speed indicators on the pilot's instrument panel. Each indicator, calibrated in r.p.m., indicates the speed of its associated engine; these circuits are not fused, and are in no way connected to the aircraft electrical system.

Fuel pumps

71. Four electrically-operated pulsometer pumps, two on each fuel distributor tank, are provided to ensure delivery of fuel from the tanks to each engine-driven fuel pump. The pumps are controlled by Type B switches on the flight engineer's No. 2 (forward) panel. A suppressor unit connected in each circuit minimises interference with the radio equipment. Further details of the pumps are contained in A.P.1095C, Vol. I, Sect. 4.

72. ***Testing.*** — Facilities for testing the current consumption of each pump are provided by four double-pole switches and an ammeter adjacent to the pump control switches. The ammeter is common to all four pump circuits; the push switches, each in parallel with its appropriate control switch, control the test circuit to each pump. To test the current consumption of each pump, ensure that the Type B switches are in the OFF position, and close each push switch in turn for a period of not less than 30 seconds. The reading on the ammeter should not be more than 7 amp.

Long range (auxiliary) fuel pumps

73. When long range (or auxiliary) tanks are installed, two electrically-operated fuel pumps are fitted, one to each auxiliary tank. These pumps are controlled by separate switches on the flight engineer's No. 1 (aft) panel. Push switches are provided on this panel for testing the current consumption of each pump, and the procedure for testing is similar to that given in paragraph 72. The same test ammeter is used.

Long range fuel contents gauges

74. Two indicators on the flight engineer's No. 1 (aft) panel indicate the amount of fuel in each auxiliary tank. These indicators and their associated tank transmitters are similar to those used for the main fuel tanks.

Fire extinguishers (tank bays)

75. On aircraft with Mod. No. 1186 embodied, twelve fire extinguishers, two for each main fuel tank, are fitted. The flame switches used in connection with these extinguishers are of the ignition cord type. The cords are carried round the tanks and are attached at each end to the explosive head of a flame switch. Details of this type of installation are contained in A.P.1095A, Vol. I, Sect. 6, Chap. 8. A brief outline of the operation is given in the following paragraphs.

76. In the event of fire breaking out in or near the fuel tanks, one or more of the cords will ignite, and the fire will spread rapidly along the cord in each direction until it reaches the flame switch. The operation of the flame switch will then initiate the discharging of the extinguishers in that section of the aircraft.

77. The circuit is connected to the same inertia switch as that used for the engine fire extinguishers, so that the system will automatically be brought into operation by a crash landing. As an additional safety precaution the extinguishers can be brought into operation by manually closing two push switches on the pilot's instrument panel.

Exterior lighting

78. ***General.*** — All exterior lamps are controlled by a main switch on the pilot's

Electrical Services

panel. A red lamp adjacent to the switch gives indication to the pilot when the main switch is on.

79. ***Navigation lamps.*** — The navigation lamps switch on the pilot's panel provides for dim or bright lighting of the wing and tail navigation lamps and has an OFF position. Dim lighting is achieved by the introduction into the circuit of a resistance when the switch is placed to the DIM position.

80. ***Identification lamps.*** — The identification lamps are controlled by a switchbox on the pilot's panel, which has provision for signalling embodied. Selection of the required coloured downward identification lamp is effected by a 3-way selector switch, labelled RED—GREEN—AMBER, on the face of distribution box 1DB.

81. ***Resin lamps.*** — The wing resin lamps are controlled by a single-pole switch on the pilot's panel. Colour selection is provided by a change-over switch on 1DB.

82. ***Headlamp.*** — The headlamp switch on 1DB provides for continuous illumination or signalling. When the switch is in the "morse" or signalling position, connection is made to the identification lamps switchbox, and the signalling key on this switch is used.

83. ***Glider tug lamps.*** — The glider tug lamps in the tail of the aircraft are controlled by a single-pole switch on the pilot's panel. This circuit also is not operative until the external lamps main switch is on.

84. ***Landing lamp.*** — The landing lamp selector switch on the pilot's panel carries provision for OFF, LOW and HIGH positions of the lamp. A twin field motor integral with the lamp operates the raising and lowering mechanism. The filament circuit is automatically switched on, by a switch within the lamp assembly, during the downward travel of the lamp.

Interior lighting

85. ***General.*** — With the exception of the cabin roof lamps, which have integral switching, all the interior lamps are controlled by dimmer switches which are fitted as close as possible to their respective lamps. The position of the various lamps is given in the following table:—

	Lamp	Position
	Supplied from fuse SS2	
1	Cabin lamp	Rear of front turret
2	Cockpit lamp and dimmer switch	Adjacent to bomb sight
3	Cockpit lamp and dimmer switch	Bomb aimer's panel, starboard
4	Cockpit lamp and dimmer switch	Bomb aimer's panel, port
	Supplied from fuses MM7 and KK6	
5	Cockpit lamps and dimmer switches	Pilot's canopy (before Mod. 1165)
6	Compass lamp and dimmer switch	Adjacent to P4 compass
7	Compass lamp and dimmer switch	Adjacent to D.R. compass
	Supplied from fuse EE1	
8	Cockpit lamps and dimmer switches (2)	Flight engineer's panels
9	Cockpit lamps and dimmer switches (2)	Navigator's panel
10	Anglepoise lamp and dimmer	Navigator's panel
	Supplied from fuse GG6	
11	Cockpit lamp and dimmer	Adjacent to the D.F. loop
12	Cockpit lamp and dimmer	Fuselage roof above 1DB
13	Cockpit lamps and dimmer switches (2)	Port and starboard sides of former 6
	Supplied from fuse TT1	
14	Cabin lamp	At centre section roof between formers 8 and 9
15	Cabin lamp	At rear of centre section roof between formers 15 and 16
16	Cabin lamp	Port side, between formers 22C and 22D
17	Cabin lamp (controlled by entrance door switch)	Port side of roof between formers 29 and 30 (rear fuselage)

Electrical Services

86. ***Pilot's ultra-violet and red lamps.*** — On aircraft with Mod. No. 1165 embodied, a dual system of cockpit lighting is employed. It consists of ultra-violet and red lamps which are controlled by four dimmer switches mounted on a panel in the cockpit roof. The lamps are fitted at the port and starboard sides of the cockpit and are controlled in pairs. Full details of this system of lighting are contained in A.P.1095A, Vol. I, Sect. 8, Chap. 13.

87. ***Emergency lamp.*** — Emergency lighting is provided by a cockpit lamp which is controlled by a single-pole switch fitted to a bracket on the control column. Power is supplied from a twin cell 2·4 volt alkaline accumulator stowed in a container on the control column.

88. ***Inspection lamp sockets.***—Sockets are provided for inspection lamps at the bomb aimer's, flight engineer's, radio operator's and navigator's stations. They are of the standard type for use with Mk. II inspection lamps, details of which are given in A.P.1095A, Vol. I, Sect. 8, Chap. 6.

Call lamps

89. Intercommunication signalling (or call lamp) boxes are situated in the fuselage at the following stations:—

Bomb aimer	Auxiliary (mid fuselage)
Pilot	Mid-upper turret
Navigator	Flare chute
Radio operator	Elsan
Rear turret.	

90. Each box contains an indicating lamp and push switch by which the attention of all members of the crew can be obtained, or if a signalling code is used, a pre-arranged signal may be arranged to call any one crew station. The system is normally used to indicate that telephonic communication is desired. Details of the system are contained in A.P.1095A, Vol. I, Sect. 1, Chap. 2.

Heated clothing

91. Provision is made for heating the bomb aimer's suit by a 3-pole socket attached to a trailing cable at the bomb aimer's port panel. On the panel are two switches, one for the "hands and feet" elements, the other for "body"; these are connected in parallel. Further details will be found in A.P.1095A, Vol. I, Sect. 4.

Turret supplies

92. ***General.*** — The electrical supplies to the turrets are controlled by four circuit-breakers, two Type B for the mid-upper turrets and two Type A for the rear turret and ammunition assister circuits. The two Type B and one Type A circuit-breakers are mounted in panel 3P (the generator control starboard panel); the remaining Type A circuit-breaker is in panel 2P. The Type A circuit-breakers are directly controlled by their integral push buttons, the Type B circuit breakers are controlled by START—STOP switches adjacent to or on their respective turrets. Economy resistances, brought into the Type B operating coil circuits when their circuit-breakers are closed, limit the current in these coils during the period that they are in operation. Descriptive and servicing details for the circuit-breakers are contained in A.P.1095A, Vol. I, Sect. 9.

93. ***Front turret*** — (***B.P. Type F Mk. I***).— The circuit-breaker operating coil switches, together with the economy resistance, are mounted on the bomb aimer's starboard panel. The heavy duty cables for the turret main supply are connected to terminal block (TB) No. 150 on, or adjacent to, the panel. Full details of this turret will be found in A.P.2796H, Vol. I, which also contains wiring diagrams of the turret electrical services.

94. ***Mid-upper turret*** — (***B.17***) — Connection to this turret, of all the necessary electrical supplies, is made by plugs and sockets mounted on a panel adjacent to the turret. The circuit-breaker operating-coil switches and the economy resistance are fitted to the turret control panel. On this panel is a Type B single-pole switch which should be normally closed when the B17 turret is used. Full details of this turret and its associated electrical services are contained in A.P.2768E, Vol. I, to which reference should be made for the wiring diagram of the turret electrical services.

Electrical Services

95. ***Rear turret*** — (***B.P. Type D Mk. I***).— The electrical connections to this turret are made through slip ring connectors at the base of the turret. The positive supplies from the Type A circuit-breakers in panels 2P and 3P are taken to terminal blocks 119A and 117A respectively, and are both connected to the turret slip ring connector "A". Two cables from the turret connector "P" are connected to earth at terminal block 119B. The turret call lamp cable from slip ring connector "G" is connected to "earth" at TB 97-C in panel 8P.

96. ***Ammunition assister motors.***—Two ammunition assister motors are mounted one on each ammunition duct to assist in feeding the ammunition belts to the rear turret. The relays for the assister motors are controlled by the firing button in the turret which is connected to the relay coils through the slip ring connector "N" and the associated micro switches.

97. The main supply for the motors is provided by the 40 amp. fuse TT3 in 3DB, and each motor is protected by a local fuse of 25 amp. rating. A positive supply cable from TB 95-A in panel 8P is connected, through a push switch labelled CASUALTY EVACUATION, to slip ring connector M. This is connected to a solenoid by-pass valve on the turret. Complete details of the turret and ammunition assisters are contained in A.P.2796J, Vol. I.

Wing flap indicator

98. This indicator, on the pilot's instrument panel, records the wing flap movement from zero to maximum. The indicator is connected to a transmitter which is fitted to the port inboard trailing edge, and operated by a linkage connected to the flap cross-shaft.

99. Access is gained to the transmitter when the flaps are lowered. The flap positions are set to agree with the calibration of the indicator dial and no adjustment should be necessary except when a flap is renewed.

Dinghy release

100. Connection is made to the dinghy operating head, in the starboard centre section dinghy compartment, by a 3-pole socket which engages with the operating head plug. Two immersion switches, one in the positive and one in the negative line, control the circuit to the operating head. They are fitted in the forward section of the fuselage.

101. In the event of the aircraft making a forced descent on water, the internal resistance of the multi-vane immersion switches is lowered by the ingress of water until sufficient current is passed through them to operate the CO_2 cylinder and so inflate the dinghy.

102. ***Testing.*** — The circuit can be tested for continuity in the following manner:—

(1) Remove the dinghy head supply socket and connect a 24-volt test lamp between poles "L" and "E" of the socket.

(2) Plug two $\frac{3}{16}$ in. test rods (preferably brass) into the holes provided at each side of the immersion switches, and check that the lamp lights.

(3) At the conclusion of the test remove the test lamp and test rods, and refit the dinghy supply socket to the plug on the operating head. The immersion switches are described in A.P.1095A, Vol. I, Sect. 7, Chap. 11.

Heated pressure head

103. An electrically-heated pressure head, fitted to the port side of the fuselage forward section, is controlled by a switch on the flight engineer's No. 2 (forward) panel. Facilities for testing the current consumption of the heating element are provided by a push switch adjacent to the control switch. Indication of the current taken by the element, which should be approximately 7 amp., is given by the test ammeter on this panel. When the aircraft is on the ground the heating element must not be switched on for more than two or three minutes, or overheating, with consequent damage to the head, will ensue.

Windscreen wiper

104. A motor-driven windscreen wiper is fitted to the pilot's windscreen. It is controlled by a single-pole switch on the auxiliary panel at the port side of the cockpit. The speed of the motor can be varied by a rheostat on this

Electrical Services

panel, and a suppressor in the circuit minimises interference with the radio equipment.

Bomb fuzing and release

105. ***General.*** — The equipment used for the control of bomb fuzing and release is situated on the bomb aimer's starboard panel. The major components are as follows:—

- Automatic distributor, Type VI (16-point)
- Selector switchbox, Type F (16-point)
- Pre-selector switch unit (16-point)
- Unterlock unit and firing switch
- Nose and tail fuzing switches, Type B
- Bomb slip heater switch, Type E
- Fuses RR1 and RR2 (20 amp.)
- Fuses RR3 and RR4 (5 amp.)
- 2-pole socket for bomb sight
- Two 6-pole plugs (for bombs-and-day camera or bombs-and-night camera).

106. From the bank of fuses mounted on the panel, supplies for nose and tail fuzing are taken from RR1 and RR2 (20 amp.), distributor heating from RR3 (5 amp.), and heavy bomb slip heaters from RR4 (5 amp.). A firing switch is incorporated on the left-hand side of the pilot's control column. The supply to this switch is broken at T.B.177, which is mounted at the base of the control column, and a further supply is taken to a plug and socket at the navigator's table for a bomb switch which is used in connection with radar equipment. A jettison switch, Type H, and a jettison pull handle for operating the selector box jettison bars, are mounted on the starboard side of the pilot's instrument panel.

107. ***Junction box. — JBA.*** — There is only one junction box in the bomb fuzing and release gear; this is referenced JBA and is situated at the front end of the bomb compartment. Fifteen plug and socket outlets from the junction box connect to each of the bomb positions. The release positive terminals in the junction box are referenced with the number on the bomb position to which they connect, and these numbers are also referenced to the respective number of the switches of the selector switchbox and pre-selector switch unit. To prevent the release of bombs when the bomb doors are closed two push switches are provided in the positive supply. They are mounted on the rear face of the bulkhead at the front end of the bomb compartment and are in the OFF position when the bomb doors are closed.

108. ***Testing.*** — In the event of a full set of bomb carriers not being available, a test set using four lamps to represent the release, jettison and fuzing circuits, should be used to plug into the socket of the bomb station under test. Select each individual bomb station in turn and check that when either the nose or tail fuzing switches are selected both fuzing lamps light. Press each release button in turn and check that the release lamp lights. Repeat above for all positions of distributor switch, and at all positions press the container jettison switch, when the lamp representing containers should light. Operate the jettison switch and check that the lamps give an indication of release of all bomb positions. Remove the automatic distributor and, with a 24-volt test lamp, check the supply at the distributor heater. Full descriptive and servicing details are contained in A.P.1095B, Vol. I, Sections 1 to 5.

D.R. compass

109. ***General.*** — The D.R. compass master unit, situated at the starboard side of the fuselage and forward of the main entrance door, is connected by means of a plug and socket to the compass junction box on the aft side of the aircraft transport joint at former 27. This junction box is in turn connected to a distribution box, Type D, situated forward of 1DB, which also carries the supply from fuse AA3. From the distribution box connection is made to the variation setting corrector at the navigator's station, and this latter unit is connected also to the pilot's repeater and to the air position and ground position indicators.

110. ***Master unit.*** — The D.R. compass master unit contains a compass-monitored gyroscope which transmits accurate heading indications to the pilot's repeater. A detailed description, followed by operating and servicing instructions, is contained in A.P.1275B, Vol. I, Sect. 3, Chap. 7.

Electrical Services

Automatic dead reckoning equipment

111. The ground position indicator and air position indicator, together with the air mileage unit at the navigator's station, form the basis of an automatic dead reckoning indicating system. The air position indicator is linked to the D.R. compass variation setting corrector and operates in conjunction with it. Further information on this equipment will be found in A.P.1275B, Vol. I, Sect. 1.

Bomb sights

112. A mounting is provided in the fuselage nose for any one of the three bomb sights—Mk. XIV, Mk. III low level, or Mk. IIA stabilised automatic. The Mk. XIV bomb sight is controlled by a switchbox forward of the bomb aimer's seat. This switch, which receives its supply from the 5 amp. fuse SS1 on the bomb aimer's starboard panel, is connected to the lamps in the sighting head. Used in conjunction with this bomb sight is a computor situated on the port side of the fuselage and adjacent to the auto-pilot control panel. The computor circuit is inter-connected with the D.R. compass installation.

113. When the Mk. III bomb sight is fitted it is controlled by a Type E control panel which then takes the place of the switchbox used with the Mk. XIV bomb sight. The panel receives its supply from the 3-way junction box, Type A, on the bomb aimer's panel.

114. The Mk. IIA bomb sight (when fitted) is controlled by its own control panel, Mk. II, and its supply is taken from the 3-way junction box, Type A. This equipment is inter-connected with the bomb release, flare chute and camera circuits via two 3-way switches and a relay, Type P. From the Mk. IIA sighting head connection is made to a lamp on the pilot's instrument panel, which indicates to the pilot when the aircraft is not steady on its bombing run.

Auto-pilot control

115. The positive supply for the auto-pilot electrical control is fed from the 5 amp. fuse JJ4 (in 2DB) to a 3-position rotary switch, labelled OFF—COURSE—JINK, on the pilot's instrument panel. From this switch connection is made via T.B.35 to a relay box on the bomb aimer's port panel. Interconnection to the D.R. compass circuit is made at this T.B. For further details see A.P.1469C, Vol. I.

Flare chute

116. ***General.*** — An electrically-operated twin cell flare chute, situated in the rear fuselage, provides for the carriage and release of flares or photoflashes. The electrical equipment on the flare chute consists of a twin field reversible motor which operates the wind deflector plate, two electro-magnetic release units, used for flares and flashes respectively, and an arrangement of micro switches, the function of which is given in the following paragraphs. Lanyard switches, attached to the flare chute, are for use in conjunction with the camera when fitted. The camera supply circuit is inter-connected with the flare chute circuit at T.B. 54-E and T.B. 55-A. A detailed description of the flare chute with illustrations showing the mechanical details is contained in Sect. 12, Chap. 1 of this Volume.

117. ***Motor control.*** — The flare chute reversible motor, used to lower and raise the wind deflector plate, is controlled (a) during bombing—when using photoflashes—by a micro switch operated by the bomb door lever when it is placed in the DOORS OPEN position, and (b) when using flares—by placing the change-over switch to the FIRE position.

118. ***Photoflash release.***—When the bomb door lever is put to the DOORS OPEN position, it actuates a micro switch which completes the circuit to the flare chute reversible motor and causes the deflector plate to move to the down position. When the plate reaches this position it actuates the down-limit micro switch, thus cutting off the supply to the motor and connecting this supply, via the change-over switch (OFF position), and the bomb firing switch, to the automatic bomb distributor terminal No. 16. From this terminal connection is made, via the camera control switch (ON position), to the photoflash release.

Electrical Services

119. ***Flare release.*** — The release of flares is accomplished by placing the change-over switch to the ON (or FIRE) position. This action completes the circuit to the flare chute motor and causes the deflector plate to move down. When the plate reaches the down position the down-limit micro switch disconnects the motor and transfers the supply through the change-over switch (ON or FIRE position) to the flare release unit.

120. A lamp adjacent to the switch indicates when the circuit to the flare release coil is completed, but is extinguished by the action of the release unit switch when the flare is dropped. The wind deflector plate is brought back to its normal (up) position when the change-over switch is placed to off.

121. ***Sequence of operations.*** — This can be summarised in the following manner:—

Bombs and night camera (using photoflash)

Operation	Effect
(1) Set the automatic bomb distributor and selector switchbox to the required bombing and photoflash sequence and place the bomb door lever to the DOORS OPEN position	The flare chute deflector plate moves to the down position
(2) Press the bomb aimer's firing switch and close the camera master switch	Photoflash released when bomb distributor contact No. 16 is reached. Camera control will start when lanyard switch is operated
(3) Place all switches off and return the bomb door lever to the DOORS CLOSED position	Deflector plate returns to the normal (up) position

Scanner heater unit

122. Three heating elements, situated inside the wall of the scanner platform, are controlled by a switch, Type B, on the port side of the fuselage at the scanner position. The operation of these elements should be checked before each operational flight.

Transmitters, Type F and Z

123. Two transmitters, Type Z, installed in the fuselage nose and a transmitter, Type F, situated at the tail of the fuselage, are used to transmit a coded signal which can be received only by friendly aircraft equipped for its reception.

124. The transmitters operate in conjunction with two flasher motors, the Z transmitters with the No. 1 motor and the F transmitters with motor No. 2. The transmitters and flasher motors are controlled by their respective switches on the navigator's control panel, which also contains two lamps which indicate when their associated transmitters are in operation.

125. Separate control facilities for the Type F (tail) transmitter are provided by a switch, Type B, and warning lamp on the radio operator's control panel.

126. The circuits are fed from the 25 amp. fuse CC4 in 1DB, and subsidiary circuit fuses are contained in a four-way fusebox on the navigator's control panel.

Turret position indicator

127. The movement in azimuth of the rear turret is directly recorded by the indicator on the radio operator's panel. The indicator is connected to the turret transmitter via slip rings B, D and F. The supply to the transmitter is obtained, via the turret control switch from slip ring A.

Electrical Services

Bonding

128. Care should be taken to ensure that all bonding connections are intact and that there is no corrosion at soldered joints or at contact points to metal fittings. Servicing of the bonding system should be carried out in accordance with the instructions contained in A.P.1464D, Vol. I, Sect. 1, Chap. 5.

Radio power supplies

129. The input circuits for the T1154/R1155 radio L.T. and H.T. power units are supplied from fuses GG1 and GG2 in 1DB. These fuses are of 20 amp. and 40 amp. capacity respectively. Positive supply for the Londex relay, used in conjunction with the L.T. power unit, is provided by fuses WW3 and WW4 in panel 2P and fuses VV7 and VV8 in panel 3P. A junction terminal D1 in 1DB connects these two fuses to the Londex relay circuit.

130. The electrical supply to the TR1143A power unit is provided from a 40 amp. fuse in panel 2P. The power unit for the inter-communication amplifier receives its supply from terminal block (TB) 38-E on the navigator's panel. The earth connection for this circuit is made via T.B. 38-D, at 43-B on the same panel.

131. The I.F.F. control unit obtains its positive supply from the 20 amp. fuse EE4 in 1DB, via T.B.31 on the radio operator's panel. The negative side of the supply socket is connected to earth at T.B.74 also on this panel.

132. The beam approach equipment (when fitted) derives its supply from the 20 amp. fuse JJ1 in 1DB via a junction box in the forward fuselage section. Wiring diagrams of the radio services are contained in Sect. 6, Chap. 2 of this Volume.

Radar power supplies

133. On aircraft with Mod. 1430 embodied, the a.c. supply for the radar equipment is provided by two motor generators, Type A, situated on the port side of the fuselage centre section, fore and aft of the flap jack. The motor generators are controlled by circuit breakers, Type B, in panel 3P. The operating coils of these circuit breakers are fed from the 5 amp. fuses VV2 and VV3 and controlled by their push switches on the navigator's panel.

134. On aircraft without Mod. 1430 embodied the radar a.c. supply is provided by two engine-driven alternators, Type U, one on each outboard engine. Voltage control is achieved by carbon pile regulators in the respective control panels, Type 5.

135. D.C. supply for the A.R.I. 5559, A.R.I. 5590 and A.R.I. 5083 radar equipment is provided by the 20 amp. fuse GG5 in 1DB. This supply is taken to the radar control switch, Type 226, at the navigator's station.

Circuit index and modification chart

136. An index of all circuits, showing the electrical modifications embodied, is given in the following table:—

Circuit	Fig. No.	Wiring diagram affected
Harness diagram—(Panels and D.B.s)	1	
Bomb fuzing and release equipment	1a	
Radial feeder distribution	2	
Routing charts		
Generator controls	3	
Generator controls (before Mod. 1430)	3a	
Engine starter; booster and ignition	4	
Propeller feathering	5	
Fire extinguisher—fire bottles	6	
Fire extinguisher—warning lamps	7	
Oil temperature thermometers	8	
Radiator temperature thermometers	9	
Radiator and oil temperature thermometers (before Mod. 1447)	9a	

Electrical Services

Circuit	Fig. No.	Wiring diagram affected
Routing charts—*contd.*		
Air intake, slow running cut-off and air cleaner controls	10	
Radiator flap controls	11	
Radiator flap controls (before Mod. 1447) and supercharger control (before Mod. 1281)	11a	
Fuel pressure warning and fuel flowmeters	12	
Fuel pressure warning and fuel flowmeters (before Mod. 1447)	12a	
Oil pressure indicators and oil dilution	13	
Engine priming and supercharger control	14	
Fuel contents gauges	15	
Undercarriage indicator	16	
Engine speed indicators	17	
Fuel pumps	18	
Fuel pumps (before Mod. 1447)	18a	
Long range tanks—fuel pumps and contents gauges	18b	
Coolant loss indicators	19	
Exterior lighting	20	
Interior lighting with pilot's U/V lamps	21	
Interior lighting with pilot's U/V lamps (before Mod. 1447)	21a	
Interior lighting (before Mod. 1165)	21b	
Camera supply and heating and heated clothing socket	22	
Call lamps	23	
Turret supplies and ammunition assister motors	24	
Flap indicator and dinghy release	25	
Heated pressure head and windscreen wiper	26	
Scanner heater and turret position indicator	27	
Bomb fuzing and release	28	
D.R. compass	29	
Automatic dead reckoning equipment	30	
Mk. XIV bomb sight and auto-pilot	31	
Mk. IIA and Mk. III bomb sights	31a	
Flare chute Mk. III	32	
Fire extinguishers (tank bays)	33	
Transmitters, Type F and Z	34	
Radio d.c. supplies	35	
A.C. supply and control	36	
A.C. supply and control (before Mod. 1430)	36a	
Motor generator for scanner unit	37	
Radar d.c. supplies	38	
MODIFICATION NO.	**UP TO 1811**	

P12752 M49376/G2286 5/48 800 C & P **Gp. 1**

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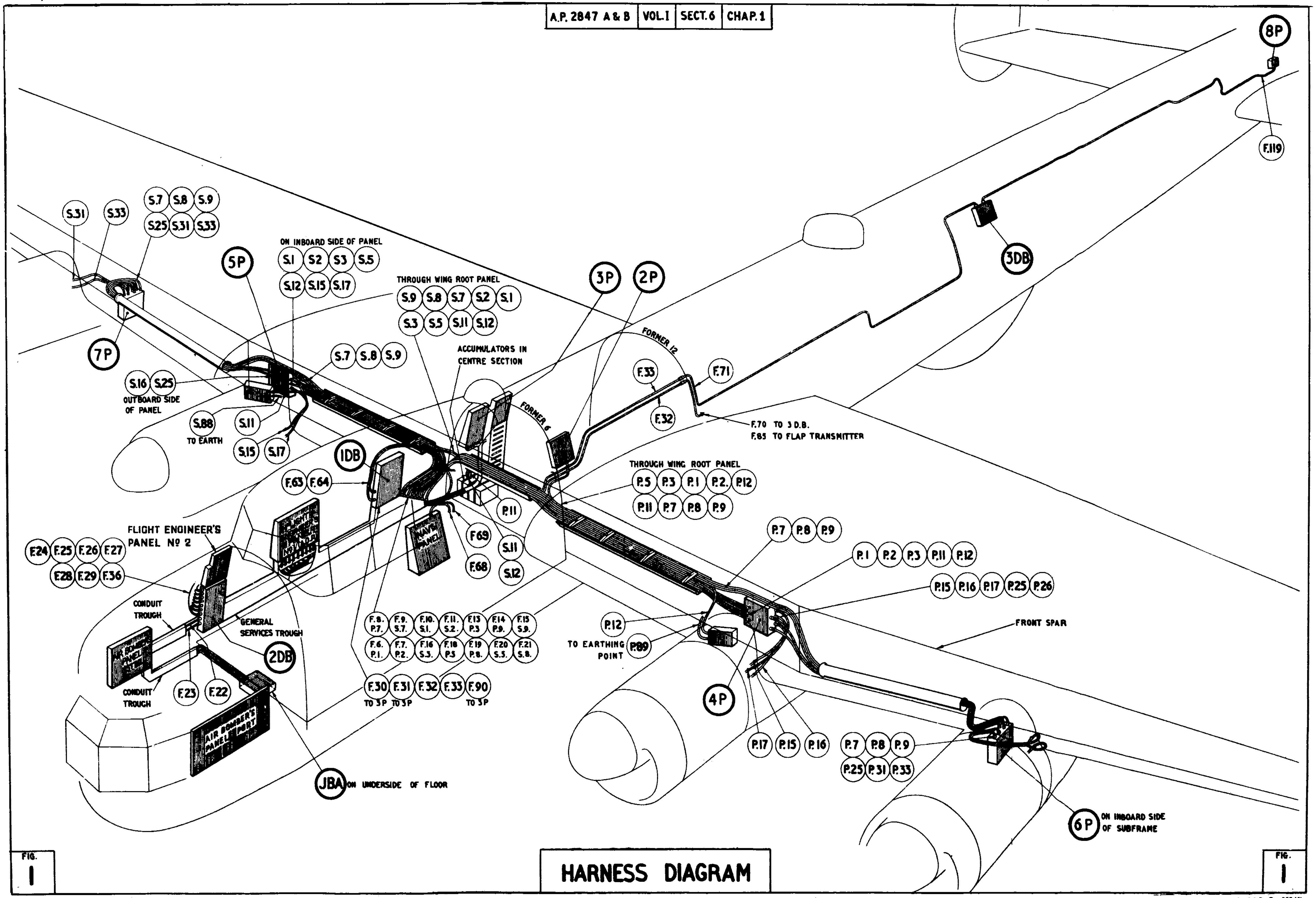

FIG. 1

HARNESS DIAGRAM

FIG. 1

PPS147 M49377/G3287 4/48 800 C&P Gp. 959 (4)

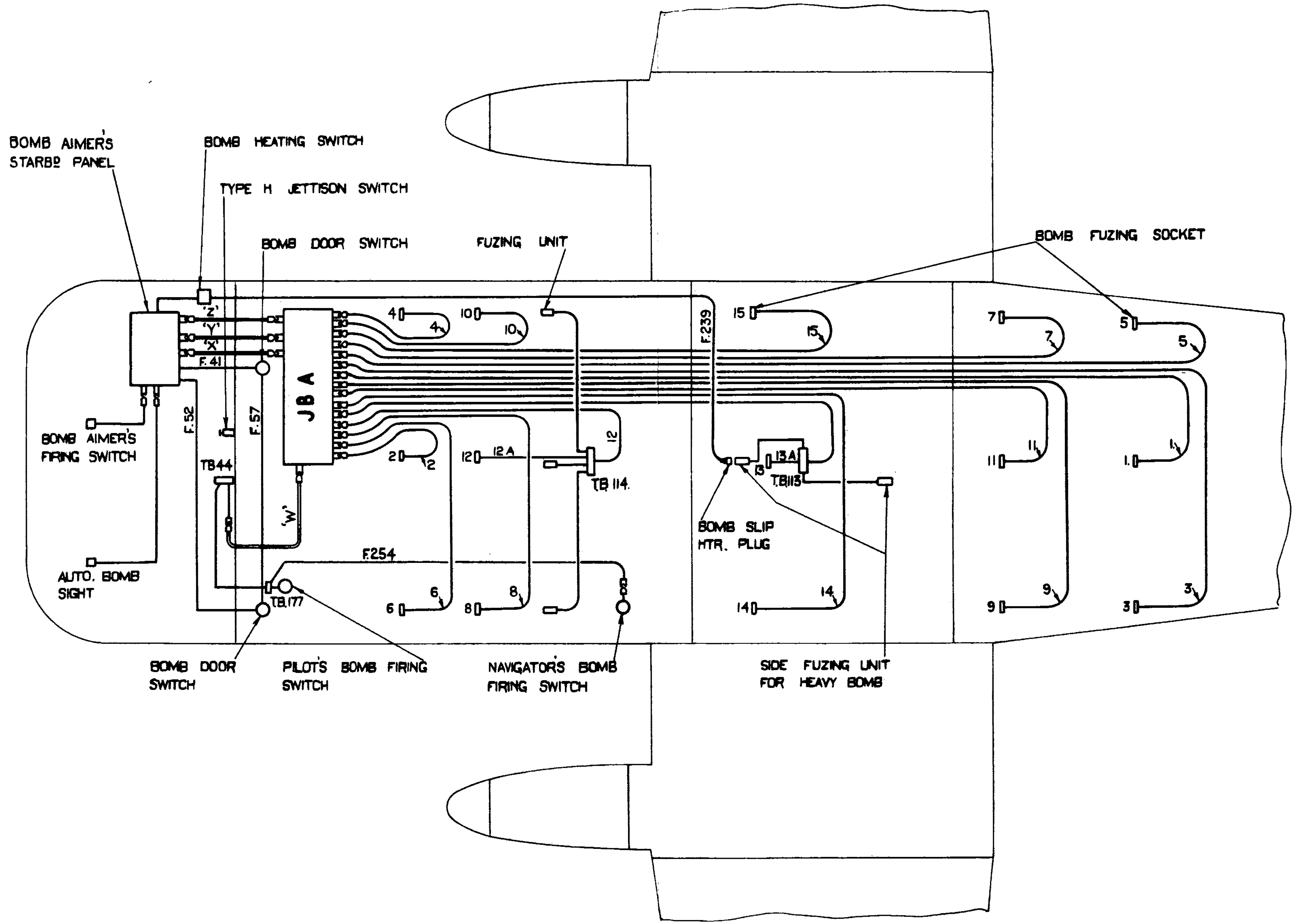

FIG. 1a

BOMB FUZING AND RELEASE EQUIPMENT

FIG. 1a

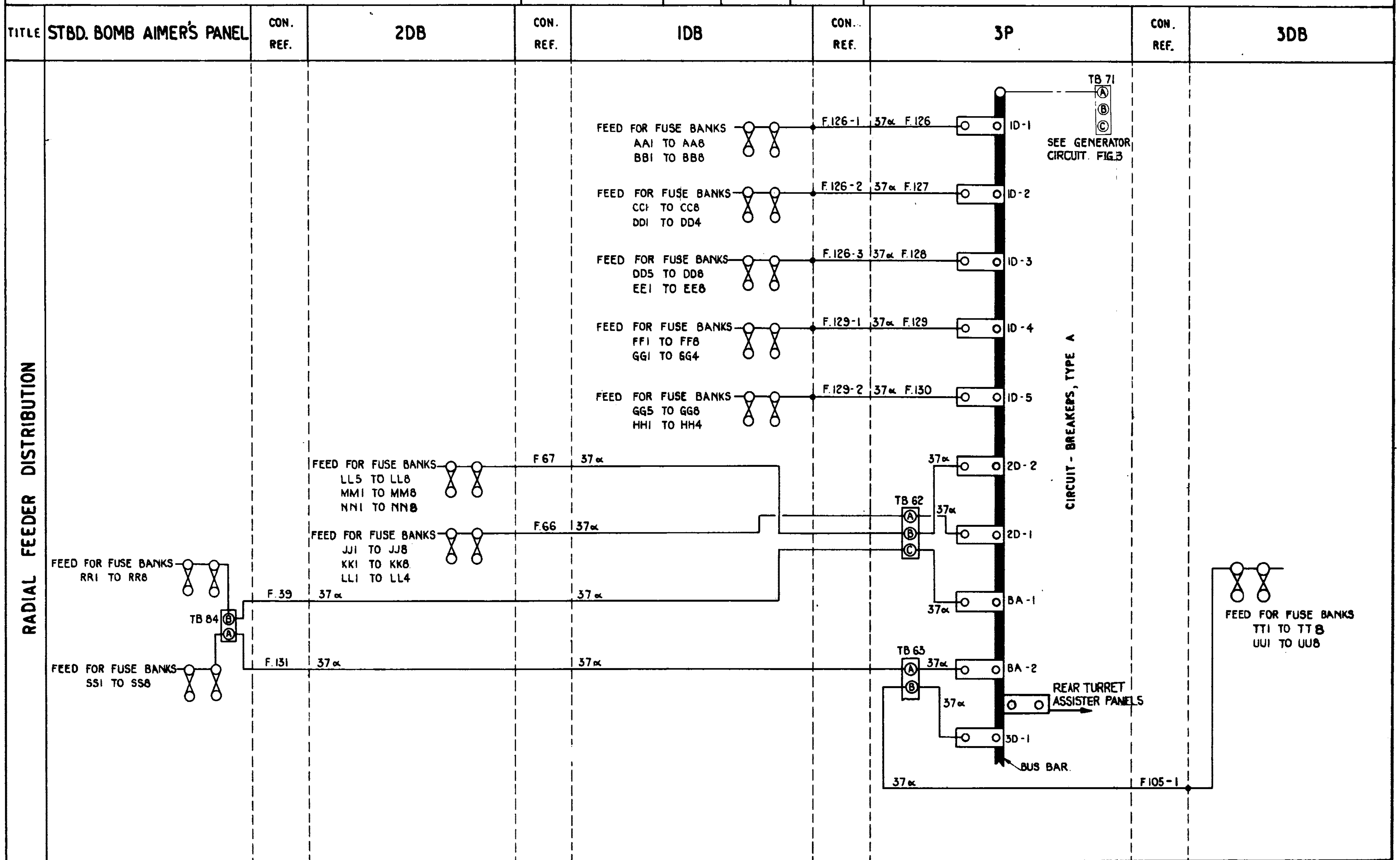

FIG. 2 ROUTING CHART – GENERAL SERVICES FIG. 2

PP5147 M49377/G2287 4/48 800 C & P Gp. 959 (4)

TITLE: GENERATOR CONTROLS (4 TYPE P GENERATORS) – A

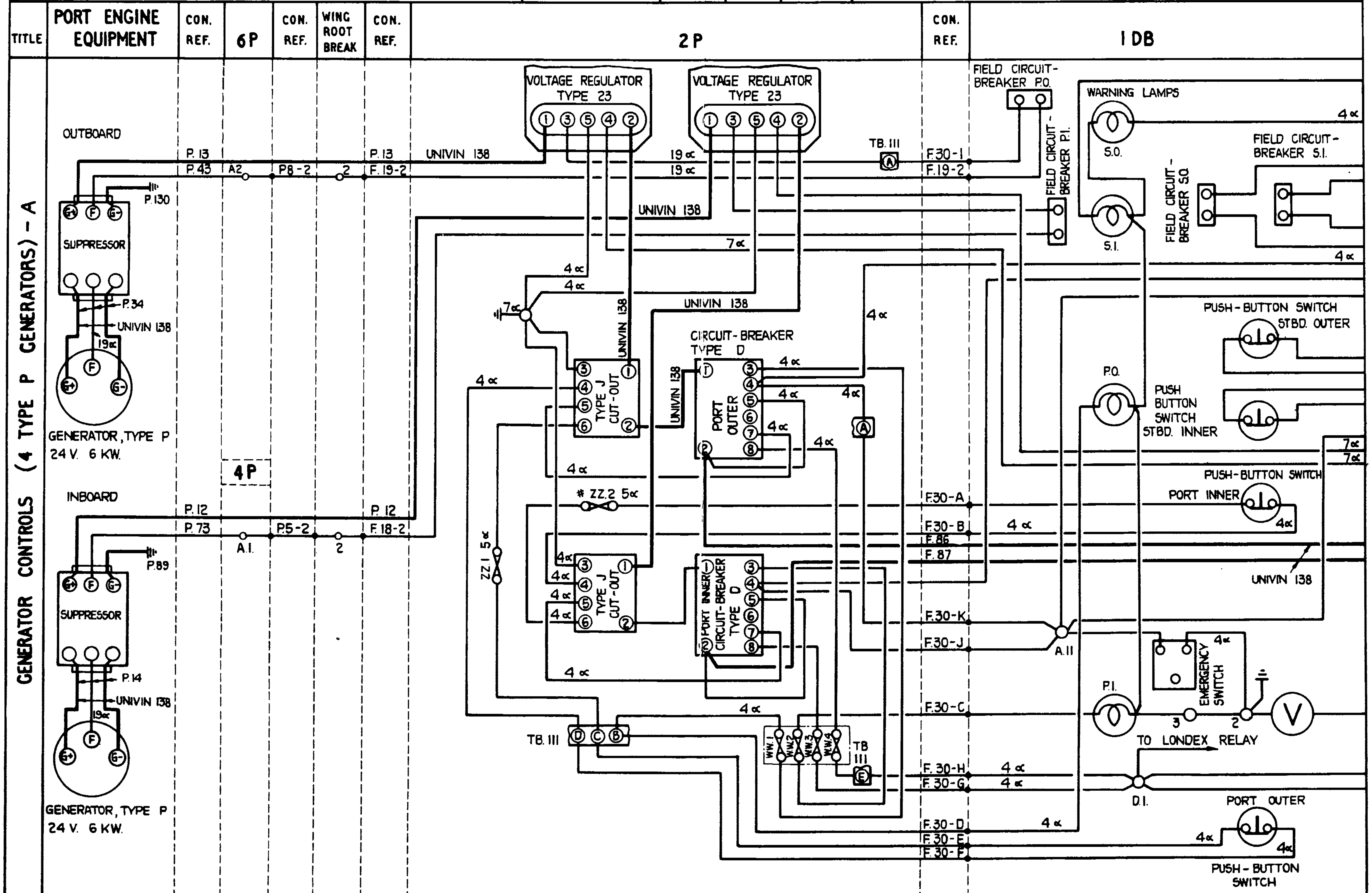

FIG. 3

ROUTING CHART

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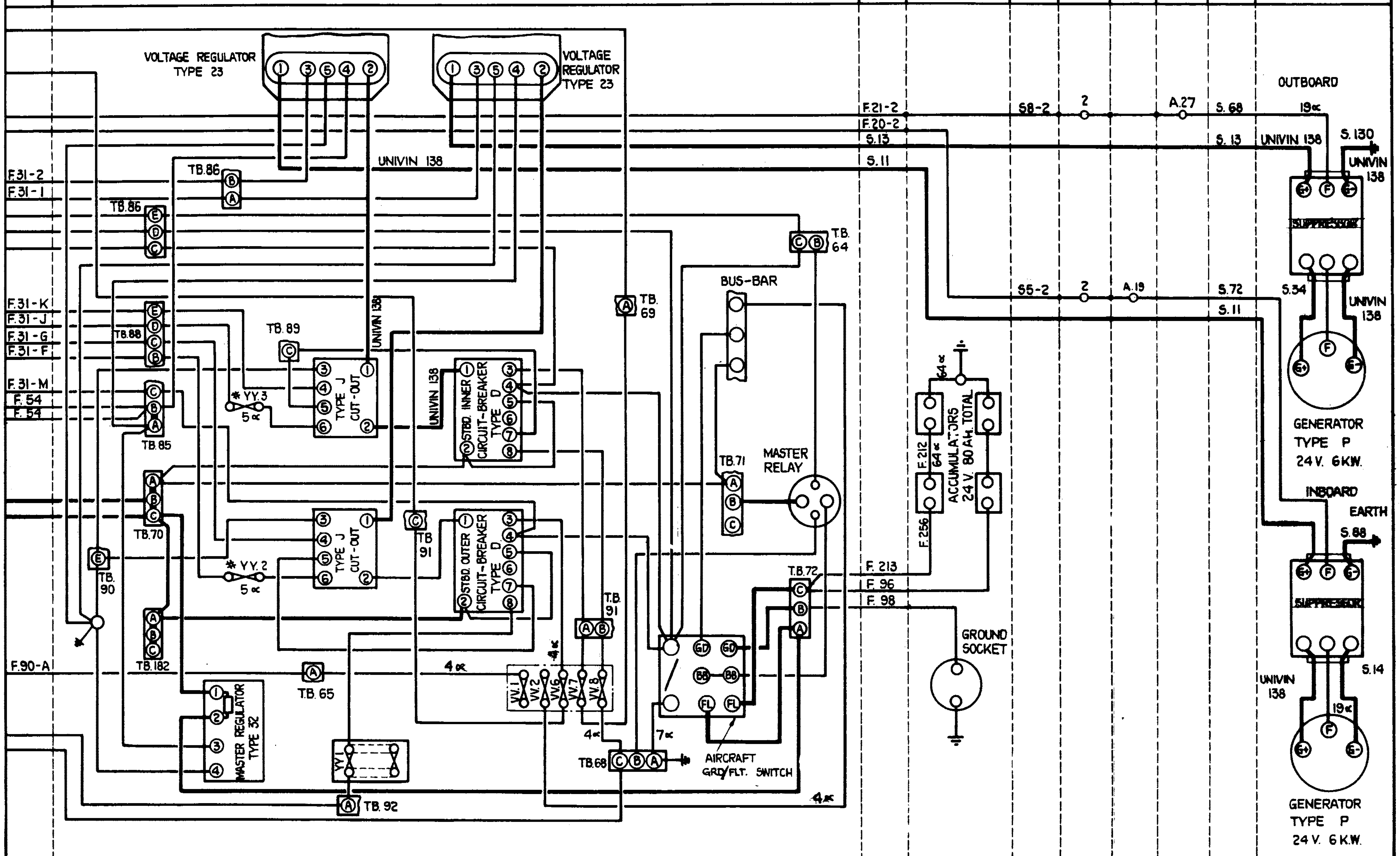


GENERAL SERVICES

FIG. 3

PP5147 M49377/G2287 4/48 800 C & P Gp. 959 (4)

TITLE	PORT INBOARD ENGINE EQUIPMENT	CON. REF.	4 P	CON. REF.	2 P	CON. REF.	I D B

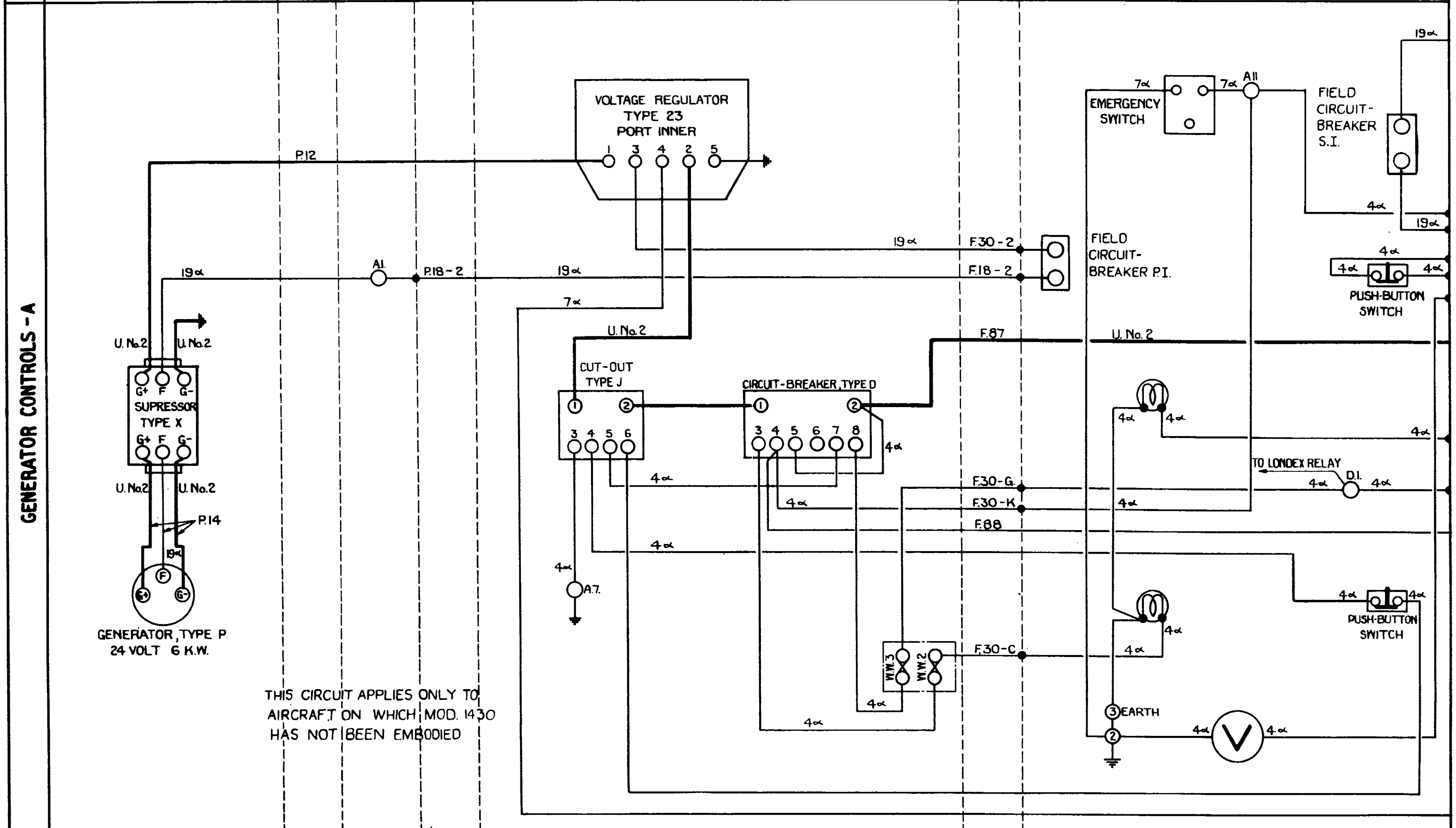
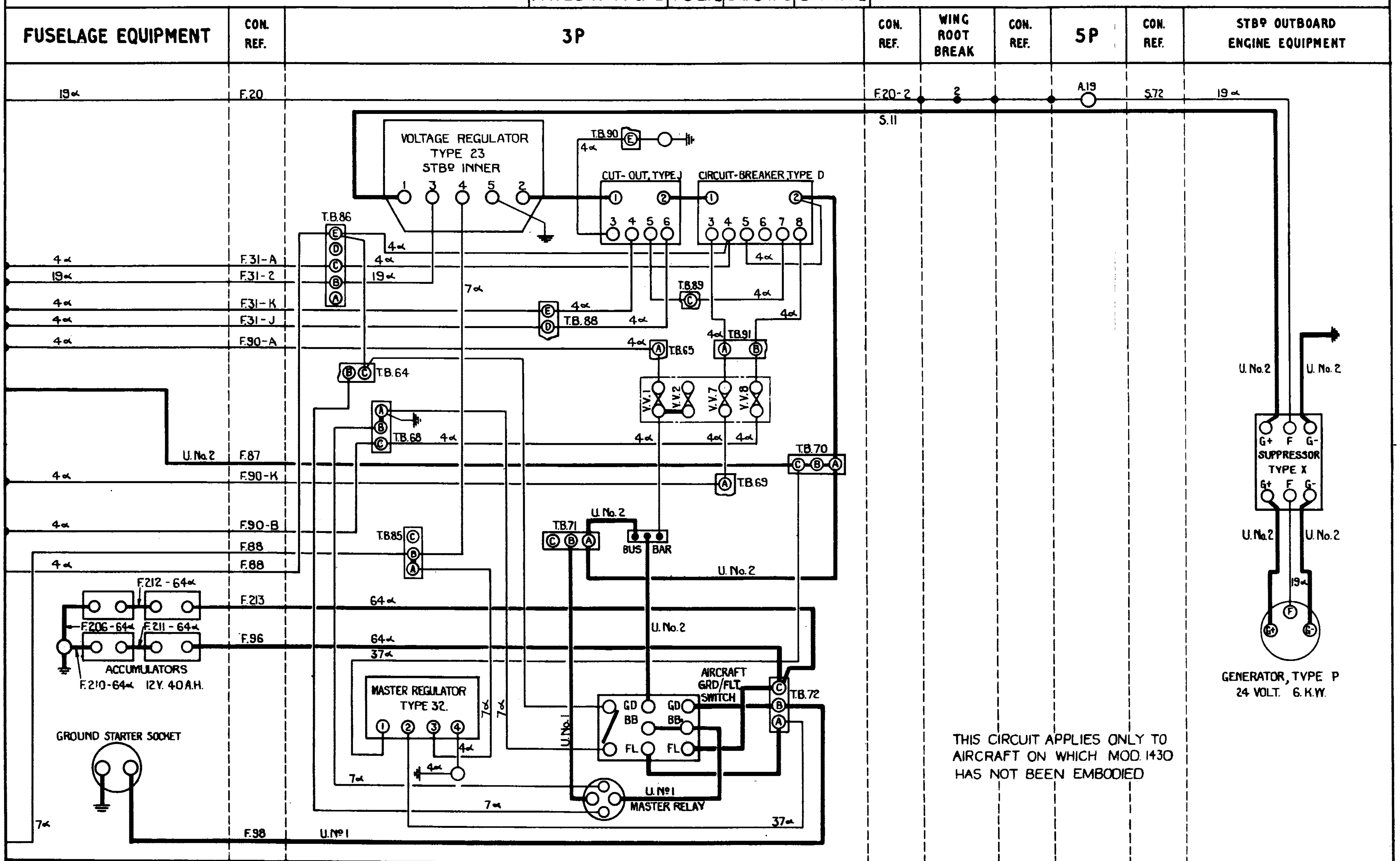


FIG. 3a ROUTING CHART



GENERAL SERVICES

FIG. 3a

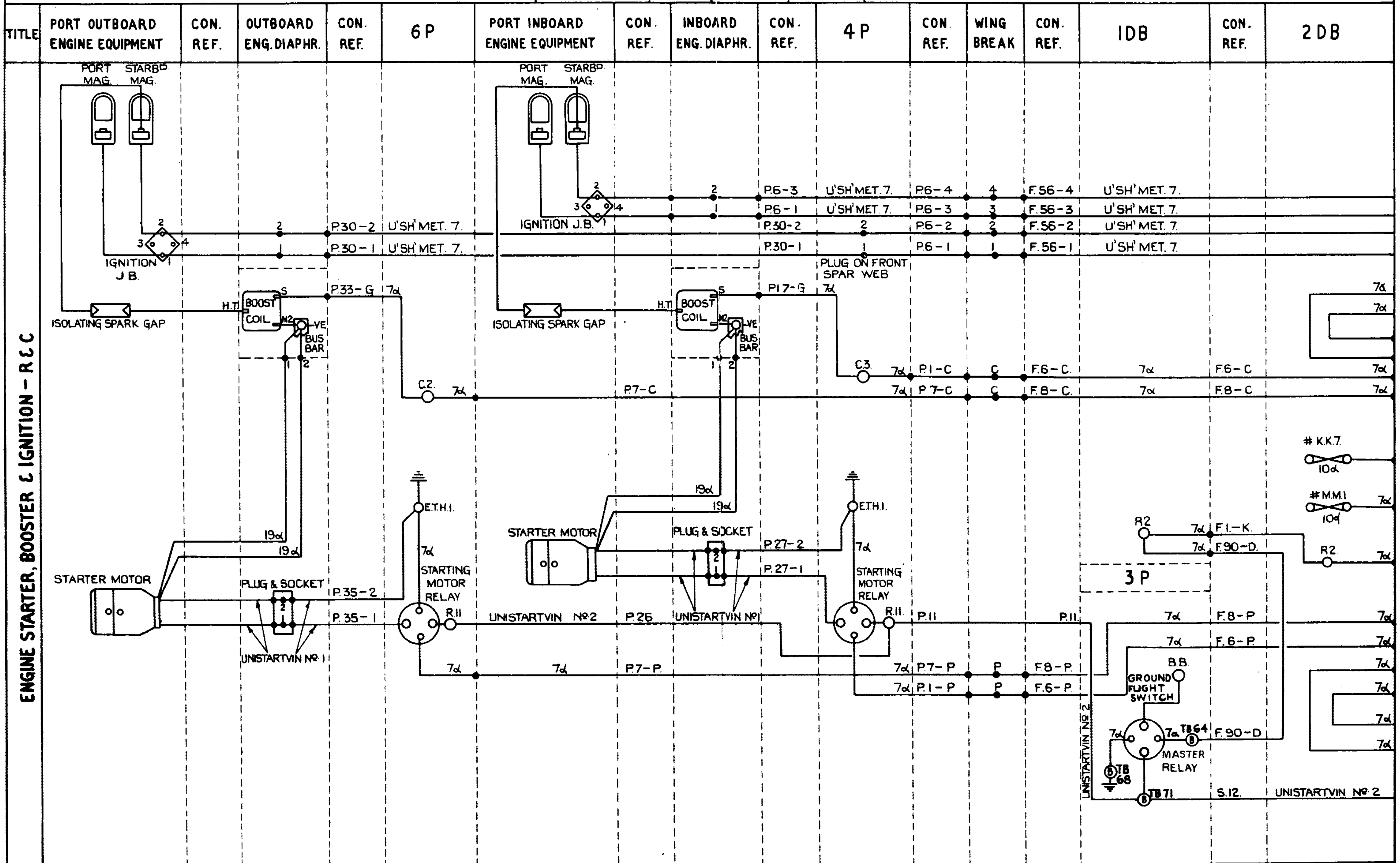


FIG. 4

ROUTING CHART

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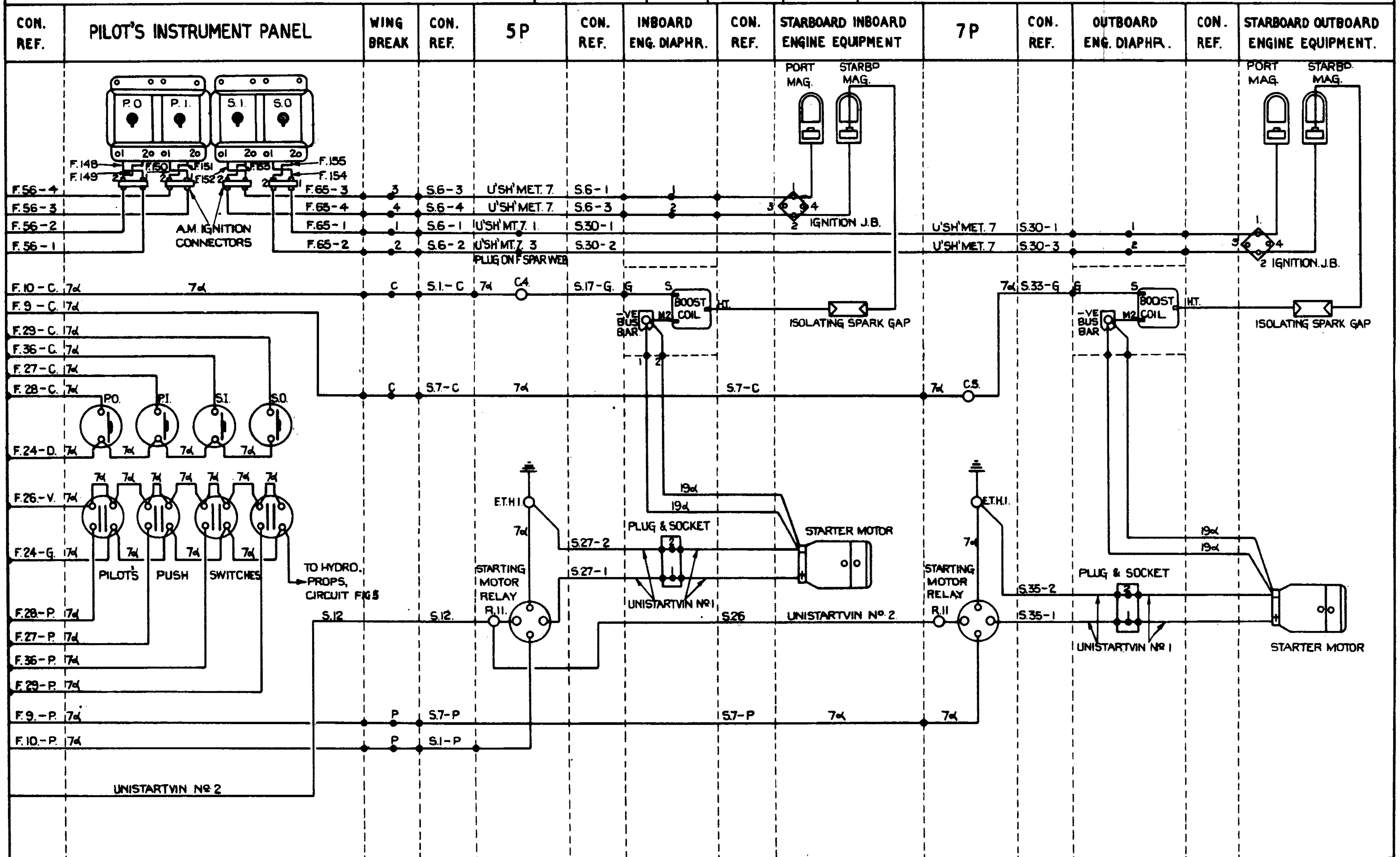

GENERAL SERVICES

FIG. 4

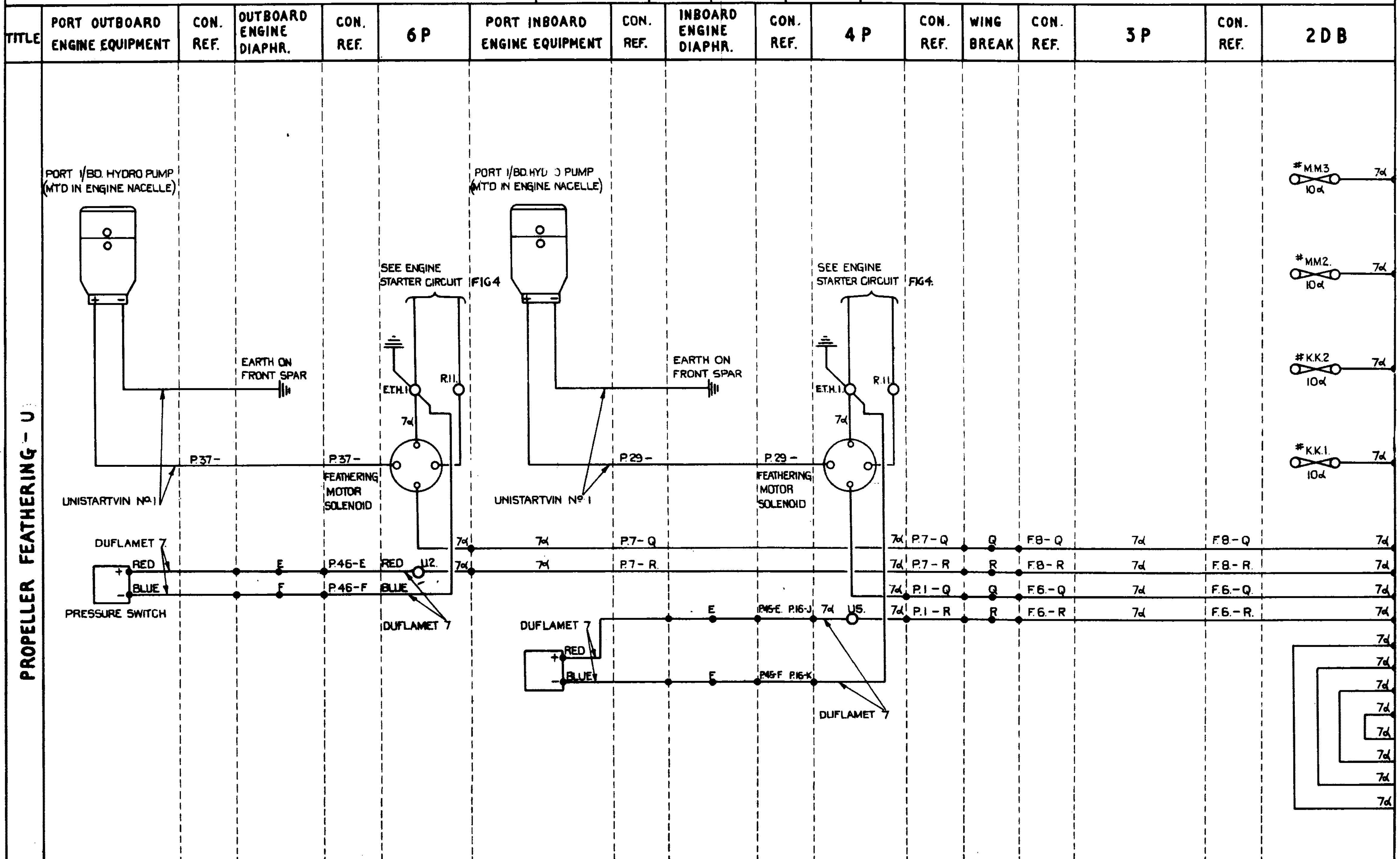

FIG. 5

ROUTING CHART

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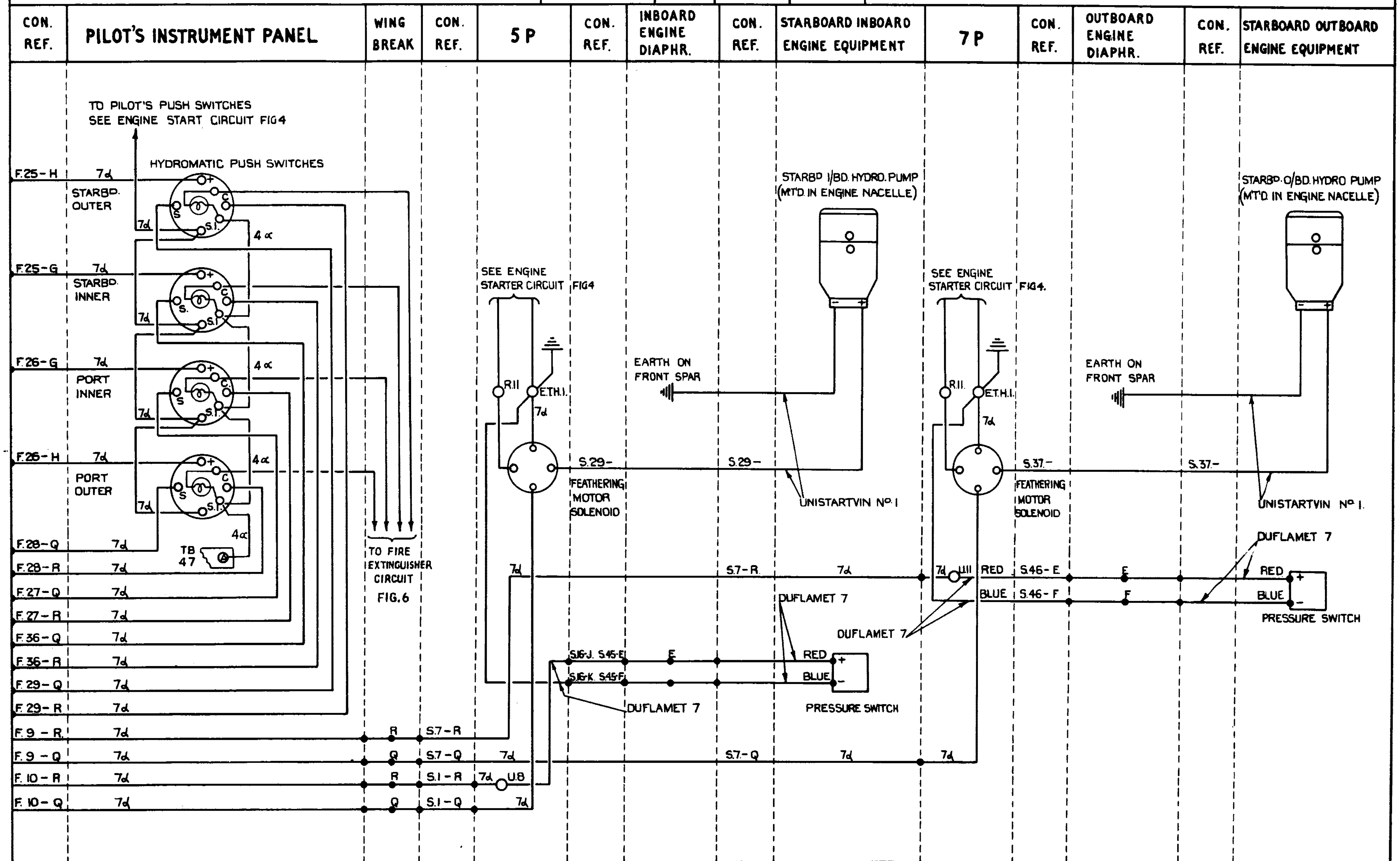

GENERAL SERVICES

FIG. 5

PP5147 M49377/G2287 4/48 800 C & P Gp. 959 (4)

TITLE	PORT OUTBD. ENGINE NACELLE EQUIPMENT	CON. REF.	6 P	PORT INBD. ENGINE NACELLE EQUIPMENT	CON REF.	4 P	CON REF.	WING ROOT BREAK	CON REF.	1DB	CON REF.	2DB

FIRE EXTINGUISHER – FIRE BOTTLES – M

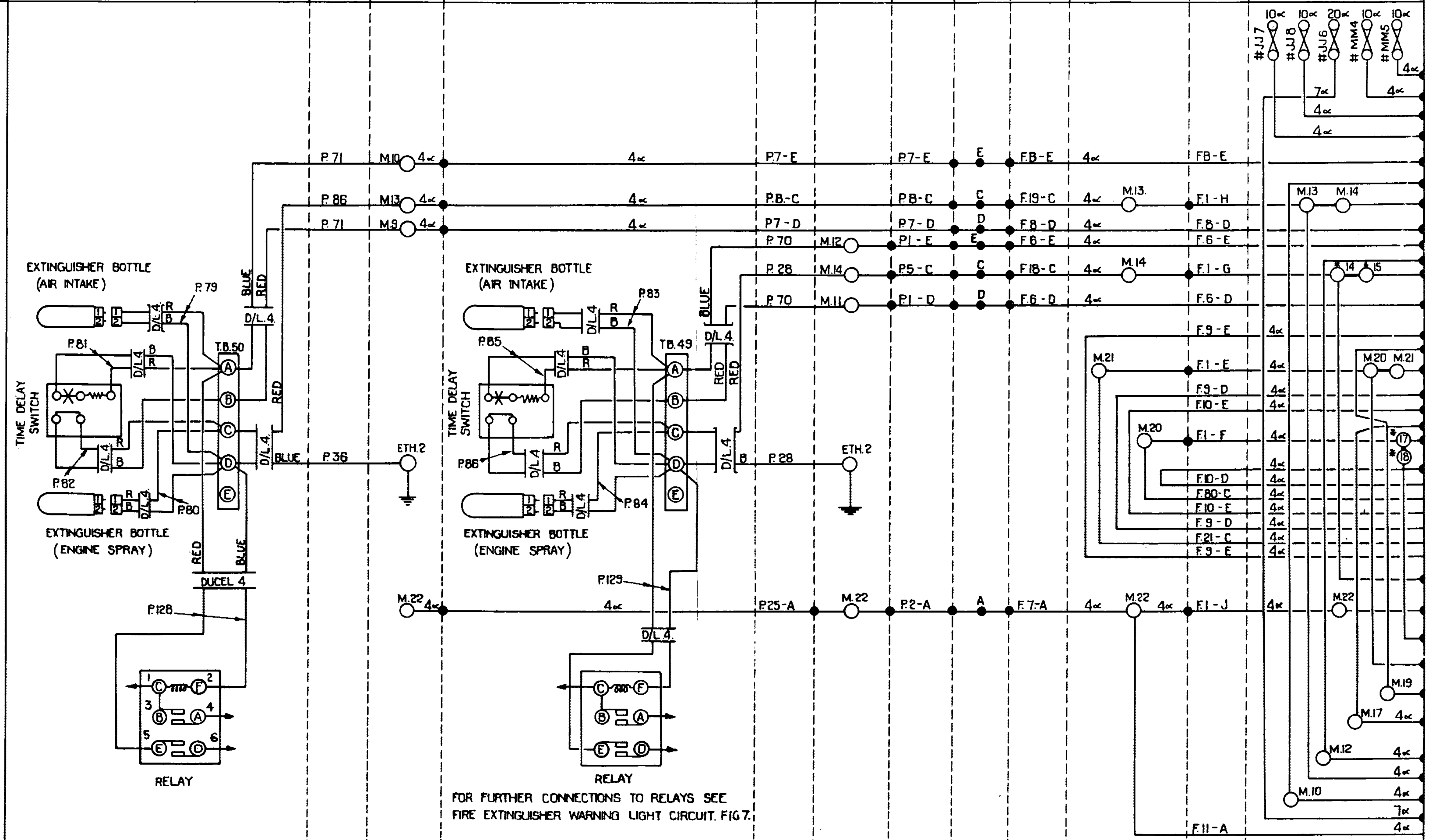

FIG. 6

ROUTING CHART

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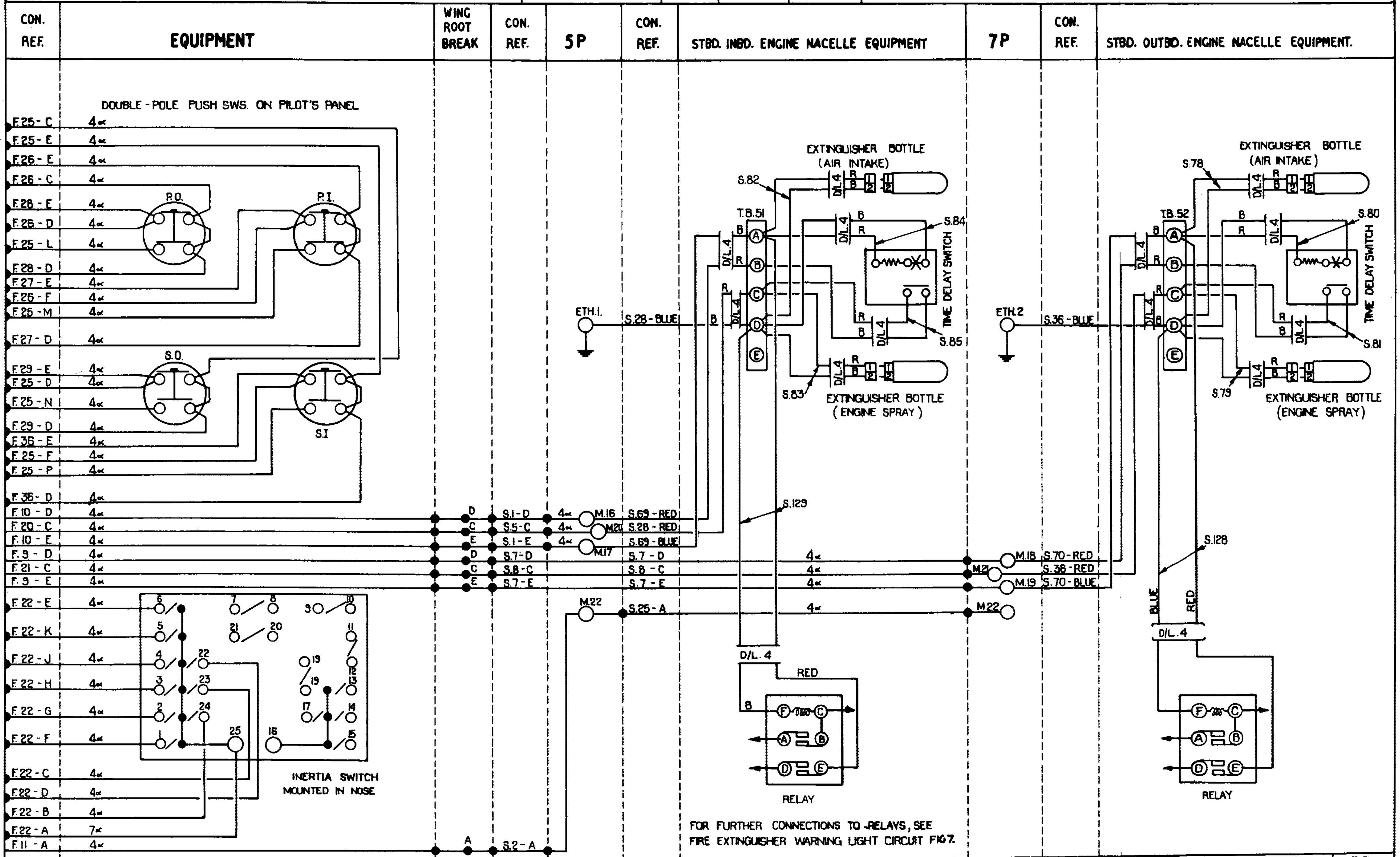

GENERAL SERVICES

FIG. 6

FIRE EXTINGUISHER – WARNING LAMPS–M

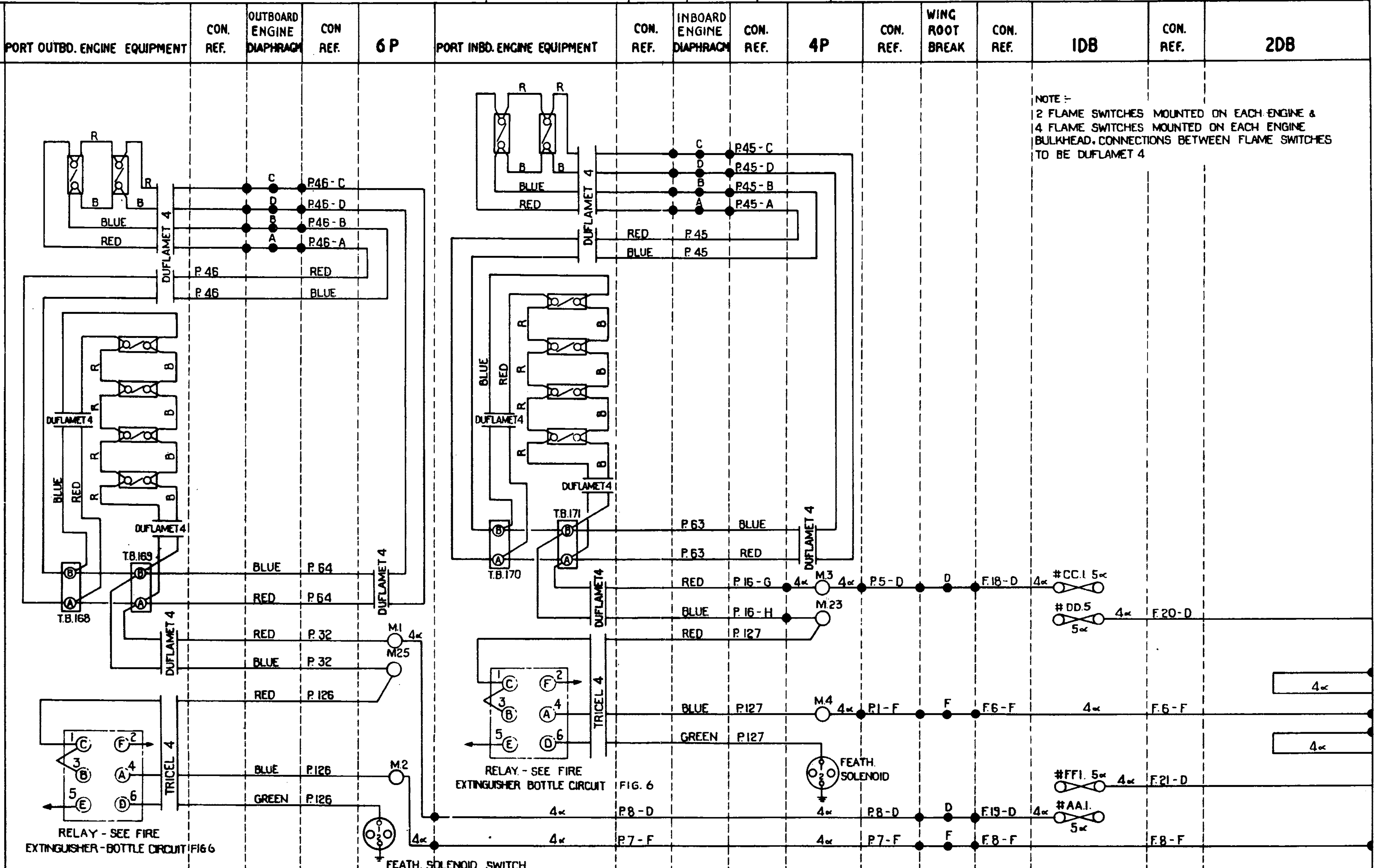

FIG. 7

ROUTING CHART

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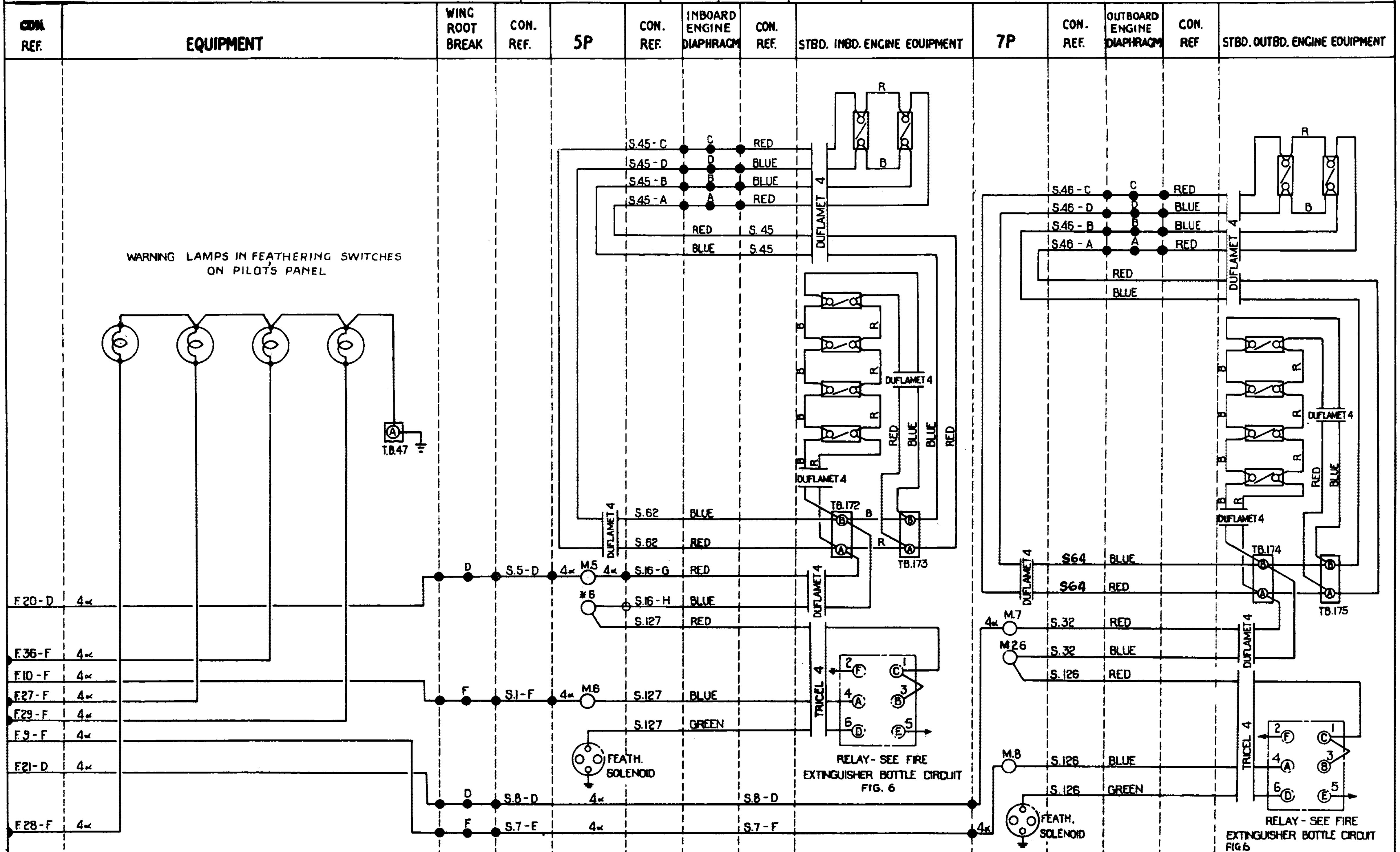

GENERAL SERVICES

FIG. 7

PP5147 M49377/G2287 4/48 800 C & P Gp. 959 (4)

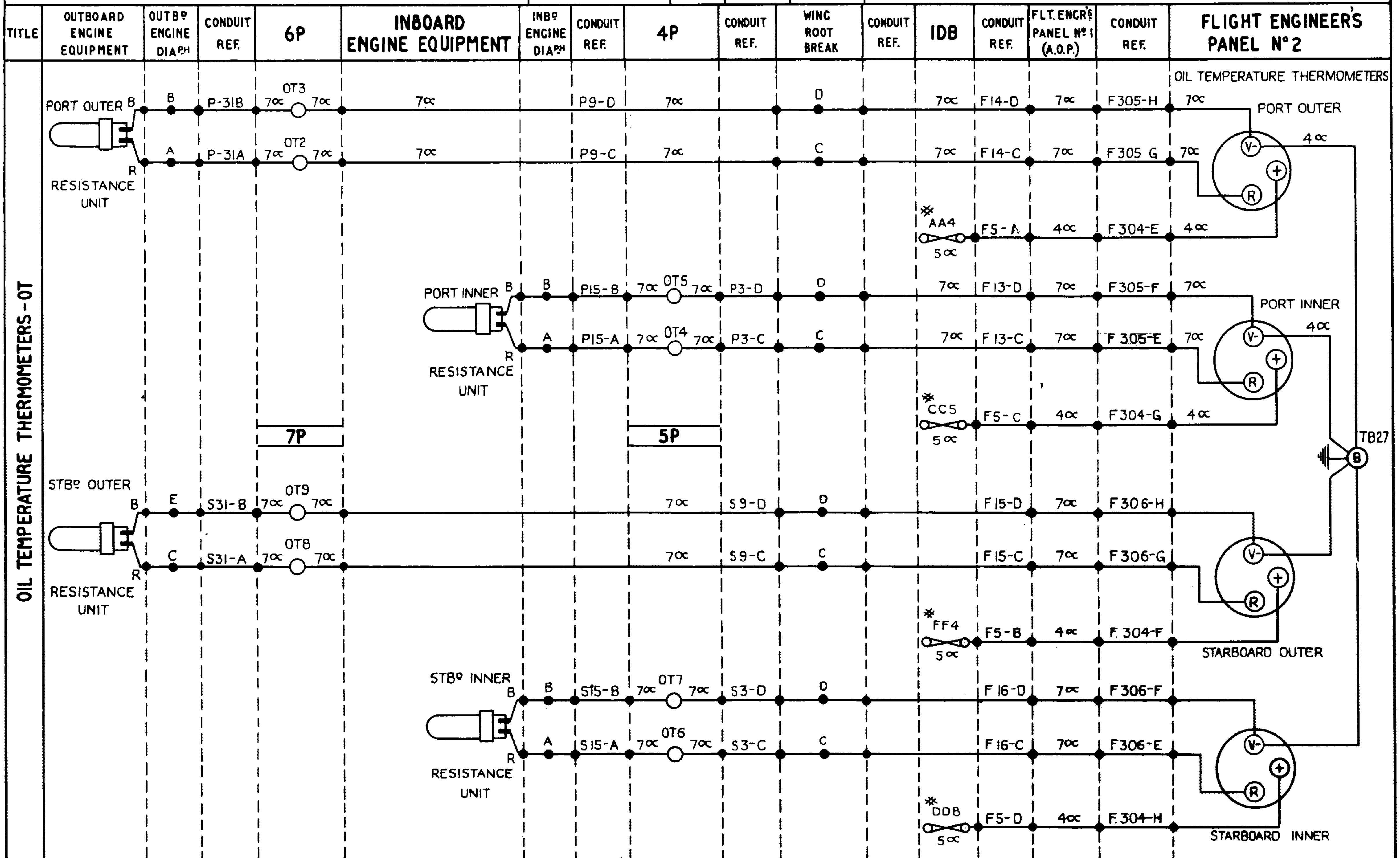

FIG. 8 ROUTING CHART-GENERAL SERVICES FIG. 8

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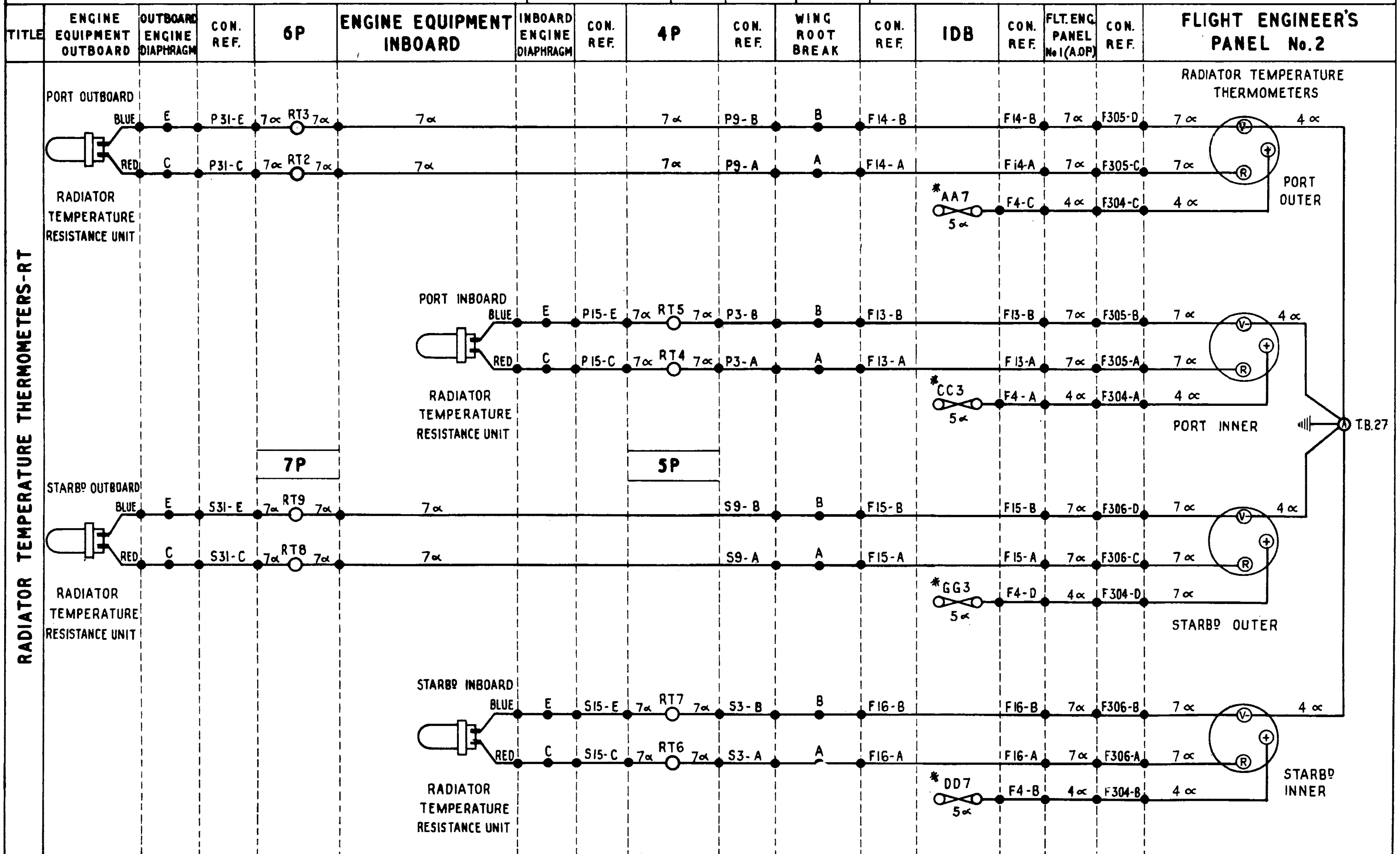

FIG. 9

ROUTING CHART - GENERAL SERVICES

FIG. 9

PP5147 M49377/G2287 4/48 800 C & P Gp. 959 (4)

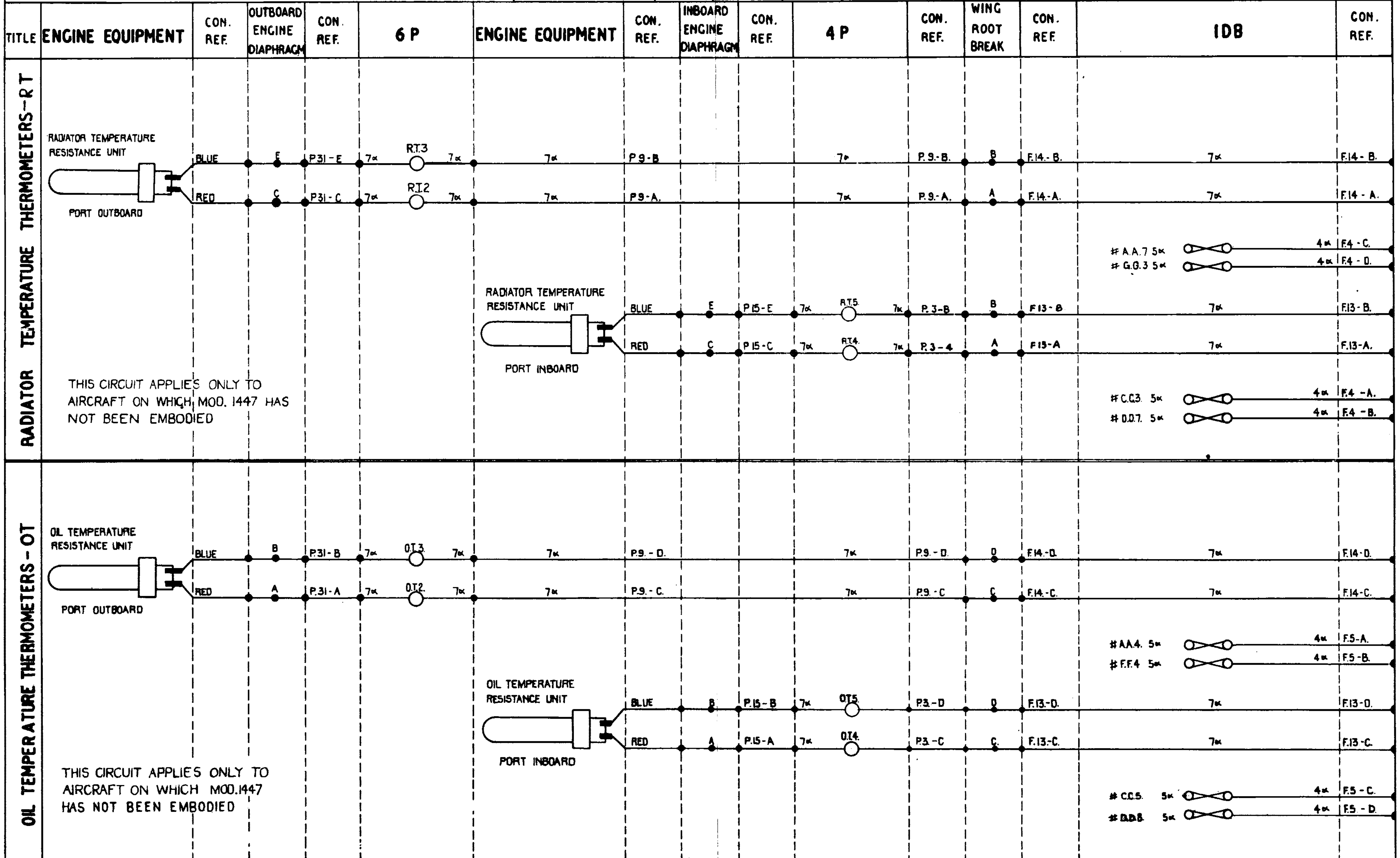

FIG. 9a

ROUTING CHART

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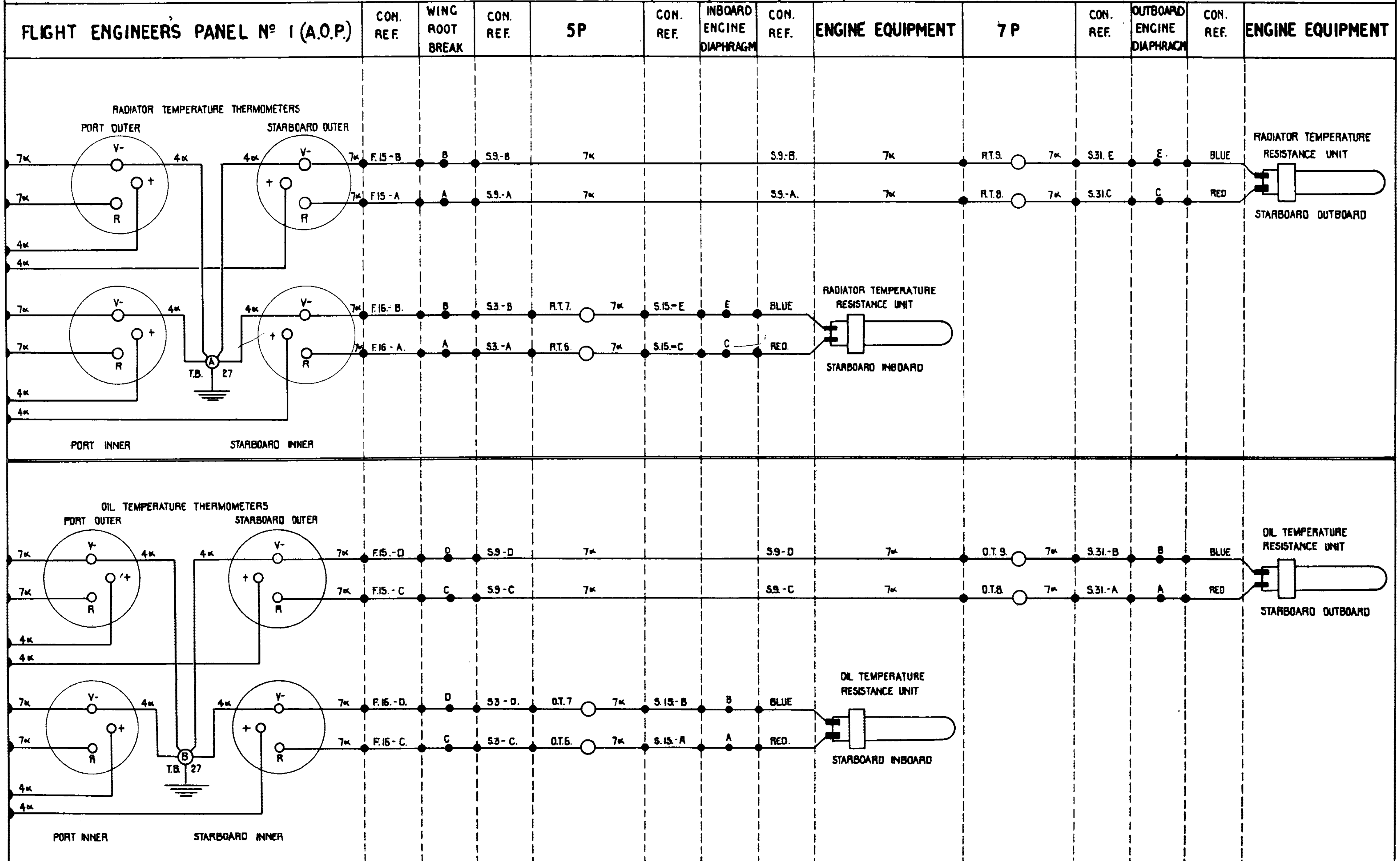

GENERAL SERVICES

FIG. 9a

PP5147 M49377/G2287 4/48 800 C & P Gp. 959 (4)

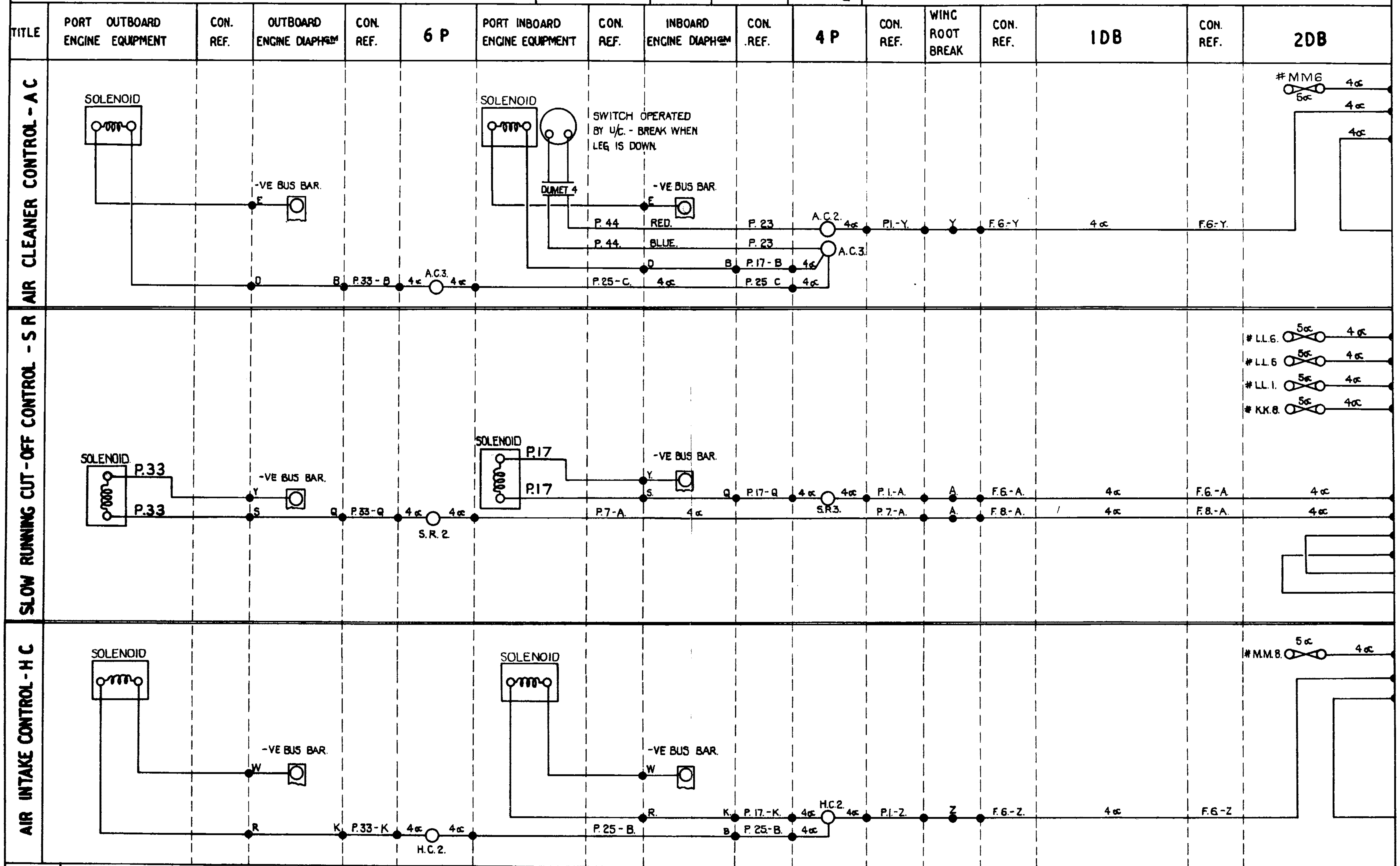

FIG. 10

ROUTING CHART

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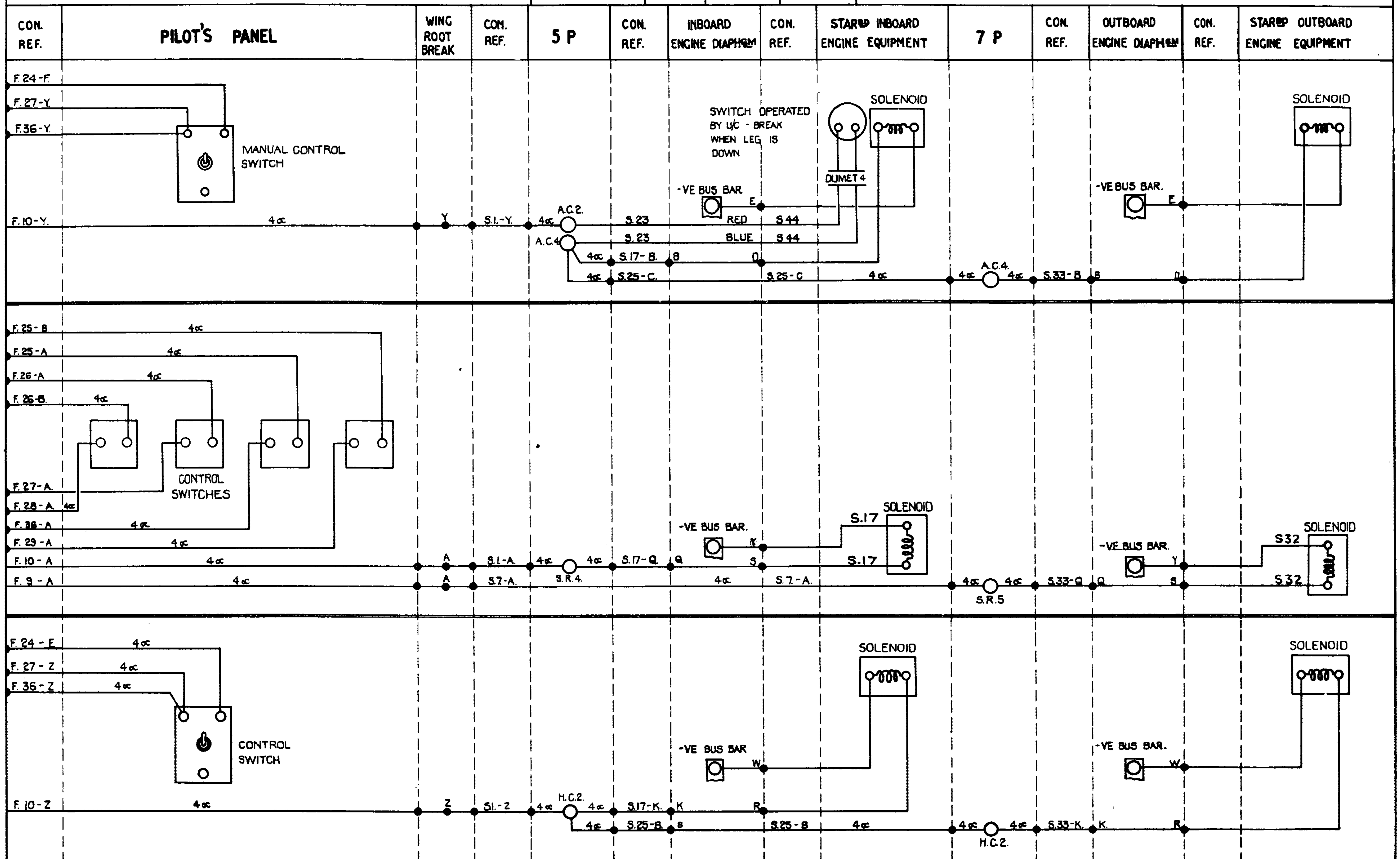

GENERAL SERVICES

FIG. 10

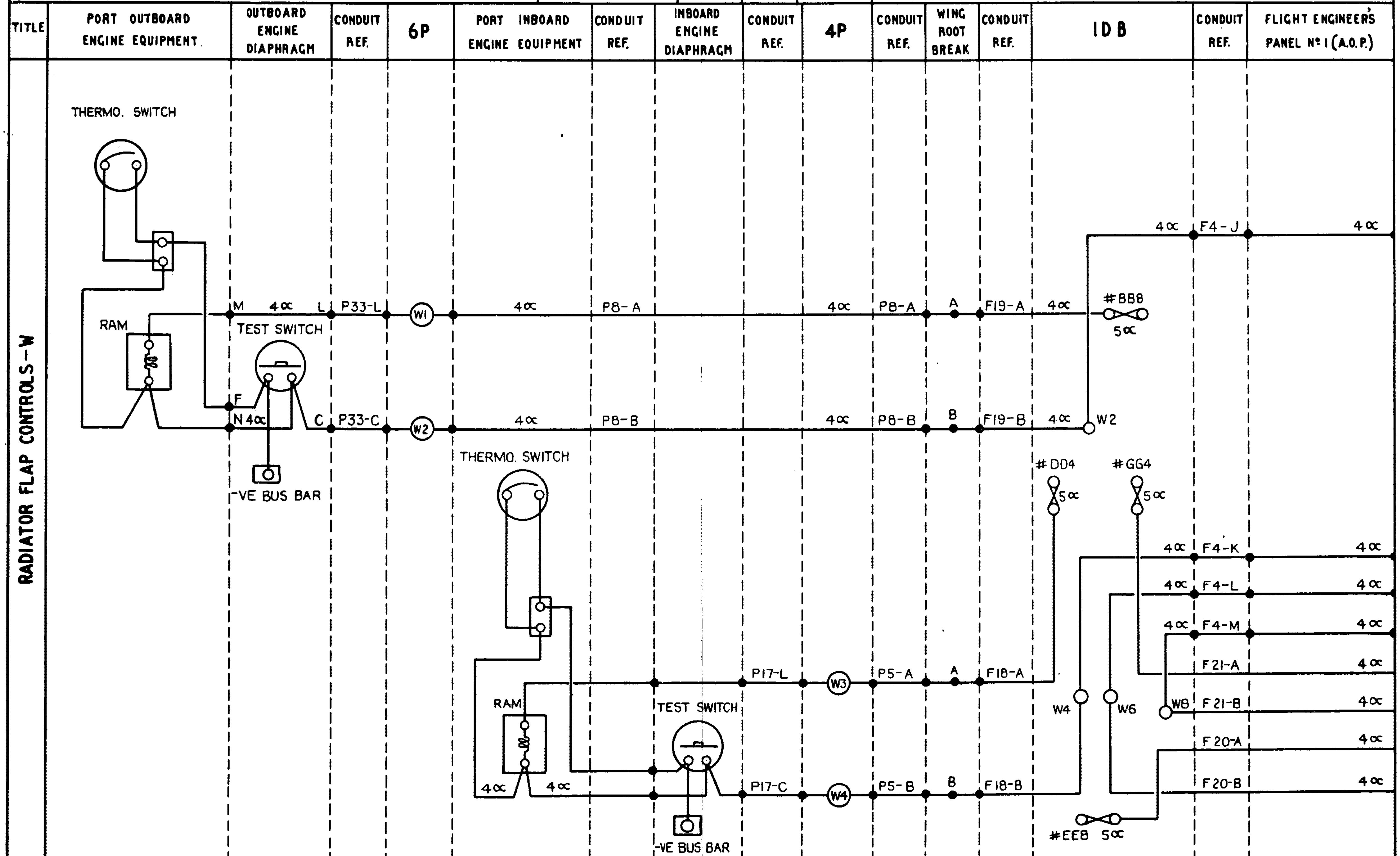

FIG. 11

ROUTING CHART-GENERAL SERVICES

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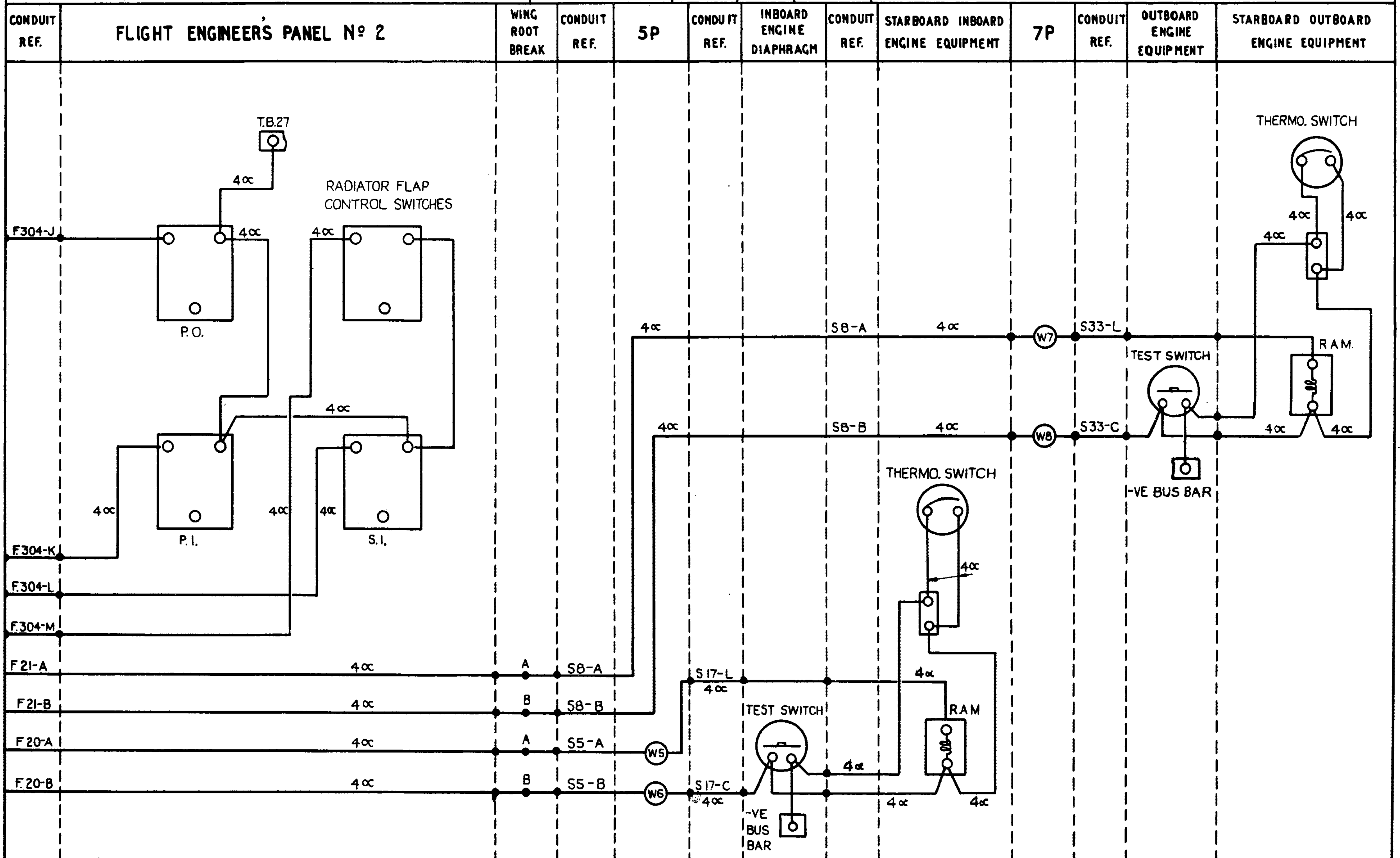

ROUTING CHART-GENERAL SERVICES

FIG. 11

PP5147 M49377/G2287 4/48 800 C & P Gp. 959 (4)

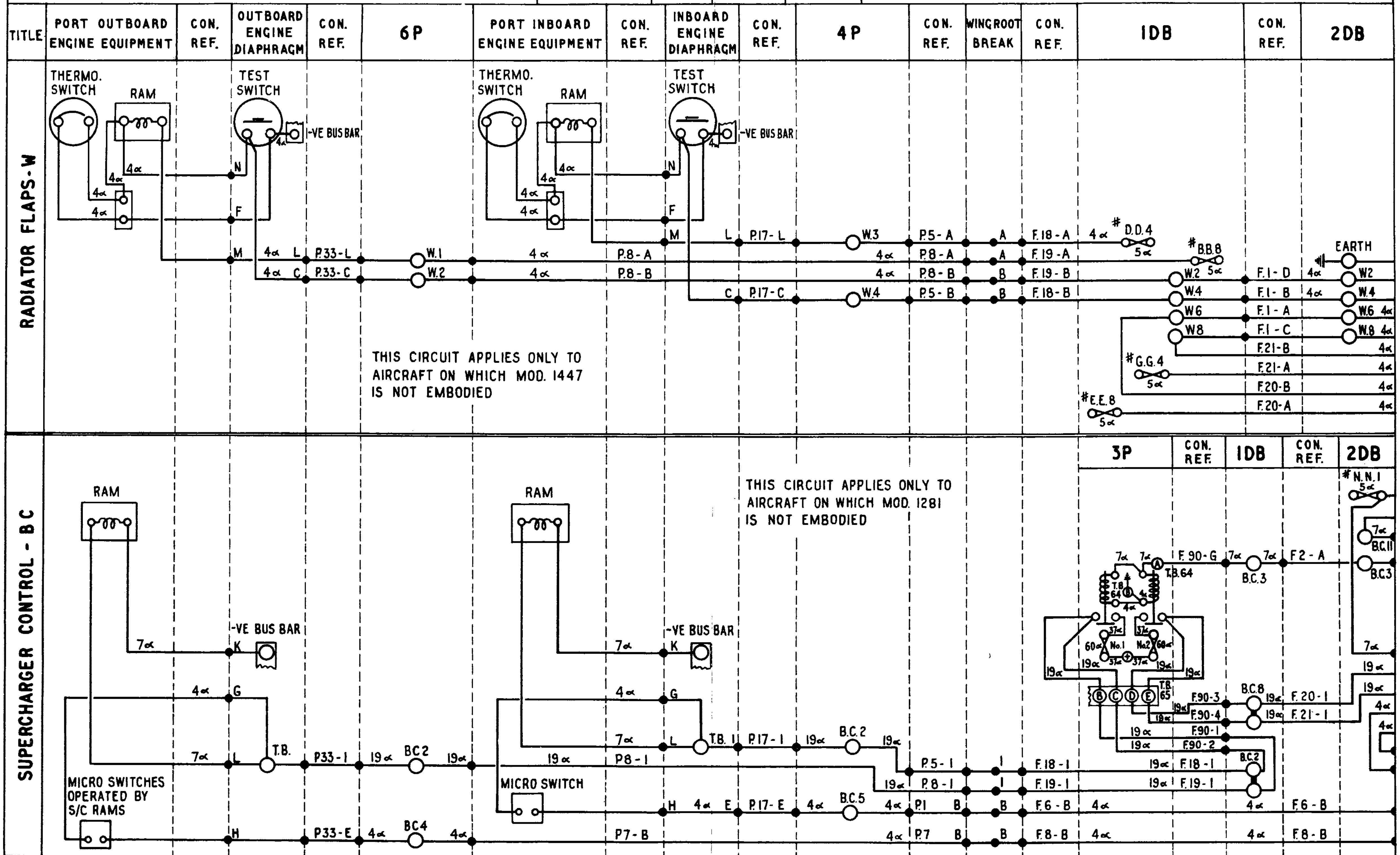

FIG. 11a

ROUTING CHART -

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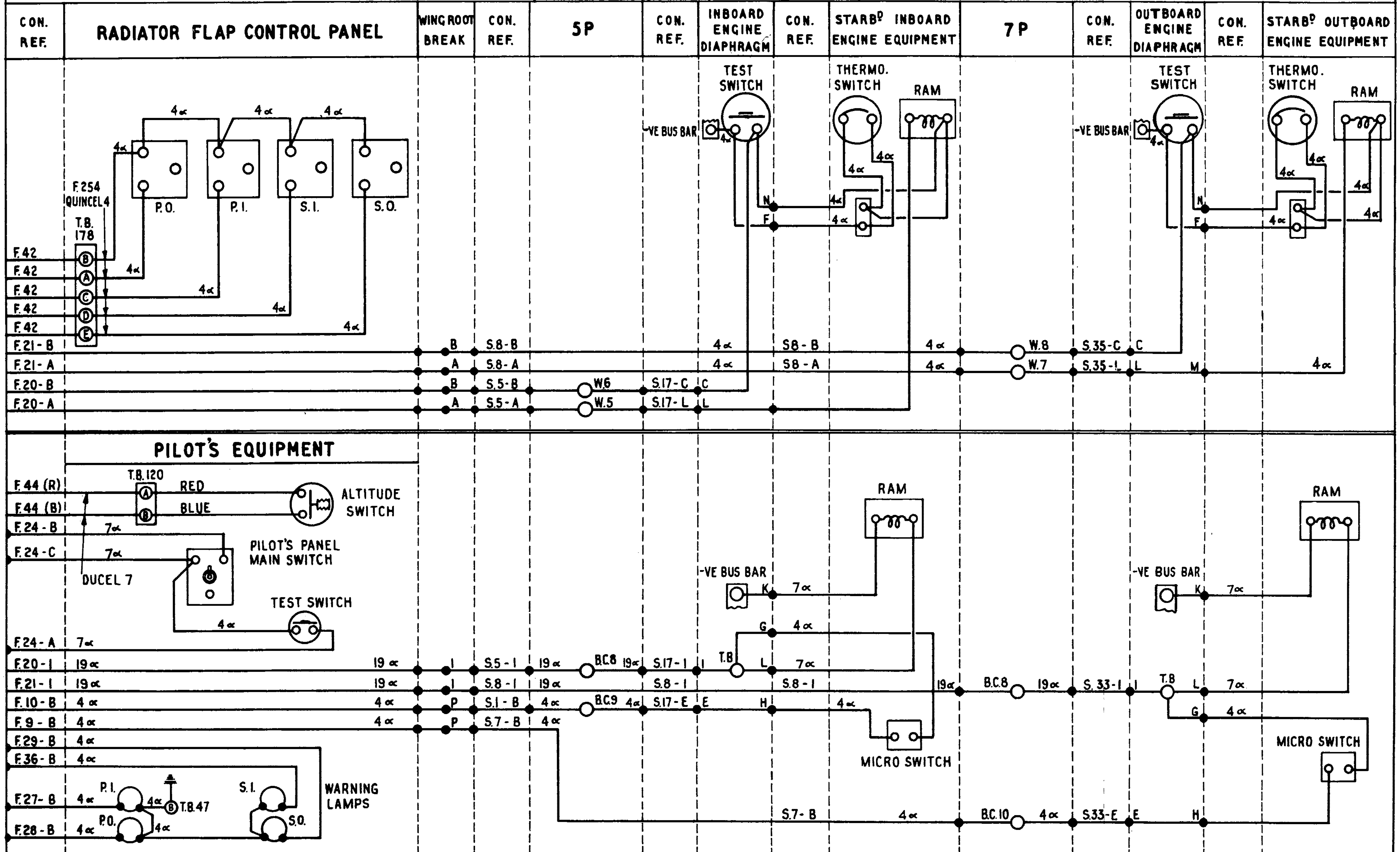

GENERAL SERVICES

FIG. 11a

PP5147 M49377/G2287 4/48 800 C & P Gp. 959 (4)

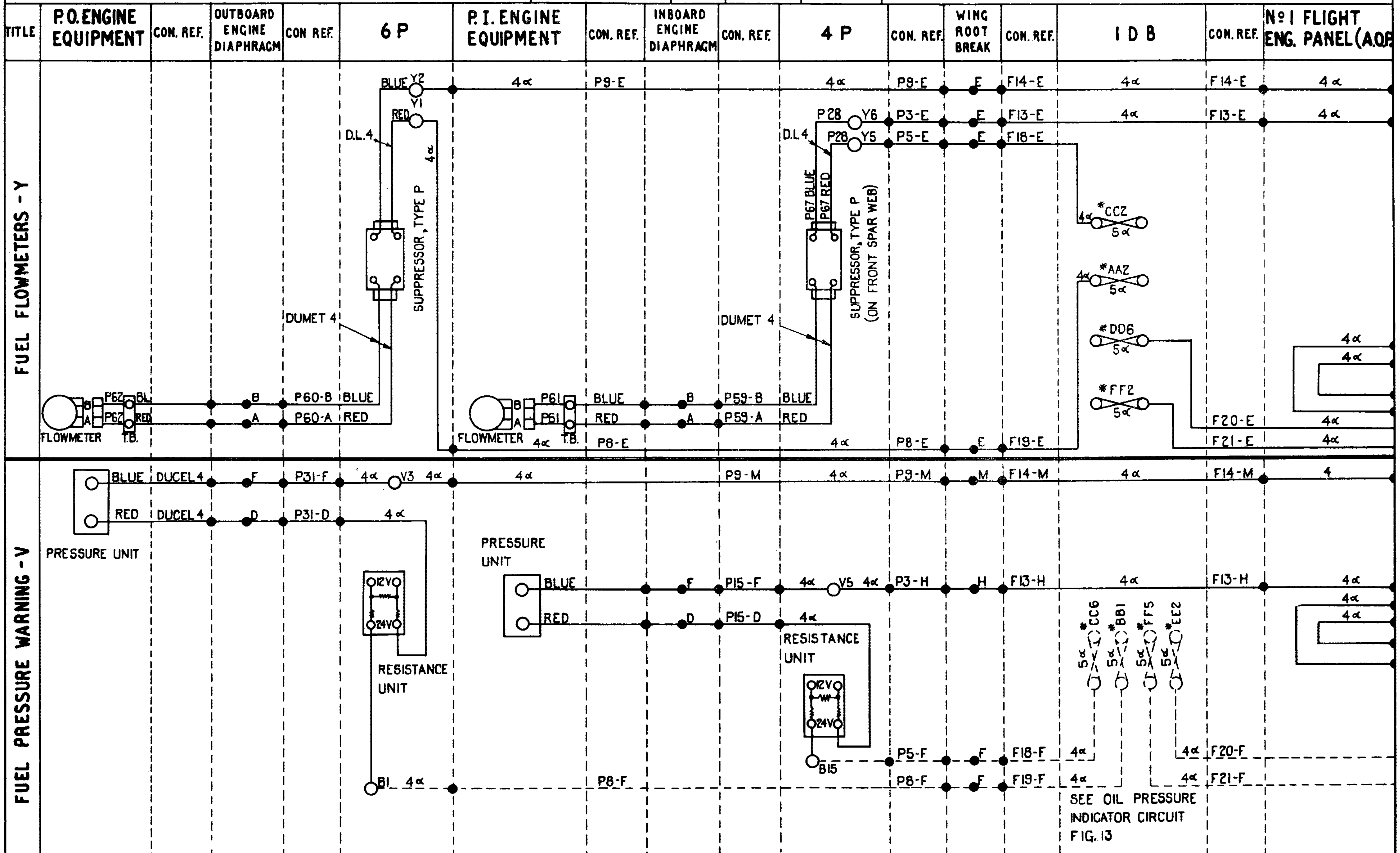

FIG. 12

ROUTING CHART – GENERAL SERVICES

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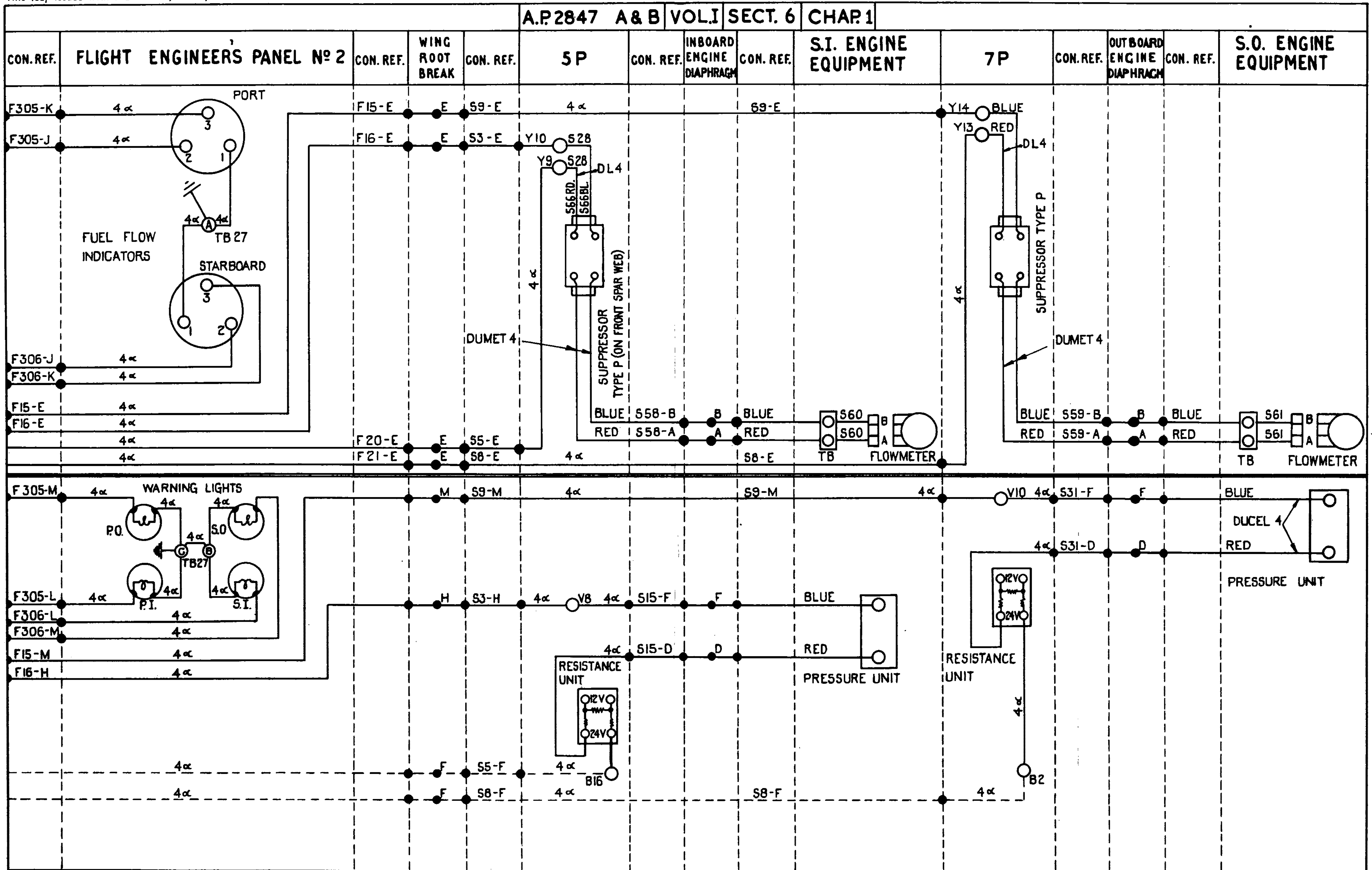

ROUTING CHART — GENERAL SERVICES

FIG. 12

PPS147 M49377/G2287 4/48 800 C & P Gp. 959 (4)

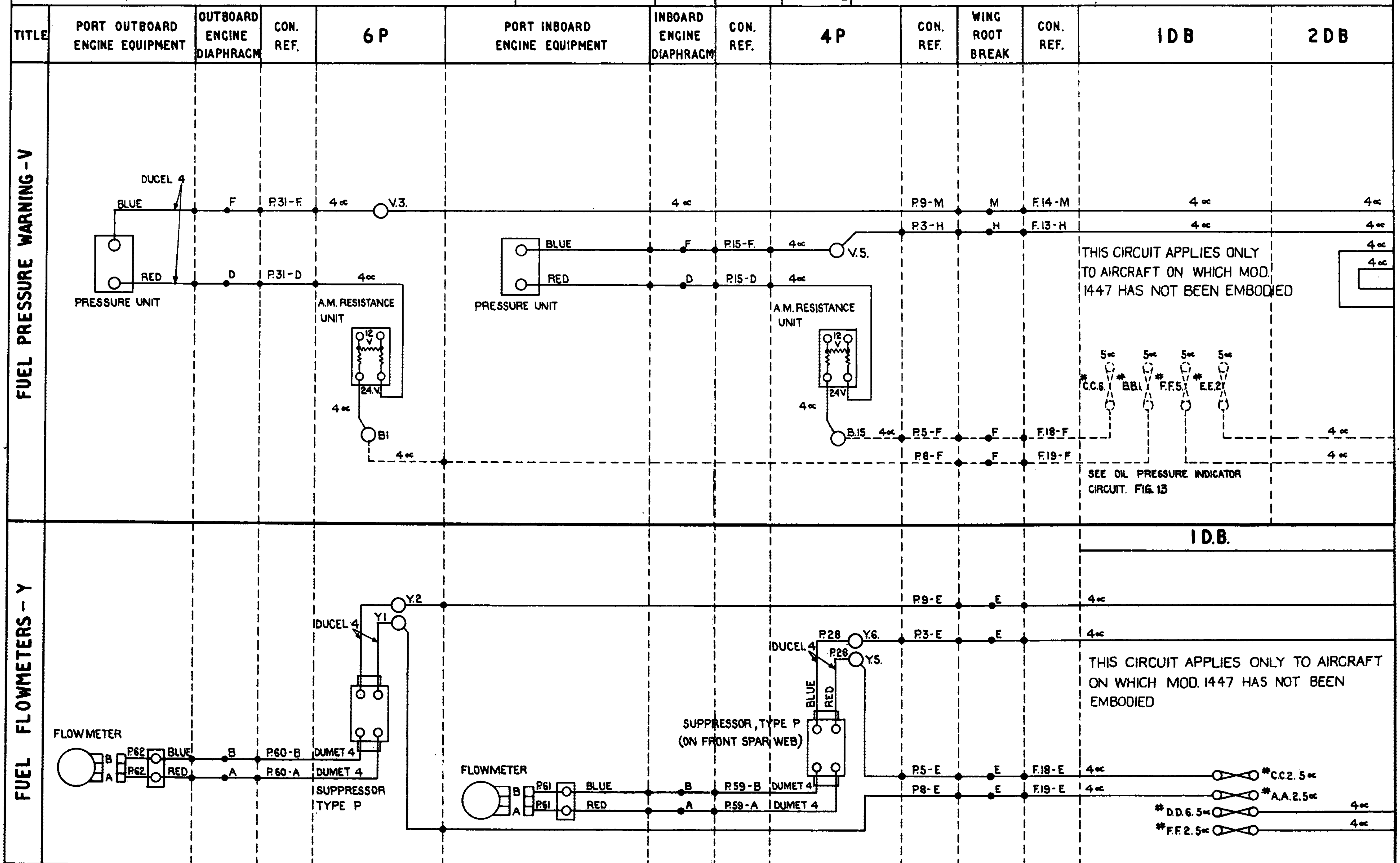

FIG. 12a

ROUTING CHART

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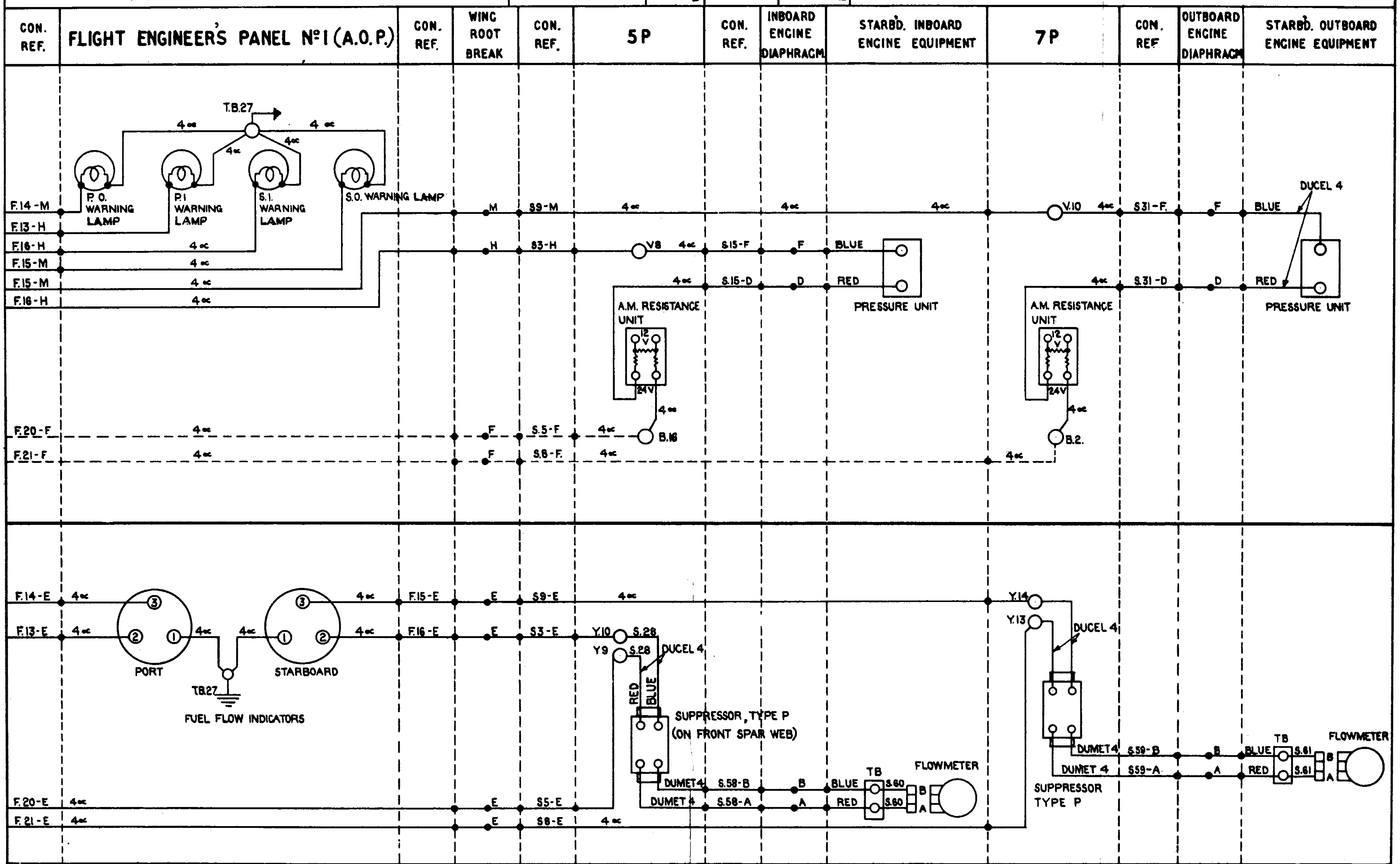


GENERAL SERVICES

FIG. 12a

PP51 47 M49377/G2287 4/48 800 C & P Gp. 959 (4)

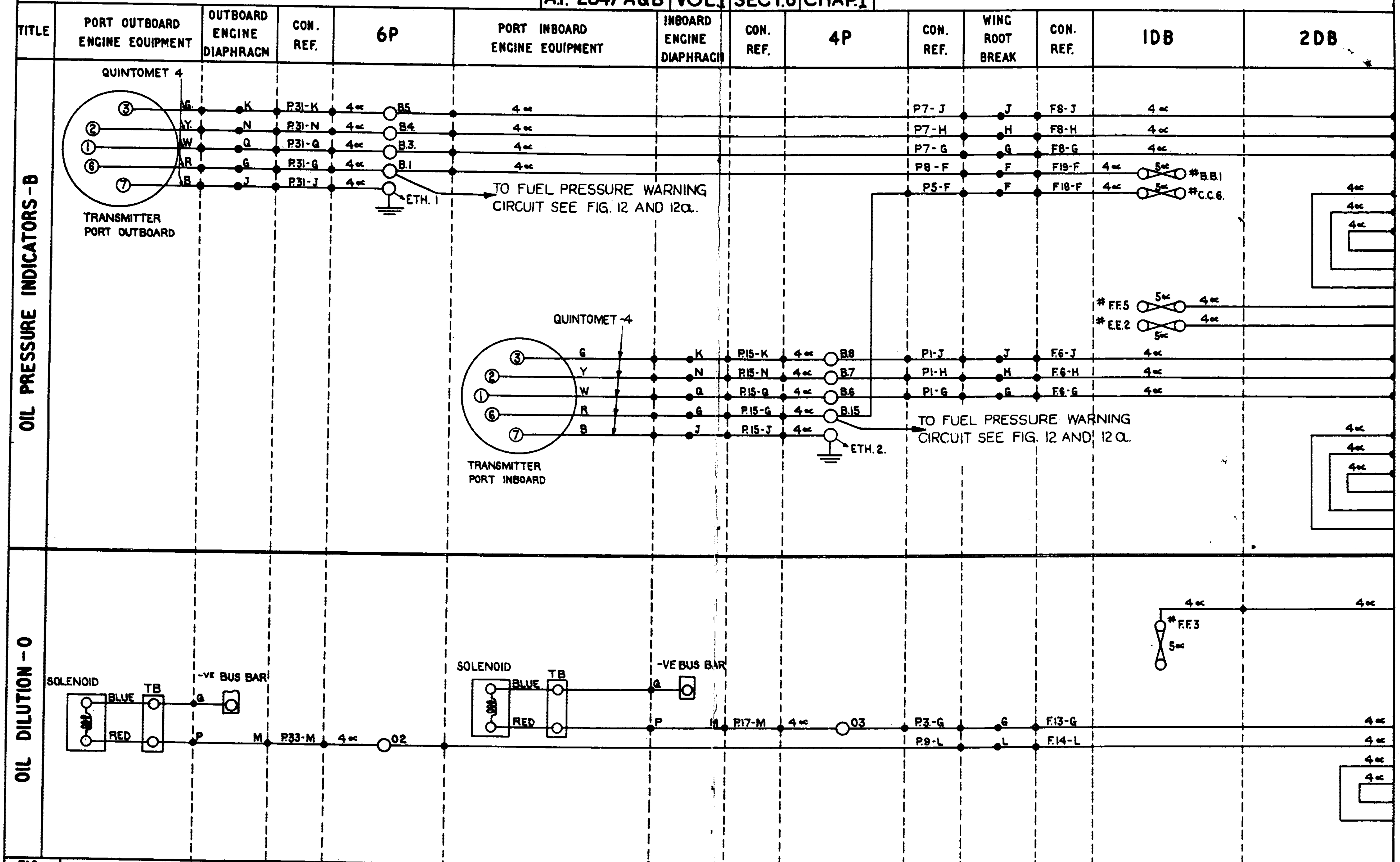
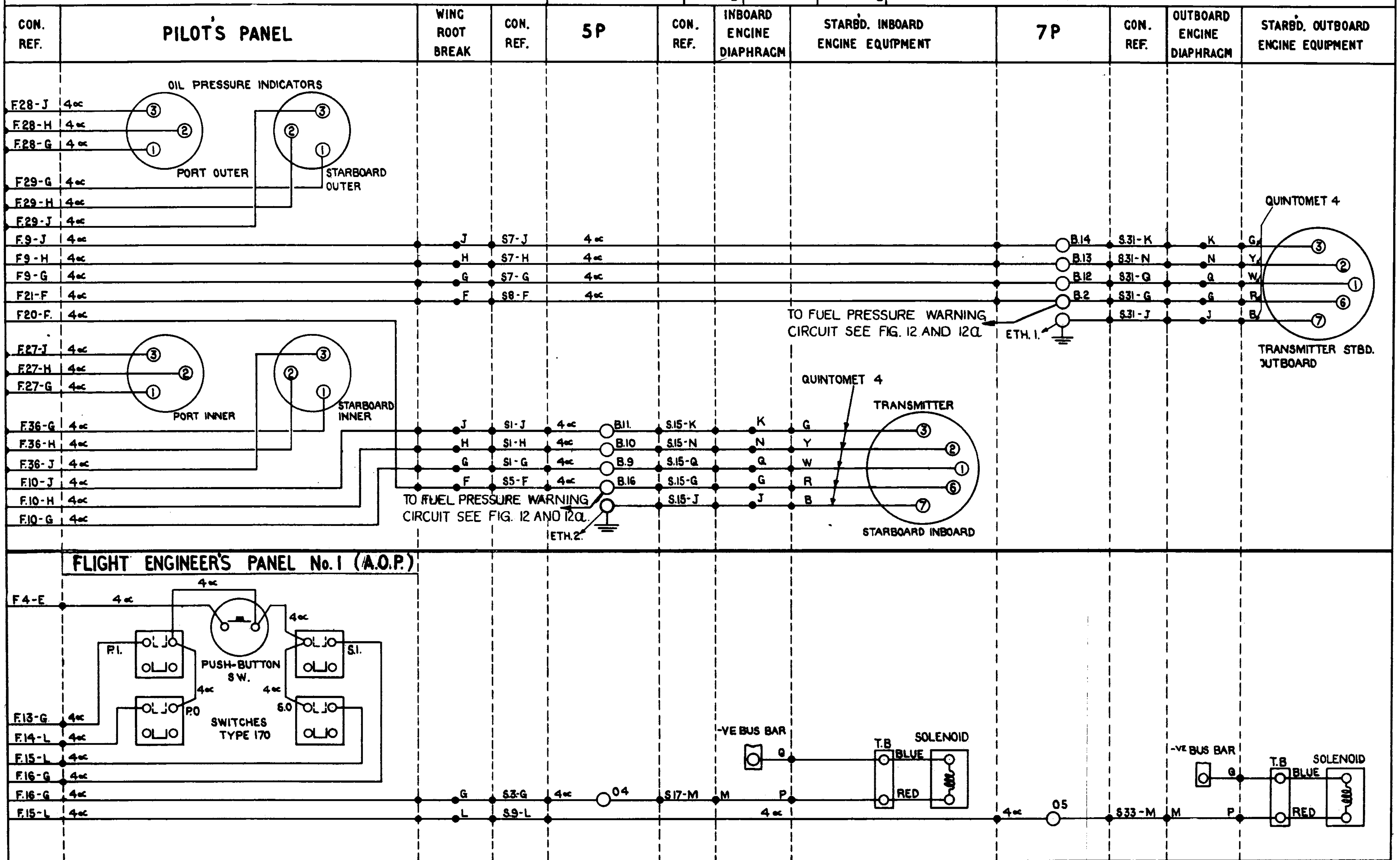


FIG. 13

ROUTING CHART



GENERAL SERVICES

FIG. 13

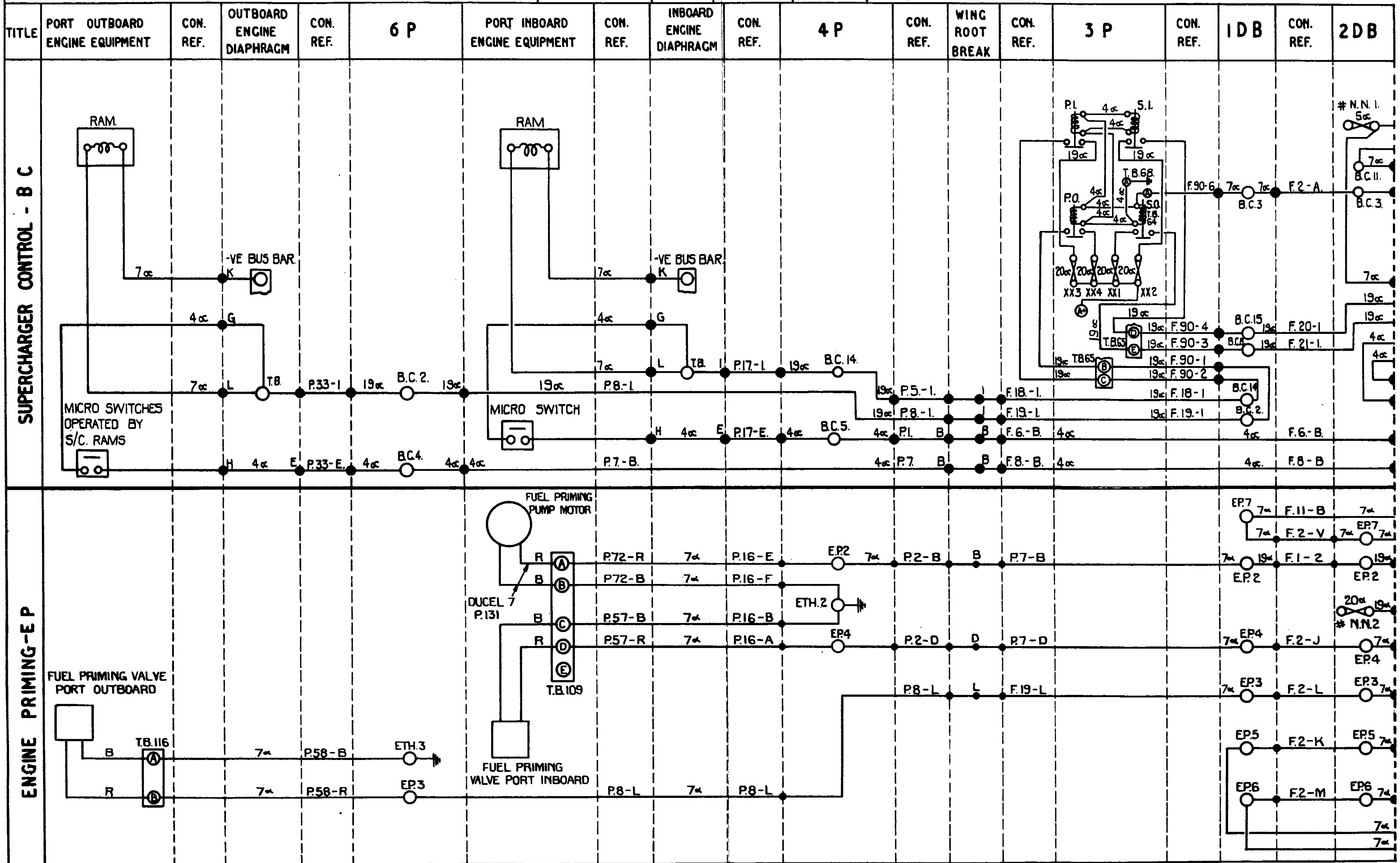


FIG. 14

ROUTING CHART

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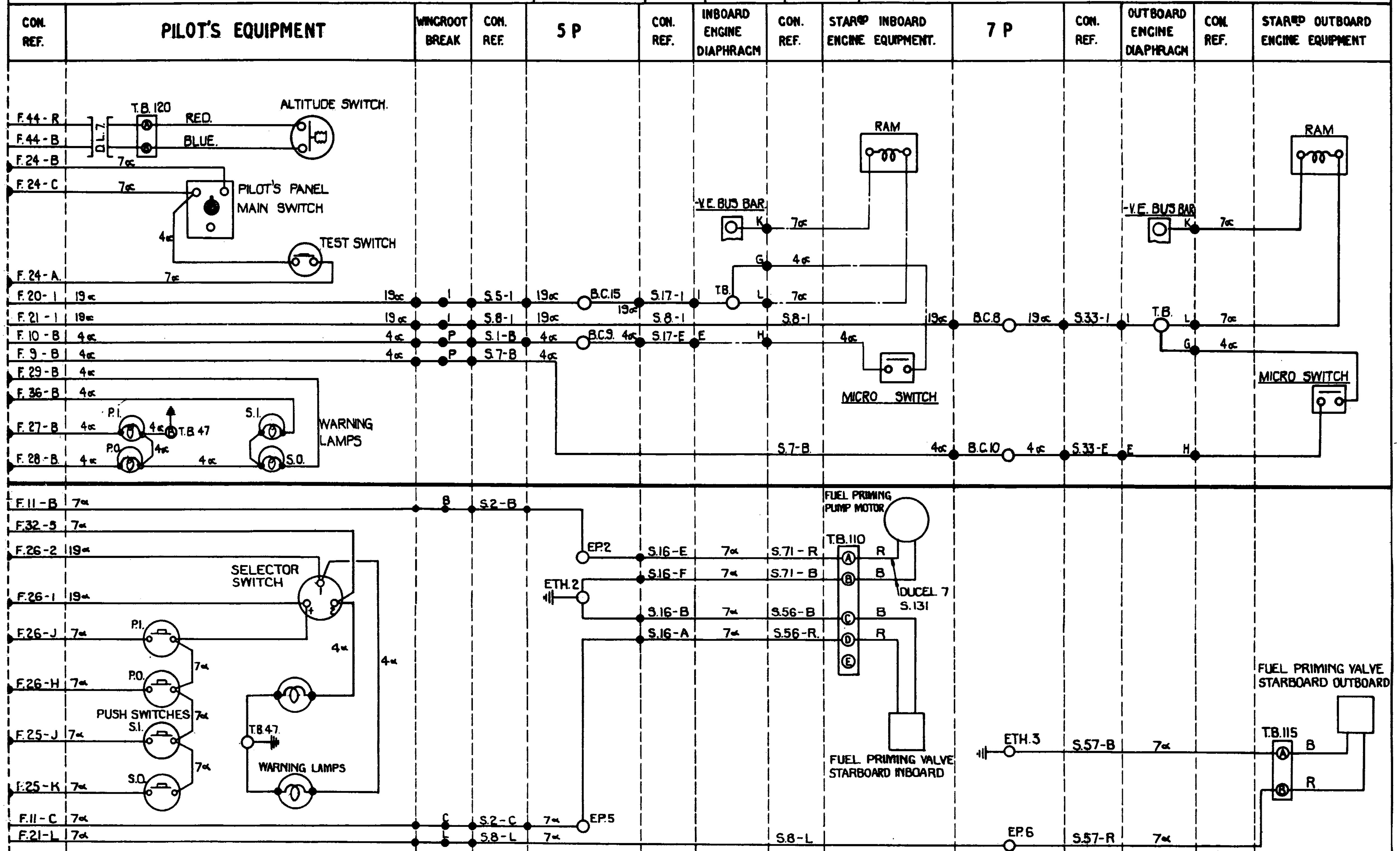

GENERAL SERVICES

FIG. 14

PP5147 M49377/G2287 4/48 800 C & P Gp. 959 (4)

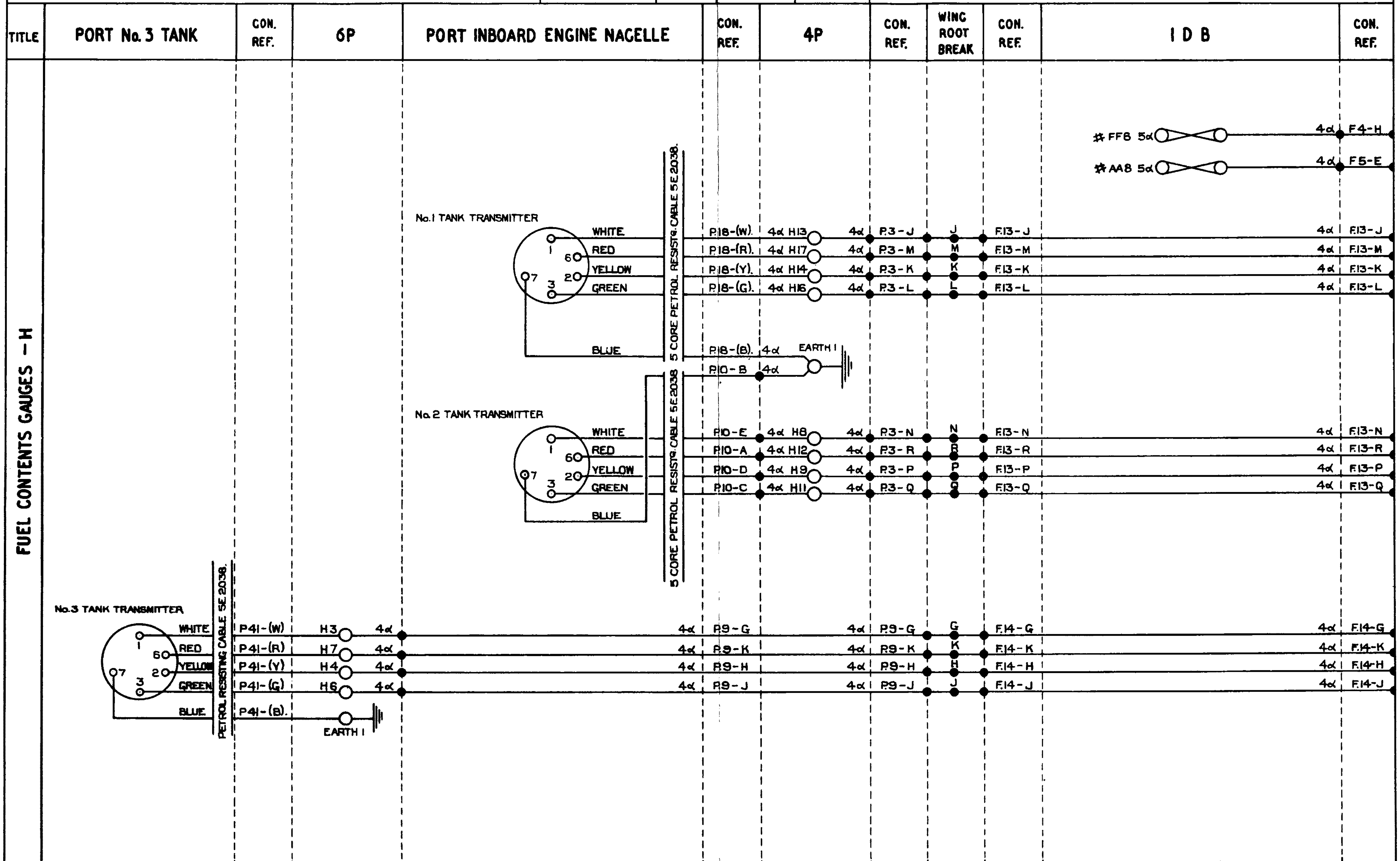

FIG. 15 ROUTING CHART

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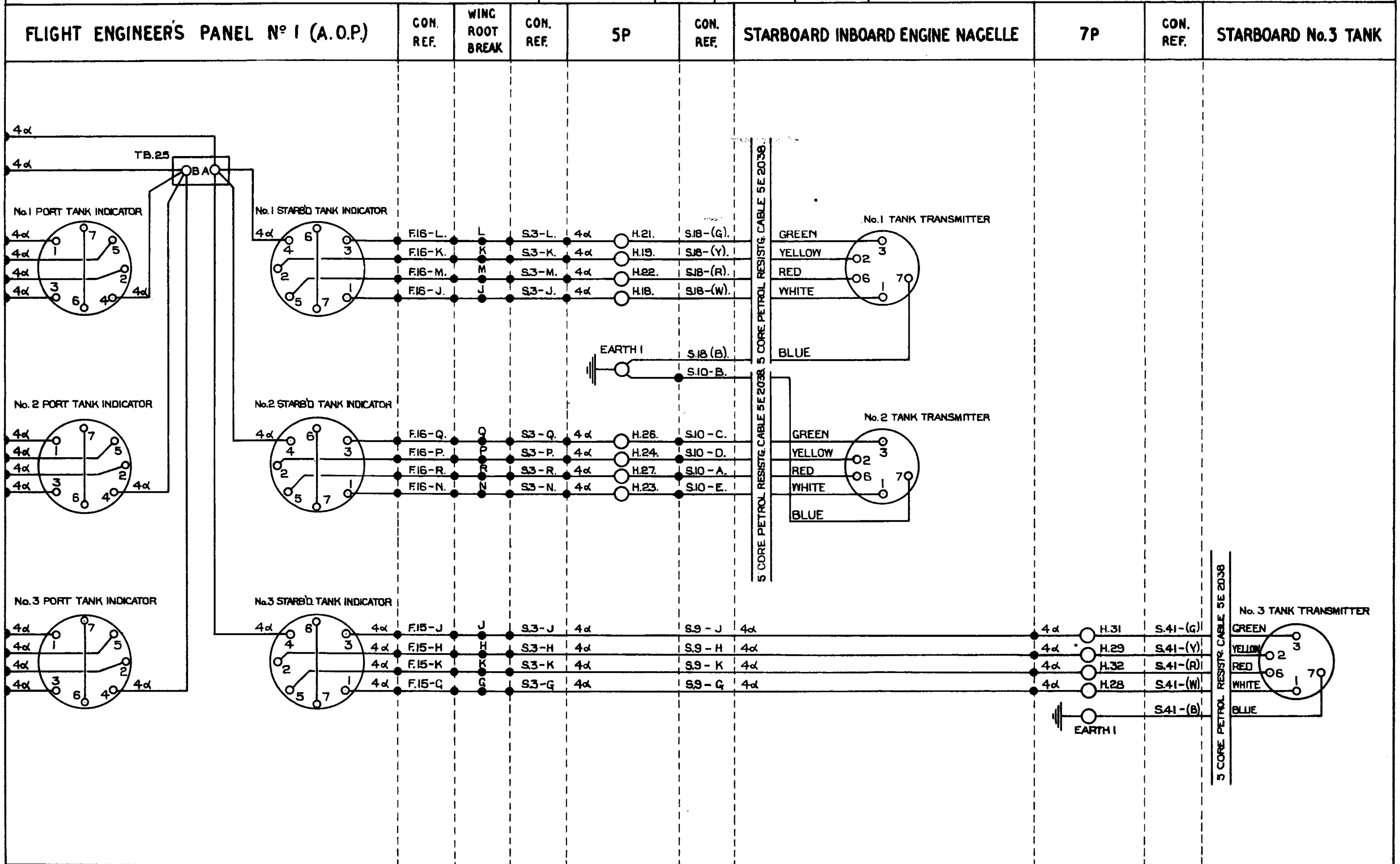

GENERAL SERVICES

FIG. 15

PP5147 M49377/G2287 4/48 800' C & P Gp. 959 (4)

UNDERCARRIAGE INDICATOR - Q

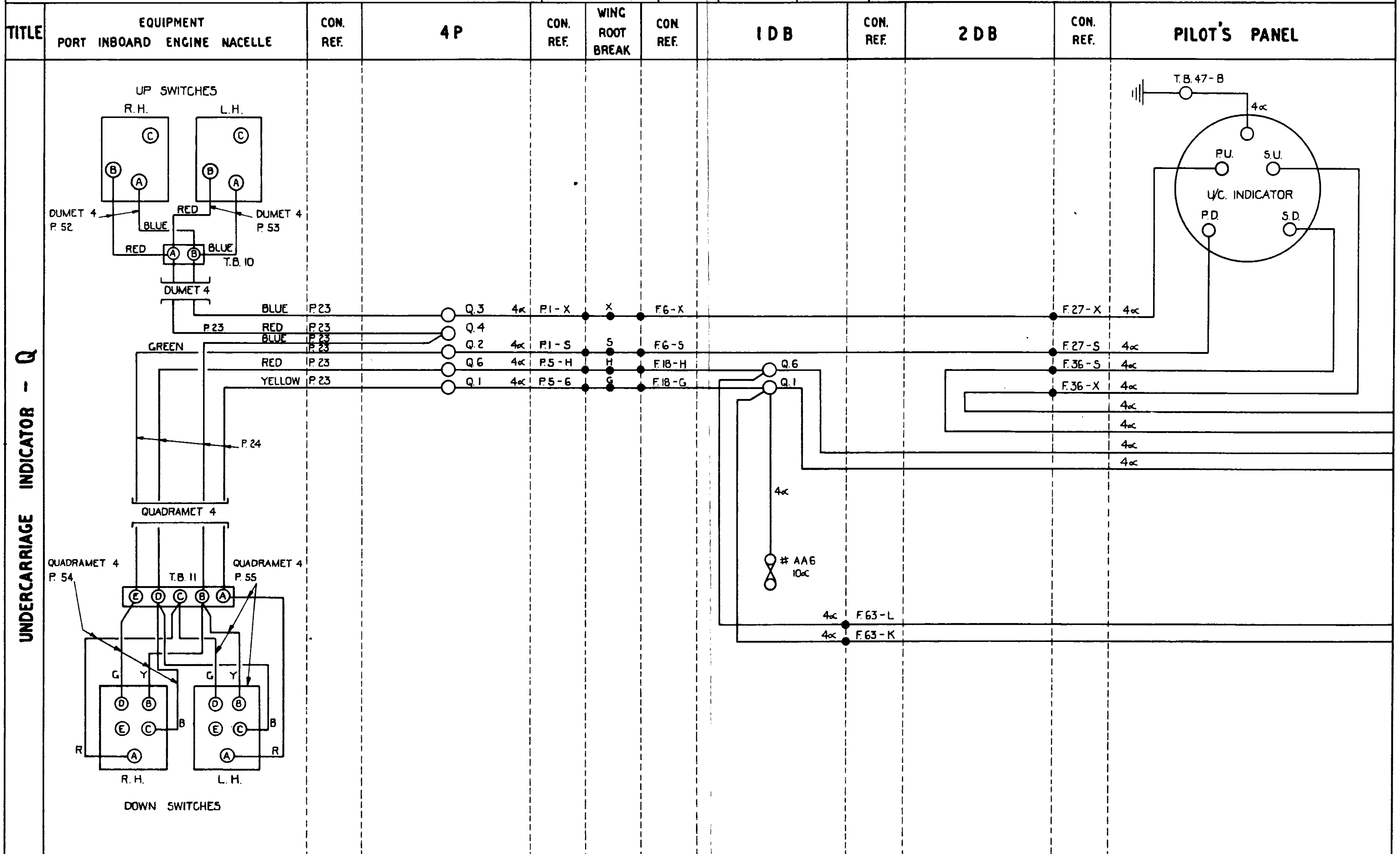

FIG. 16

ROUTING CHART

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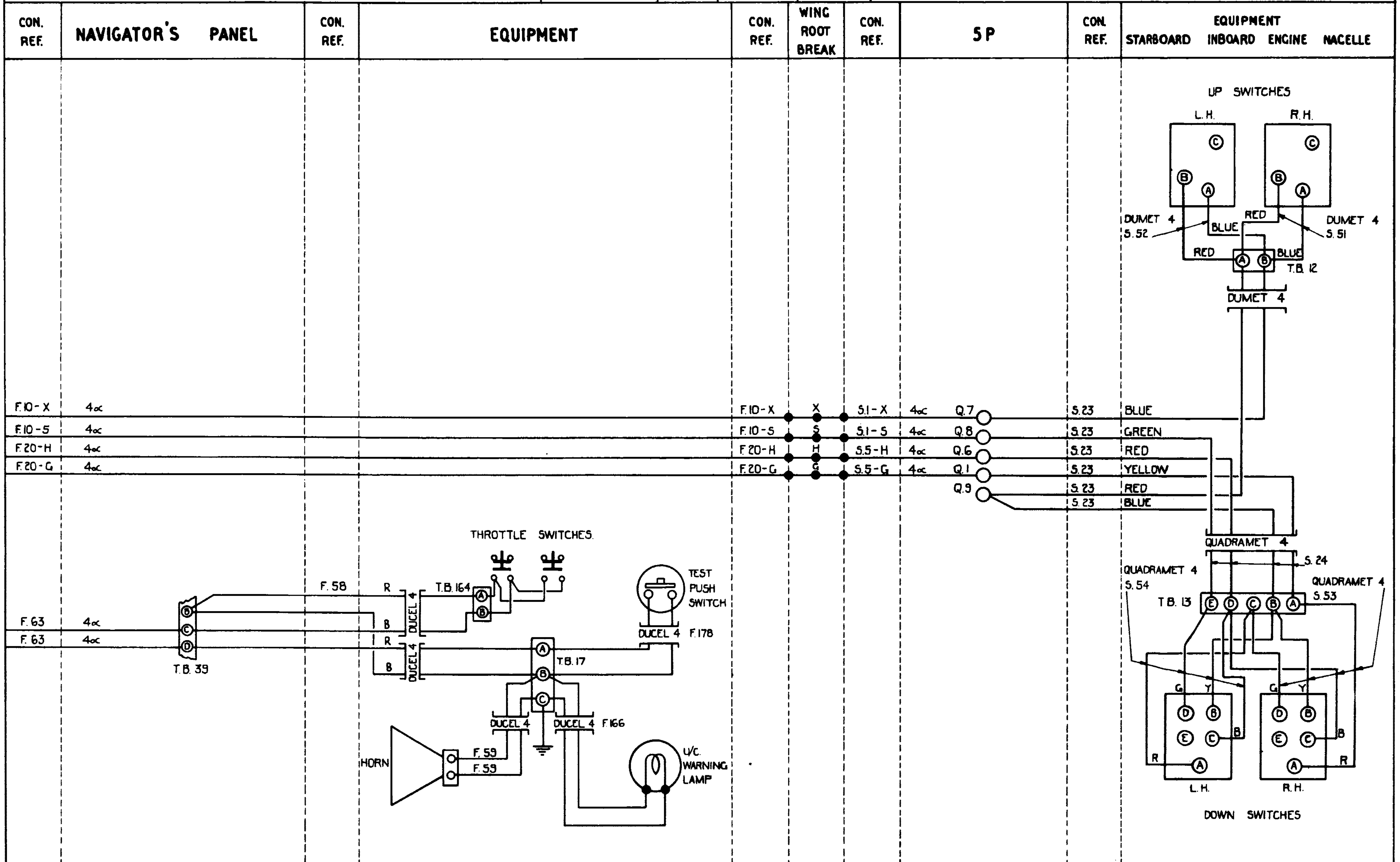


GENERAL SERVICES

FIG. 16

PP5147 M49377/G2287 4/48 800 C & P Gp. 959 (4)

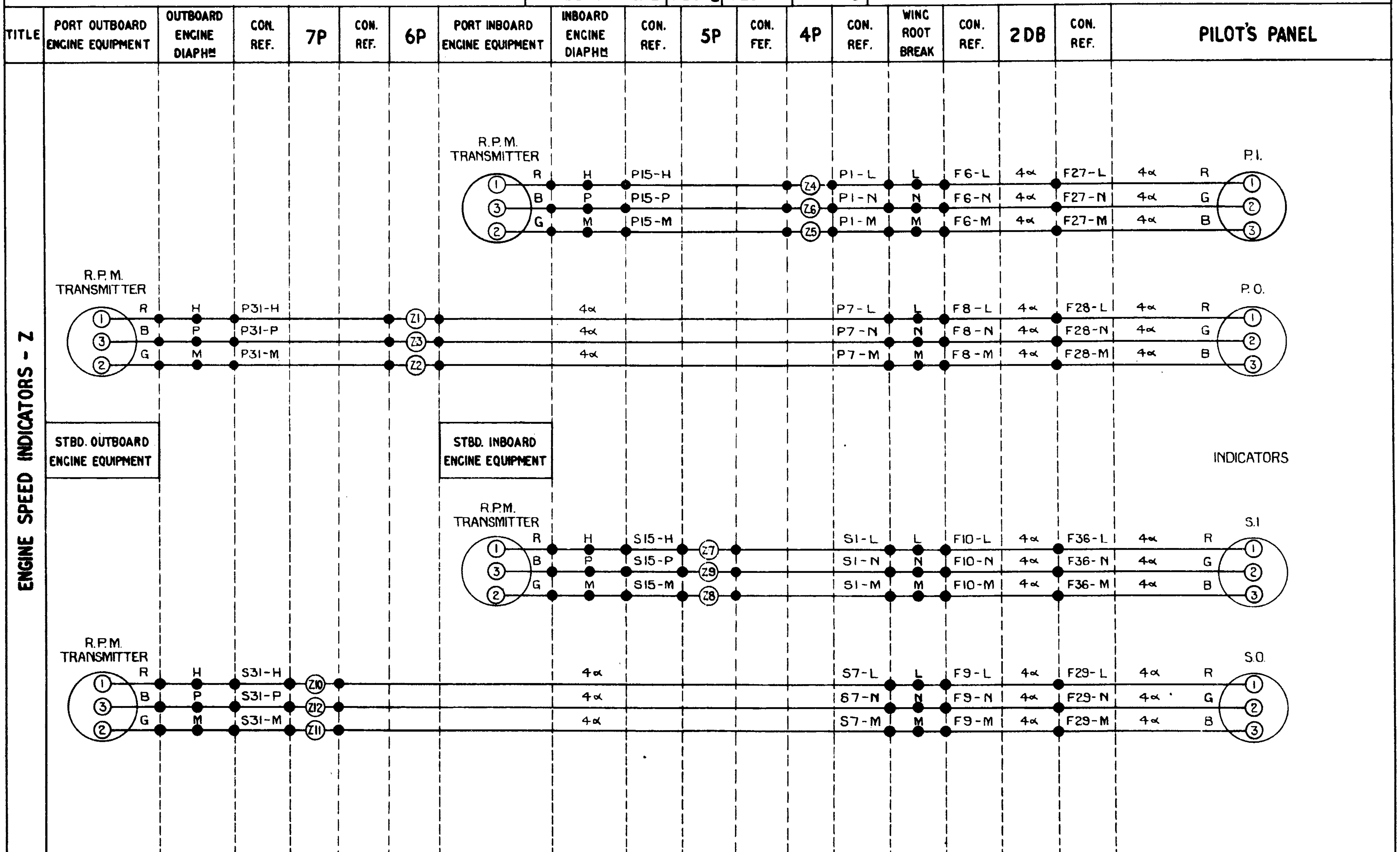


FIG. 17 ROUTING CHART- GENERAL SERVICES FIG. 17

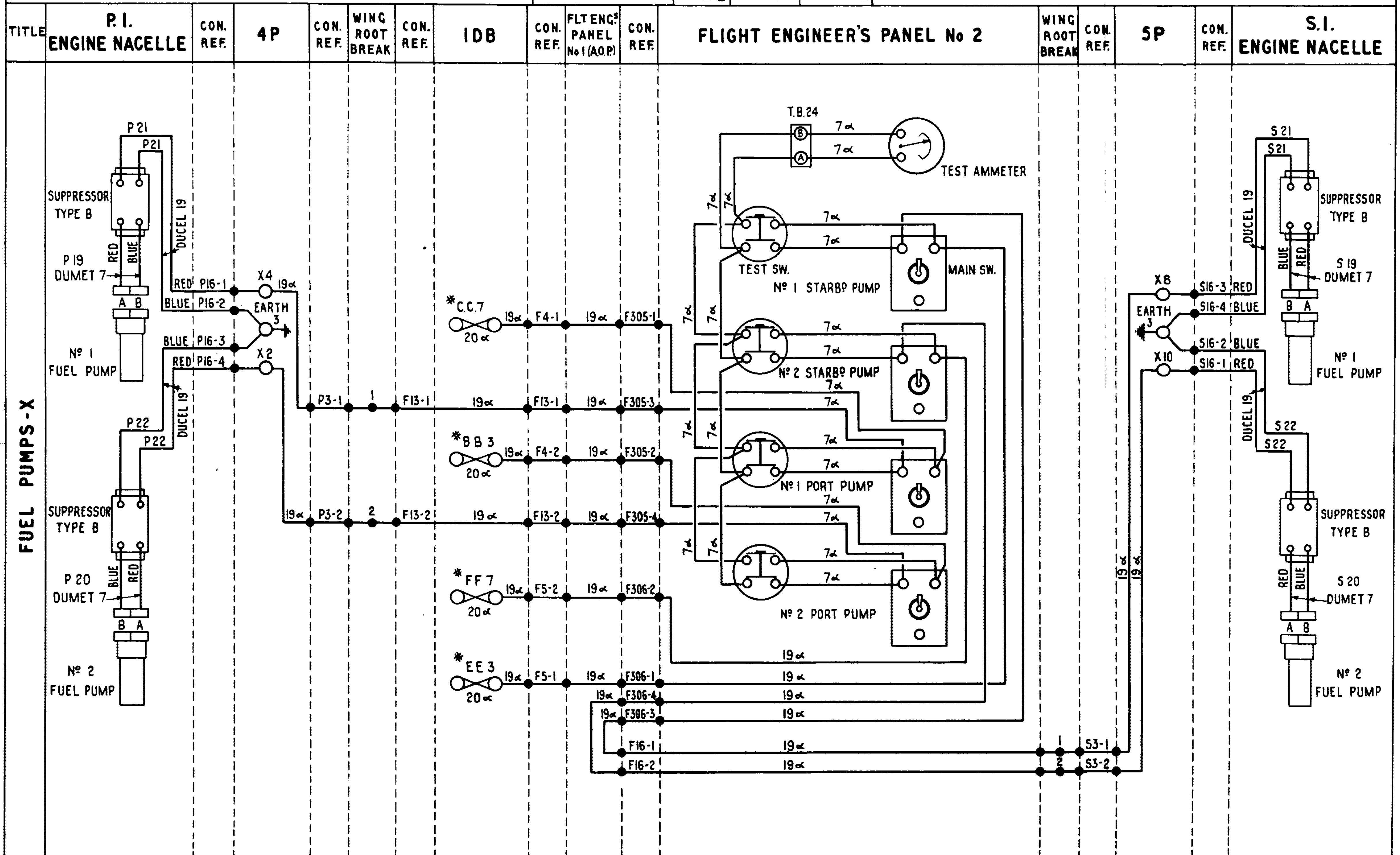


FIG. 18 ROUTING CHART - GENERAL SERVICES FIG. 18

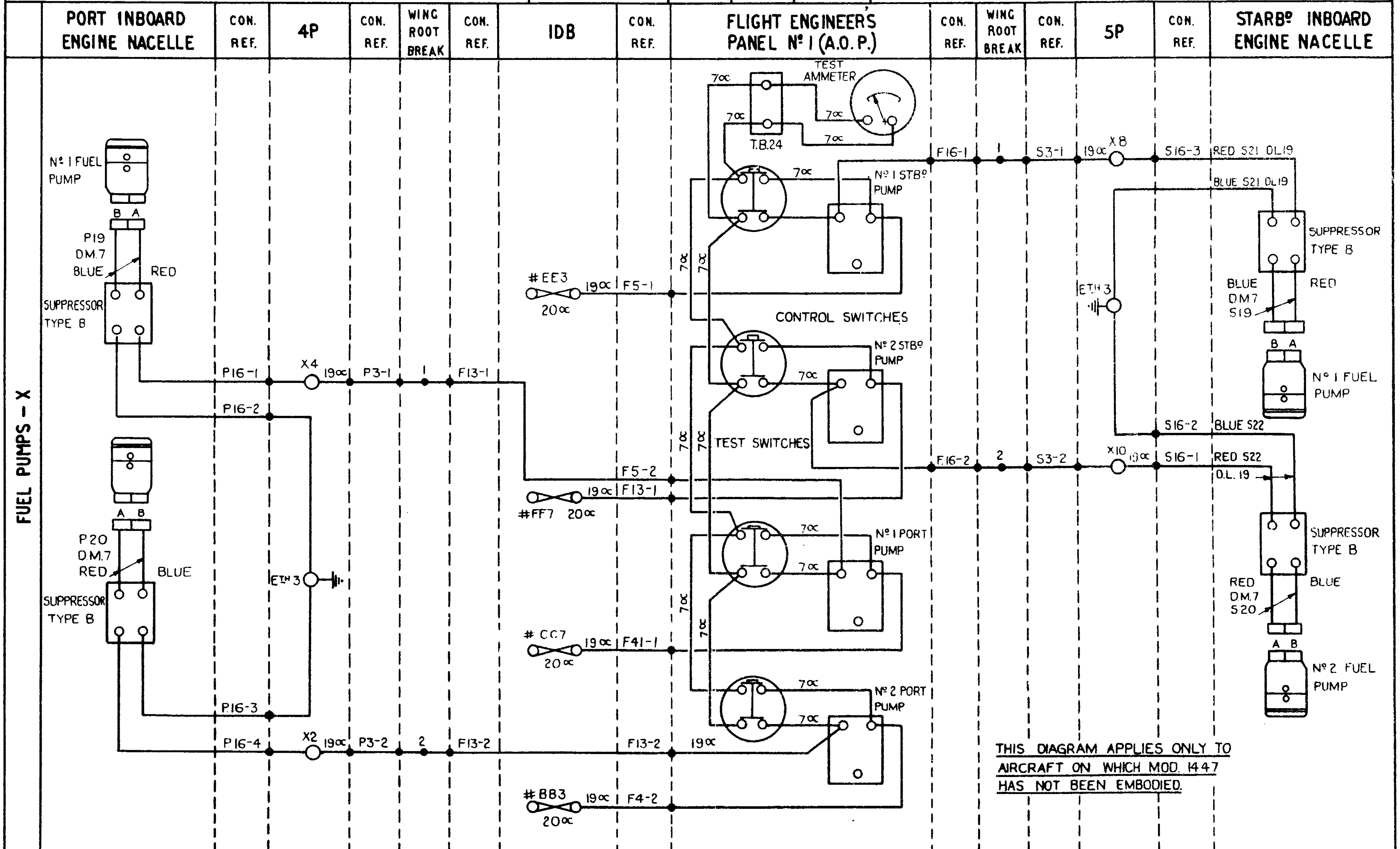


FIG. 18a

ROUTING CHART – GENERAL SERVICES

FIG. 18a

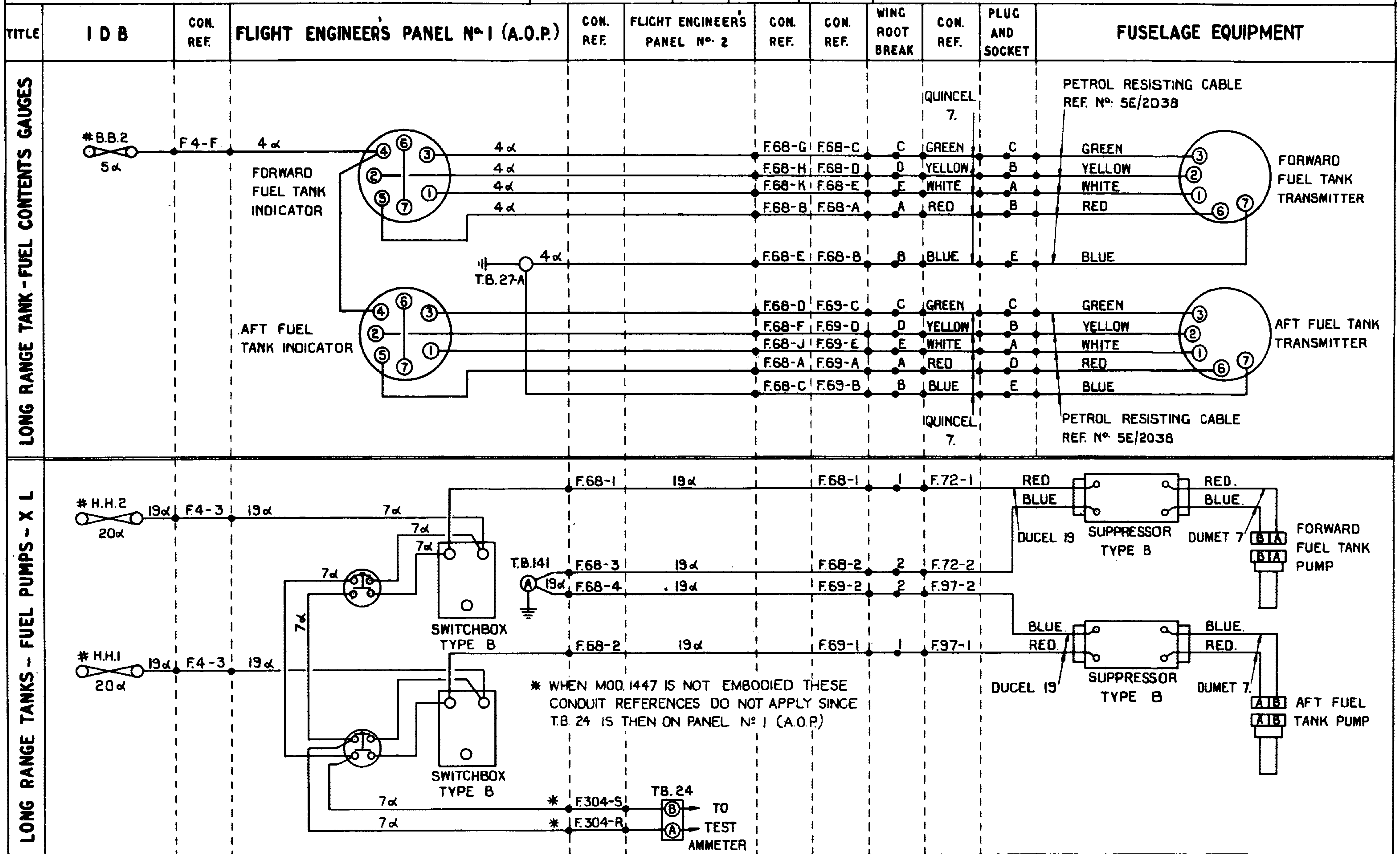


FIG. 18b

ROUTING CHART - GENERAL SERVICES

FIG. 18b

PP5147 M49377/G2287 4/48 800 C & P Gp. 959 (4)

TITLE	PORT OUTBOARD ENGINE EQUIPMENT	PORT OUTB'D. ENGINE DIAPH R.M.	CON. REF.	6P	PORT INBOARD ENGINE EQUIPMENT	PORT INBOARD ENGINE DIAPH R.M.	CON. REF.	4P	CON. REF.	PORT WING ROOT BREAK	CON. REF.	COOLANT LOSS PANEL

COOLANT LOSS INDICATOR - L C

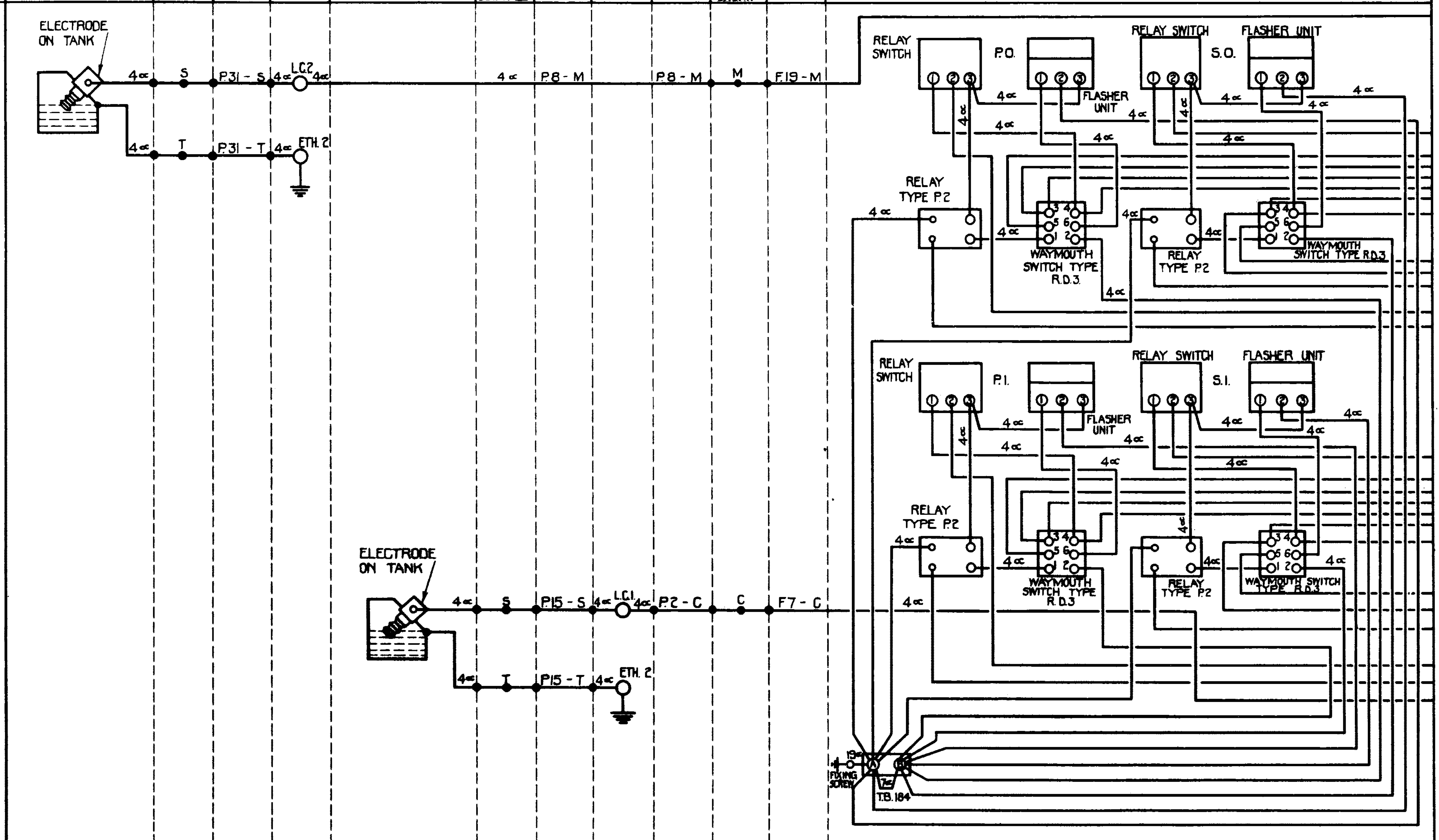
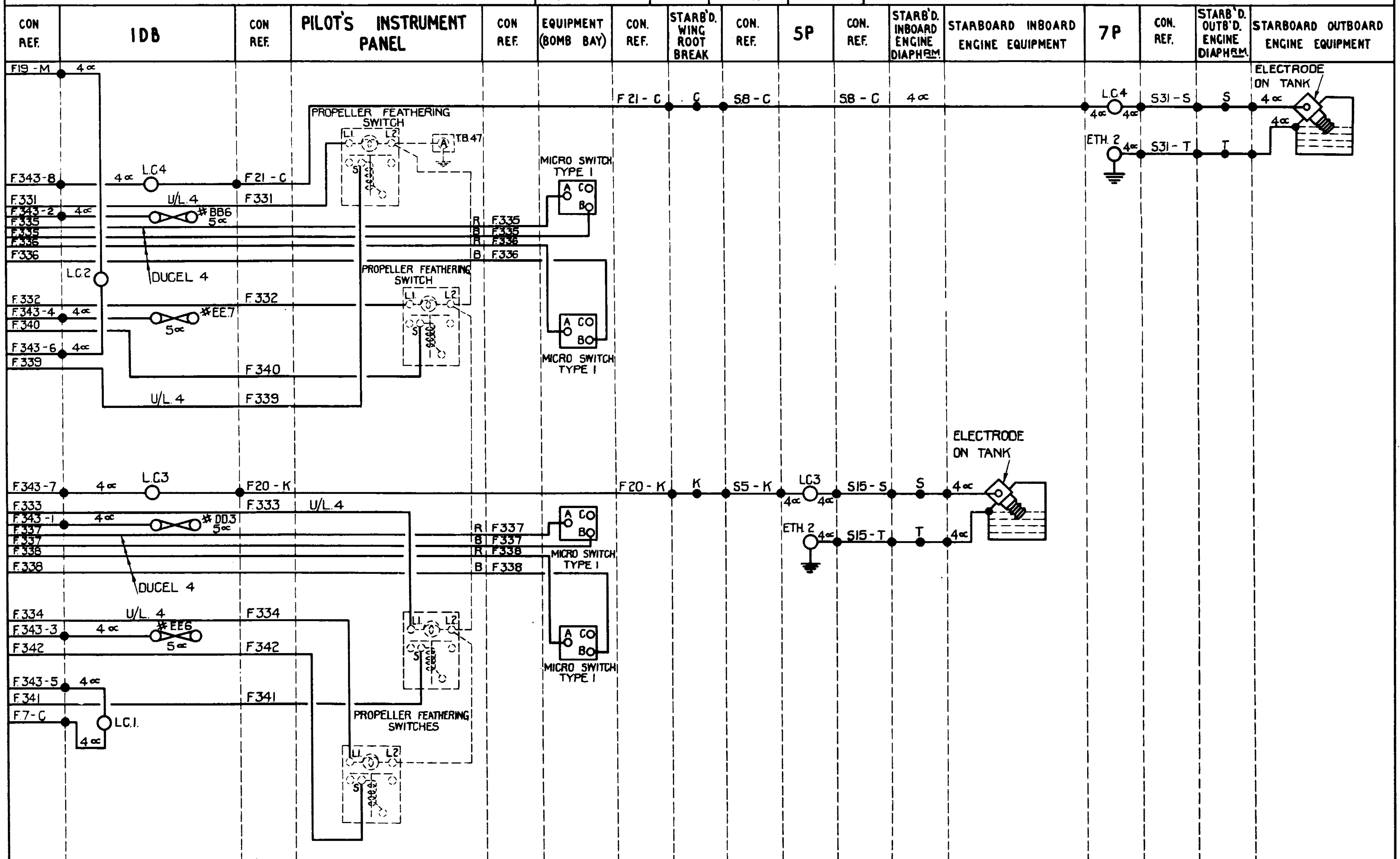


FIG. 19

ROUTING CHART

This leaf issued with A.L. No.60 March 1948



GENERAL SERVICES

FIG. 19

PP5147 M49377/G2287 4/48 800 C & P Gp. 959 (4)

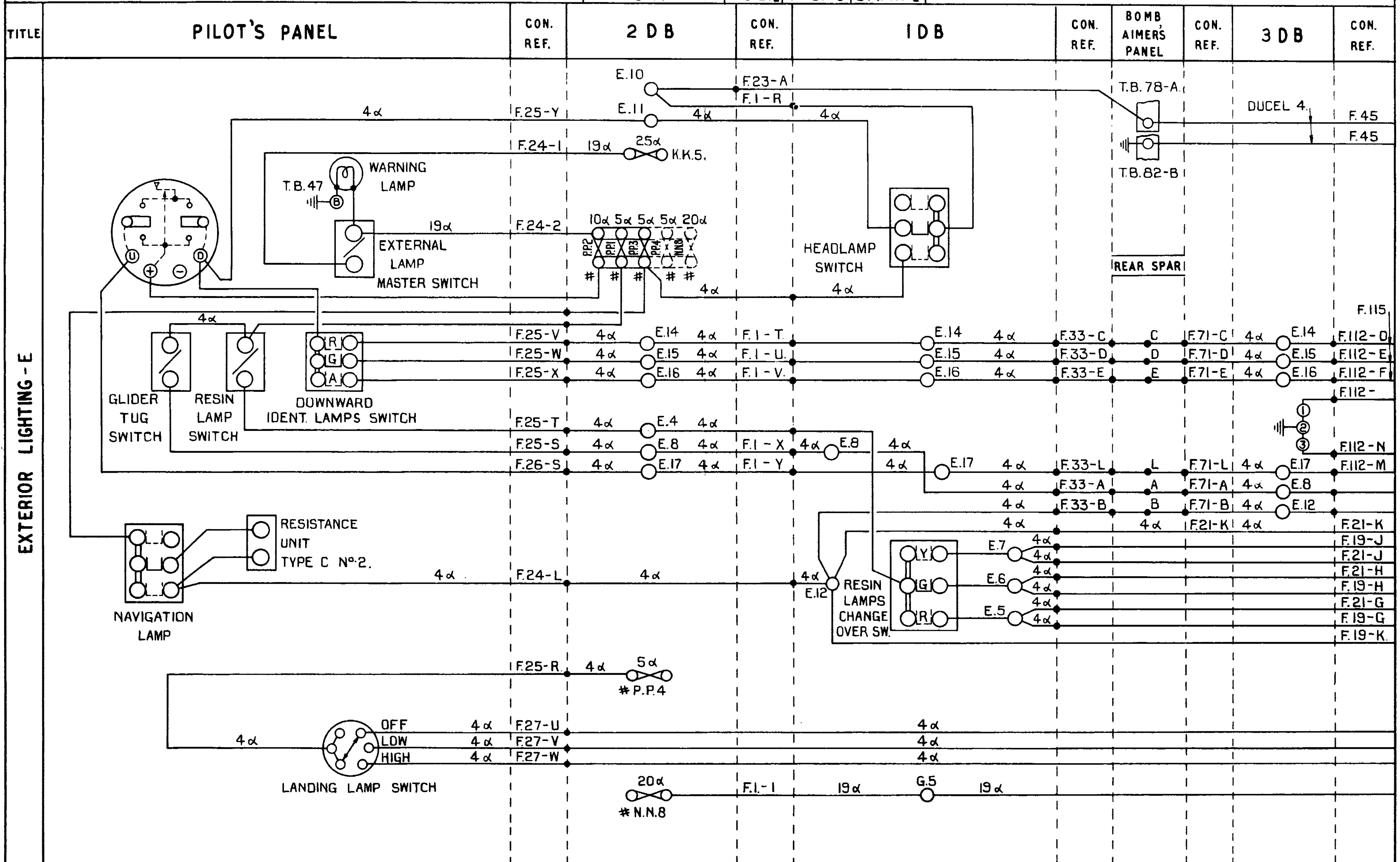


FIG. 20

ROUTING CHART

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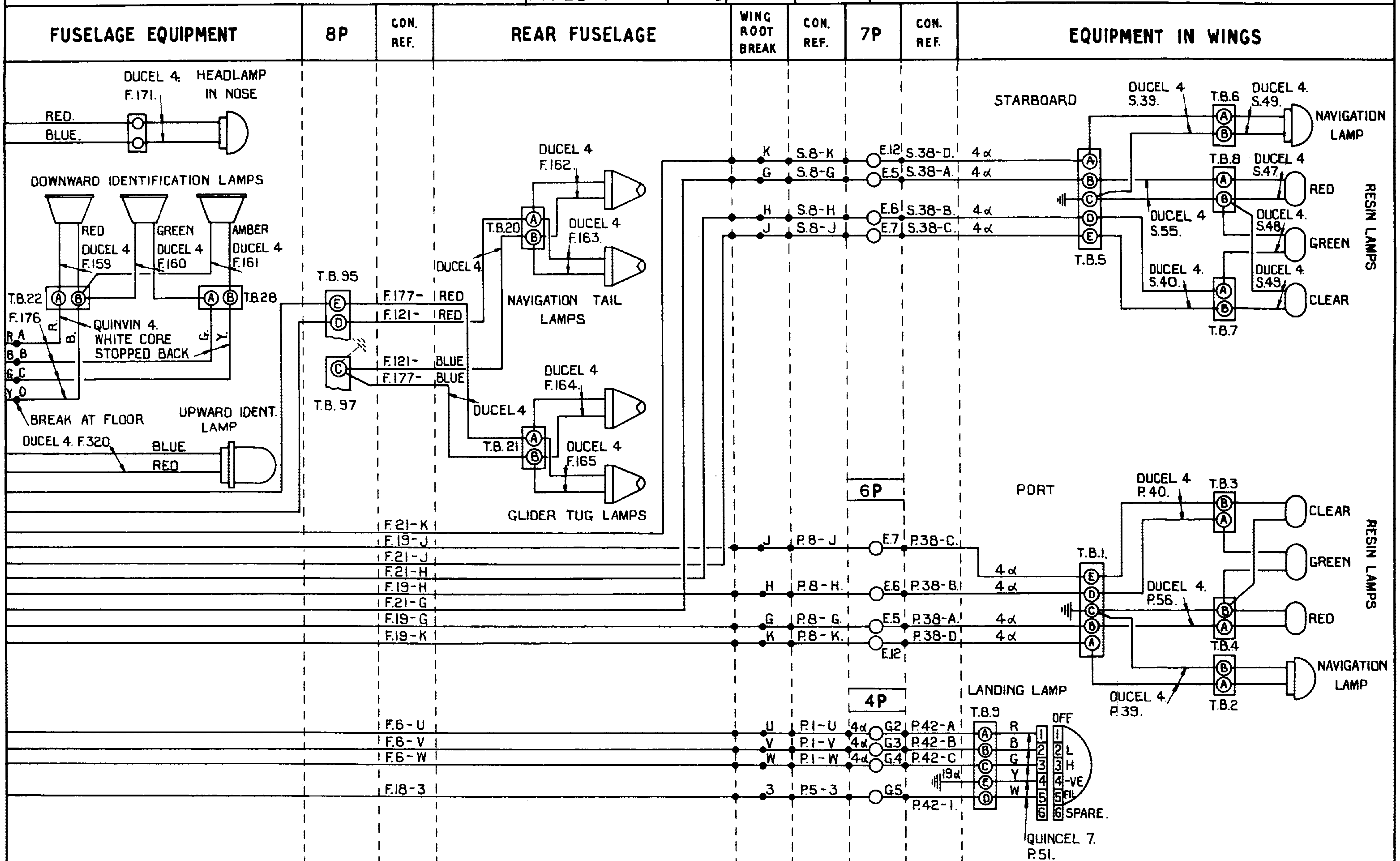

GENERAL SERVICES

FIG. 20

PP5147 M49377/G2287 4/48 800 C & P Gp. 959 (4)

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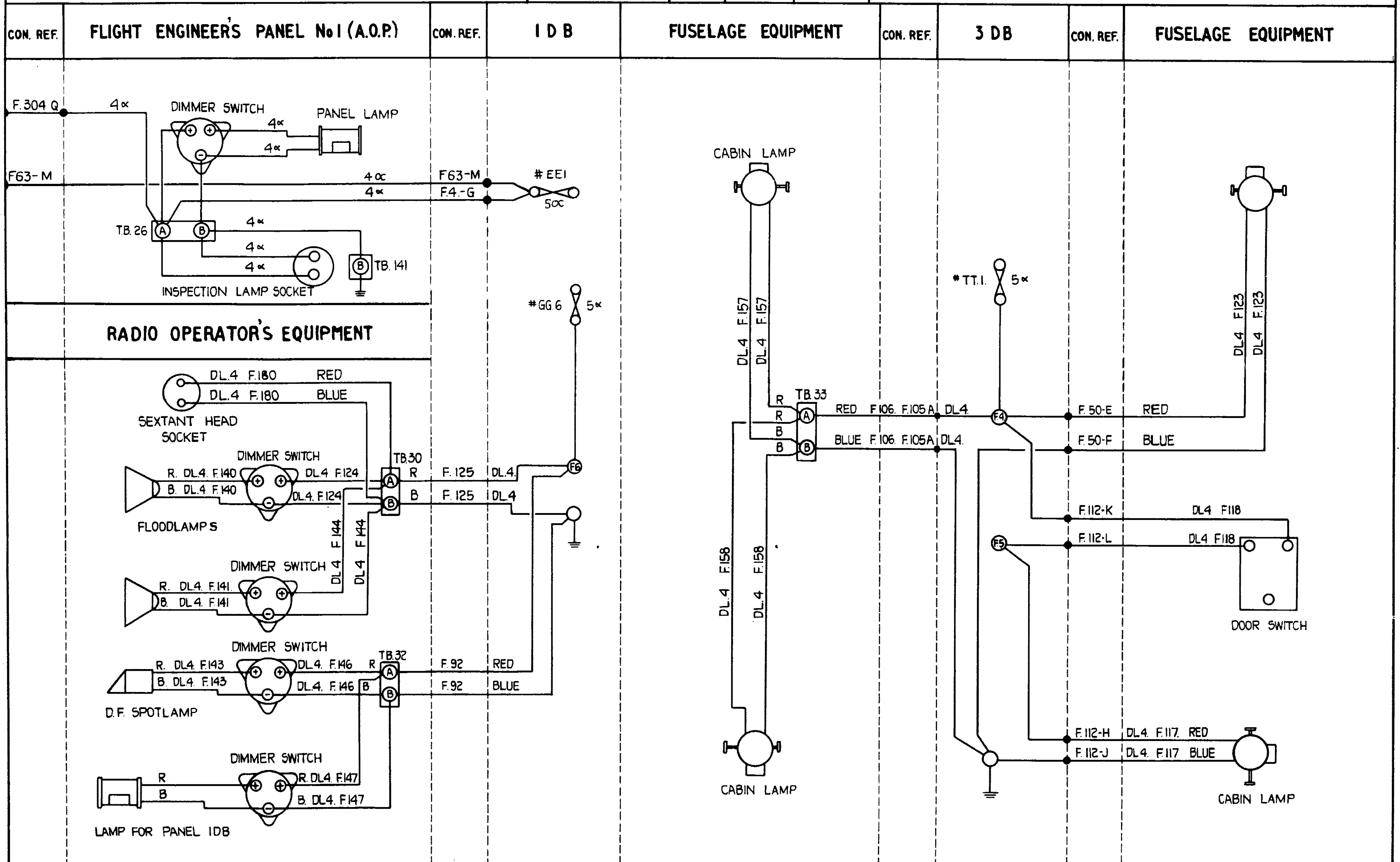
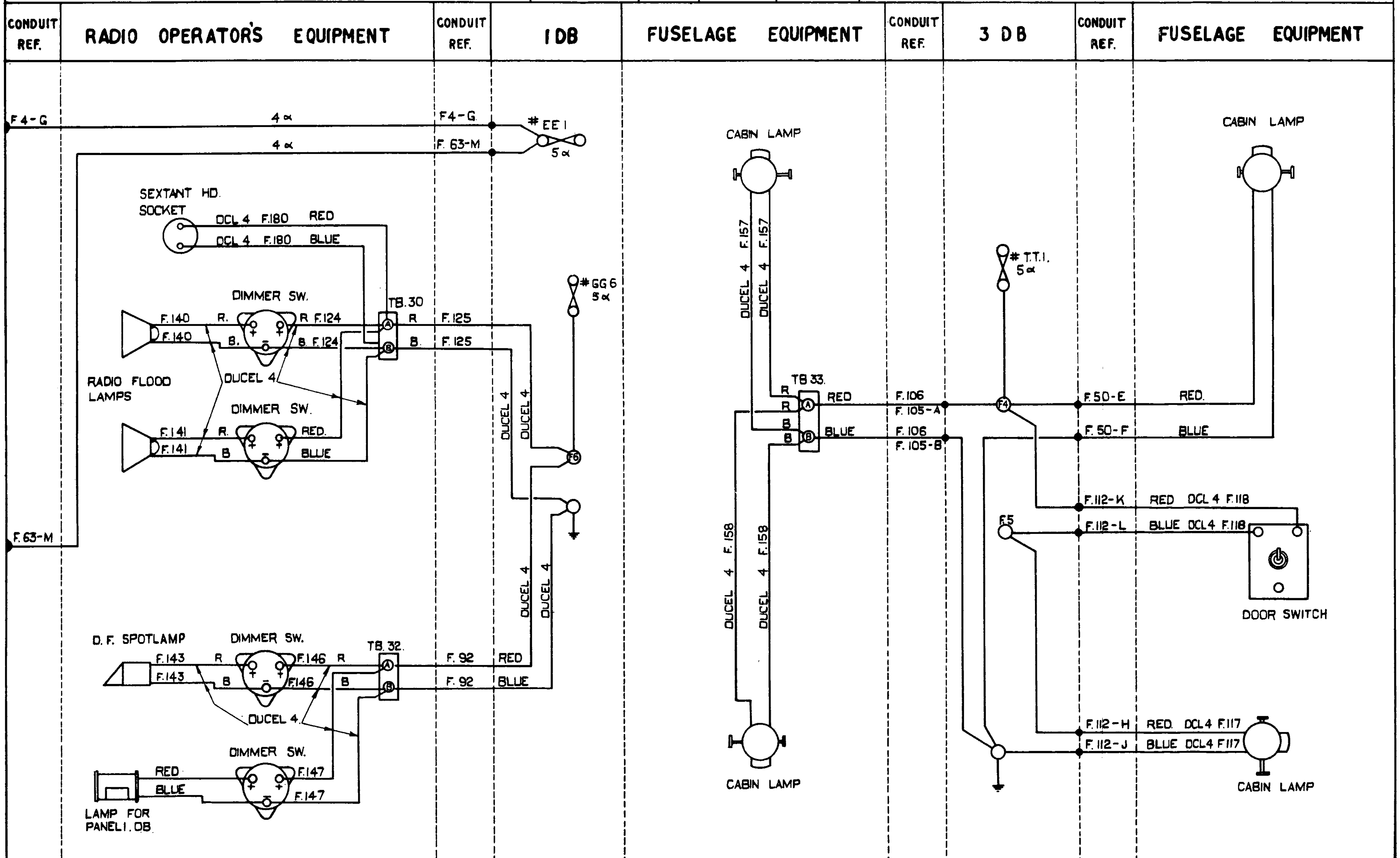


GENERAL SERVICES

FIG. 21

PP5147 M49377/G2287 4/48 800 C & P Gp. 959 (4)

This leaf issued with A.L. No.60, March 1948



GENERAL SERVICES

FIG. 21a

PP5147 M49377/G2287 4/48 800 C & P Gp. 959 (4)

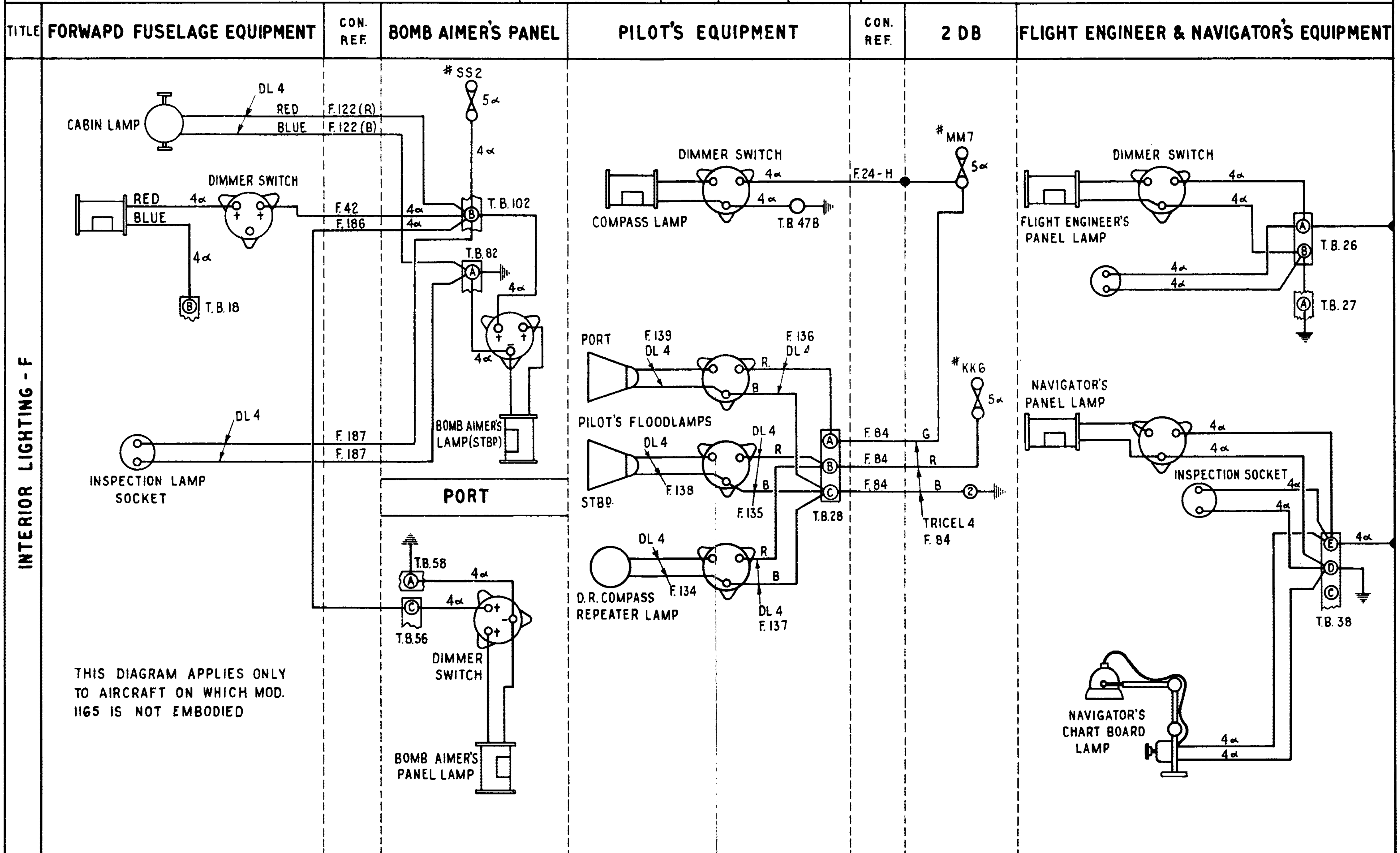
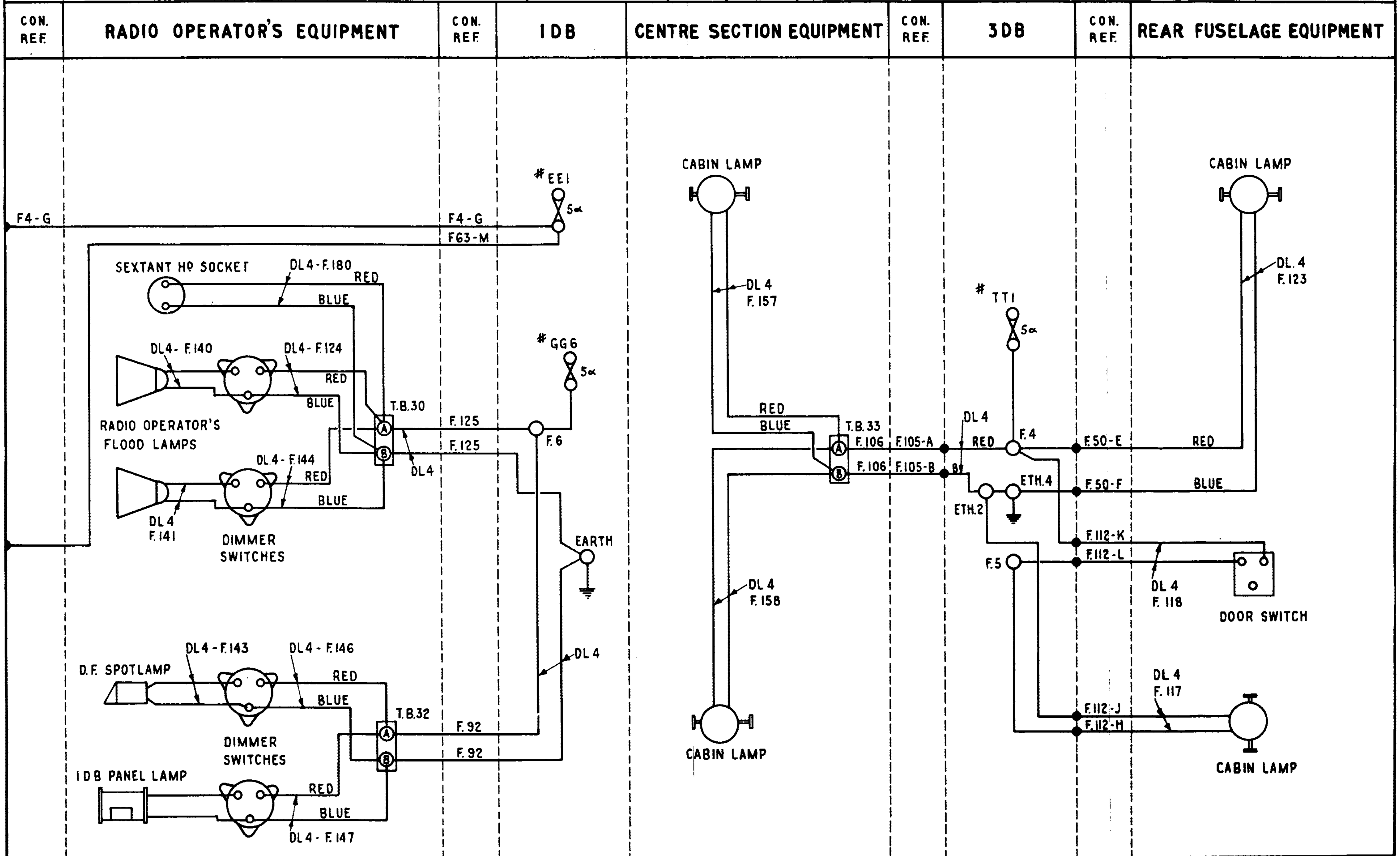


FIG. 21b

ROUTING CHART

This leaf issued with A.L. No. 60, March 1948



GENERAL SERVICES

FIG. 21b

PP5147 M49377/G2287 4/48 800 C & P Gp. 959 (4)

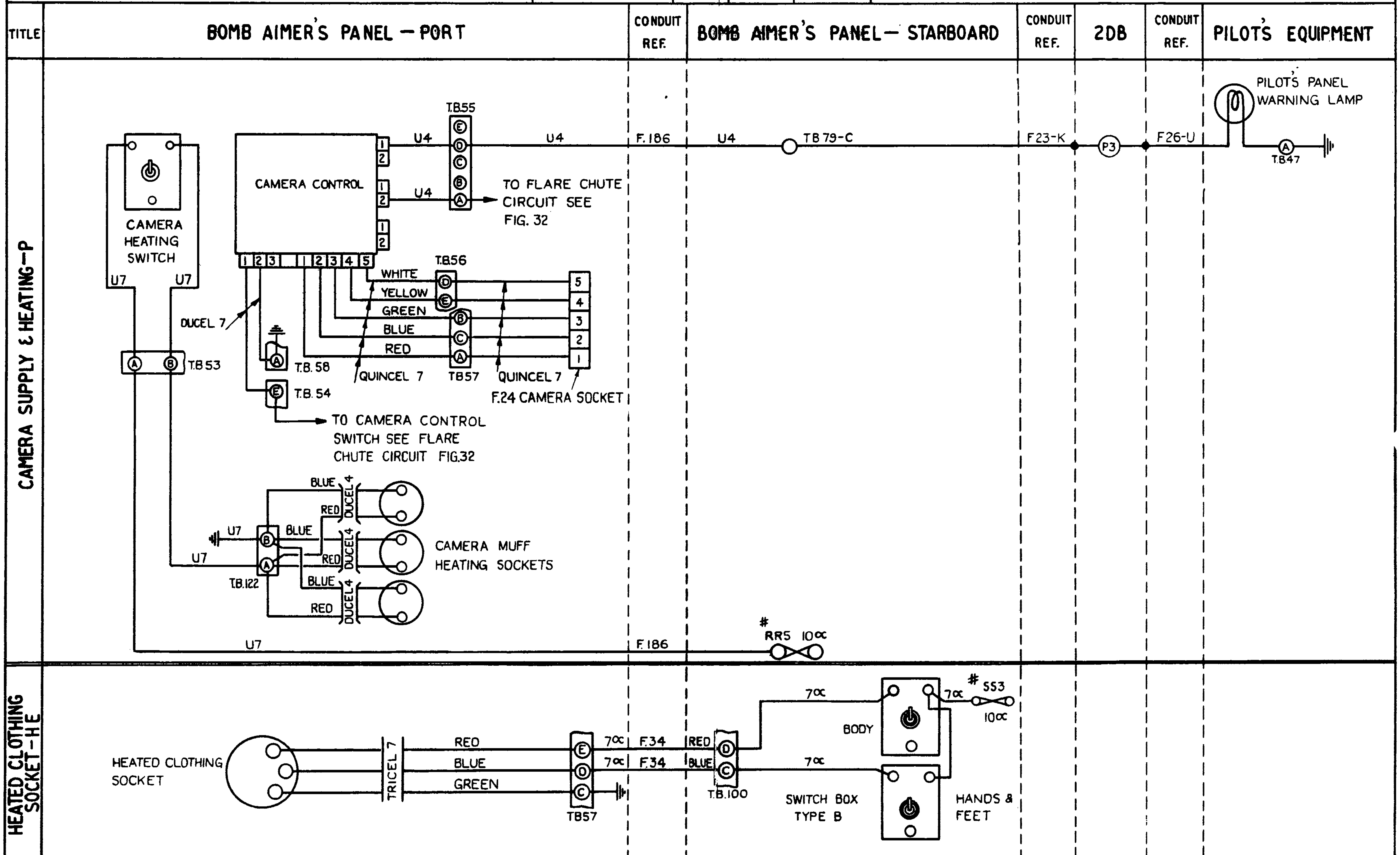


FIG. 22

ROUTING CHART GENERAL SERVICES

FIG. 22

This leaf issued with A.L. No.60, March 1948

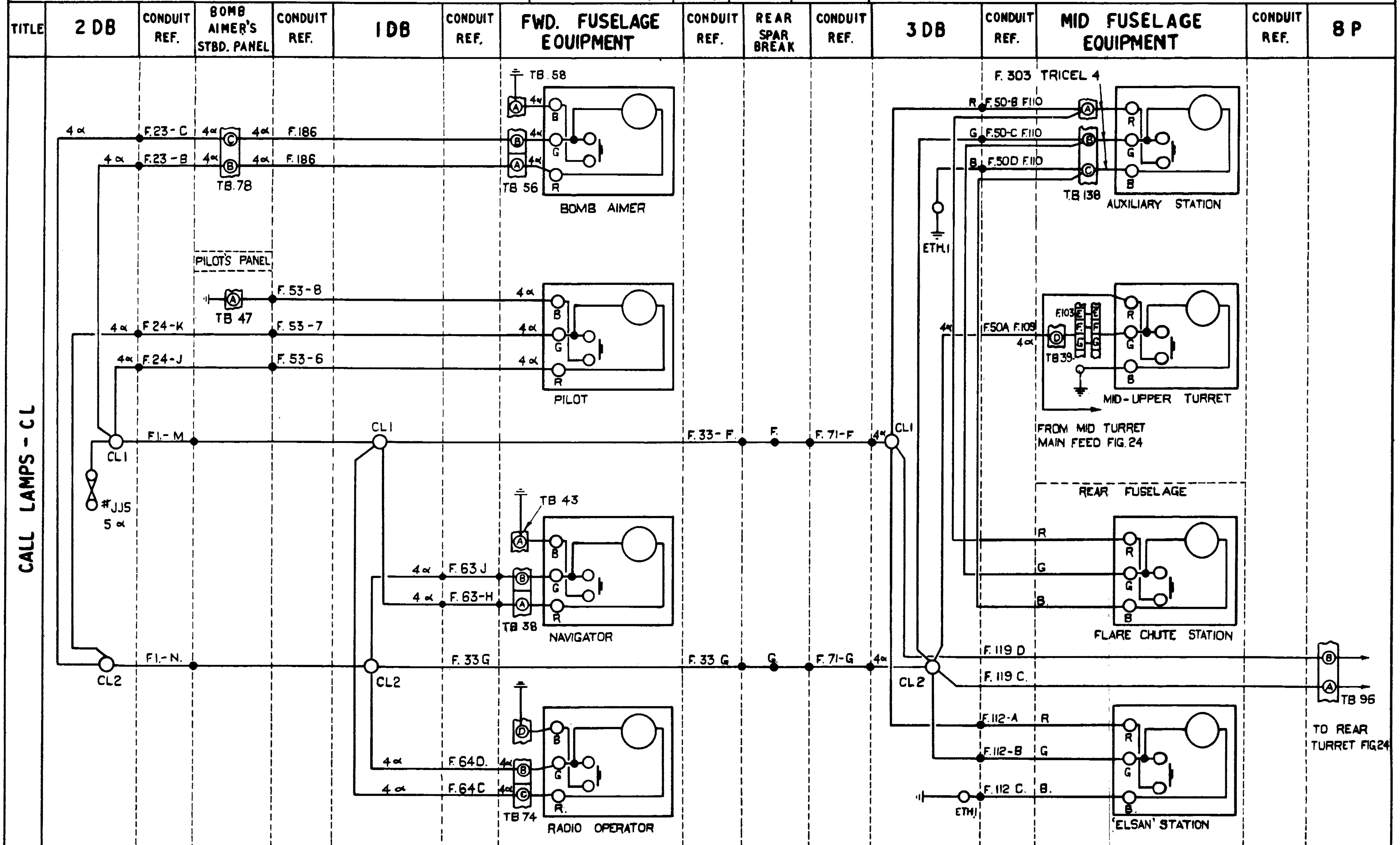


FIG. 23

ROUTING CHART GENERAL SERVICES

FIG. 23

PP5147 M49377/G2287 4/48 800 C & P Gp. 959 (4)

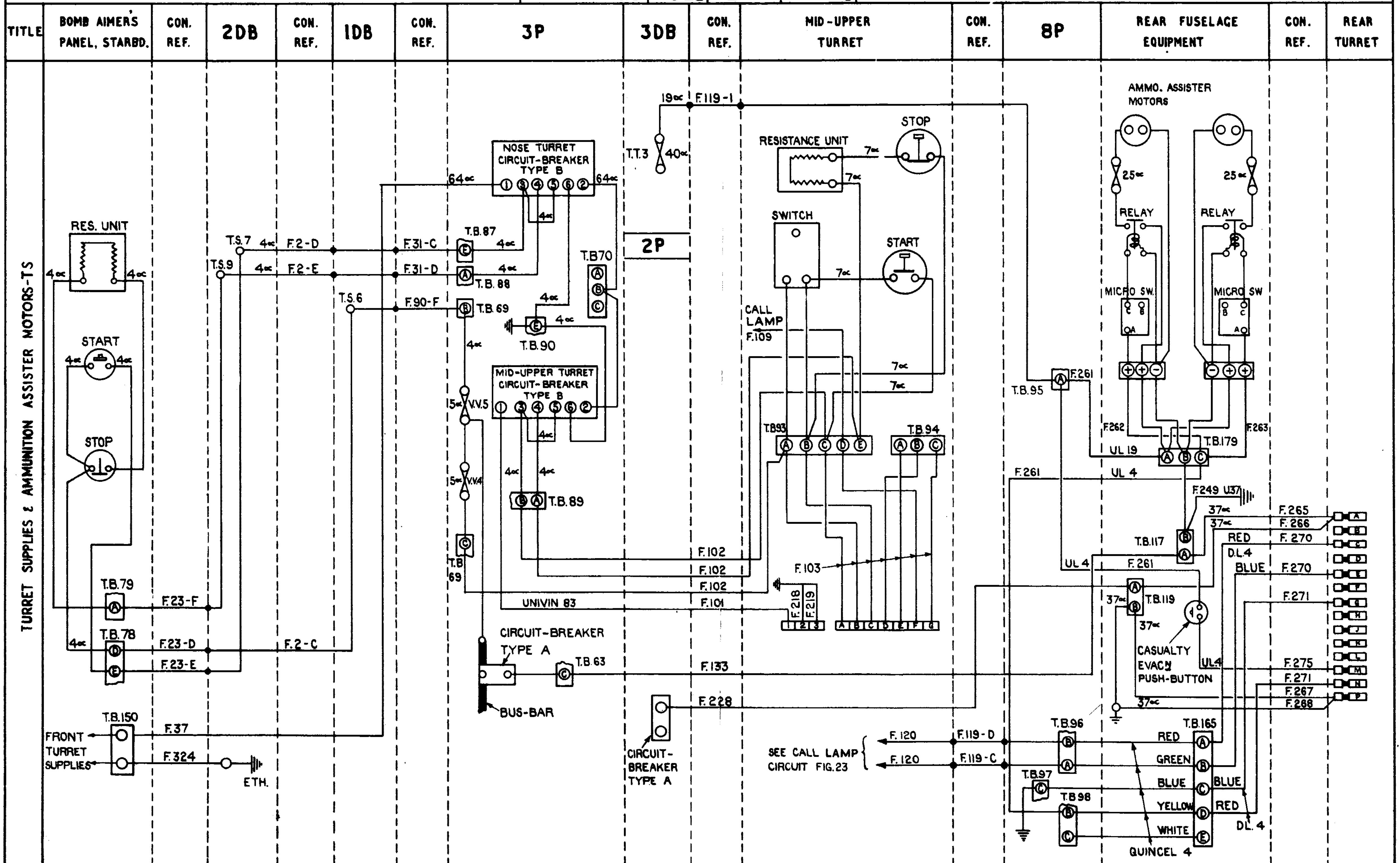


FIG. 24

ROUTING CHART - GENERAL SERVICES

FIG. 24

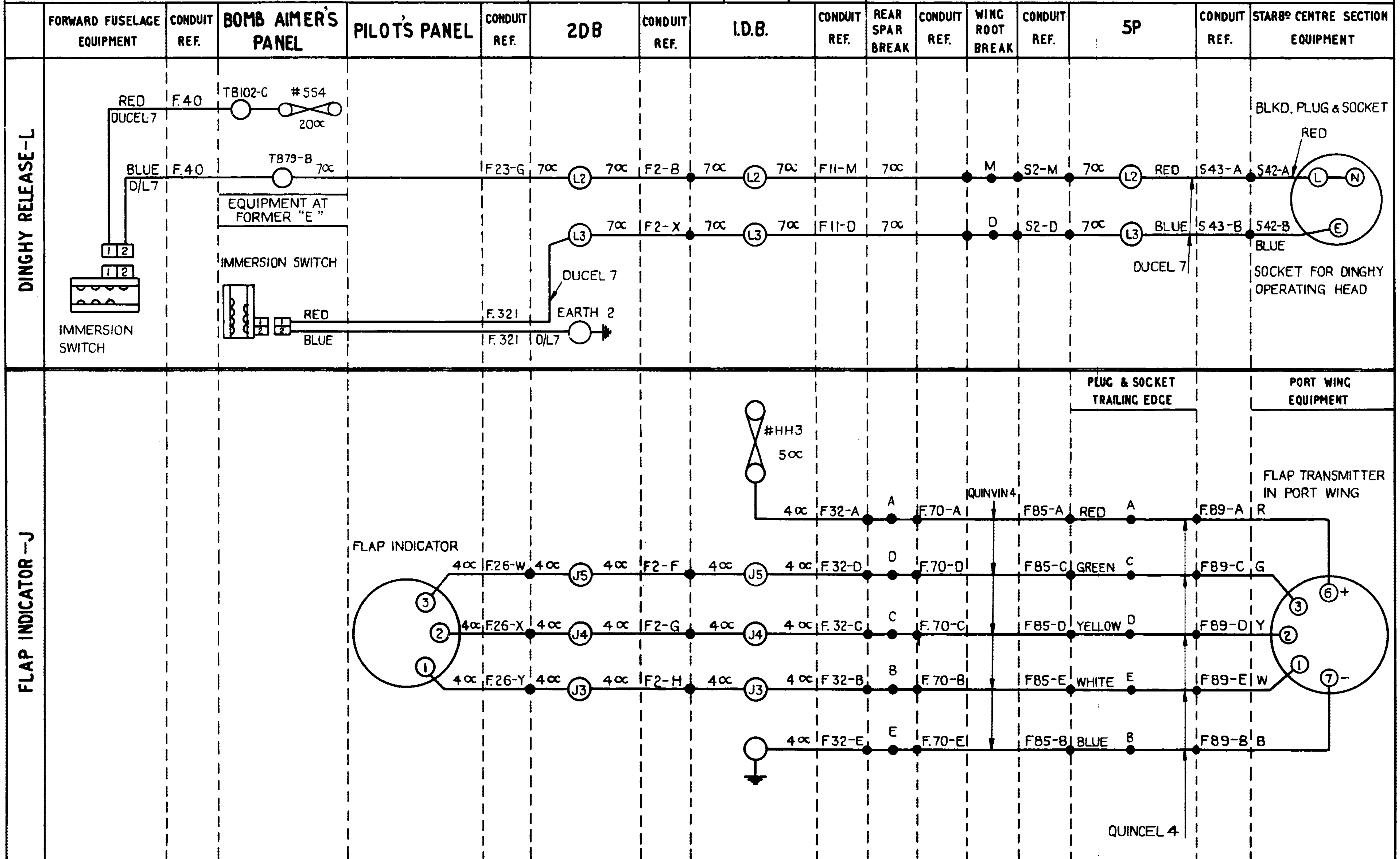


FIG. 25

ROUTING CHART-GENERAL SERVICES

PPS147 M49377/G2287 4/48 800 C & P Gp. 959 (4)

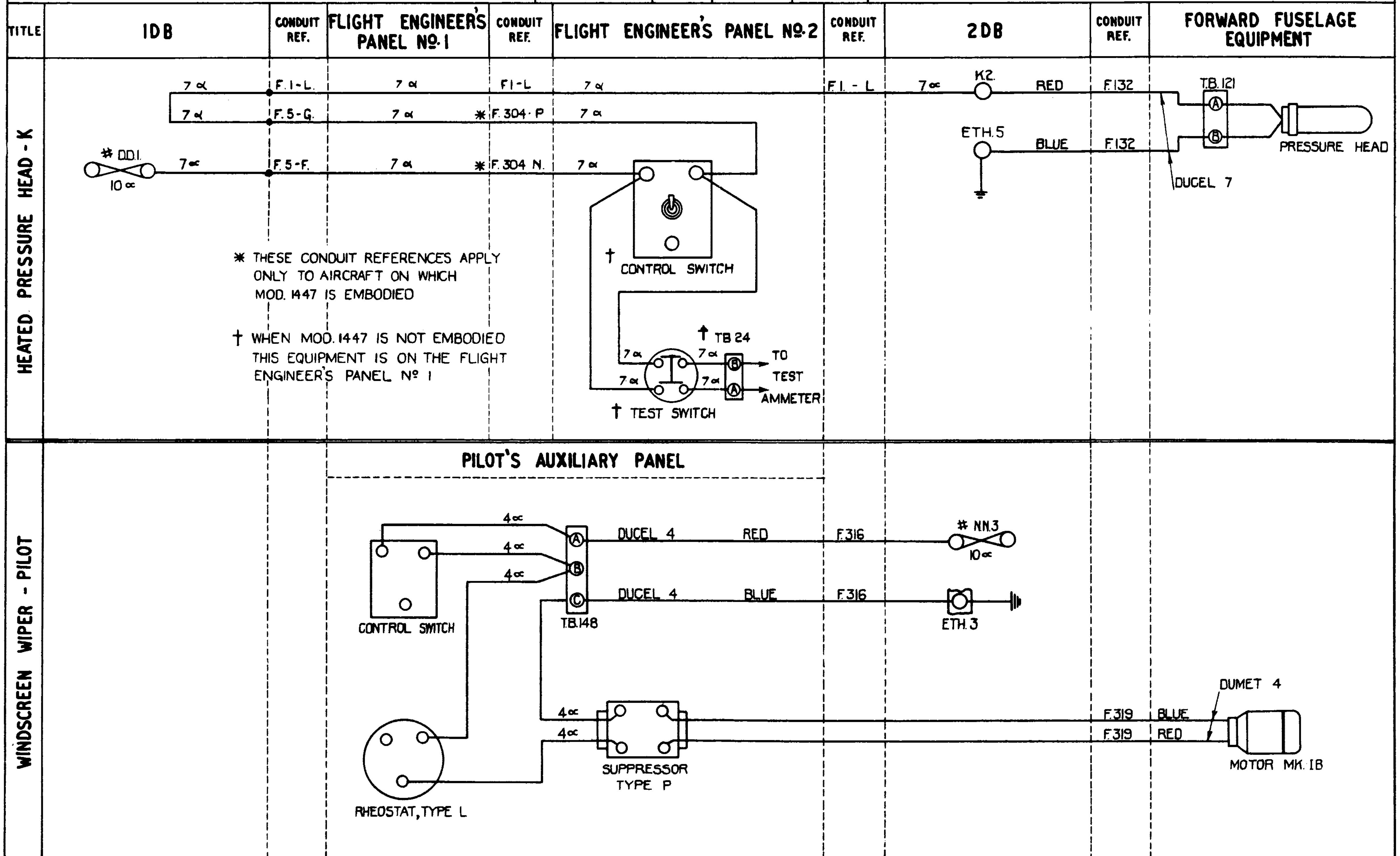


FIG. 26

ROUTING CHART - GENERAL SERVICES

FIG. 26

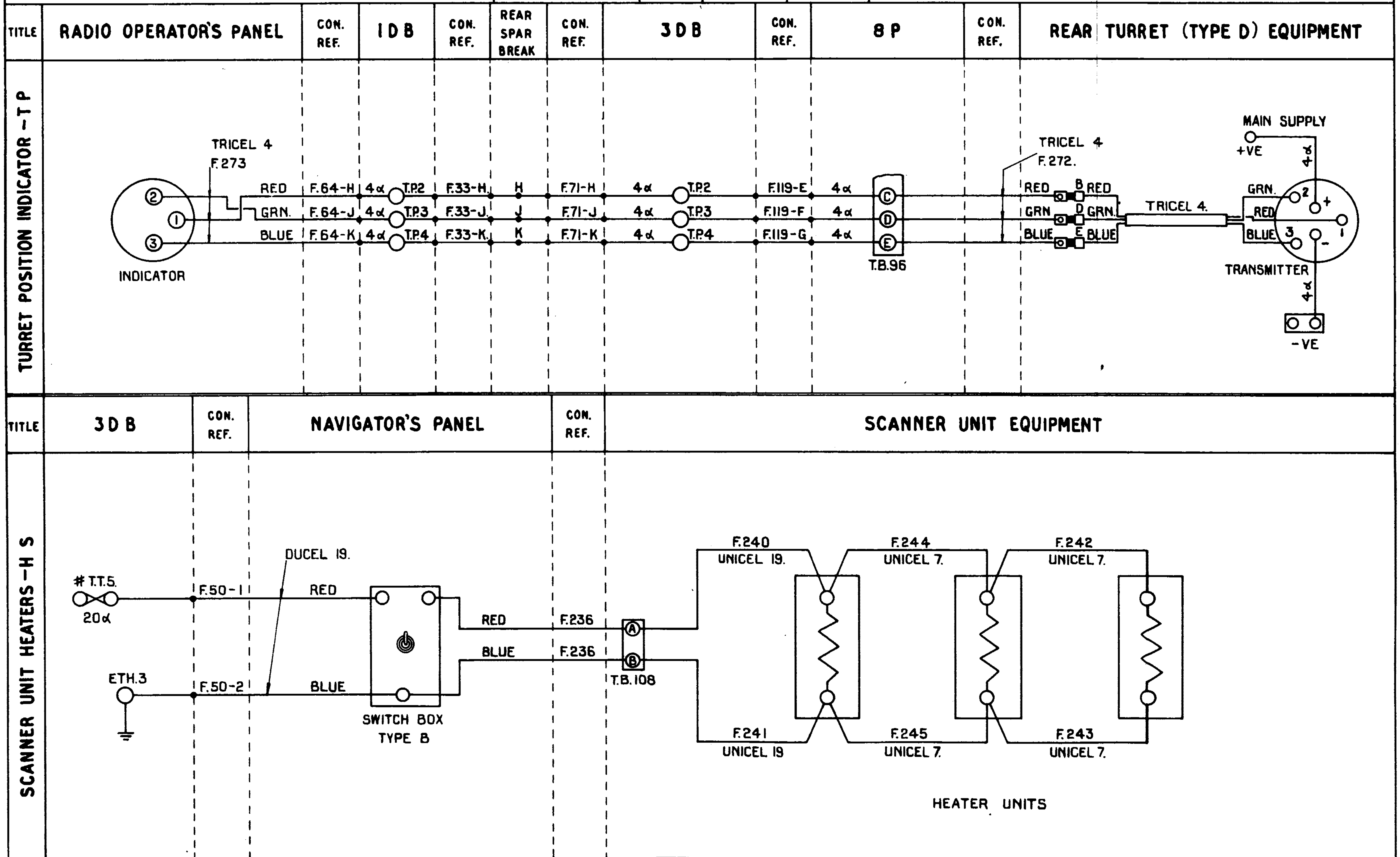


FIG. 27

ROUTING CHART-GENERAL SERVICES

FIG. 27

PP5147 M49377/G2287 4/48 800 C&P Gp 959 (4)

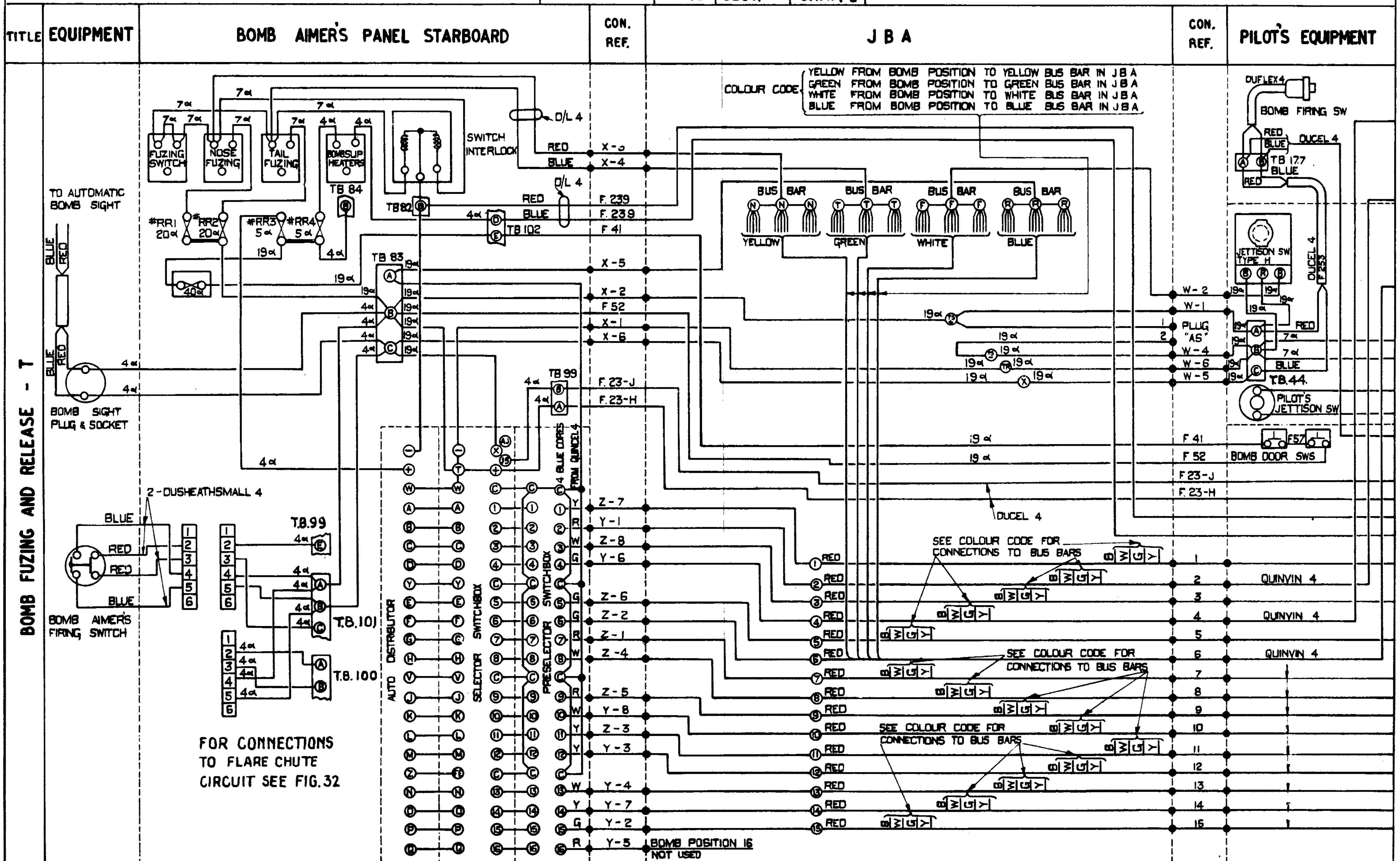
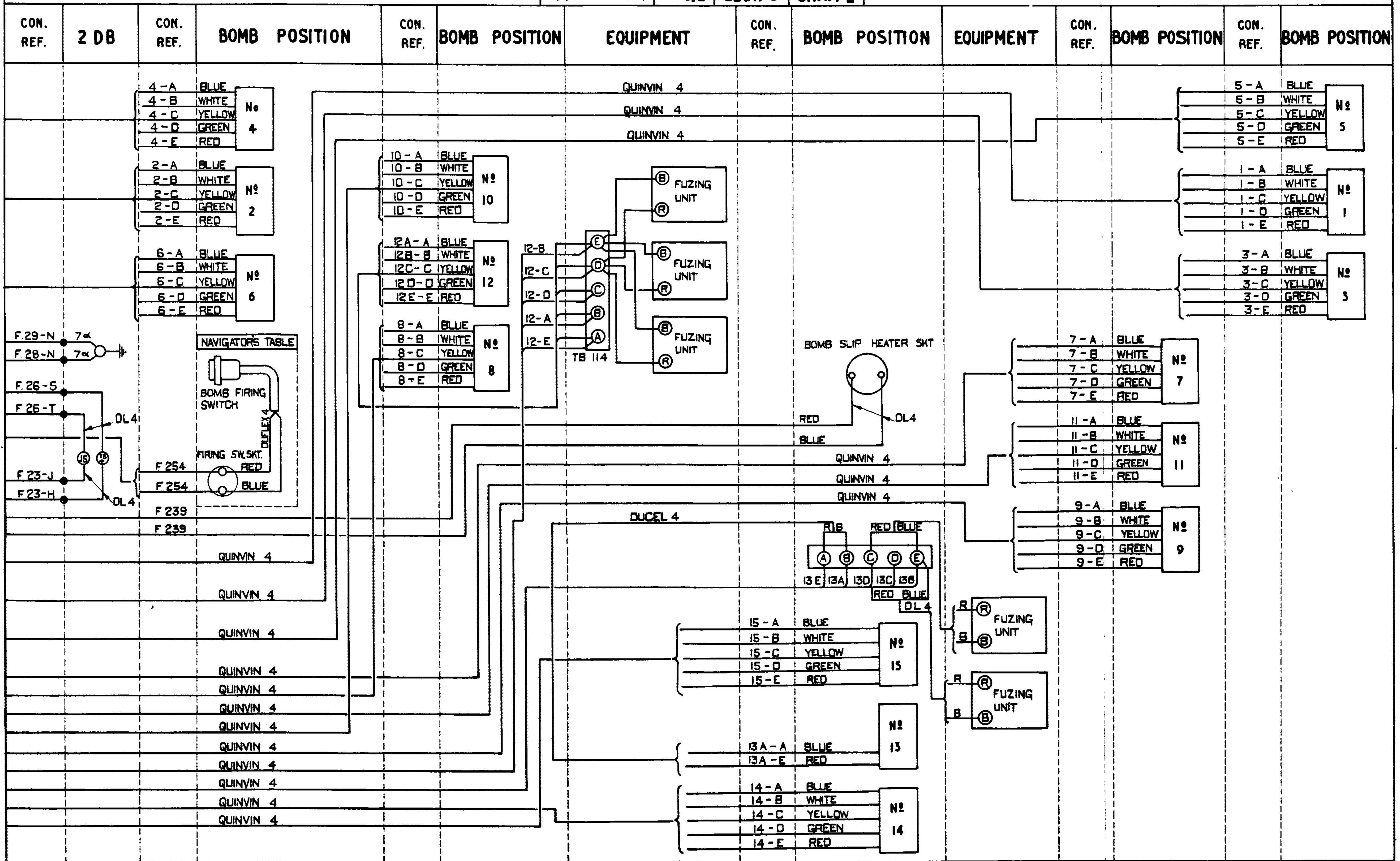


FIG 28

ROUTING CHART

This leaf issued with A.L. No.60, March 1948



GENERAL SERVICES

FIG. 28

TITLE: EQUIPMENT — IDB

D.R. COMPASS — DR

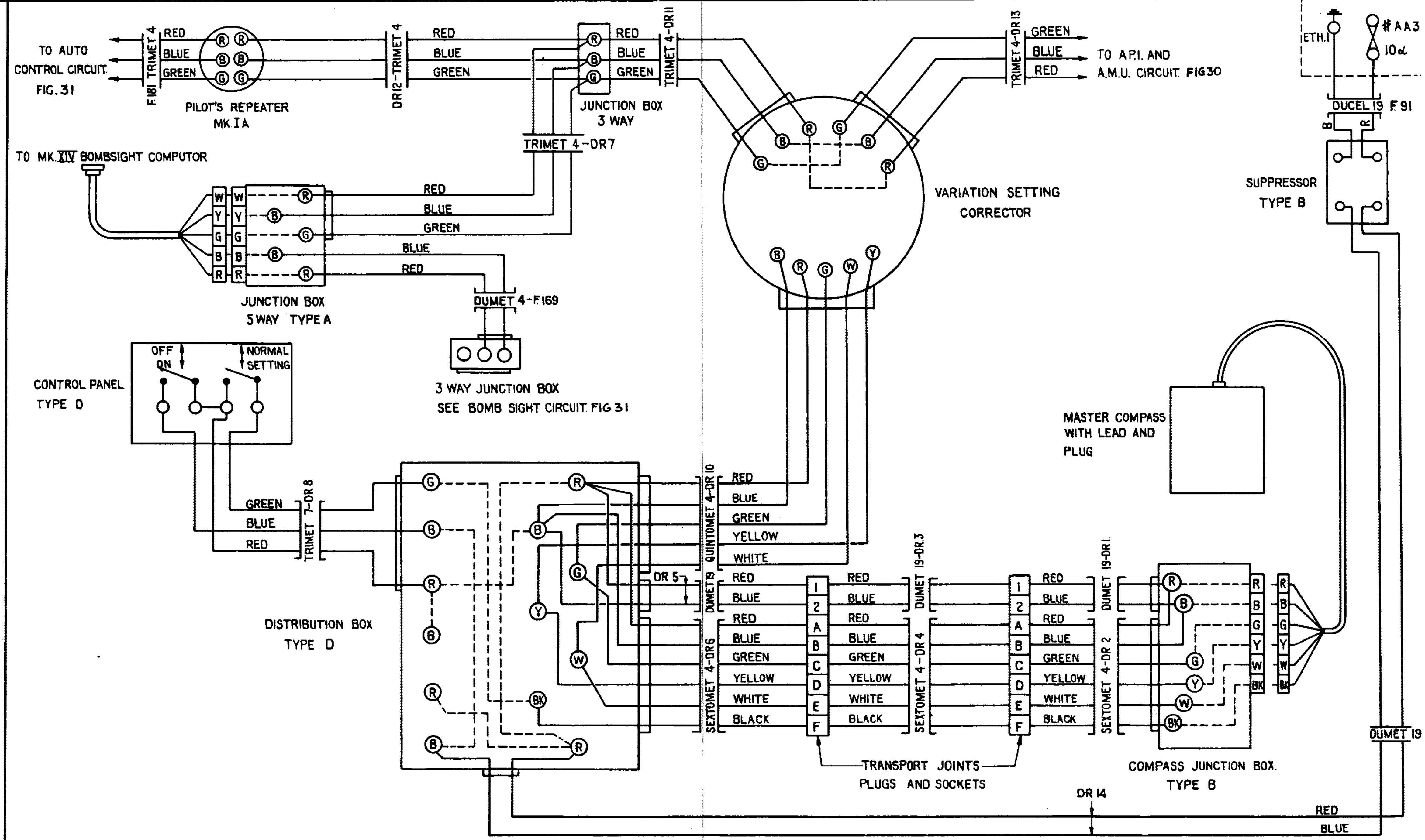


FIG. 29 — ROUTING CHART GENERAL SERVICES — FIG. 29

This leaf issued with A.L. No.60, March 1948

TITLE	IDB	CON. REF.	NAVIGATOR'S PANEL	NAVIGATOR'S EQUIPMENT

AUTOMATIC DEAD RECKONING EQUIPMENT

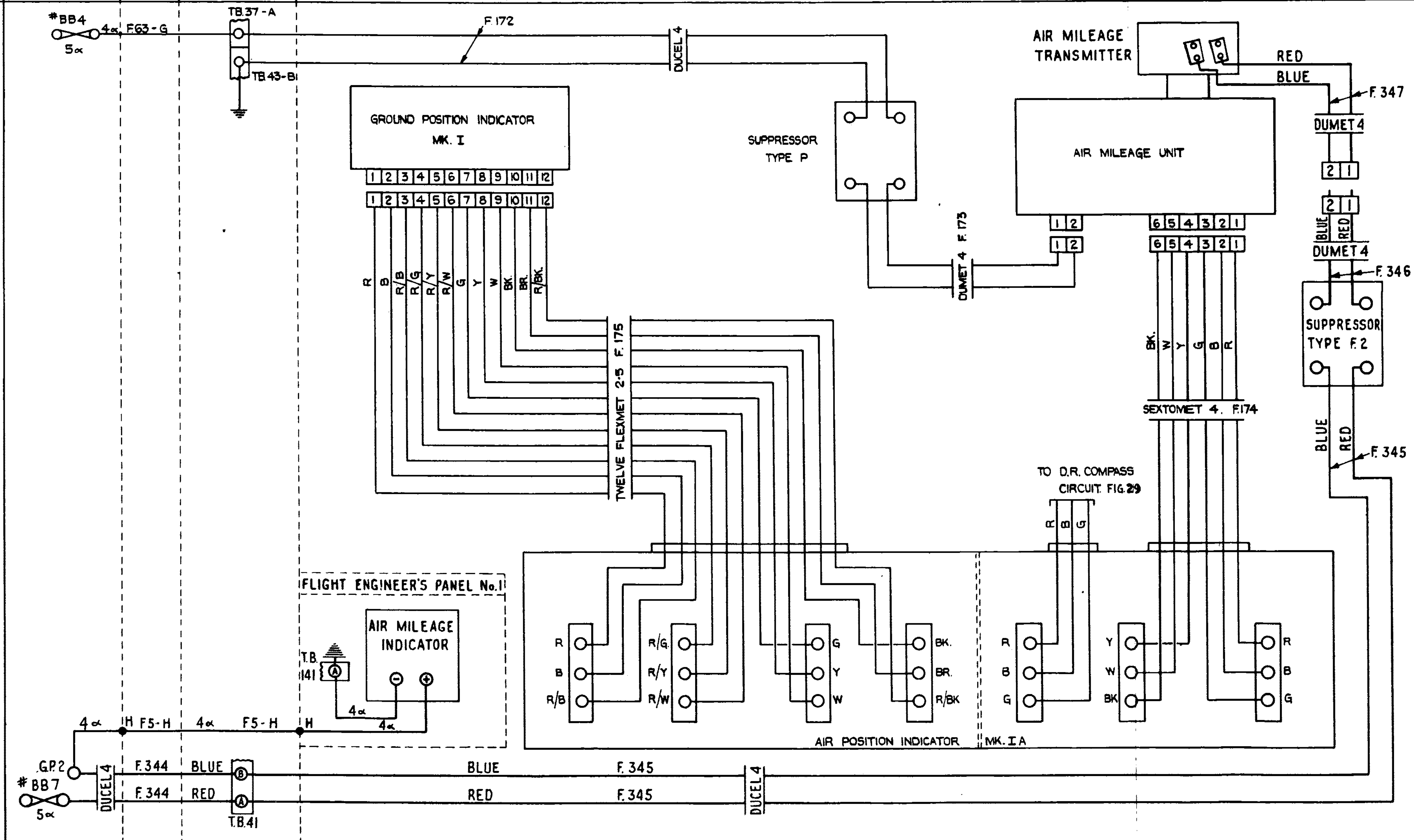


FIG. 30

ROUTING CHART – GENERAL SERVICES

PP5147 M49377/G2287 4/48 800 C & P Gp. 959 (4)

TITLE	FWD. FUSELAGE EQUIPMENT	CON. REF.	BOMB AIMER'S PANEL STARBOARD	EQUIPMENT	CON. REF.	PILOT'S PANEL	CON. REF.	2 DB

MK. XIV BOMB SIGHT-I AND AUTO PILOT-S

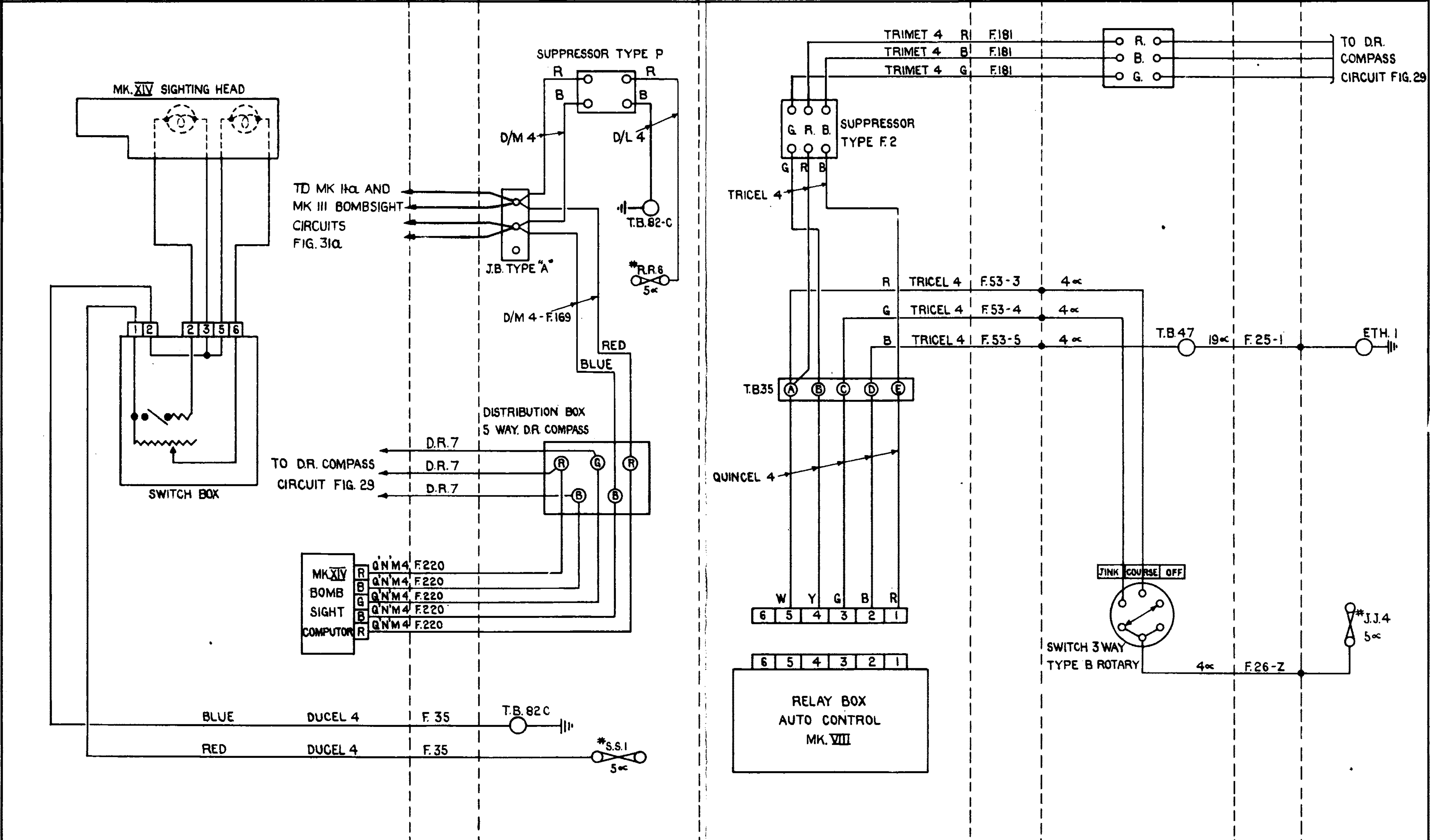


FIG. 31 ROUTING CHART-GENERAL SERVICES FIG. 31

This leaf issued with A.L. No. 60, March 1948

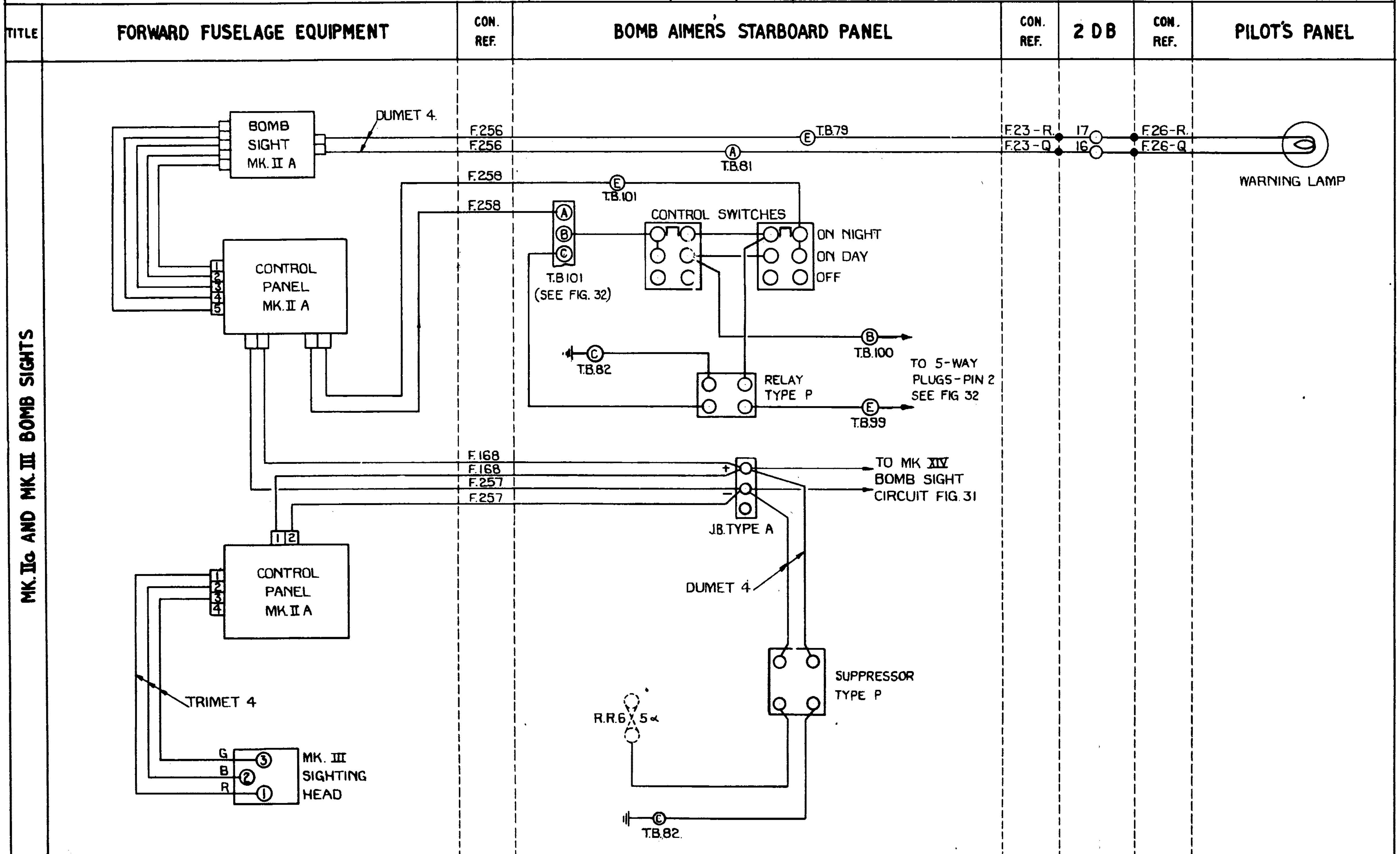


FIG. 31a

ROUTING CHART-GENERAL SERVICES

FIG. 31a

PP5147 M49377/G2287 4/48 800 C & P Gp. 959 (4)

TITLE	BOMB AIMER'S EQUIPMENT	CON. REF.	BOMB AIMER'S PANEL - STARBOARD	CON. REF.	BOMB AIMER'S PANEL - PORT	CON. REF.	2DB

FLARE CHUTE, MK. III - FC

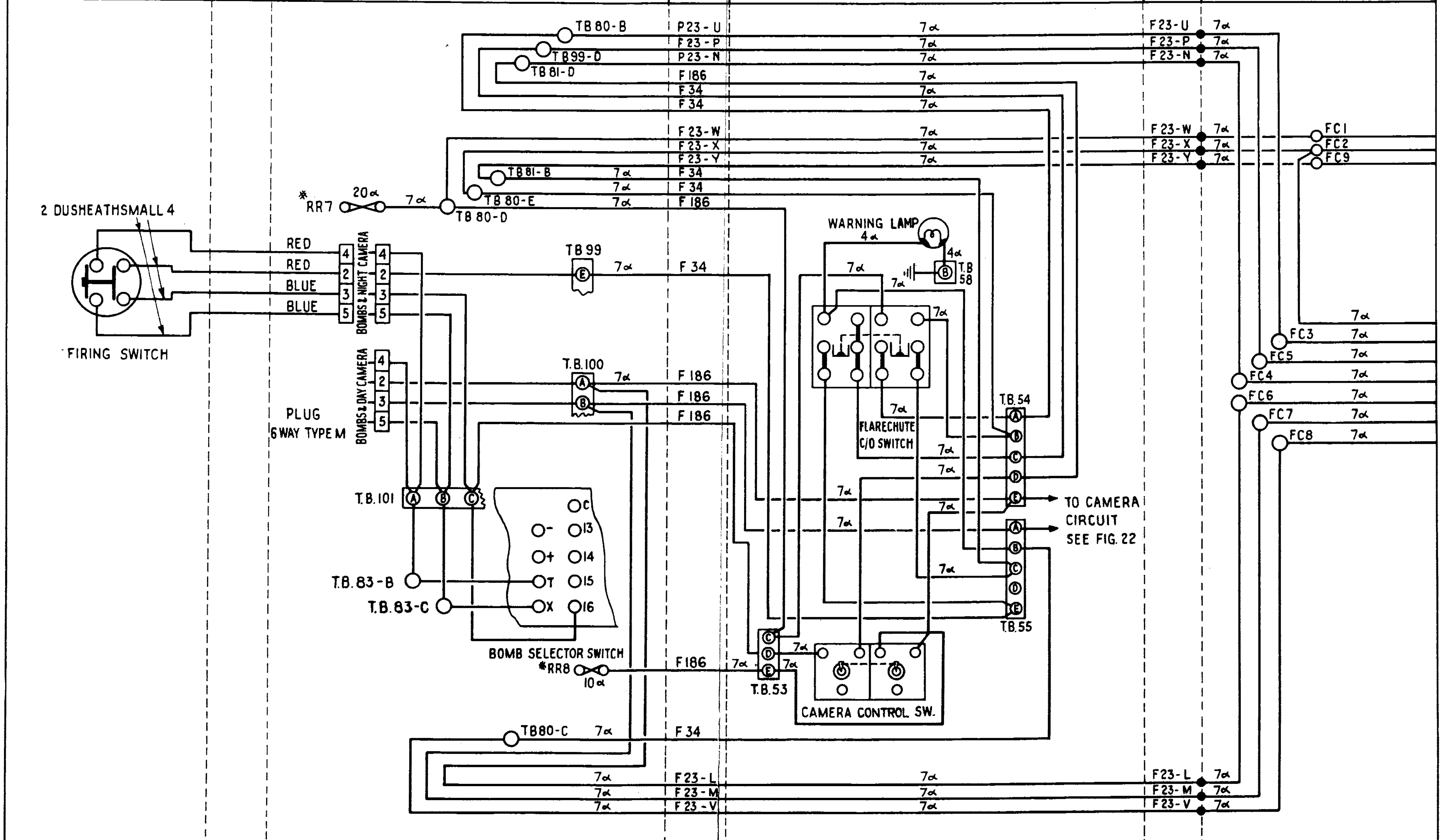
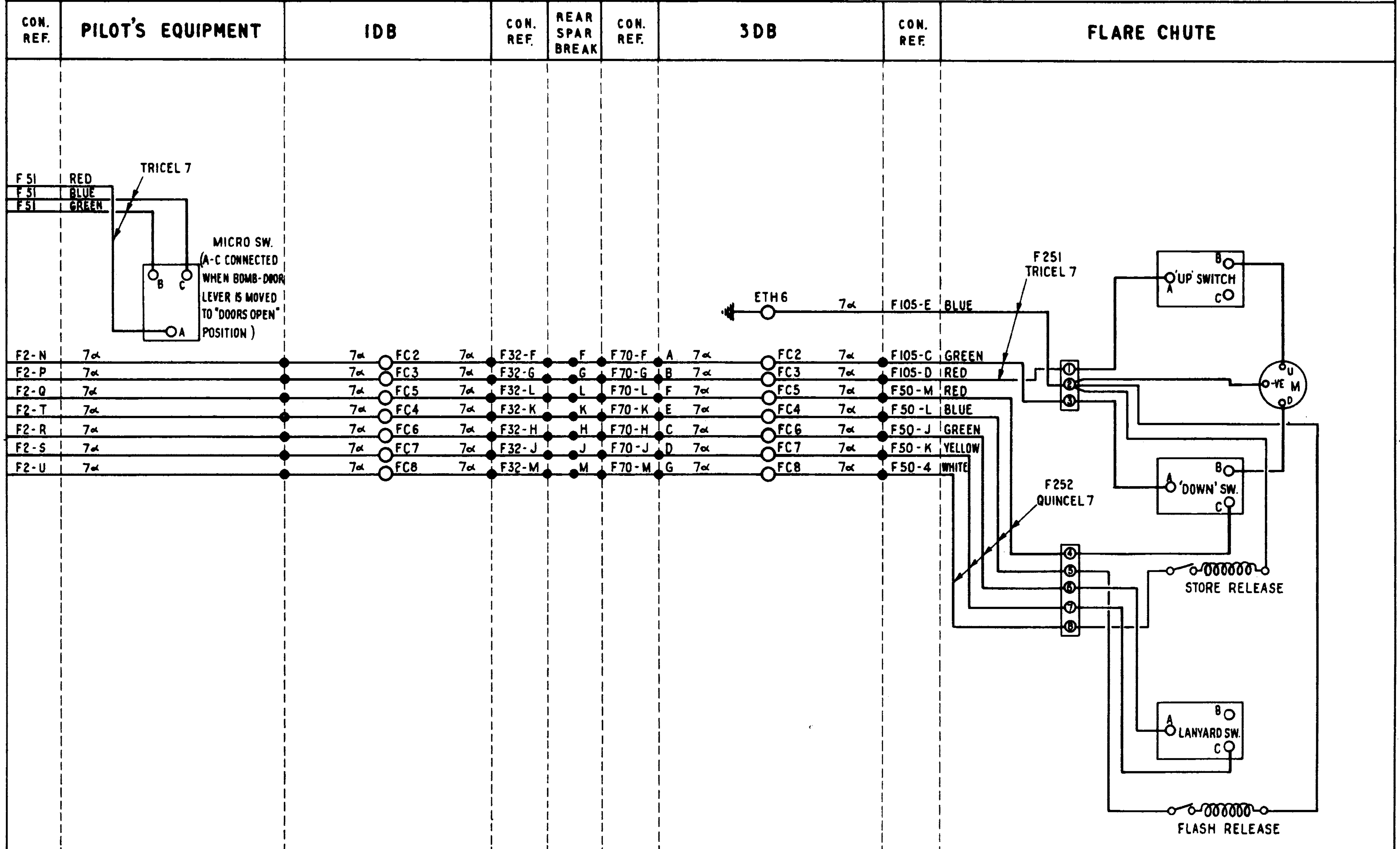


FIG. 32 ROUTING CHART -



GENERAL SERVICES

FIG. 32

PP5147 M49377/G2287 4/48 800 C&P Gp. 959 (4)

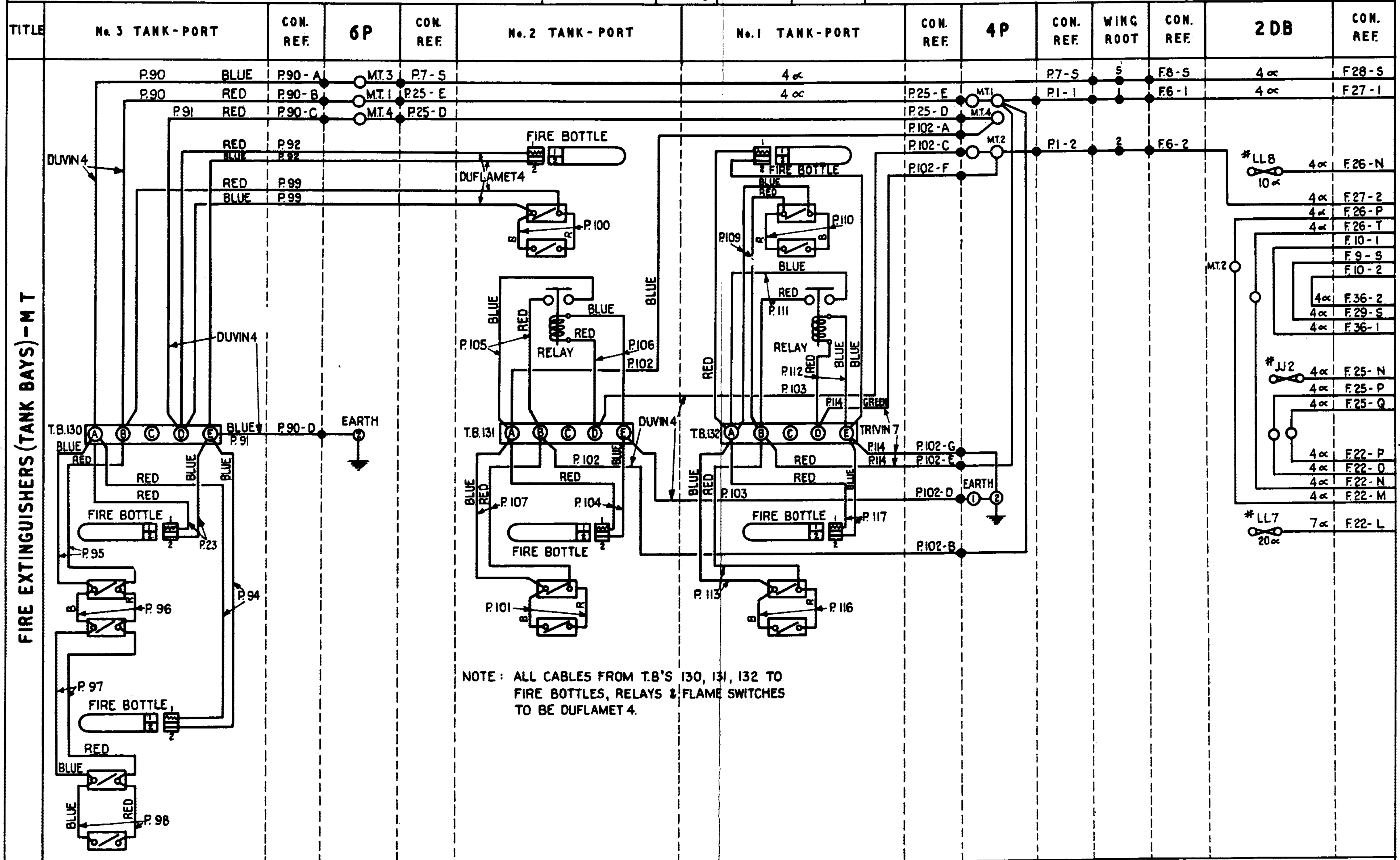
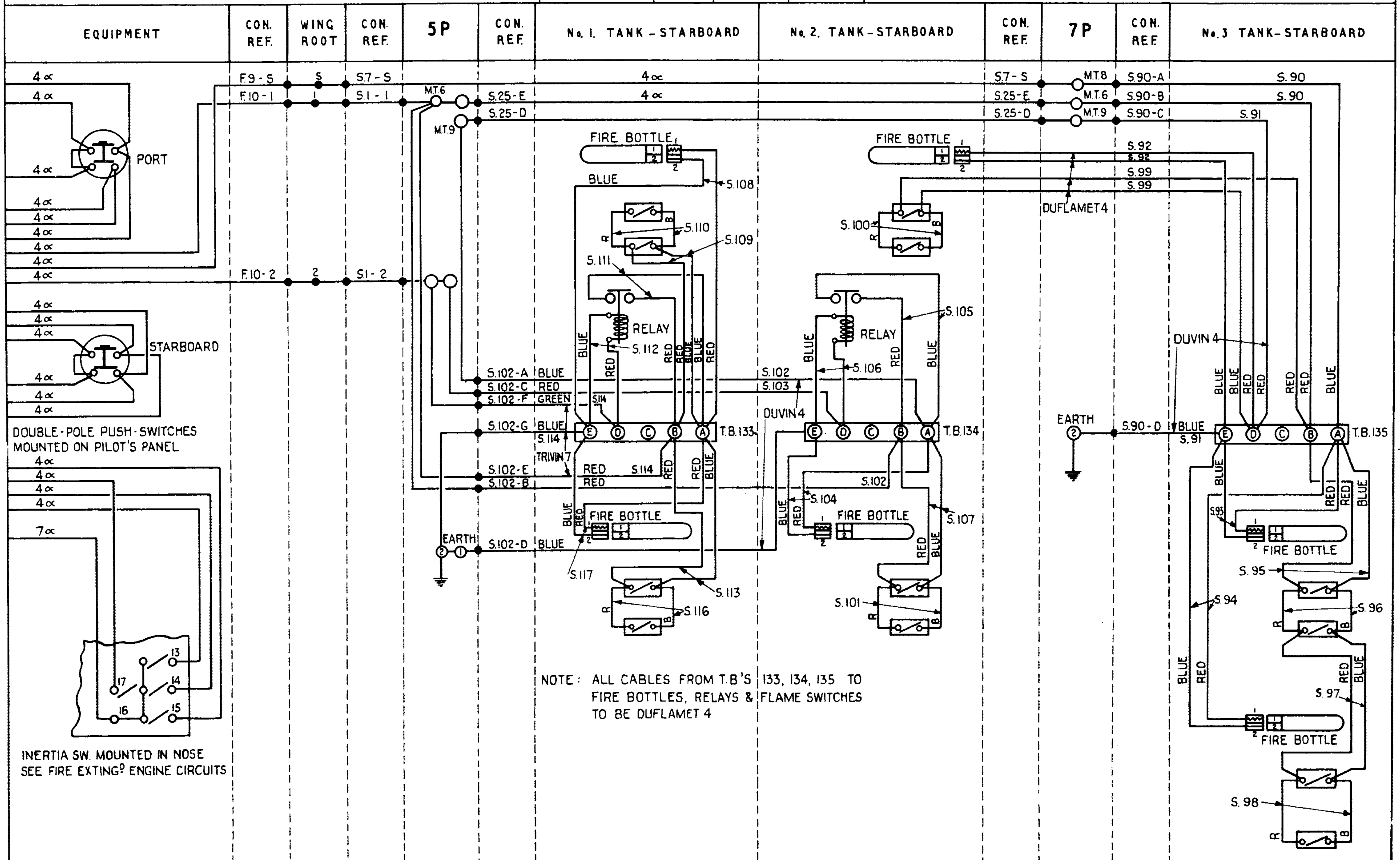


FIG. 33

ROUTING CHART

This leaf issued with A.L. No. 60, March, 1948



GENERAL SERVICES

FIG. 33

PP5147 M49377/G2287 4/48 800 C & P Gp. 959 (4)

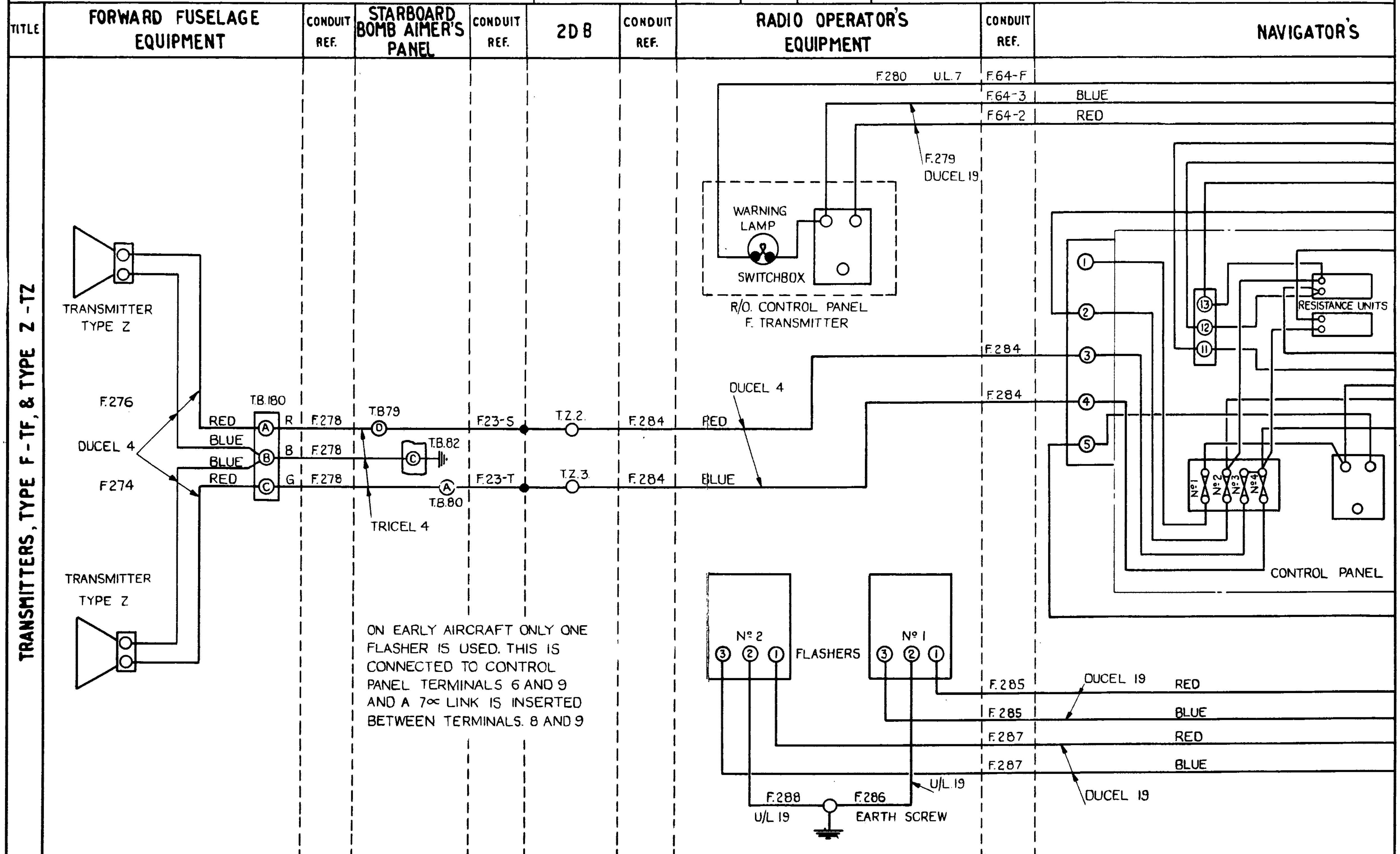
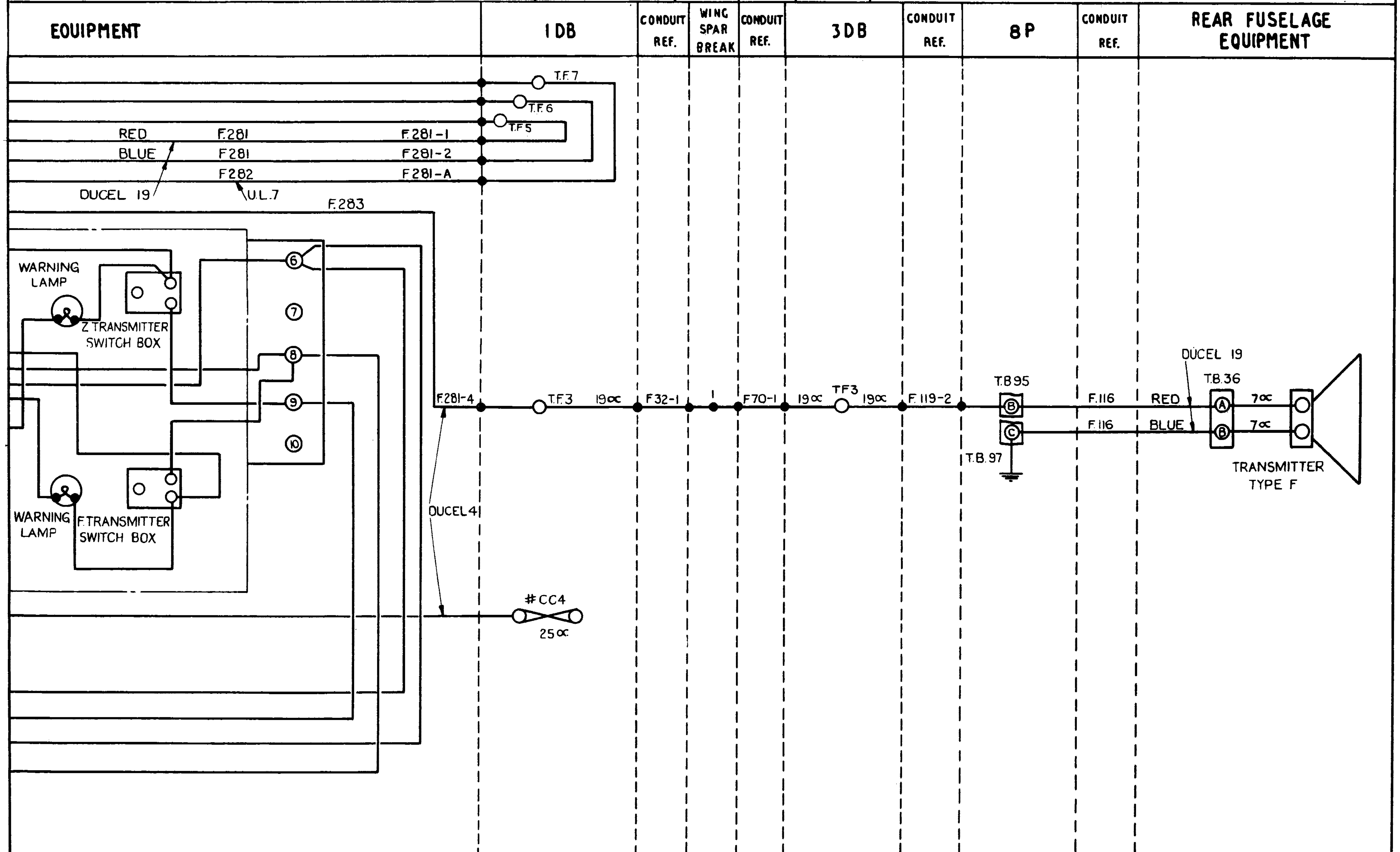


FIG. 34

ROUTING CHART-GENERAL SERVICES

This leaf issued with A.L. No.60, March, 1948



ROUTING CHART-GENERAL SERVICES

FIG. 34

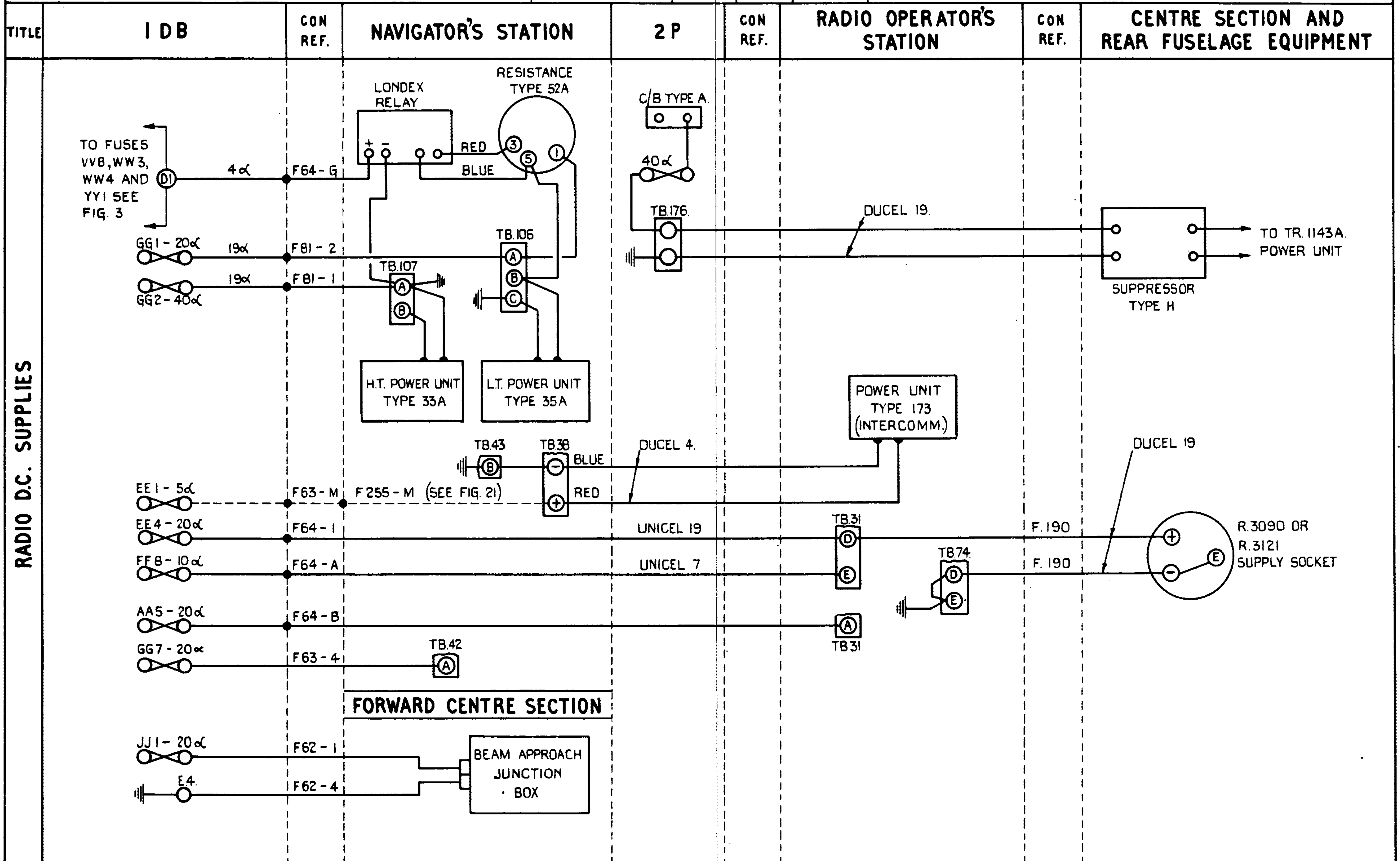


FIG. 35

ROUTING CHART — GENERAL SERVICES

FIG. 35

This leaf issued with A.L. No.60, March, 1948

TITLE	NAVIGATOR'S PANEL	CONDUIT REF.	IDB	CONDUIT REF.	3P	CONDUIT REF.	CENTRE SECTION EQUIPMENT

A.C. SUPPLY AND CONTROL

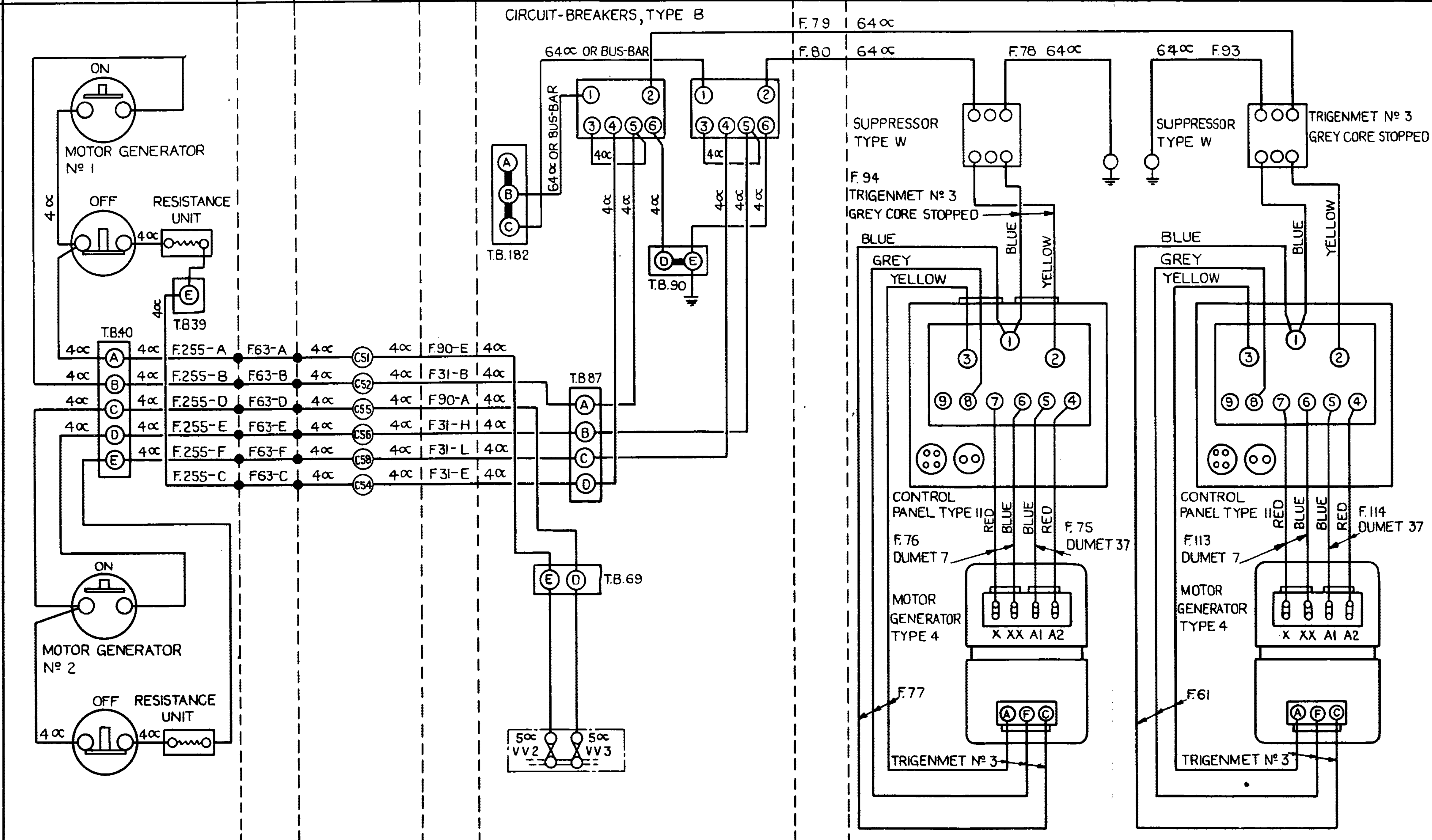


FIG. 36 ROUTING CHART-GENERAL SERVICES FIG. 36

PP5147 M49377/G2287 4/48 800 C.&P. Gp. 959 (4)

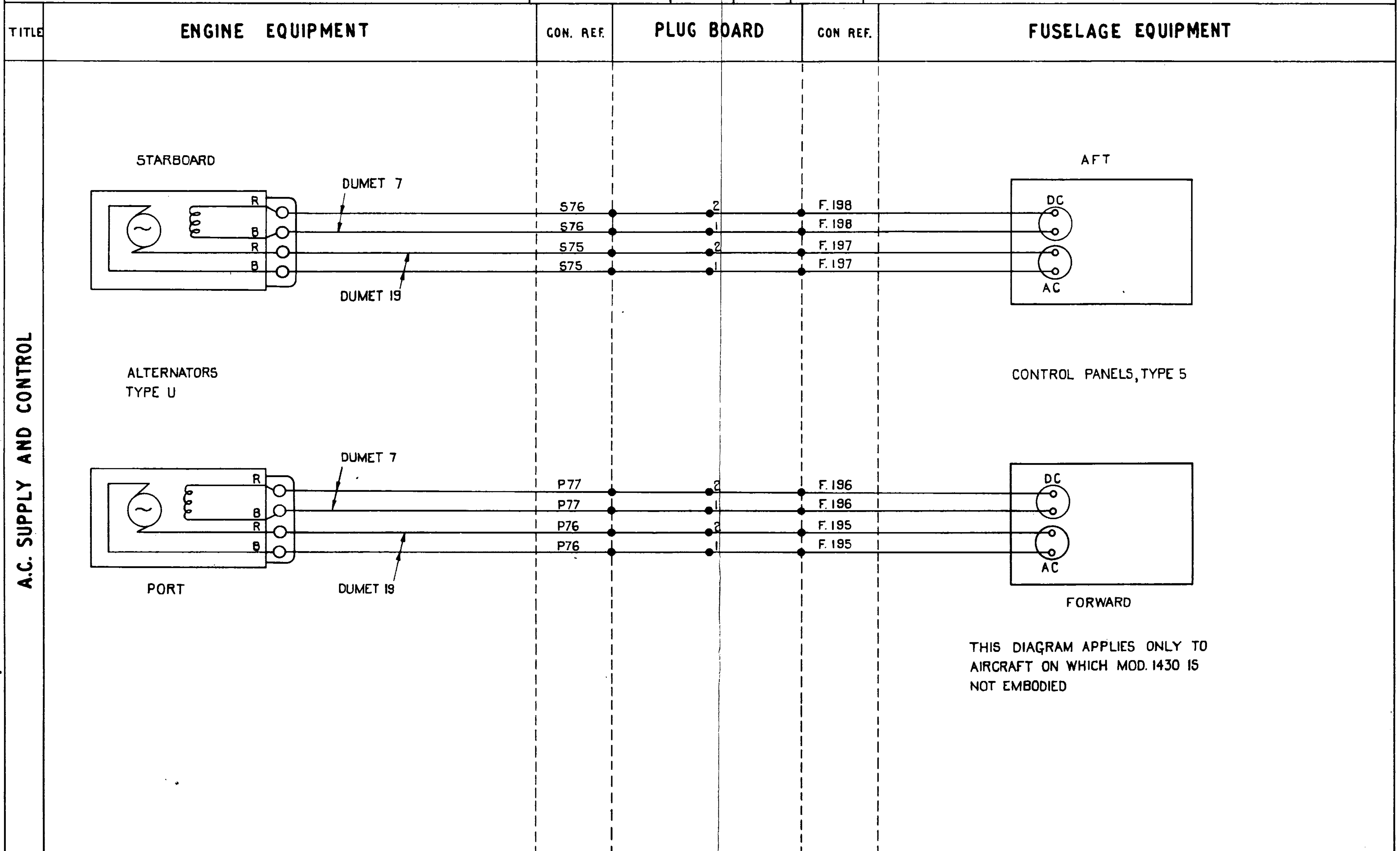


FIG. 36a

ROUTING CHART — GENERAL SERVICES

FIG. 36a

This leaf issued with A.L. No.60, March 1948

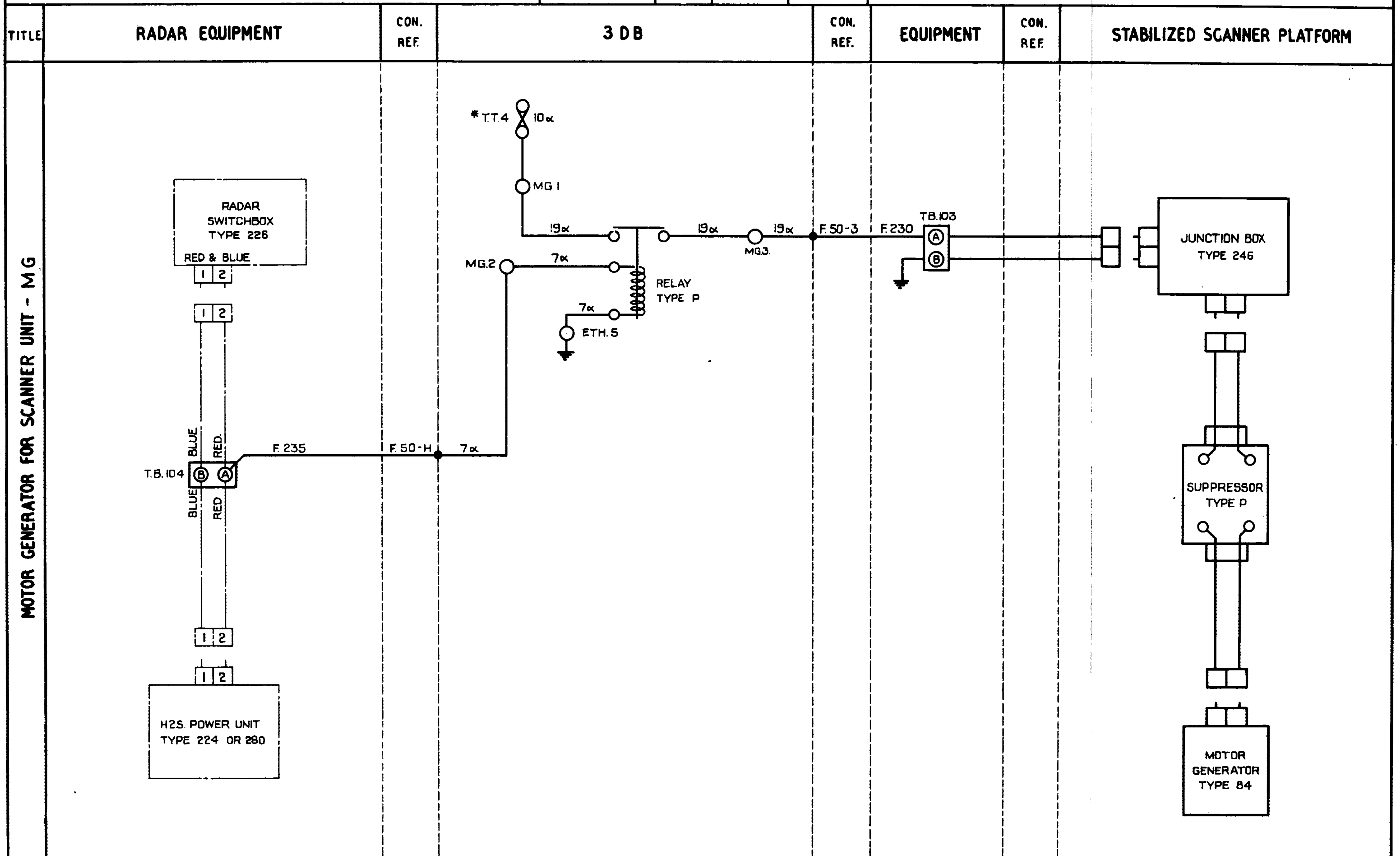


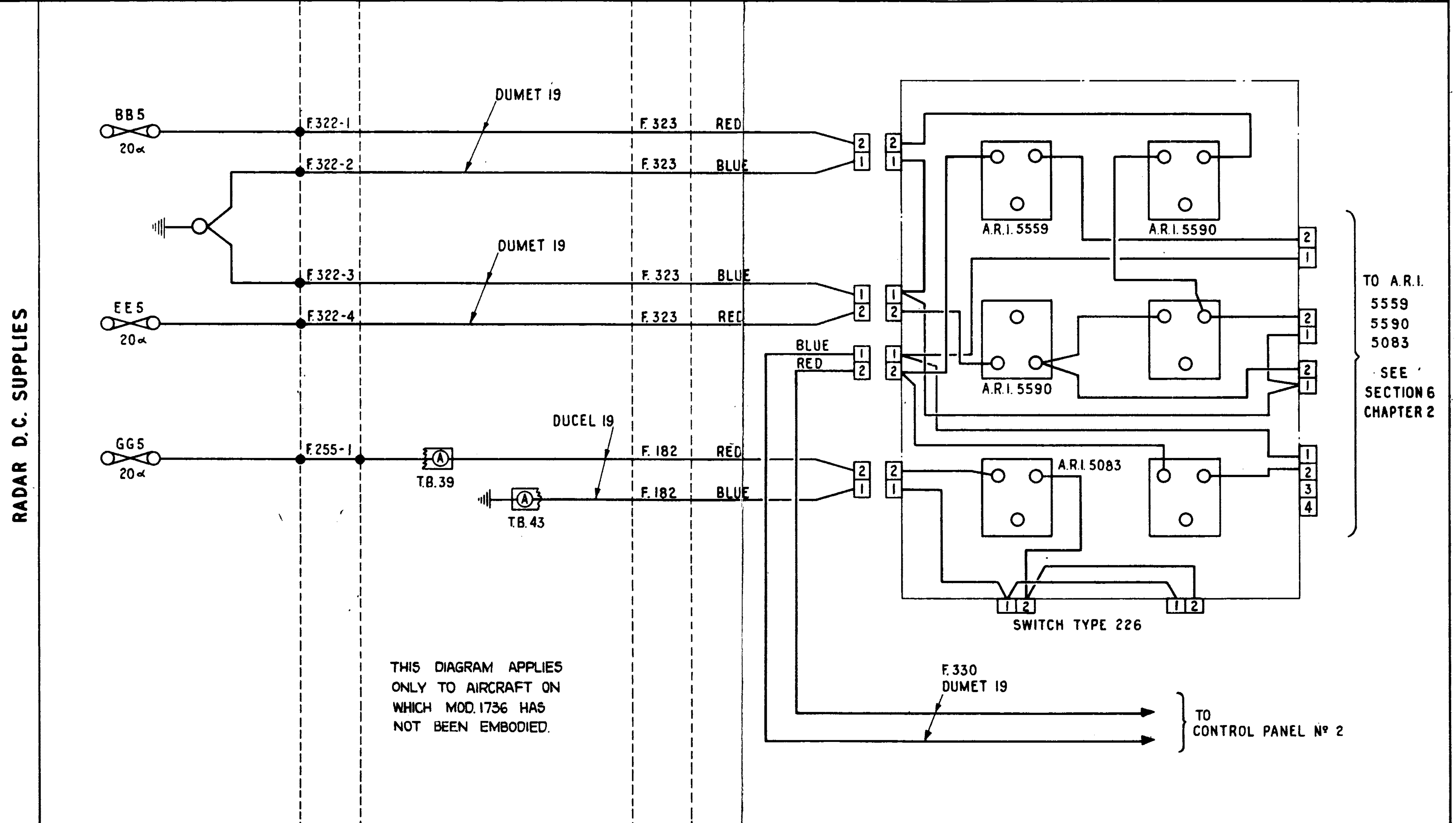
FIG. 37

ROUTING CHART - GENERAL SERVICES

FIG. 37

PP5147 M49377/G2287 4/48 800 C & P Gp. 959 (4)

TITLE	IDB	CON. REF.	NAVIGATOR'S PANEL	CON. REF.	RADAR EQUIPMENT



THIS DIAGRAM APPLIES ONLY TO AIRCRAFT ON WHICH MOD. 1736 HAS NOT BEEN EMBODIED.

FIG. 38

ROUTING CHART - GENERAL SERVICES

FIG. 38

7 • DESCRIPTION OF STRUCTURE

(11065) T14574/G2588 1050 11/44 M20691 C & P 752

CHAPTER I

FUSELAGE

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

** To be issued later*

General

1. The five sections into which the fuselage is divided are: nose, front centre, intermediate centre, rear centre, and rear sections, but for transport purposes the nose and front centre sections are treated as one unit. The nose section embodies the nose turret and the air bomber's station. The pilot's, second pilot's, navigator's, fighting control and wireless operator's stations are in the front centre section. The intermediate centre section houses sundry items of equipment. The dorsal turret is in the rear centre section, which also contains operational equipment. The rear section carries the tail unit and tail turret. For identification of formers, reference should be made to the relevant illustration in Sect. 4, Chap. 3.

Construction

2. The fuselage is of light-alloy monocoque construction, built up with transverse channel-section formers stiffened by fore-and-aft angle stringers. The framework is covered with light-alloy sheet riveted to the formers and stringers with mushroom-head rivets. The stringers are secured to the formers by small attachment brackets, the formers being cut away to allow the stringers to pass through (*see fig. 1, 2 and 3*). Between formers E and 22E, the fuselage section above the main floor level is constant; from former 22D aft, the fuselage tapers slightly in elevation, and in plan also from former 22E.

3. From the nose aft, the formers are lettered and numbered as follows: K to A (excluding I) 1 to 22, 22A to 22E, 23 to 41 inclusive. Former 1 is the first complete former in the front centre section. The sections of formers 1, 6, 9, 12 and 18 in the bomb compartment are of pressed steel.

Nose section

4. Formers E, F, G and H in the nose section of the fuselage are complete, but forward of former H the formers are cut away at the top to receive the gun turret mounting ring (*see fig. 5*). Brackets mounted on these formers carry the ring, which is also supported by a channel member running across the fuselage. Secured to this member and to former H is a draught screen having an access door. A fairing, built up in a similar manner to the surrounding fuselage, covers the space between the front turret and the draught-screen. Under the turret is the air bomber's position. The air bomber's window has a tubular framework, and comprises four toughened glass panels and eleven perspex panels. In the floor of the nose section, and partially covered by the air bomber's sliding seat (*see para. 22*), is the crew

Fuselage

entrance and parachute exit door, which is a pressed light-alloy framework covered top and bottom with light-alloy sheets. The housing for the door is formed of channel-section intercostals between formers G and J. On the port side of the floor at the rear of the nose portion is a circular window for vertical photography. Beside it on the centre line of the aircraft is the chute for reconnaissance flares (*see fig. 6 and 7*).

Front centre section

5. The front centre section comprises that portion of the fuselage between the main plane front spar and former E. An extruded member runs the full length of the section on each side and carries the transverse channel-section floor members, which, with the channel-section intercostals, form the framework of the floor (*see fig. 6 and 7*). The floor covering is light-alloy sheet. Along the top of the cut-away formers, on each side, runs the cockpit rail (*see fig. 1*), an inverted U member. The bomb bay walls comprise the skin, stringers, and short formers below the floor, and the bottom edges consist of two extruded channels which support the bomb door hinges.

6. The extreme front and rear formers of the front centre section, E and 6 respectively, are angle members which form the joints with the other sections, and a bulkhead below the floor level at former E divides the bomb compartment from the nose.

7. Three bomb gear housings are fitted between bomb beams B and C, and three between beams 3 and 4, in the main floor. Each of these latter beams is supported for the carriage of heavy bombs by a vertical tie-rod, bolted at the lower end to the beam, near the centre line of the fuselage, and at the upper end to the top of the fuselage former, which is locally reinforced. Cross channels are fitted between the bomb beams and are braced together by light-alloy intercostals.

8. The first pilot's floor is a raised platform on the port side in the front of the cockpit, built of fore-and-aft channel members with intercostals between, and covered with light-alloy sheet on both upper and lower surfaces. On the port side it is attached to the formers and on the starboard side it is supported from the main floor on a braced frame of channel members.

Intermediate centre section

9. The intermediate centre section of the fuselage is built on the front and rear spars of the main plane (*see fig. 2*). The section is uniform throughout and of similar construction to the front centre section except that the floor is deeper and the construction of the front and rear formers is different. These formers are constructed of two angles riveted to an extension of the spar web to form a channel section.

10. A draught-proof bulkhead at former 8 is hung on a central post which also serves as a tie-rod supporting the main floor in the vicinity of the bomb gear housing. The door and the surrounding panels are made of plywood.

11. Between bomb beams 8 and 9 there are three bomb gear housings, the outer two being of standard type and the centre one designed to carry an R.A.E. heavy bomb slip unit.

Rear centre section

12. The rear centre section comprises that portion of the fuselage between the main plane rear spar and former 27. The bomb compartment ends at former 22, and aft of former 22D the fuselage tapers in plan and elevation. The construction aft to former 22 is similar to that of the front centre section (*see fig. 3*). The section of former 22 below the main floor is formed into a bulkhead for the end of the bomb compartment.

13. Six bomb gear housings are fitted into the floor, three between bomb beams 13 and 14, and three between beams 18 and 19. The three housings between beams 13 and 14 are strengthened in a manner similar to those between beams 3 and 4 in the front centre section (*see para. 7*).

14. The dorsal turret is supported in a mounting ring attached to a deck plate. This plate is stiffened by a hexagonal structure consisting of two longerons and four intercostals. The longerons and the apex of the intercostals

Fuselage

are fixed to formers 19 and 22, which are stiffened by arch members and cross members (*see fig. 5*).

15. In the floor of this section is a circular hole (*see fig. 6*). When this is not used for fitting special equipment it is filled with a wooden hatch. Formers 22C and 22D are cut away at the bottom to accommodate the ring frame (*see fig. 3*).

Rear section

16. The rear section, which is the portion aft of former 27, tapers in plan and elevation in continuation of the rear end of the rear centre section (*see fig. 3*). The fuselage ends at former 41, and from this a tubular framework projects to support the tail gun turret mounting ring (*see fig. 5*). A detachable fairing fits under this framework and forms the tail of the fuselage below the turret. Where the tail plane enters the section between formers 35 and 38, the skin, formers and stringers are cut away. Below this in the centre of the floor is fitted the tail wheel mounting beam, which is a built-up structure (*see fig. 9*). Between formers 29 and 31 on the starboard side, hinged on the leading edge and opening inwards, is the entrance door for the dorsal and tail gunners. Aircraft incorporating Mod. Lanc. 1205, have a metal door, with light-alloy stiffeners and skins; others have a wooden door with spruce stiffeners and ply-wood panels. A rubber retaining spring is provided to hold the door open. A wooden walkway over the tail plane leads to the rear turret, which is separated from the cabin by a pair of wooden draughtproof doors.

17. Immediately opposite the main cabin door, and on the port side of the aircraft, is a chute for photo-flash flares.

Bomb doors

18. The bomb doors form the lower surface of the fuselage between formers E and 22. They are of light-alloy construction built up from a central spar, with nose and main ribs tapering in each direction, and with special hinge and edge extruded channels. The spar is made up with T-section extruded flanges connected by a sheet web having flanged lightening holes. The main nose and end ribs are pressings, flanged for the attachment of the inner and outer skins of light-alloy sheet (*see fig. 8*). The hydraulic jack attachment at each end consists of a trunnion mounted in ball bearings between the two end ribs. Each door has seven ball bearing or "oilite" bush hinges: one central datum hinge, four intermediate hinges, and two end hinges, all attached to the hinge beam at the lower edge of the bomb compartment wall. Between the hinge bearings a curved sealing strip maintains the seal as the doors move. To seal the joint between the doors when closed, a spruce strip is attached to the projecting flange on the edge channel of the port door, and a brush sealing strip is similarly attached to the starboard door.

Canopy

19. A transparent canopy covers the cut-away portion of the front centre section forward of former 1, and is faired into an astrodome at former 5. The windscreen at the front is supported by a diecast frame, to which is bolted a welded steel tubular structure (*see fig. 4*), extending aft to former 1. The remaining portion of the frame is built up of spruce. An inward-opening direct-vision window is fitted in each side of the windscreen. In each side, at the forward end of the canopy is a sliding window and in the roof, just behind the pilot's chair, there is an emergency exit (*see Sect. 2*). Just forward of the dome is a streamlined blister to accommodate the D.F. loop aerial mounted between formers 2 and 3.

Seats

20. ***First pilot's seat.***—This is a box-type (*see fig. 10*) with a tubular framework. It is mounted in a tubular underframe, and is adjustable for height by a lever at the left-hand side which turns the short levers on the ends of which the seat is mounted. A stud on the hand lever engages with a notched quadrant in the underframe and locks the seat in the required position. The stud can be released by pressing a spring-loaded button on the end of the lever. Armour plate is fitted on the back of the seat, and above the seat behind the pilot's head.

Fuselage

21. ***Second pilot's seat.***—The second pilot's seat is a folding structure supported on the starboard side of the fuselage (*see fig. 10*). The seat itself is built on a plywood base padded with sponge rubber. The base is stiffened by two inverted U-section members on to which two bearer tubes are welded. A support frame at the outer edge of the seat holds it in a horizontal position and, when the seat is folded vertically upwards, this frame slides in a slot in the seat support members. The back rest is a strap of canvas webbing, bolted to an eyebolt on the cockpit rail, and hooked to the first pilot's seat. The attachment is unhooked from the first pilot's seat when the seat is stowed so that the backrest can be folded down the back of the seat. A tubular footrest is fitted in sliding bearings on the underside of the pilot's floor, and when not in use can be slid beneath the pilot's floor.

22. ***Air bomber's seat.***—The air bomber's seat is similar in design to the first pilot's seat (*see para. 20 and fig. 10*). It employs the same underframe, but the seat box is not strengthened by a tubular frame, and there is no armour plate. The seat is mounted in a sliding frame running in guides on the floor, and is locked in position by plungers which enter holes in the guides. The plungers are raised to release the seat by depressing knobs at the forward ends of the slides. The seat is pushed forward to clear the parachute exit (*see Sect. 2*).

23. ***Navigator's seat.***—This is a bench-type seat mounted in the front centre section against the navigator's table. It is supported by 3 tubular legs with three feet each, and can be tilted, if necessary, to give more space in the gangway behind it.

24. ***Wireless operator's seat.***—The wireless operator's seat is integral with the cover over the front spar and has a padded seat and back rest (*see relevant illustration in Sect. 5*). Under the light-alloy panelling it is supported by a tubular framework.

Navigator's table

25. The table for the navigator and wireless operator is constructed from plywood and spruce members, and is bolted to formers A, 1, 2, 3 and 4 on the port side. At the rear inner edge, it is bolted to the vertical tie-rods; at the front end it is supported by a tubular leg, and a support tube for a wireless receiver. Part of the top is hinged to give access to a map compartment for the navigator and at the rear end there is a hinged flap which allows the wireless operator access to a stowage. Attached to the underside of the table are stowages for two R.F. units.

P7410 M /G141 5/45 1050 C & P Gp. 1

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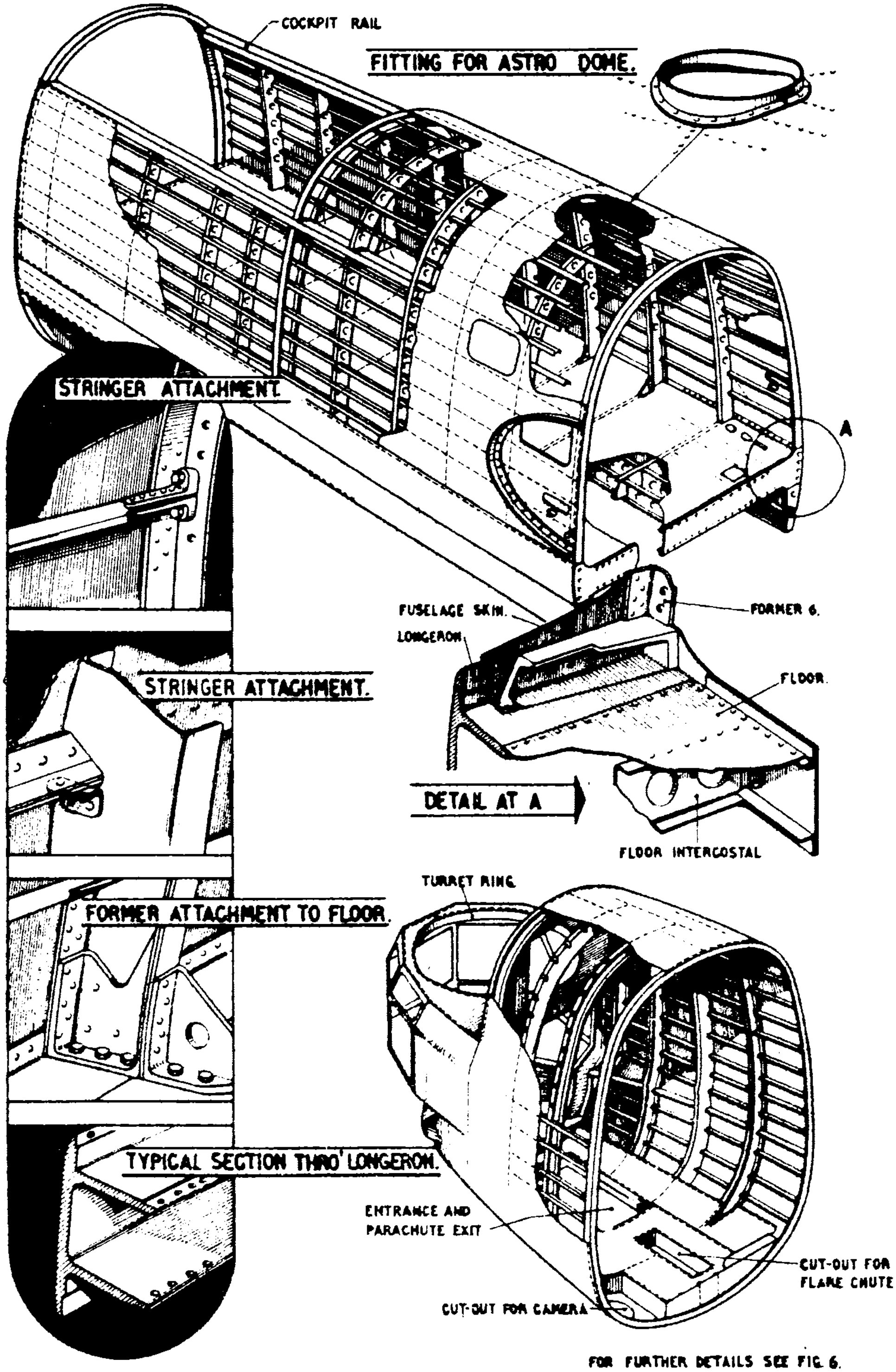

FOR FURTHER DETAILS SEE FIG. 6.

FIG. 1 — FUSELAGE SECTIONS (1) — FIG. 1

PP3639 M /G142 4/45 1050 C&P Gp. 959 (4)

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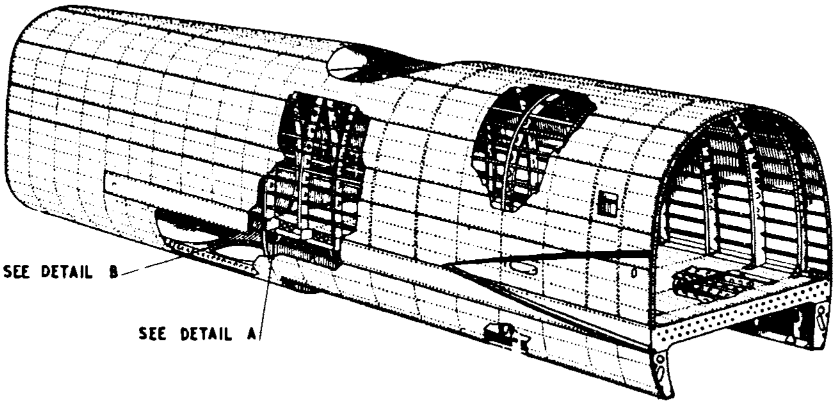
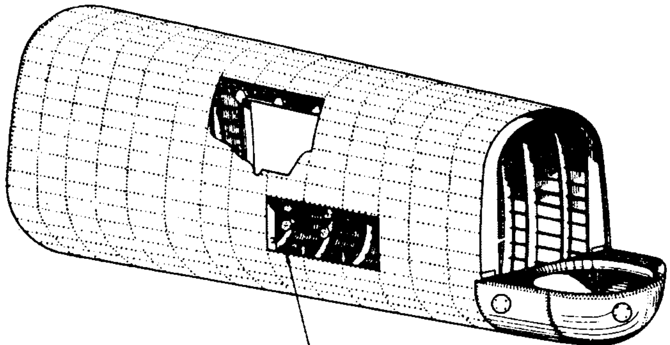
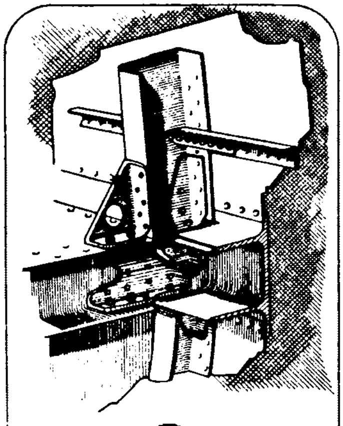
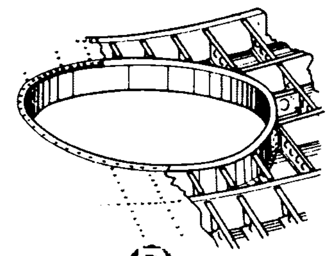






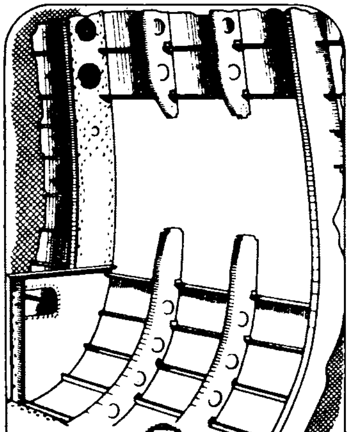
A

DETAIL OF FLOOR JOINT AT FORMER 22



B

DETAIL OF RING IN REAR CENTRE SECTION FLOOR



C

DETAIL OF STRUCTURE FORMERS 35 TO 38

FIG. 3 — FUSELAGE SECTIONS (3) — FIG. 3

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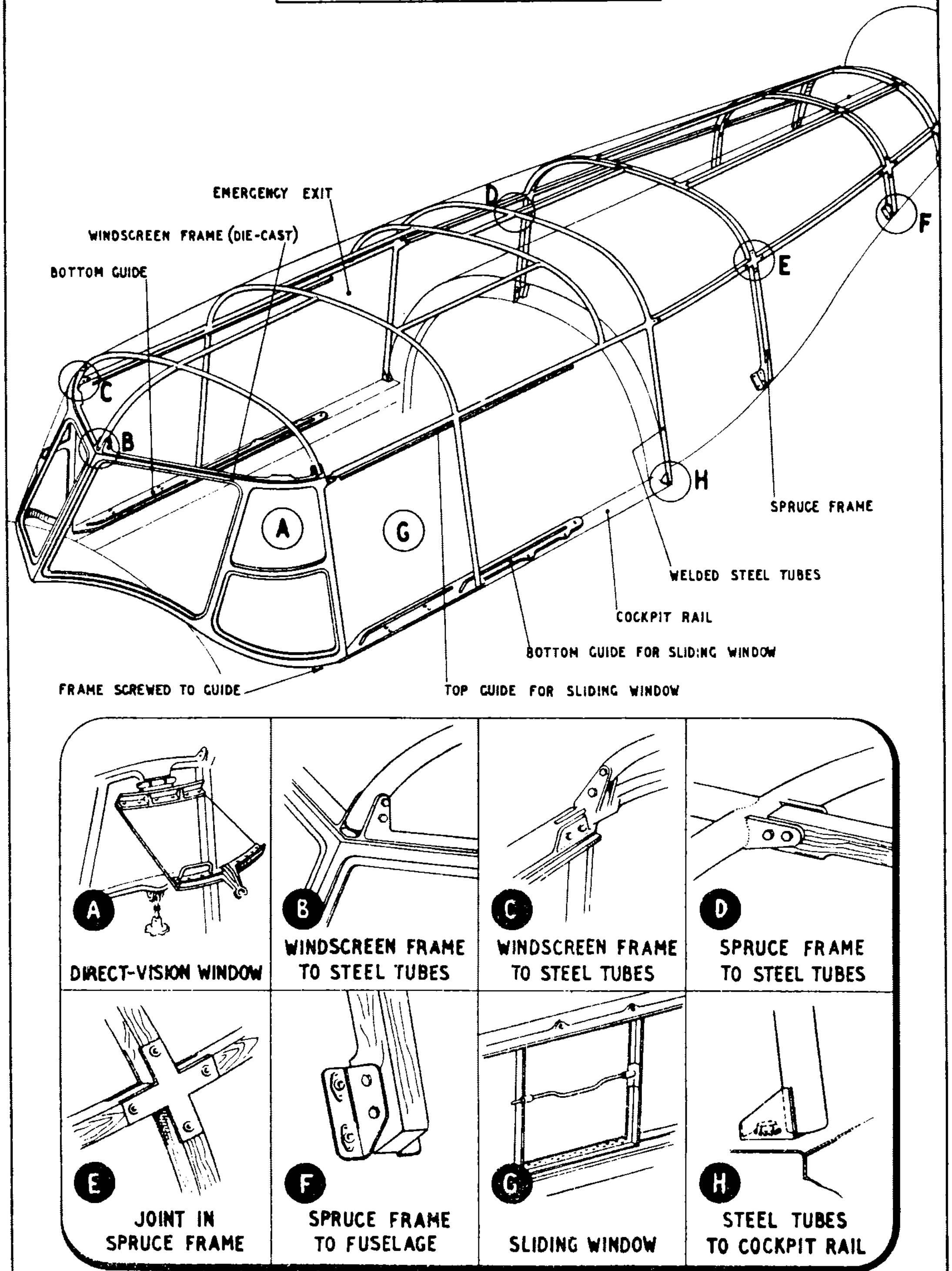

FIG. 4 CANOPY FIG. 4

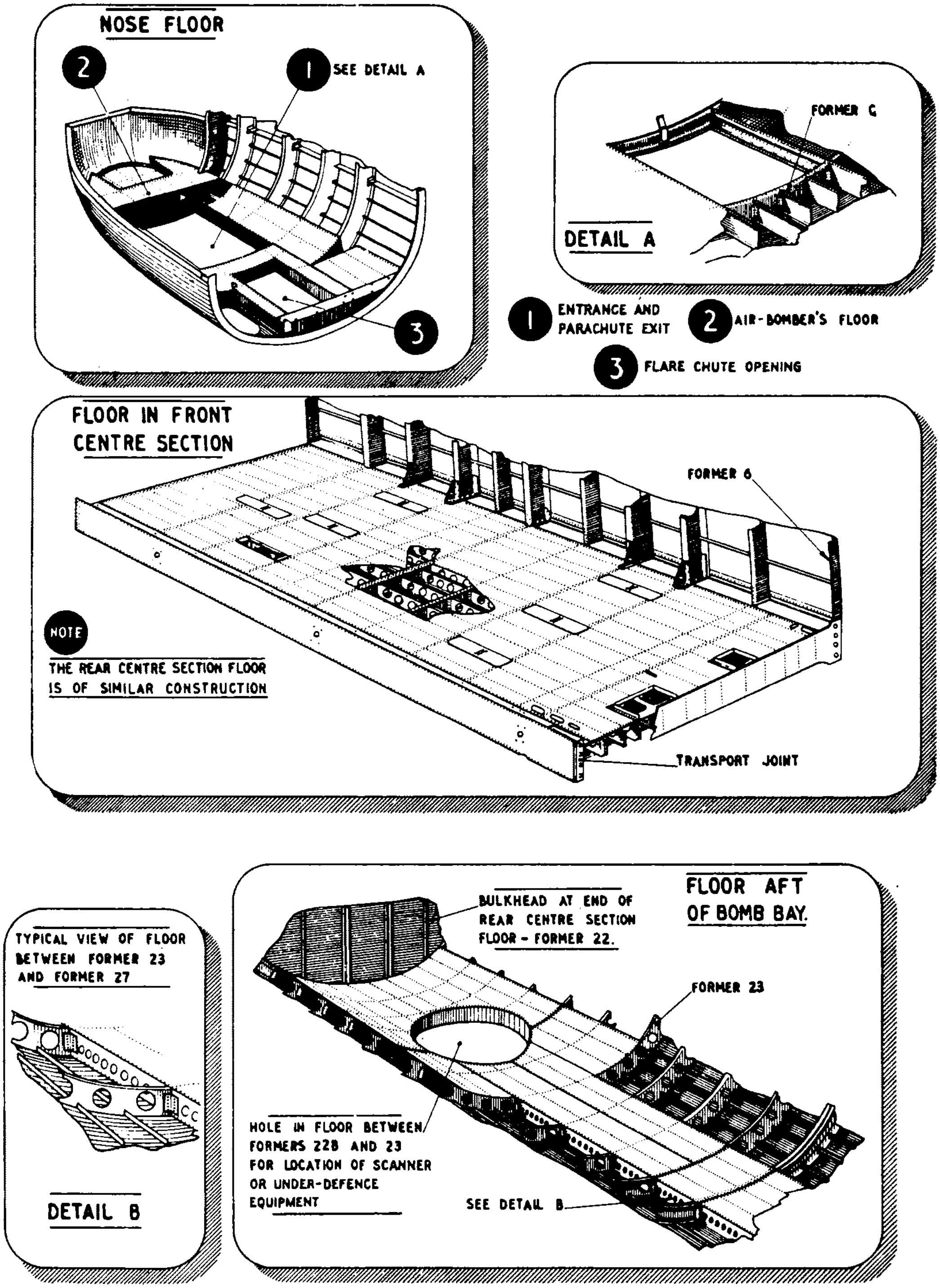

FIG. 6 — FLOORS — FIG. 6

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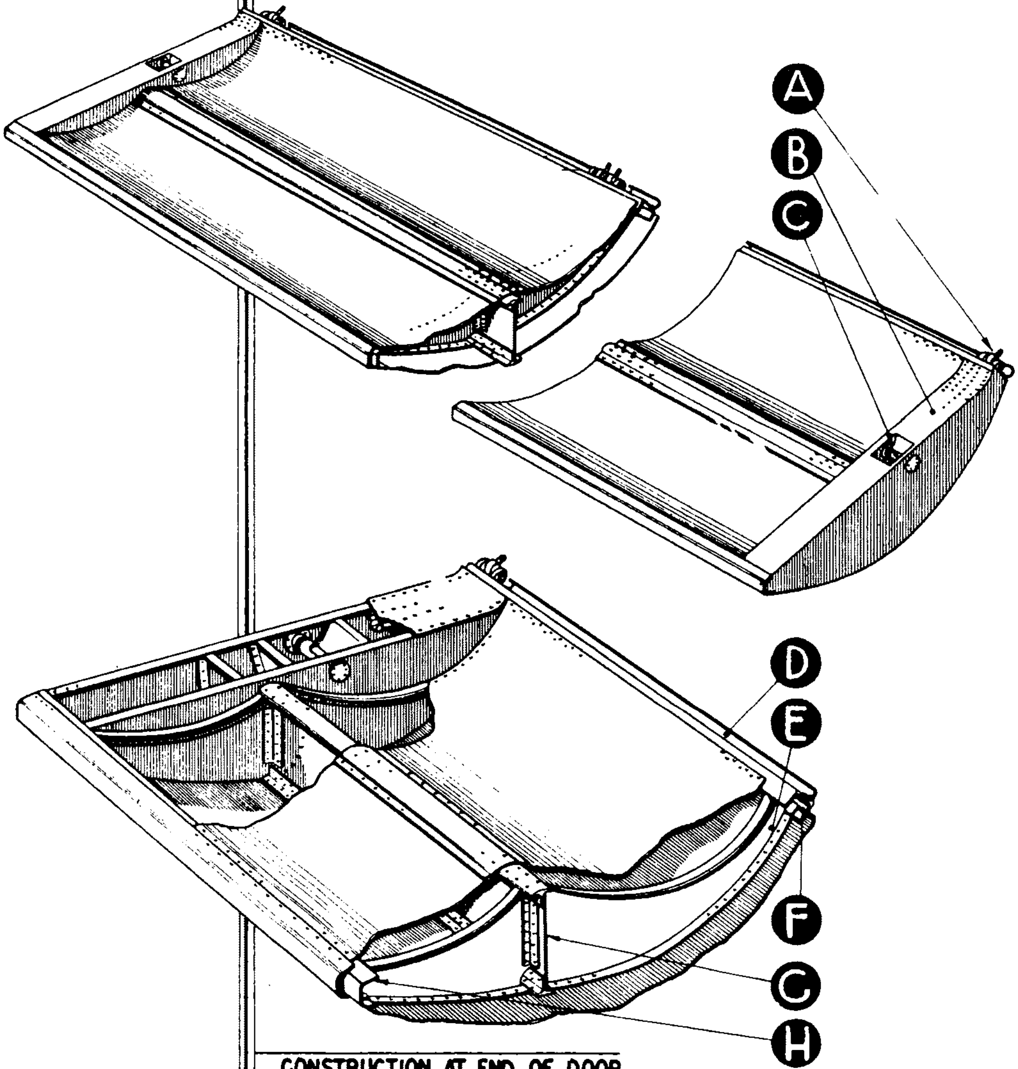
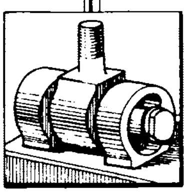


CONSTRUCTION AT END OF DOOR



VIEW OF HINGE A

B BOMB DOOR END RIB
C JACK ATTACHMENT
D SEALING STRIP
E INTERMEDIATE RIB
F HINGE CHANNEL
G BOMB DOOR SPAR
H EDGE CHANNEL

FIG. 8 BOMB DOORS FIG. 8

REPRINT PP4029 M /G2287 10/45 1050 C & P Gp. 959(4)

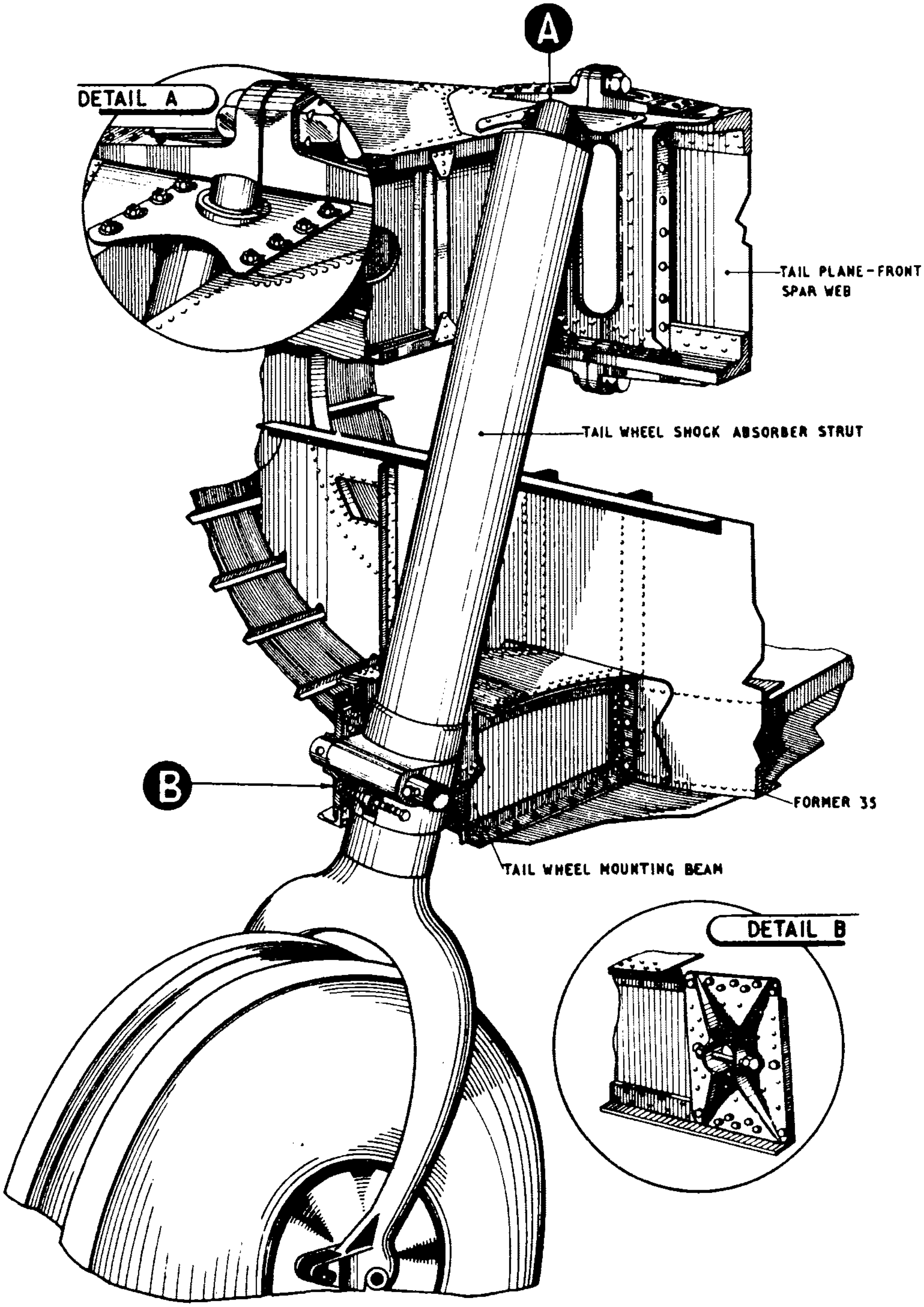


FIG 9 TAIL WHEEL MOUNTING IN FUSELAGE. FIG 9

PP4029 M /G2287 10/45 1050 C&P Gp. 959 (4)

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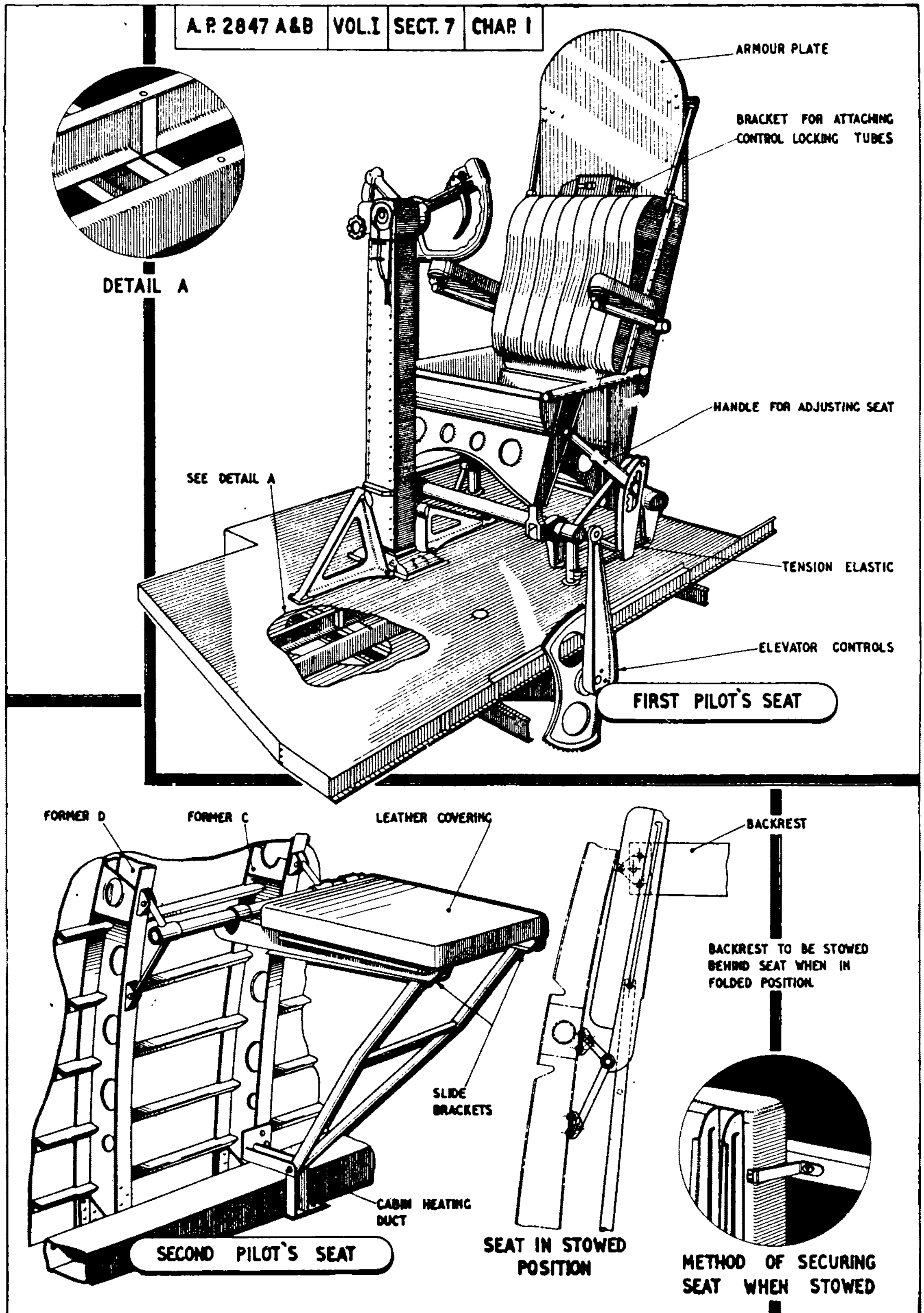

FIG. 10 PILOTS' SEATS AND ATTACHMENTS FIG. 10

REPRINT PP4029 M /G2287 10/45 1050 C & P Gp. 959(4)

CHAPTER 2

MAIN PLANE

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

General

1. The main plane is a cantilever member, with a centre section integral with the intermediate centre section of the fuselage, and intermediate and outer sections which taper outboard on both leading and trailing edges. Dihedral is confined to the intermediate and outer sections. Wing tips are semi-circular in plan, and the wing tip trailing edge is detachable. The basis of each section is formed by front and rear spars, separated by ribs which determine the aerofoil contour. The centre plane has transverse stringers. All sections have light-alloy plating attached to the spars and ribs and, in the case of the centre plane, to the stringers as well (*see relevant illustrations in this Section and in Section 5*).

2. Manufacture, assembly and transport are facilitated by the division of the main plane into sections; structural components are bolted together and flying control members hinged to the related components. These sections consist of:—

(i) Centre plane with trailing edge and hinged leading edge.

(ii) Intermediate plane, port and starboard, each with a trailing edge bolted to the rear spar.

(iii) Outer plane, port and starboard, with detachable wing tip.

(iv) Ailerons, built up of inner and outer sections each side, and hinged to extend across part of the trailing edges of the intermediate and outer planes.

(v) Inner and outer flaps, port and starboard, hinged to the trailing edges of the centre and intermediate main plane sections.

3. A total of six fuel tanks is carried between the spars of the centre and intermediate planes; one tank in each side of the centre plane and two tanks in each intermediate plane. Balloon barrage cable cutters are inset in the reinforced leading edge of all sections.

Spars

4. ***Spar booms.***—The spars consist of top and bottom booms to which heavy-gauge, light-alloy webs are attached with the boom innermost. The booms are light-alloy extrusions.

5. The four booms for the centre plane are milled away at intervals, but full cross-sectional area is left at the ends and at the points of attachment to fuselage formers 6 and 12. Inside the fuselage the top booms have steel plates attached at one edge, these plates being supplemented by light-alloy bars.

Main Plane

The ends of the booms also have steel plates, secured by set screws, to provide reinforcement at the point where the joint pins are fitted and offering a machined face for fitting the intermediate plane attachment shackles (*see Sect. 7, Chap. 1, fig. 2*).

6. Intermediate plane booms are milled at their inboard ends, forming a channel section; the booms are milled away to angle section further outboard, but regain full cross-sectional area, and are supplemented by steel plates, both ends where the joint pins engage.

7. The thickness of the spar booms in the outer plane is consistent but the width decreases progressively towards the outer end; the inboard end is stepped up in width to accommodate the joint pin holes and strengthen that area. The ends of the rear spar booms are contoured to the tip.

8. ***Spar webs.***—The web plates form a total of eight contiguous sections, front and rear, with ends abutting and linked by joint plates. Each centre section spar has one web on either side of the aircraft centre line, joined by front and rear plates; the intermediate plane spars each have two web plates connected by riveted joint plates, and one web is used for each outer plane spar. The front spar of the outer plane has a pressed light-alloy tip outboard, conforming to the contour of the wing tip. Attachment of the web to the centre-section top front boom and to both rear booms is by double-ended studs. The trailing edges are attached to the projecting shanks of the rear spar studs.

9. ***Spar joints.***—Each of the four spar assemblies has four joints (*fig. 2*). The joint is made by assembling the boom ends with high-tensile joint pins through reamed holes in the booms and through steel shackles fore and aft of each boom, completing the assembly by the addition of joint plates bolted to the adjacent webs.

10. ***Rib numbering.***—The numbering of the ribs is not straightforward, the centre plane numbers being independent of those of the ribs in the intermediate plane and outer plane. *(For details see Sect. 4, Chap. 3, fig. 5.)*

11. ***Nose portion.***—The hinged leading edge of the centre plane is described in para. 24. All other nose ribs are similar in design; they are of pressed light-alloy sheet, and each has a large flanged lightening hole in the centre. The outer flanges are cut away in places to receive the T-section stiffeners behind the B.B.P. plates.

12. ***Centre portion.***—Between the spars there are two types of rib (*fig. 1 and 2*). The majority are of pressed light-alloy, having lightening holes with pressed flanges, and stiffening flutes. These ribs are riveted to attachment angles on the spar webs and, except where two ribs are assembled together, the flanges to which the skin is riveted are inboard. The ribs at both ends of the intermediate plane and the inboard end of the outer plane are of channel-section, girder construction.

13. Engine ribs are of girder type, built up from deep channel-section members secured at the joints by gusset plates, and are bolted to the spar booms and webs. Other girder-type ribs are of channel section, but of lighter construction. The inner of the two inboard engine ribs has a web riveted to it (*fig. 1*).

14. The centre plane tank ribs are of box formation built up from light-alloy webs separated by diagonal stiffening channels. Reinforcing strips are riveted to the lower flanges which are shaped to receive the nose and top of the tank. The rib webs are cut out for the top-hat-section stringers on the top centre plane skin.

15. The intermediate plane tank ribs are similar to the ribs described in para. 12, except that they are made in three pieces. The front and rear portions are riveted to angles on the spars, and the gap between them is spanned by shallow channels riveted to the ends. The upper flanges of these ribs are riveted to light-alloy sheets which form the floors of the fuel tank compartments (*fig. 2*).

16. The three ribs outboard of the outer wall of the outboard tank compartment are of pressed light-alloy sheet with flanged lightening holes, but have rib booms top and bottom which are bolted to angles themselves

Main Plane

bolted to the spar booms (*fig. 4*). Between the rib booms are vertical top-hat stiffeners, on the outboard side of the rib, and spaced between the lightening holes. The web is riveted to angles on the spar webs.

17. The light intermediate ribs outboard of the outer tank, between the main ribs, are manufactured from light-alloy shallow channels top and bottom, stiffened by vertical flutes and bolted at the ends to the spars, with the flanges inboard. Reinforcement between the flanges is provided by top-hat-section stiffeners riveted to the bottom of the channels on the outboard side.

18. Ribs 1 and 14 have deep channel members top and bottom, bolted at the ends to the spars, and with a web of light-alloy sheet stiffened by top-hat members of the same material (*fig. 2*).

19. ***Trailing portion.***—The trailing portions of the ribs (i.e. behind the rear spars) are of pressed light-alloy sheet, with lightening holes and stiffening flutes (*fig. 5*).

Centre plane

20. The fuselage centre section is integral with the centre plane, and the front and rear spars have additional web plates bolted to them in the middle to form the fuselage transport joints at formers 6 and 12. The longerons of the fuselage floor are attached to these formers. Shoe brackets connect the spar booms, formers, and skin; the fuselage shell is built up of formers, stringers and light-alloy skin mounted to the floor structure (*see Sect. 7, Chap. 1*). Angles are secured to the outside of the fuselage skin. The skin forming the plating over the centre tank bays is also part of the aerofoil surface for the centre section wing and is riveted to those angles. The front spar has additional strengthening plates as described in para. 6.

21. Each inboard engine rib has a light-alloy web on the inboard side forming the outer end of the fuel tank compartment; the fuselage skin forms the inner ends. Each detachable fuel tank is secured by five steel straps to the tank ribs; the hinged ends of these adjustable straps are attached to brackets on the front and rear spars.

22. In the bottom surface of the centre plane are two large doors for access to the fuel tanks (*fig. 3*). The doors are stiffened by light-alloy top-hat stiffeners.

23. Outboard of the fuel tank compartments are the engine nacelles which also house the main landing wheel units when retracted. The forged light-alloy undercarriage beams on which both undercarriage and engine sub-frames are mounted are bolted on the forward side of the front spar through the spar booms. The spars are here braced together by two engine ribs as described in para. 13. Two intermediate ribs between the engine ribs support the top skin.

24. ***Hinged leading edge.***—Hinged to the top boom of the front spar by a piano hinge is the leading edge. It consists of C-shaped pressed light-alloy ribs covered with light-alloy skin and three T-section stiffeners running from end to end. The forward contour is strengthened by a heavy-gauge light-alloy plate containing balloon barrage cable cutters. The leading edge is slotted at the lower edge, to engage studs on the front spar bottom boom, and is supported by a channel-section nose rib at the engine nacelle.

25. There is a faired opening in the starboard leading edge for the cabin heater inlet duct, and a fairing on the underside covers the by-pass outlet duct.

Intermediate plane

26. The intermediate sections differ from the centre section in that they have no stringers. The outboard engines and sub-frames are underslung from the front and rear spars. In each wing between the spars are two fuel tank compartments, one either side of the engine.

27. The spar web is split just outboard of the outboard engine rib (rib 8) and the two parts are riveted to joint plates. Outboard of the outer tank compartment there are three ribs of pressed light-alloy (*see para. 16*) and the end rib is of light girder construction (*see para. 13*). Between these are eight light ribs (*see para. 17*). Rib 14B has a section cut out of the bottom boom which is attached to

Main Plane

an intercostal between ribs 14A and 15. The top and bottom rib booms at this point are interconnected by a vertical channel.

28. ***Engine sub-frame attachment.***—Heavy-gauge steel channels bolted to the front spar form the two front pick-up points for the engine subframe, and the rear attachment is to two heavy-gauge steel channels on rib 7A. The engine ribs (i.e. ribs 7 and 8) and this intermediate rib are all of girder construction between the spars (*see para. 13*). The two engine ribs, in addition, have light-alloy webs stiffened by vertical top-hat sections, and form the ends of the fuel tank compartment.

29. ***Fuel tank compartments.***—The ribs at the other ends of the tank compartments, i.e. ribs 1 and 14, are both built up of deep light-alloy channels top and bottom, bolted to the spar booms. To these channels are riveted light-alloy webs stiffened by top-hat section stiffeners. The tank ribs are alternarively single and double. The double ribs consist of two single ribs back-to-back (*see para. 15*). To the top of these ribs is riveted a flooring of light-alloy sheet (*fig. 4*).

30. ***Fuel tank access doors.***—There are two doors, in the top surface of the intermediate plane, which give access to the fuel tank compartments. They are built on a rectangular frame with formers and intercostals to which are riveted two skins with hand-holes and filler access panels.

31. ***Leading edge.***—The nose ribs are of pressed light-alloy with large flanged lightening holes, and are attached to angles riveted to the front spar web. Two T-section stiffeners strengthen the leading edge which has heavy-gauge light-alloy plating at the nose, and is fitted with four balloon barrage cable cutters. Alternate ribs inboard of the engine nacelle have light mounting channels for control rods and fairings.

Outer plane

32. The outer section of the main plane contains no equipment except a balloon barrage cable cutter and wing-tip navigation lamps. The inboard rib, No. 19, is of light girder construction (*see para. 13*) and the rest are of pressed light-alloy (*see para. 12*). The flanges of the ribs are inboard except at ribs 22 and 33 which are double ribs. Rib 40 has no lightening holes, being stiffened by flutes. The extreme wing tip is a large U-section curved to the contour. The trailing section of the tip is detachable, and built up of ribs without flutes and a U-section trailing edge. In this section is an acetate housing for the identification lamps, and three access panels. The nose ribs are of pressed light alloy with a large flanged lightening hole. Two stiffeners reinforce the nose which incorporates a balloon barrage protector plate, the cable cutter being fitted between ribs 29 and 30.

Aileron

33. The aileron (*see fig. 6*) is made up of an inner and an outer section jointed by a torque shaft bolted to laminated end plates between ribs 12 and 14 (corresponding to ribs 19 and 20 of the main plane). This joint is covered, after assembly, by a light-alloy fairing attached by screws and anchor nuts. Both sections are of similar general construction, employing a main spar with top and bottom booms, light-alloy ribs, contoured nose plating and nose ribs riveted by attachment angles to the spar, a V-section trailing edge member and the whole structure plated with light-alloy sheet. The inner section has thirteen ribs and the outer section fifteen; these are numbered 1 to 28 consecutively from the inboard end, which is in line with wing rib No. 12. The four ball-bearing hinges are located between aileron ribs 4 and 5 and 11 and 12 on the inner section, and between ribs 16 and 17 and 25 and 26 on the outer section. The hinges connect to L-shaped brackets bolted to the upper surface of the main plane trailing edge. Deflector plates are fitted to the trailing edges of the inboard ends of the inner sections. A trimming tab is inset in the trailing edge, extending between ribs 10 and 13, and a balance tab is hinged to the inboard end of the trailing edge on the outer section between ribs 14 and 22. Lead mass-balance weights bolted along the inside of the nose structure of each section should be within the same limits for total weight,

Main Plane

namely $18\frac{1}{2}$ lb. $\begin{smallmatrix}+1\\-0\end{smallmatrix}$ lb. Balance discs are fitted over bolts (one $\frac{1}{4}$ in. and one $\frac{3}{8}$ in.) at each side of the forward edge of the gap formed for the operating fork and link tube. Up to twelve discs may be added to each section, for the purpose of establishing static balance (*see Sect. 4, Chap. 3*).

34. ***Trimming tabs.***—Each inner aileron carries a trimming tab at the outboard end, attached to the aileron by a piano-type hinge and with operating arm assembly riveted to the under surface. The tab is assembled from a light-alloy channel spar, five stiffening ribs and 26 s.w.g. light-alloy skin riveted to the structure. Trimming tab adjustment is controlled from a handwheel on the right-hand side of the pilot; final transmission of movement is by a screw-jack mounted in the aileron trailing edge.

35. ***Balance tabs.***—At the inboard end of each outer aileron is a balance tab of similar construction to the trimming tabs and attached by a piano-type hinge to the aileron. Operation is through the medium of a connecting rod between an eyebolt on one of the hinge brackets and a lever on the balance tab. (*For rigging instructions, see Sect. 4,. Chap.* 3).

Flaps

36. The split-trailing-edge type flaps are in three sections, the inboard section running the span of the centre plane trailing edge, with inner and outer outboard sections located under the inner portion of the intermediate plane. The flap sections are operated by push-pull tubes and connecting rods or links with a universal-joint action (*fig. 7*). The tube operating the outer sections is connected to the inner tube by two ball joints with inter-connection tube and the inner tube is connected to the flap jack piston rod by another ball-joint. The flaps spars are of inverted U-section, flanged outward at the base and riveted to the skin; the leading edge is of channel-section and the trailing edge is made from a light-alloy extrusion; between the two latter members are flanged ribs. The riveted skin covering is reinforced by corrugated sheets and the trailing edges of the ribs strengthened by a light-alloy strip riveted to the rib flange. The connecting links pivot on circlip-retained steel pins in the operating tube, and engage in high-tensile steel eyebolts which are free to make partial rotary movement in the spar. The connecting links are spaced eight for the centre plane flap, and six for the inner section and three for the outer section of the intermediate plane flap. The flaps hinge on piano-type hinges bolted to the flap leading edge channel member and to the false spar of the centre and intermediate plane trailing edges. The rear section of the inboard engine nacelle fairing is attached to the underside of the centre plane flap by bolts through the flanged edges of the nacelle fairing. (*See Sect. 4, Chap. 3 for rigging data*).

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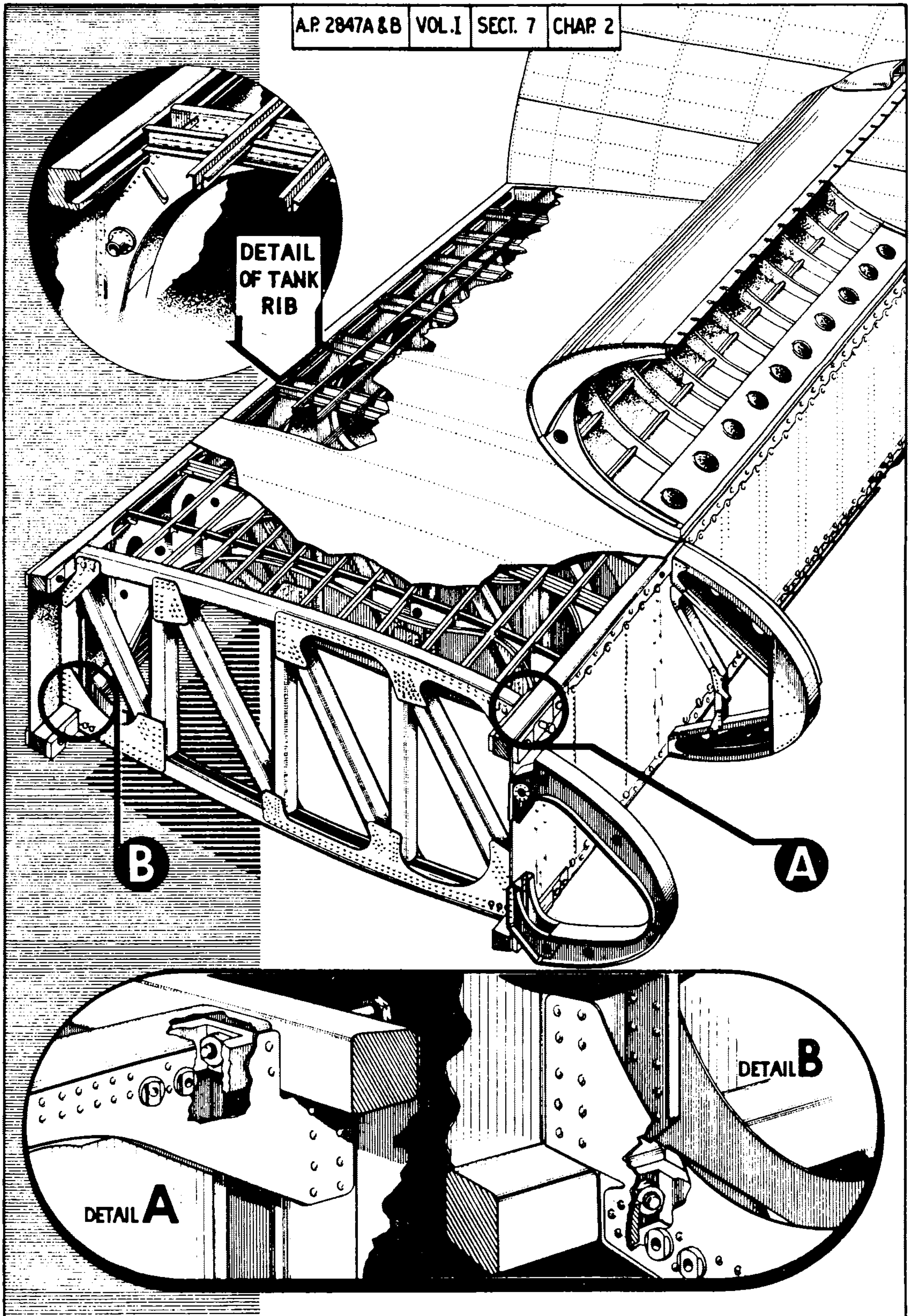

FIG. 1 — CENTRE PLANE — FIG. 1

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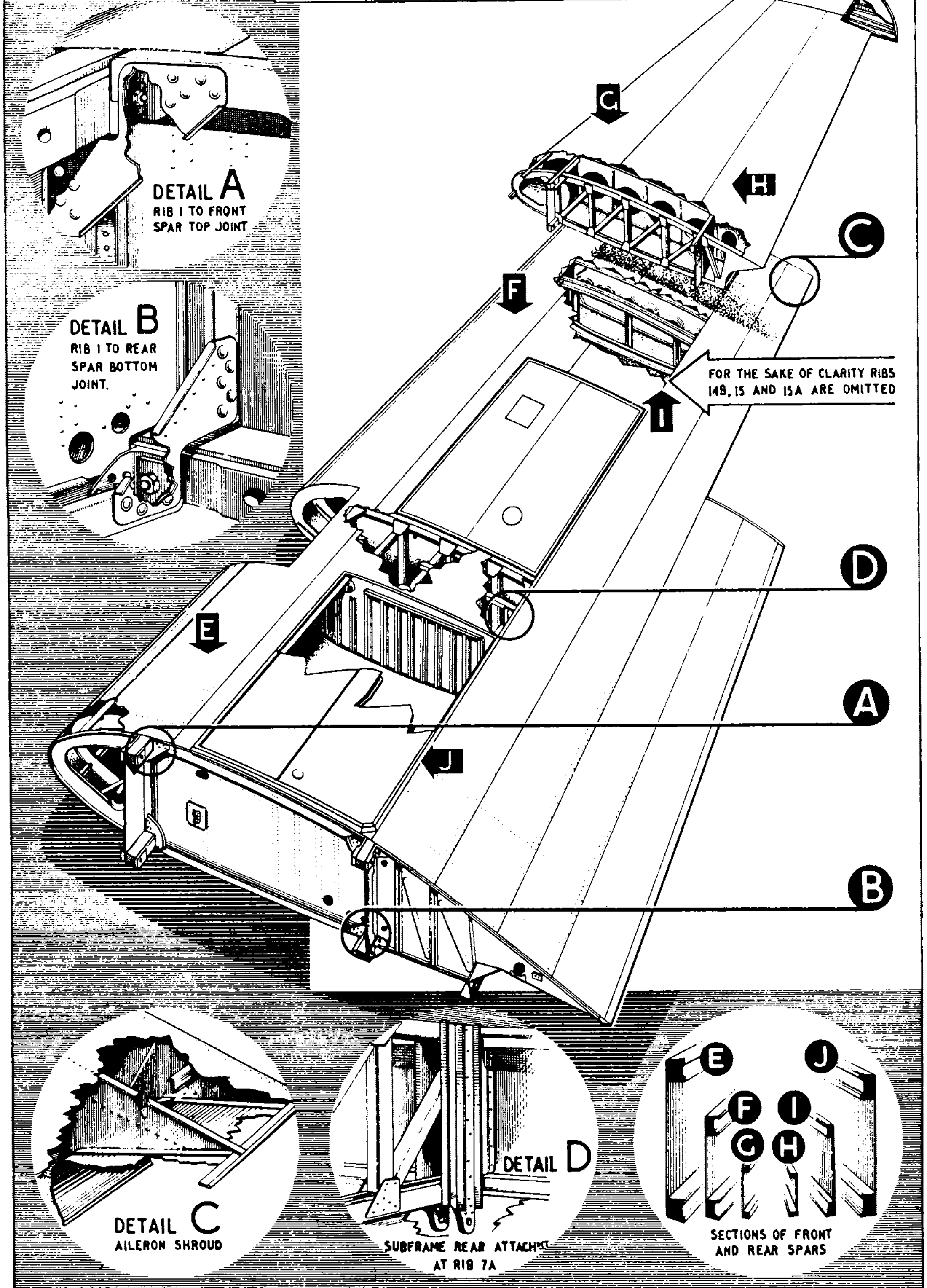

FIG. 2

MAIN PLANE

INTERMEDIATE AND OUTER SECTIONS

FIG. 2

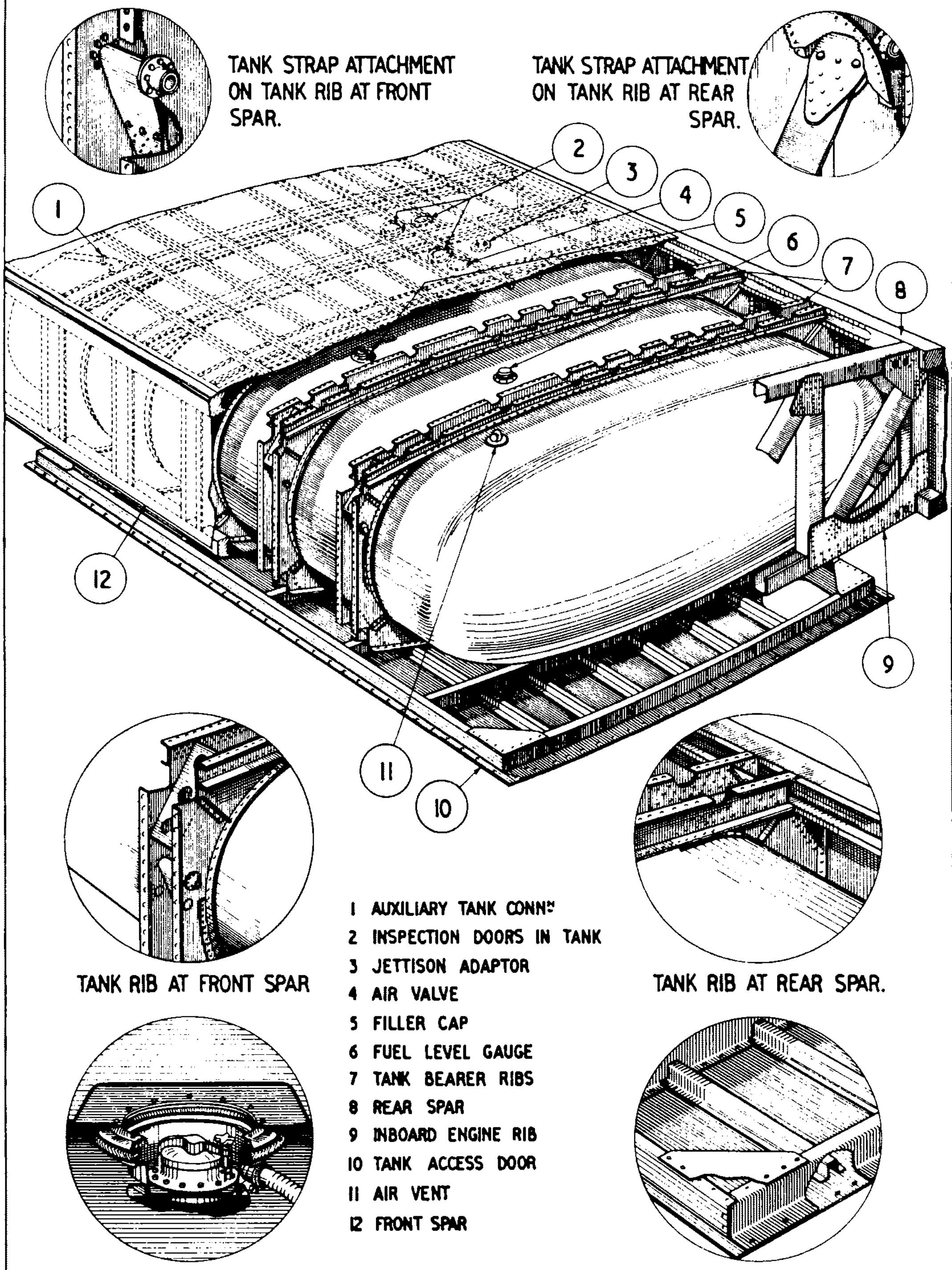

FIG. 3 — **Nº 1 FUEL TANK MOUNTING** — FIG. 3

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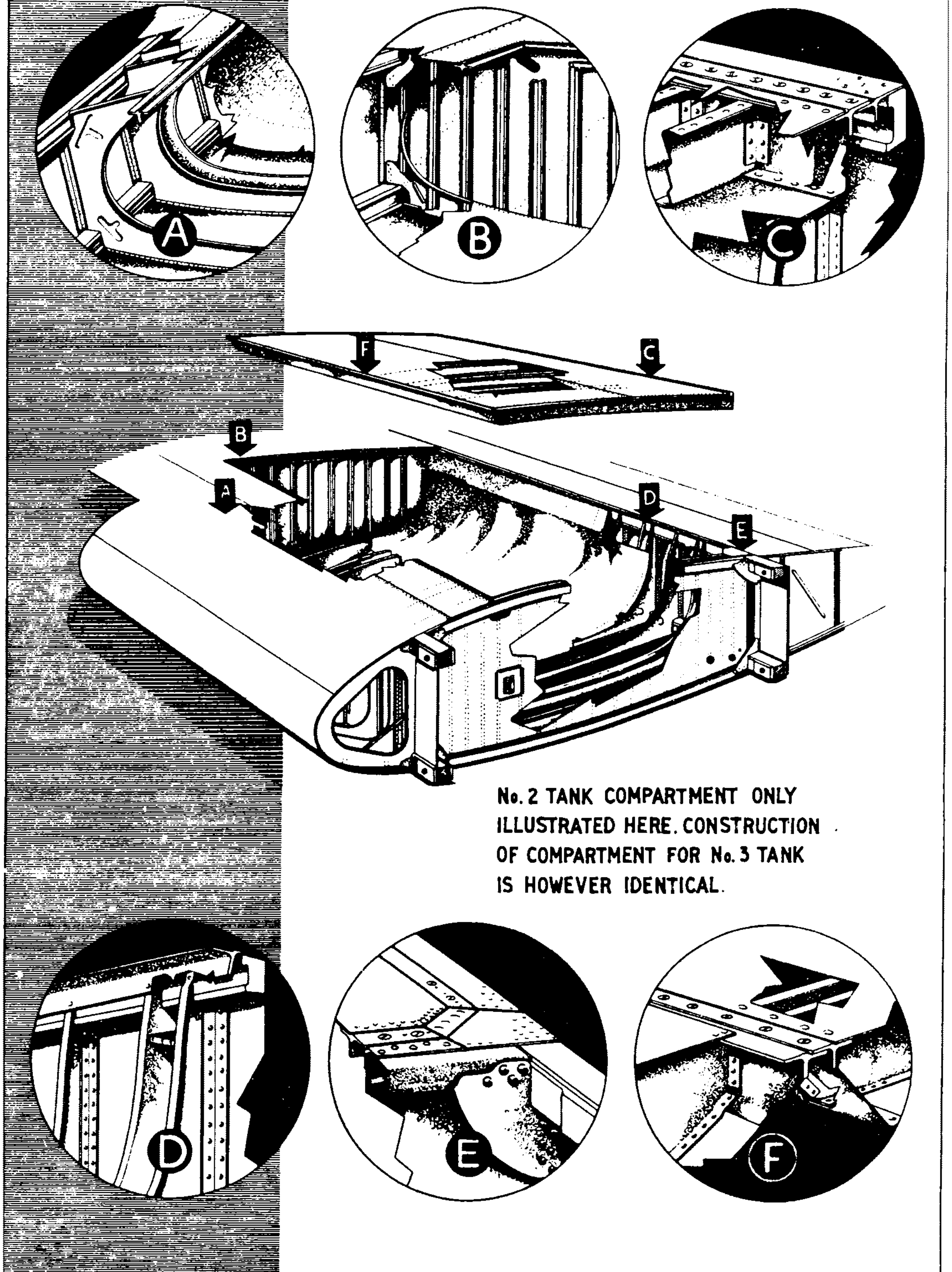

FIG 4 **No. 2 & 3 FUEL TANK COMPARTMENTS** FIG 4

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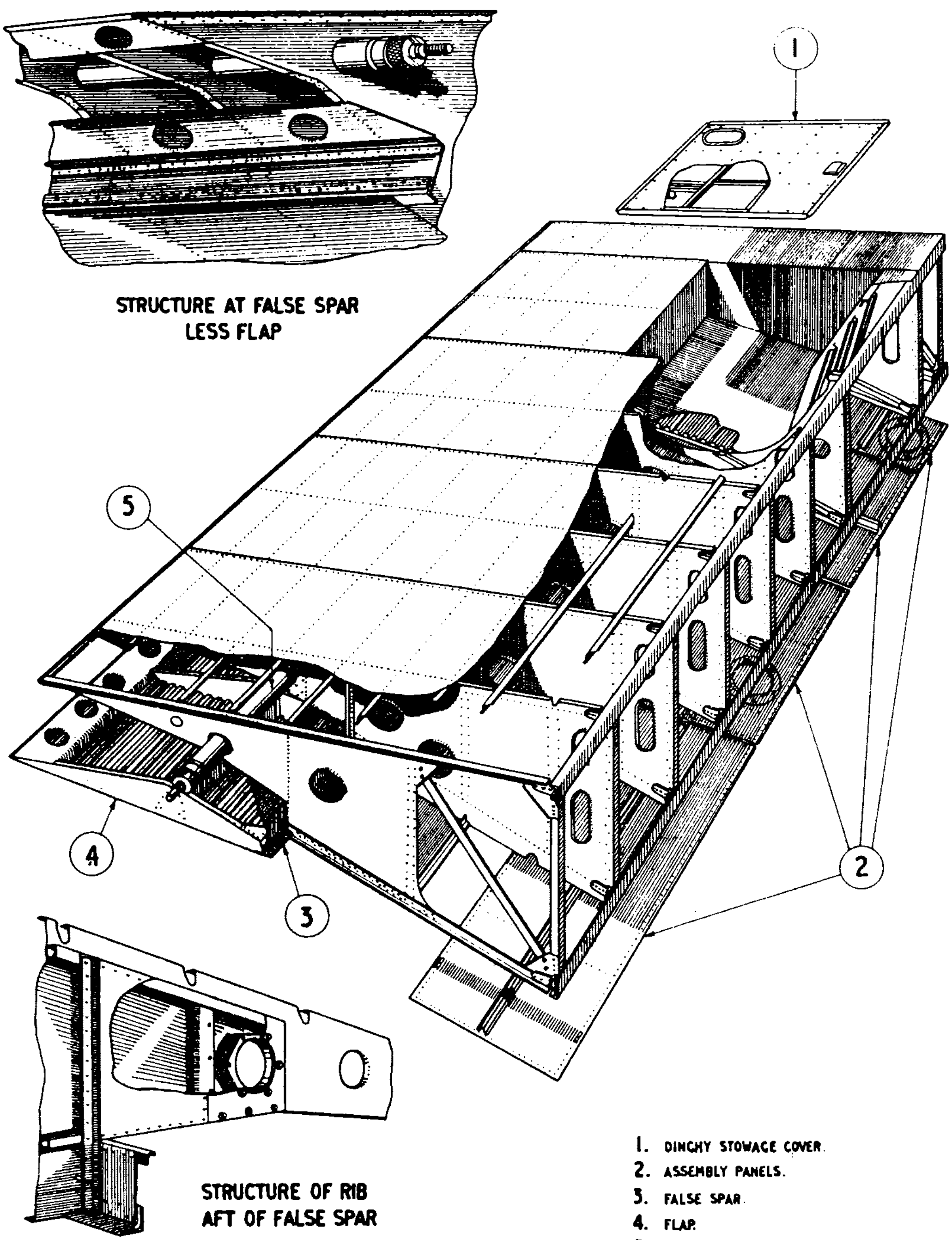

FIG. 5 MAIN PLANE - CENTRE SECTION - TRAILING EDGE FIG. 5

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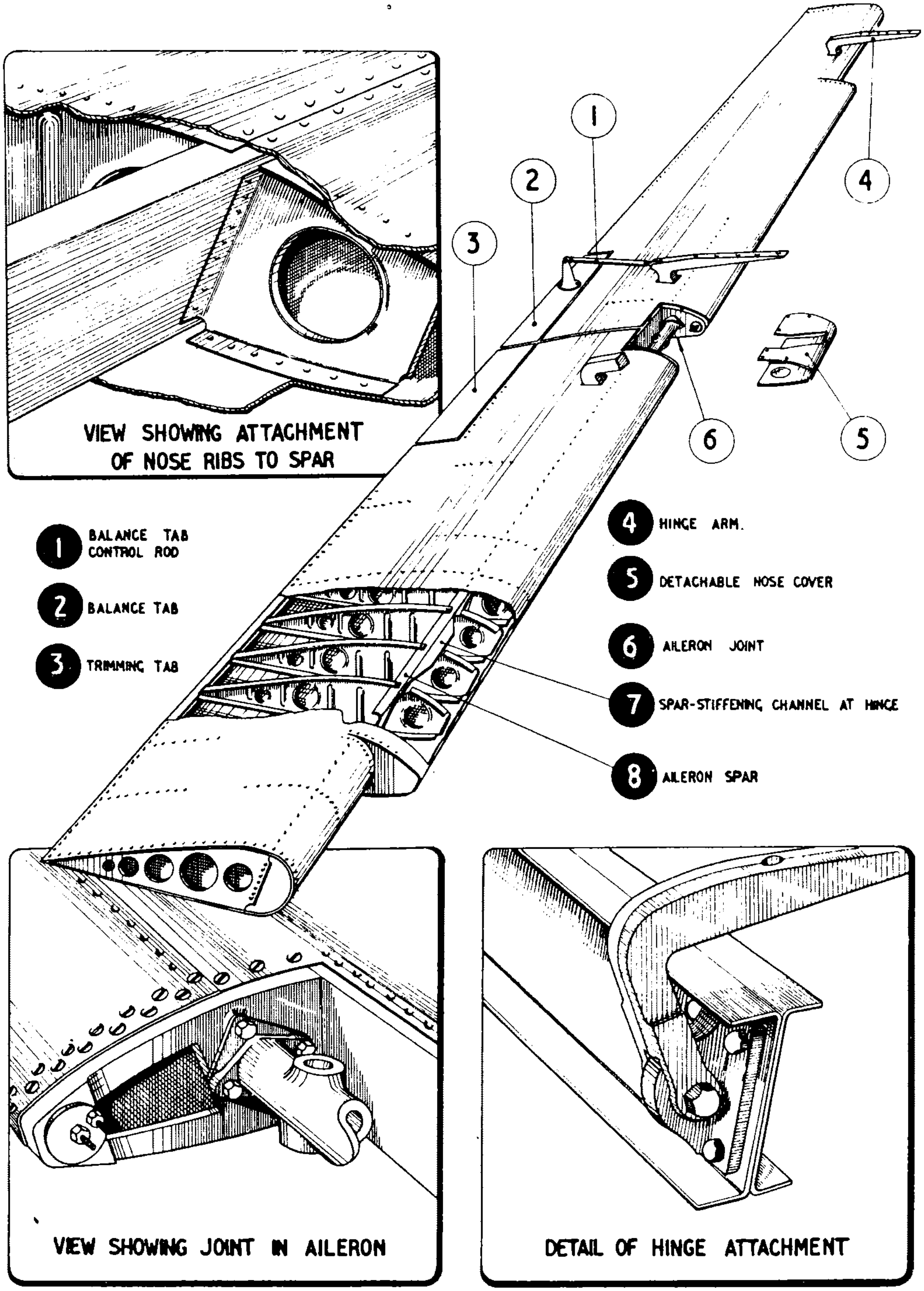

FIG. 6 **AILERON** FIG. 6

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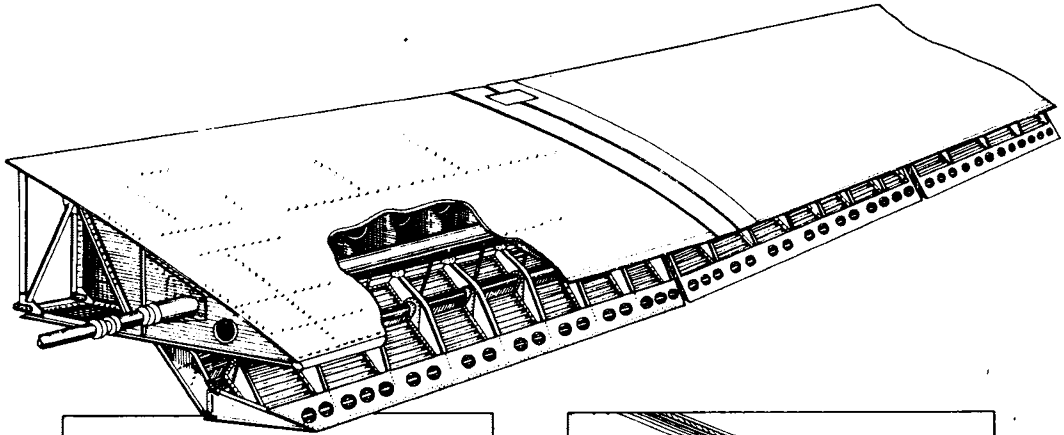
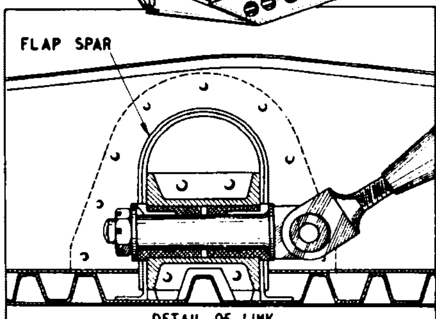
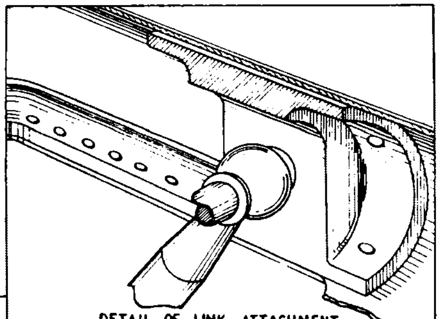
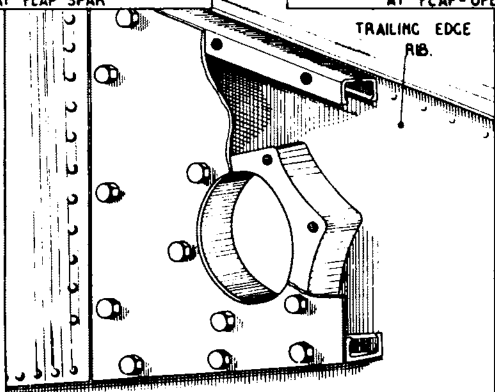




DETAIL OF LINK ATTACHMENT AT FLAP SPAR


DETAIL OF LINK ATTACHMENT AT FLAP-OPERATING TUBE



ARRGT. OF BEARING FOR FLAP-OPERATING TUBE

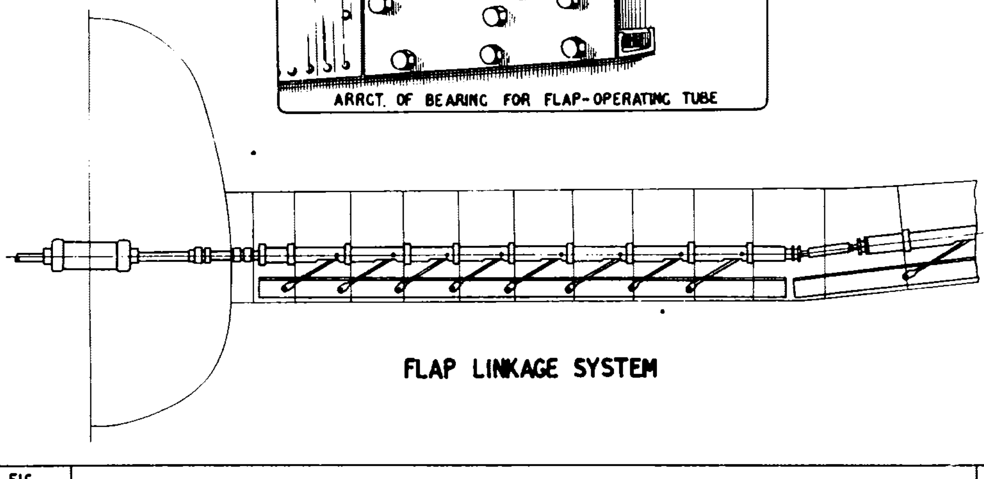

FLAP LINKAGE SYSTEM

FIG. 7

FLAP

FIG. 7

PP4214 M /G3492 1/46 1050 C&P Gp. 959 (4)

CHAPTER 3

TAIL UNIT

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

1. The tail unit consists of a two-spar tail plane with fins and rudders at the two extremities. The tail plane is made in halves which are bolted together inside the fuselage. The front spar is bolted to fuselage former 35, and the rear spar to former 38. The fins are bolted to the ends of the spars.

2. Each of the four main control surfaces (two elevators and two rudders) has a trimming tab and each elevator has a balance tab.

Tail plane

3. The tail plane (*see fig. 1*) consists of port and starboard sections, each built up of a front and rear spar, with sixteen ribs braced by transverse stringers, and a light-alloy skin riveted to the ribs and stringers. The leading edge of the tail plane is stiffened by intermediate nose riblets riveted to the front spar. The spars consist of top and bottom extruded angles with a web riveted between them. The ribs are made up in two sections, the nose fitted forward of the front spar, and the major section fitted between the spars. These sections are formed from light-alloy sheet, flanged at the upper and lower edges, and having flanged lightening holes. The webs of the centre portions are also strengthened with vertical top-hat-section stiffeners, except rib 14 which has angle stiffeners. At the intersection of the ribs and stringers, the ribs are cut away and the stringers secured by small attachment brackets. The main ribs, i.e. between the spars, are also cut away and fitted with attachment brackets at the spar booms. The elevator hinge brackets (of which there are three for each elevator) are of light-alloy and are bolted to the rear spar; laminum washers are fitted as necessary between the spar and the brackets to ensure the position of the hinge-line. The inner hinge on each side is the datum hinge and is secured in its housing by circlips. The elevator does not extend the full length of the tail plane, as a small detachable trailing-edge portion is fitted to the rear spar of the tail plane at the outer end and is cut away to allow for the movement of the rudder.

Elevators

4. The two elevators are connected inside the fuselage by a steel torque tube which is fastened to steel liners in the inboard ends of the elevator spars by couplings fitted with spring steel shims. The spars are tubular and are cut away in three places for the hinges. The eyebolts which form the hinges are fitted with ball races and are secured in bushes through the steel hinge boxes welded in the elevator spar. Each spar passes through holes in the sixteen pressed light-alloy ribs, and is riveted to angle collars attached to them. Angle-section stringers are riveted to the ribs, which are cut away to receive them, and the trailing edge is formed by a V-section light-alloy channel. The skin is of light-alloy sheet and is riveted to the ribs, stringers and trailing edge with mushroom-head rivets on the upper surface, and pop-dome rivets on the under surface. In the leading edge of the elevator is a mild-steel bar which acts as a mass balance, while a short tube at the inboard end accommodates additional weights if these are required for mass balance adjustment (*see* relevant illustrations in Sect. 5).

5. ***Trimming tab.***—The trimming tabs are at the inner end of the elevators and are made of three light-alloy formers and three wooden

Tail Unit

formers covered with a light-alloy skin, the components being triangular in section. Attachment to the elevators is by piano hinges on the top surfaces (*see fig. 4*).

6. ***Balance tab.***—An additional tab is fitted outboard of the trimming tab, and is operated by a connecting rod fitted between a lever on the tab and an arm on the elevator hinge bracket (*see fig. 4*). The loads on the moving elevator are thus balanced by the movement of the tab.

Fins

7. The fins (*see fig. 2*) are built up on front, rear and intermediate fin posts, with vertical stringers and intercostals, a nose stiffening channel and nine horizontal ribs. The structure is covered with light-alloy sheet. The fin posts consist of light-alloy webs to which extruded angle booms are riveted top and bottom. On the front post light-alloy packing strips are riveted to the face of the web at its four intermediate ribs, high tensile steel stiffeners are riveted in the flange of the booms at rib 7, and a stiffening plate is located between ribs 6–7 and 7–8. The rear fin post has additional stiffeners to take the three rudder hinge brackets, which are bolted to the rear face; the tip is a laminated synthetic fibre block faired to aerofoil contour. The fin ribs are flanged at the edges and cut away for the stringers and intercostals attached to the ribs at these points by small brackets. Flanged lightening holes give additional stiffness to the rib web. The leading edge is of laminated mahogany, the skin being attached by means of countersunk-head woodscrews. An aerial pulley attachment bracket is fitted in the top of the fin, with an access door in the outboard skin. Detachable panels in the skin give access to the rudder trimming tab controls.

Rudders

8. The rudders are of similar construction to the fins (*see fig. 2*), and are attached to the latter by three ball-bearing hinges which are bolted to the rear face of the fin post. The rudder is the horn-balance type, with a full-length rudder post and fourteen lateral ribs in the main section, strengthened by intercostals extending between ribs 1B and 2A (numbering from the top, downward), and an angle stiffener running from rib 4 to rib 7; the three lowermost ribs of that section are continued forward to form the upper three ribs of the forward facing horn-balance which has four small vertical intercostals. The unit is covered with light-alloy sheet in which are detachable panels for access to trimming tab controls. At the front of the rudder post is a shroud which is cut away for the hinges, cuffs being fitted round these after assembly. The trailing edge is a light-alloy extrusion. Mass-balance weights on tubular arms are bolted to each side of the rudder post at rib 2 (the fourth rib from the top). The structure is further strengthened by angle members forming the mounting for the rudder lever between ribs 8 and 9.

9. ***Trimming tab.***—The rudder trimming tabs are hinged into the trailing edge of the rudder and are constructed from seven blocks, a large intermediate block which carries the operating lever, and a fairing block at the lower end, all covered with light-alloy skin. The nose portion, to which the trimmer hinge is attached, is of light-alloy skin in U-section and riveted through the main, or rear section, skin. The operating lever is bolted by flat-head 4 BA bolts through the nose and rear sections at the intermediate block, with a shaped light-alloy packing between the base of the lever and the outer face of the skin covering. Chamfered washers are fitted under the 4 B.A. thin locknuts.

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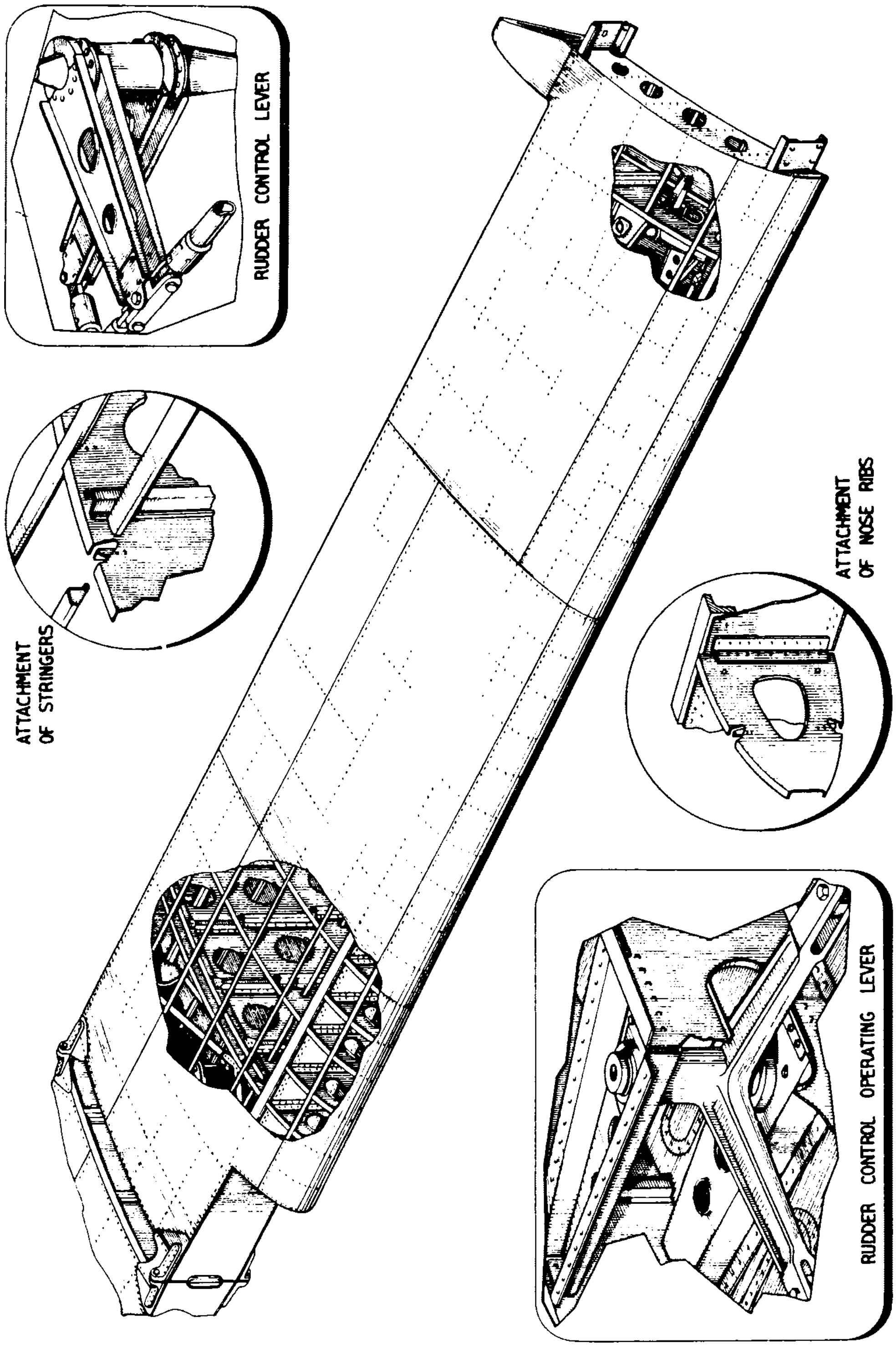

FIG. 1 TAIL PLANE FIG. 1

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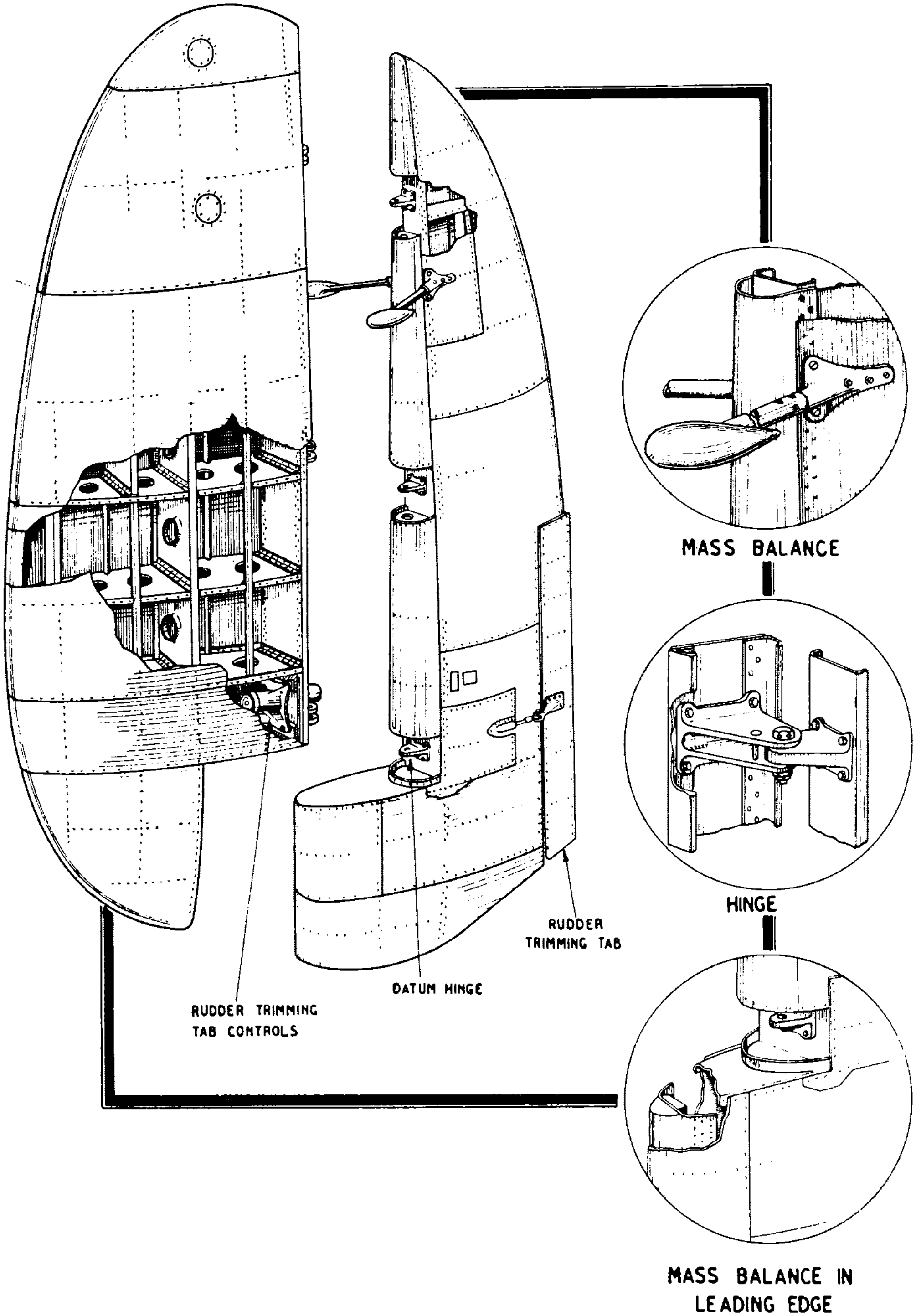

FIG 2 — FIN & RUDDER — FIG 2

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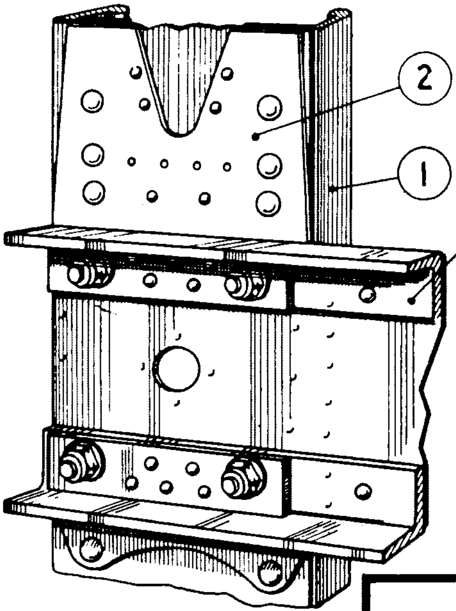

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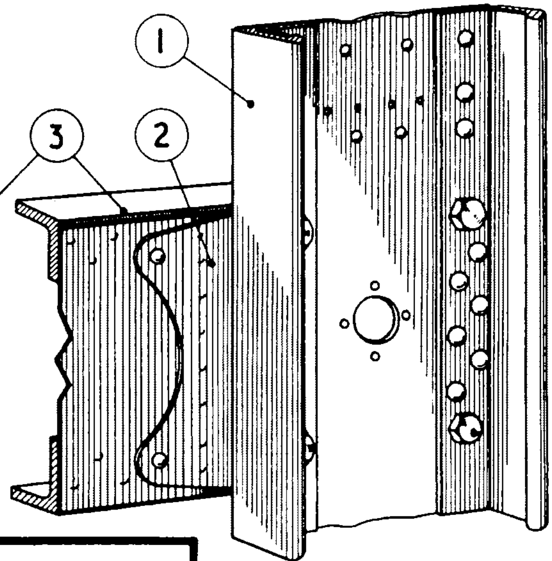

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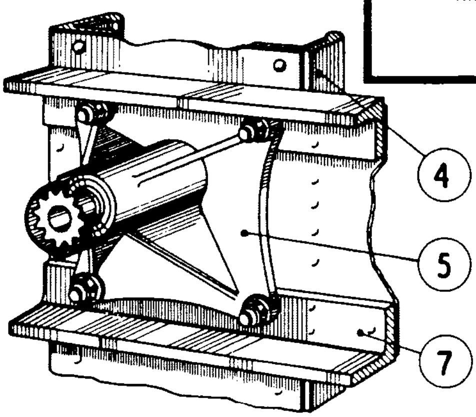
1. FRONT FIN POST
2. REINFORCING PLATE
3. TAIL PLANE FRONT SPAR
4. REAR FIN POST
5. RUDDER TRIMMING TAB CONTROL BRACKET
6. RUDDER HINGE BRACKET
7. TAIL PLANE REAR SPAR



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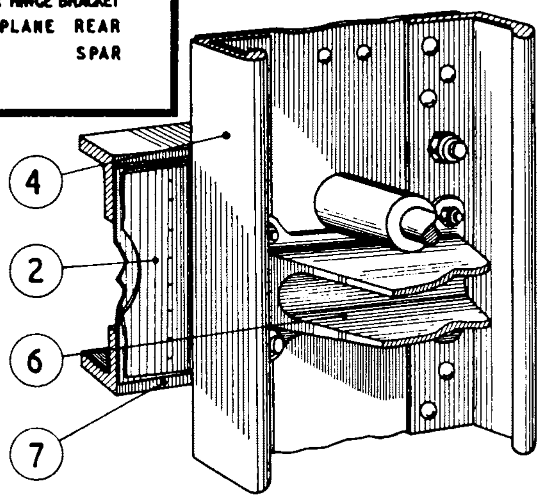

VIEW LOOKING FORWARD

REAR SPAR TO REAR FIN POST

FIG. 3 MOUNTING OF FIN TO TAIL PLANE FIG. 3

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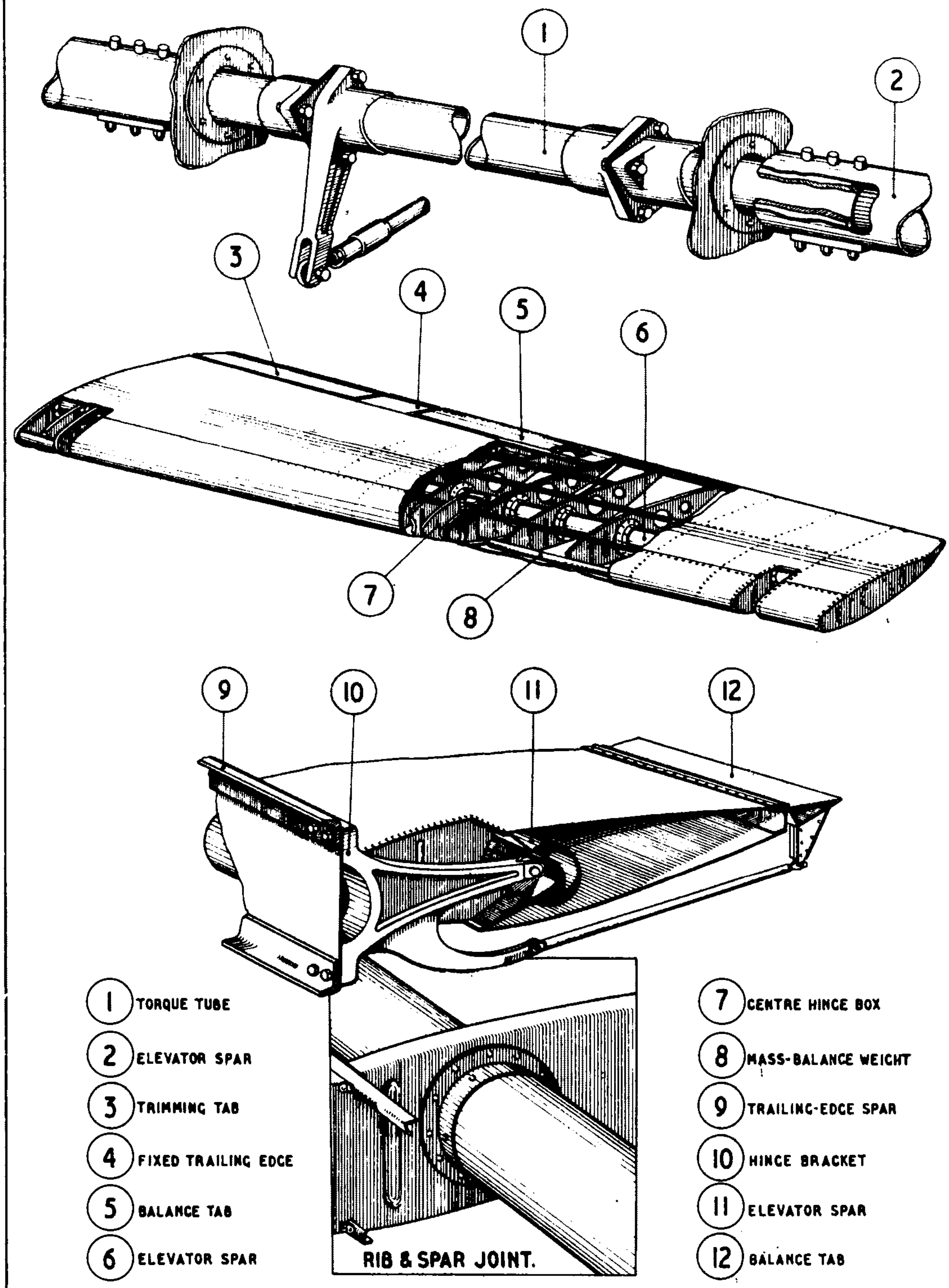

FIG. 4 ELEVATOR FIG. 4

CHAPTER 4

FLYING CONTROLS

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

**To be issued later*

1. The flying controls are:—

(i) Ailerons—controlled by rotation of the handwheel on the control column.

(ii) Elevators—controlled by fore-and-aft movement of the control column.

(iii) Rudders—controlled by movement of pendulum-type rudder pedals mounted behind the pilot's instrument panel.

(iv) Trimming tabs—controlled by handwheels on the trimming tab control box, mounted on the pilot's floor at the starboard side of the pilot's seat.

A Mk. VIII automatic pilot, operated by an Arrow-type compressor on the port inboard power plant, is also fitted.

Control column

2. The control column, which is of rectangular section, passes through the pilot's floor and is bolted to a cross shaft beneath (*see fig. 4*). A panel on the aft face gives access to the aileron controls within the column. The handwheel at the top of the control column rotates on a spindle which carries a sprocket for operating the aileron controls, and a spur gear which comes into operation when the dual control arm is in position. The dual control arm, when fitted, projects horizontally from the control column head, and carries a second handwheel connected by chains and sprockets with a gear which meshes with that in the control column.

Rudder pedals

3. The rudder is controlled by means of conventional pendulum-type pedals pivoted on torque shafts behind the pilot's instrument panel (*see fig. 5*). The shafts are interconnected by spur gears, causing them to rotate in opposite directions. To limit the movement of the pedals a stop bracket is fitted at the forward end of the pilot's floor. The pedals themselves are of tubular construction, and each footrest can be independently adjusted by lifting it up and moving it over the spring-loaded ratchet mechanism provided on each arm of the pedals. A spring locking catch on each pedal has to be released before adjustment can be made.

Aileron controls

4. The ailerons are controlled by rotation of the pilot's handwheel, which is connected by chains, sprockets and tie rods to a torque shaft on the main floor beneath the pilot's floor (*see fig. 1*). Similar connections from the torque shaft run aft on the port side of the fuselage to a double-armed lever on the rear face of the rear spar. The lever is a light-alloy forging, mounted on an extruded channel-section bearer, a stop bracket being provided to limit the movement. A jointed light-alloy push-pull control tube, attached to the top arm of the lever and supported by Tufnol bearings in the main plane ribs, extends outboard to port and starboard to intermediate channel-section

Flying Controls

levers, near the outboard ends of the main plane centre section. The levers are pivoted at the top by a steel tube, which is bolted to a bracket built up from two angle members; these in turn are bolted to the aft face of the rear spar web near the outboard ends of the main plane centre section (*see fig. 1, detail D*). Another control tube fixed to the bottom of each lever extends to the lever mounted on the fore-and-aft torque shaft in the trailing edge of the main plane at the junction between the two sections of the aileron. At the rear end of the torque shaft is mounted a rocking lever which actuates the aileron operating fork. The operating fork is secured to a cylindrical forging by a centre pin passing through the axis of the forging, which connects the two sections of the aileron. The lever on the torque shaft and the aileron operating fork are both light-alloy forgings with ball races at all bearing points. A self-aligning bearing is used where the rocking lever connects with the aileron operating fork.

Elevator controls

5. To the lower end of the control column, on the underside of the pilot's floor, is attached a cross-shaft mounted on two ball race bearings. This shaft consists of a forging bolted to the base of the column and a transmission tube of non-magnetic steel, on the port end of which is a lever for the elevator push-pull tube and a sprocket quadrant for the automatic pilot chain. Both the lever and quadrant are light-alloy forgings. Stop brackets are fitted to the pilot's floor to limit the fore-and-aft movement of the control column. From the elevator lever a jointed push-pull control tube, supported by spherical bearings, runs aft through the spars and formers along the port side of the fuselage (*see fig. 2*). The tube terminates in a square-section rod supported, to prevent turning, in square bearings of mild steel in formers 33 and 34. From a bracket on the square rod a connecting rod extends aft to a lever on the underside of the elevator spar torque shaft (*see Chap. 3, fig. 4*).

Rudder controls

6. The rudder control push-pull rods (*see fig. 3*) are similar to those for the elevator, running from a bracket on the port rudder pedal (*see fig. 5*) to a square-section rod at formers 32 and 33, from which a connecting rod operates a lever between the tail plane spars. This lever is mounted on a vertical spindle which revolves in ball bearings, the bearing housing being attached to the top and bottom booms of rib 1. Attached to this lever is a second lever which is interconnected by means of push-pull rods with one arm of an L-shaped lever at each end of the tail plane. The outer levers are light-alloy forgings and are mounted in a similar manner to the centre lever. The second arm of the outer lever is interconnected with the actuating lever on the rudder by means of an adjustable connecting rod which has a ball race fitted at each end.

Trimming tab control gearbox

7. The control box (*see fig. 9*) is a light-alloy casting bolted to the pilot's floor, the end plates being detachable to allow easy access to the bevel gears which operate the various controls. These gears run in oilite bearings fitted in bosses formed in the casting. Each control has an independent indicator inset in the top of the box.

Elevator tab controls

8. ***Trimming tab.***—The elevator trimming tabs (*see fig. 7*) are operated from a handwheel on the control gearbox from which cables run downward to the main floor and then through the intercostals to pulley brackets on the port side of the main floor and on former C. From here the cables run aft along the port siae of the fuselage through fairleads on the formers in the bomb compartment to a pulley bracket on former 39. The cables then pass up into the tail plane, round a further pulley and outboard in each direction along the tail plane. Chains attached to the ends of the cables pass round sprockets in bearings passing through the elevator spar. Each sprocket is screwed internally and has an eyebolt screwed into it which picks up a connecting rod, the other end of which is attached to the operating lever on the tab. Rotation of the sprocket moves the the connecting rod and thus the tab.

9. ***Balance tab.***—The balance tabs on the elevators are connected to an arm on the elevator centre hinge bracket by a rod attached

Flying Controls

to a lever on the lower surface of the tab. When the elevator is moved the tab is automatically moved in the opposite direction. .In aircraft incorporating Mod. No. 1420 the lever on the tab is provided with five holes for the attachment of the operating rod, allowing adjustment of the lightness of the elevator control.,

Rudder trimming tab controls

10. The rudder trimming tab (*see fig. 8*) is operated from a handwheel on the control gear box from which cables run downwards to the main floor and then to pulley brackets on the port side of the main floor. From here, the cables run aft along the port side of the fuselage through fairleads on the formers in the bomb compartment to pulley brackets mounted aft of former 37. The cables then pass up to a pulley bracket in the tail plane and outboard in each direction along the tail plane. Chains attached to the ends of the cables pass round sprockets on the forward face of the rear fin posts and are themselves connected together by a balance cable along the tail plane. The sprockets are attached to shafts which incorporate universal joints at the rudder hinge lines. Aft of this joint the shaft has a turnbuckle action and adjusts a connecting rod which actuates a short lever on the rudder trimming tab.

Aileron tab controls

11. ***Trimming tab.***—A trimming tab is fitted to the inboard end of each aileron and these are operated by a handwheel (*see fig. 6*). Cables pass from the control box to three double pulleys under the floor members at formers C and D and then aft along the starboard side of the fuselage through fairleads on the formers in the bomb compartment. Just aft of the rear spar each cable divides, the four cables running parallel to pulleys just forward of former 16, where they pass up through the floor and through the fuselage sides into the trailing edge of the main plane, and outboard into the aileron to the trimming tab control gear. In the main plane the cable are supported by fairleads, and turnbuckles are provided for adjustment. The control gear consists of a cable bobbin on a screwed spindle, operating a threaded sleeve on the end of a rod connected to the tab. The assembly is supported on the aileron spar by a ball end in a socket which is bolted to the spar web, a retaining nut being screwed finger-tight and secured with a split pin.

12. ***Balance tab.***—A balance tab is fitted to each aileron (*see Sect. 7, Chap. 2, fig. 6*) and is connected to an eyebolt on the aileron hinge arm by a rod attached to a lever on the upper surface of the tab. Six holes (*one* in aircraft not incorporating Mod. 1401) are provided in the lever to allow for adjustment.

P9572 M /G3491 2/46 1050 C & P Gp. 1

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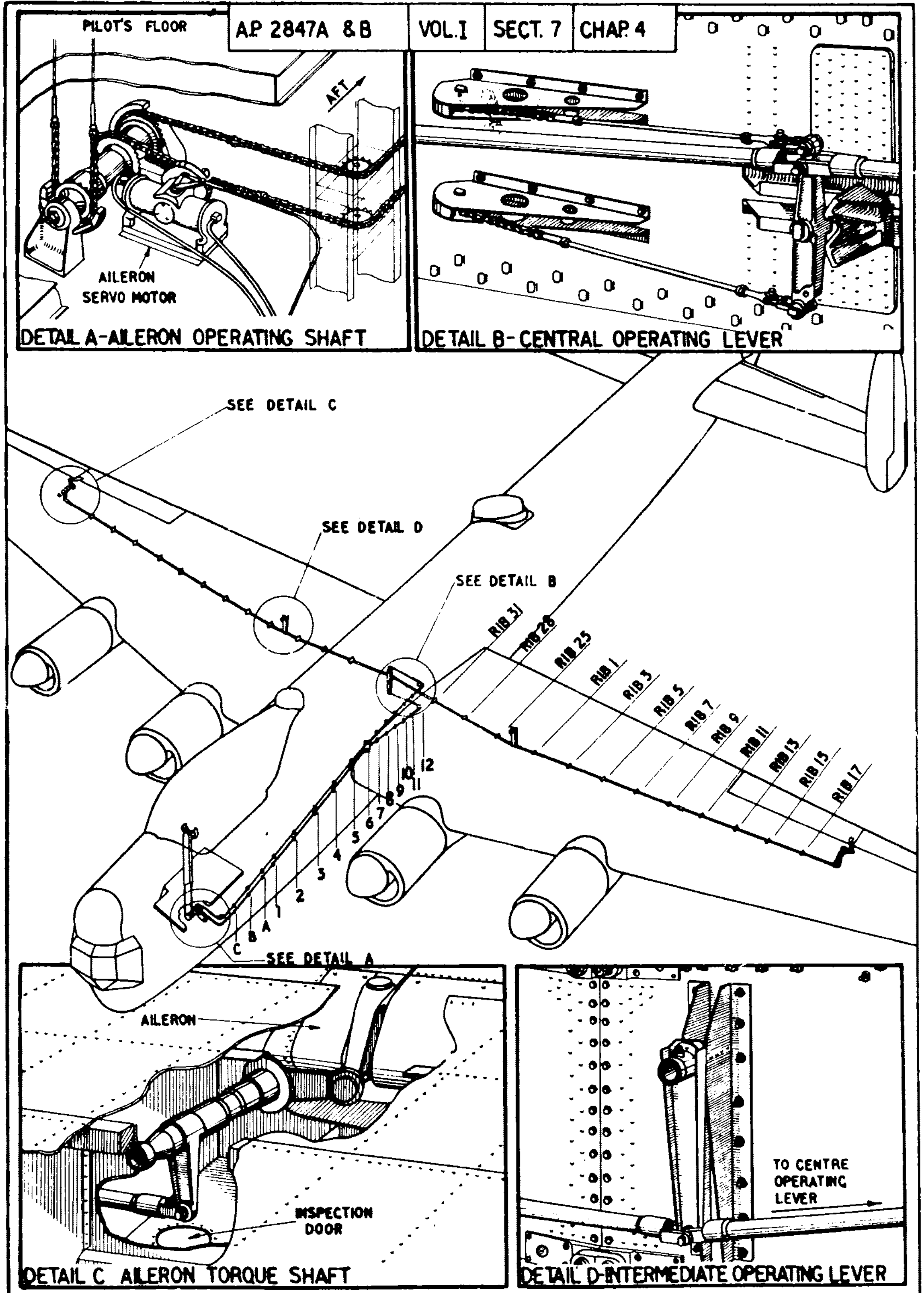

FIG. 1 — AILERON CONTROLS — FIG. 1

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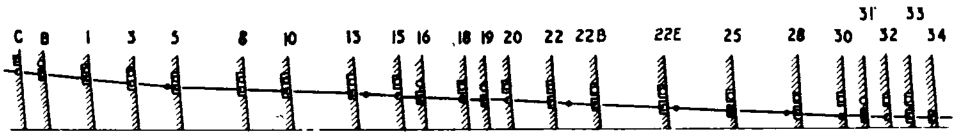
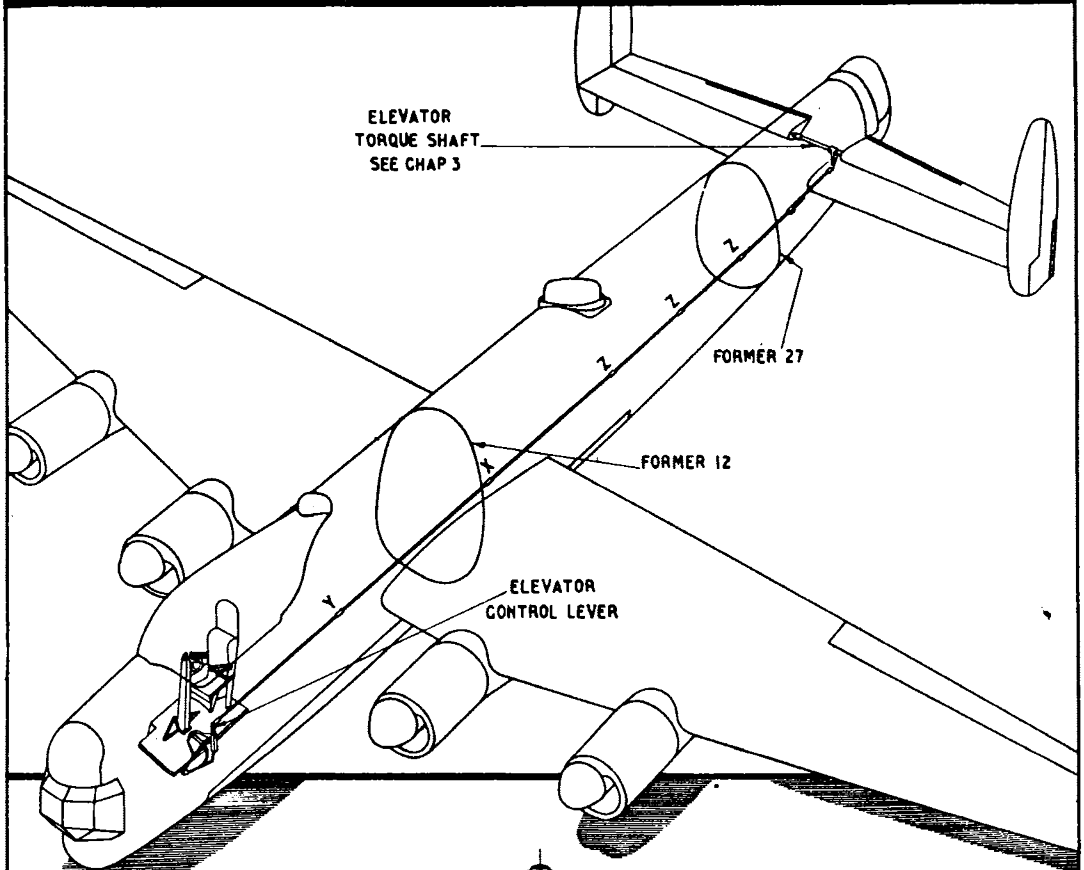
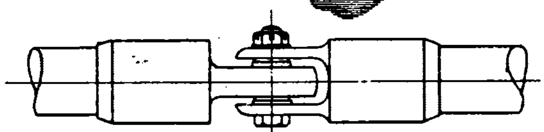


DIAGRAMMATIC ARRANGEMENT OF FORMERS & BEARINGS.





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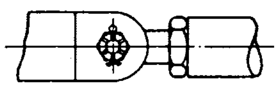

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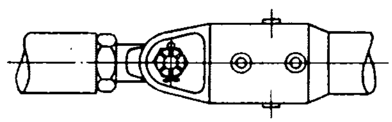

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FIG. 2 — **ELEVATOR CONTROLS** — FIG. 2

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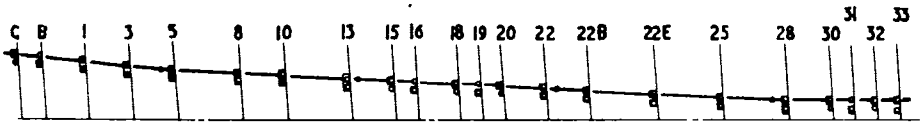

DIAGRAMMATIC ARRANGEMENT OF FORMERS & BEARINGS

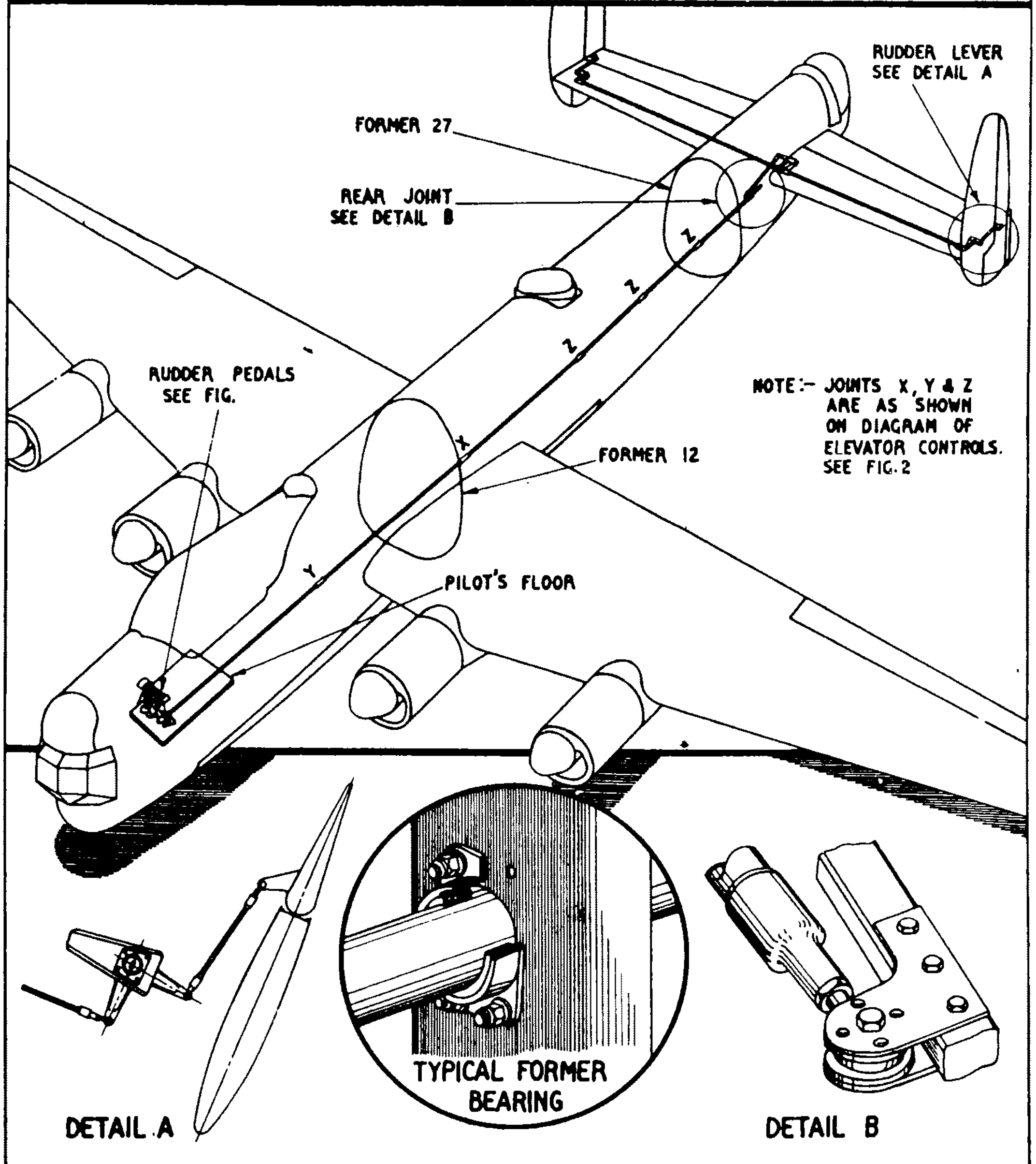

FIG. 3 — RUDDER CONTROLS — FIG. 3

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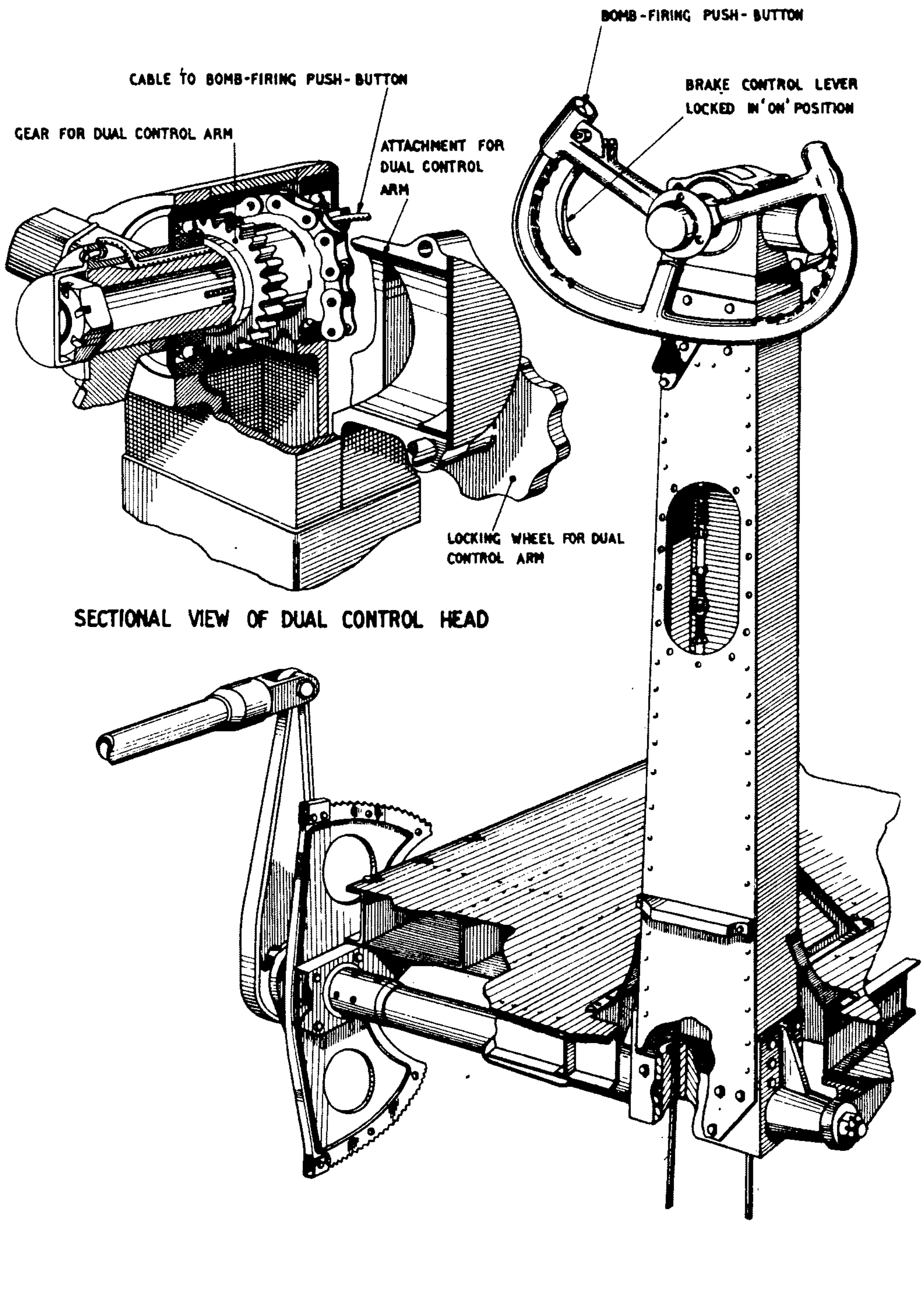

FIG. 4 — CONTROL COLUMN & CROSS SHAFT — FIG. 4

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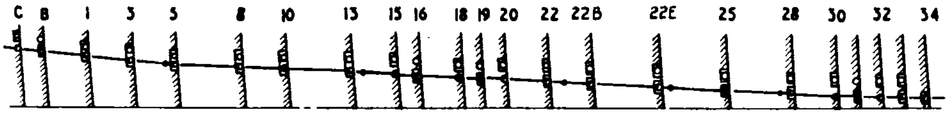

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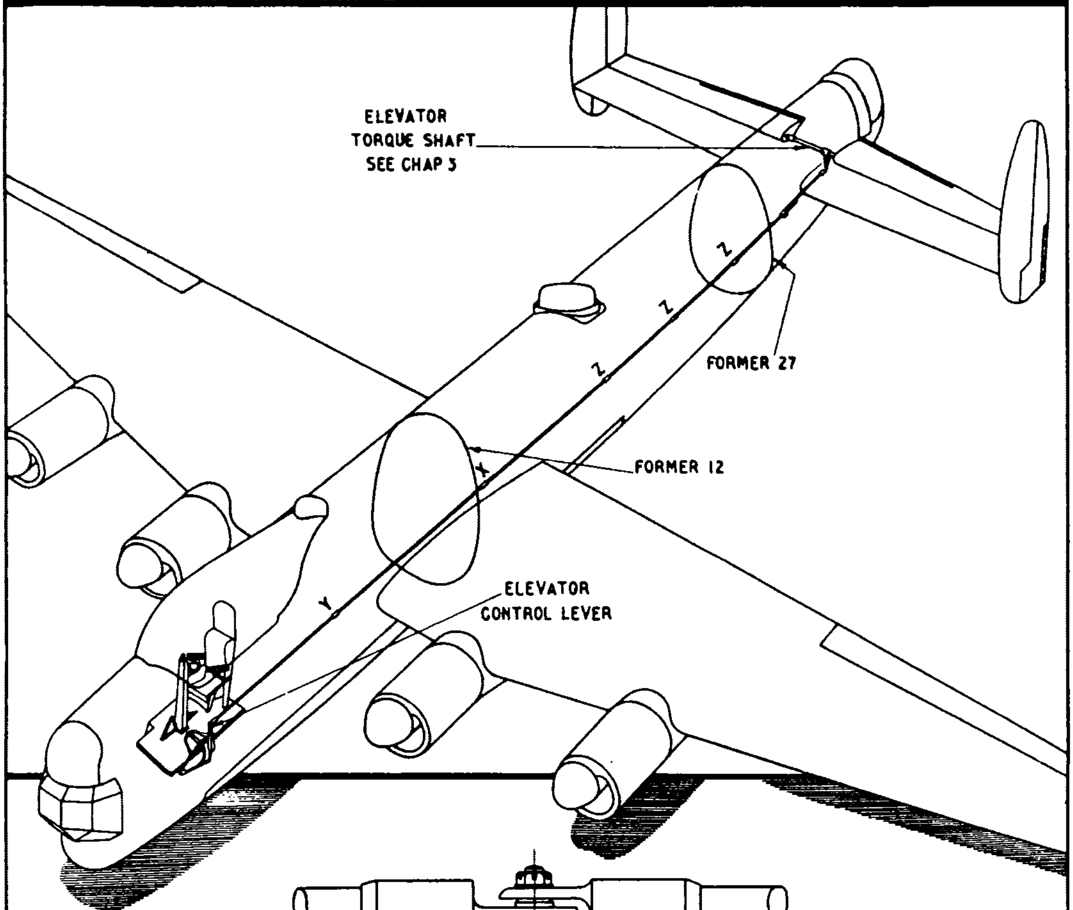

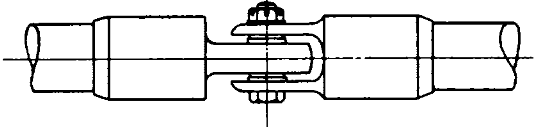

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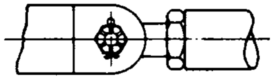

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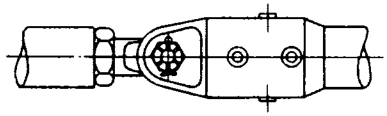

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FIG. 2

ELEVATOR CONTROLS

FIG. 2

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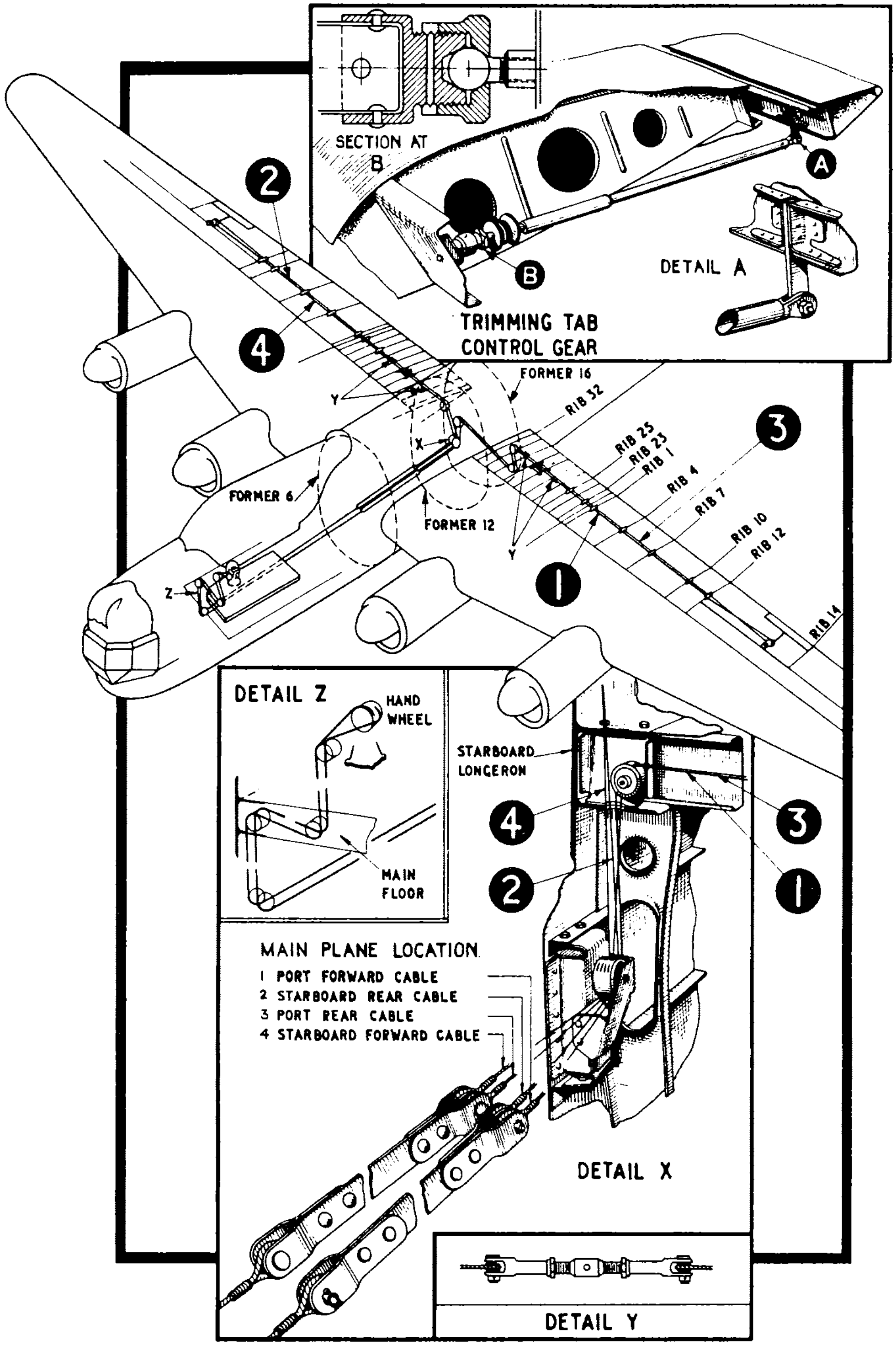

FIG. 6 AILERON TRIMMING TAB CONTROLS FIG. 6

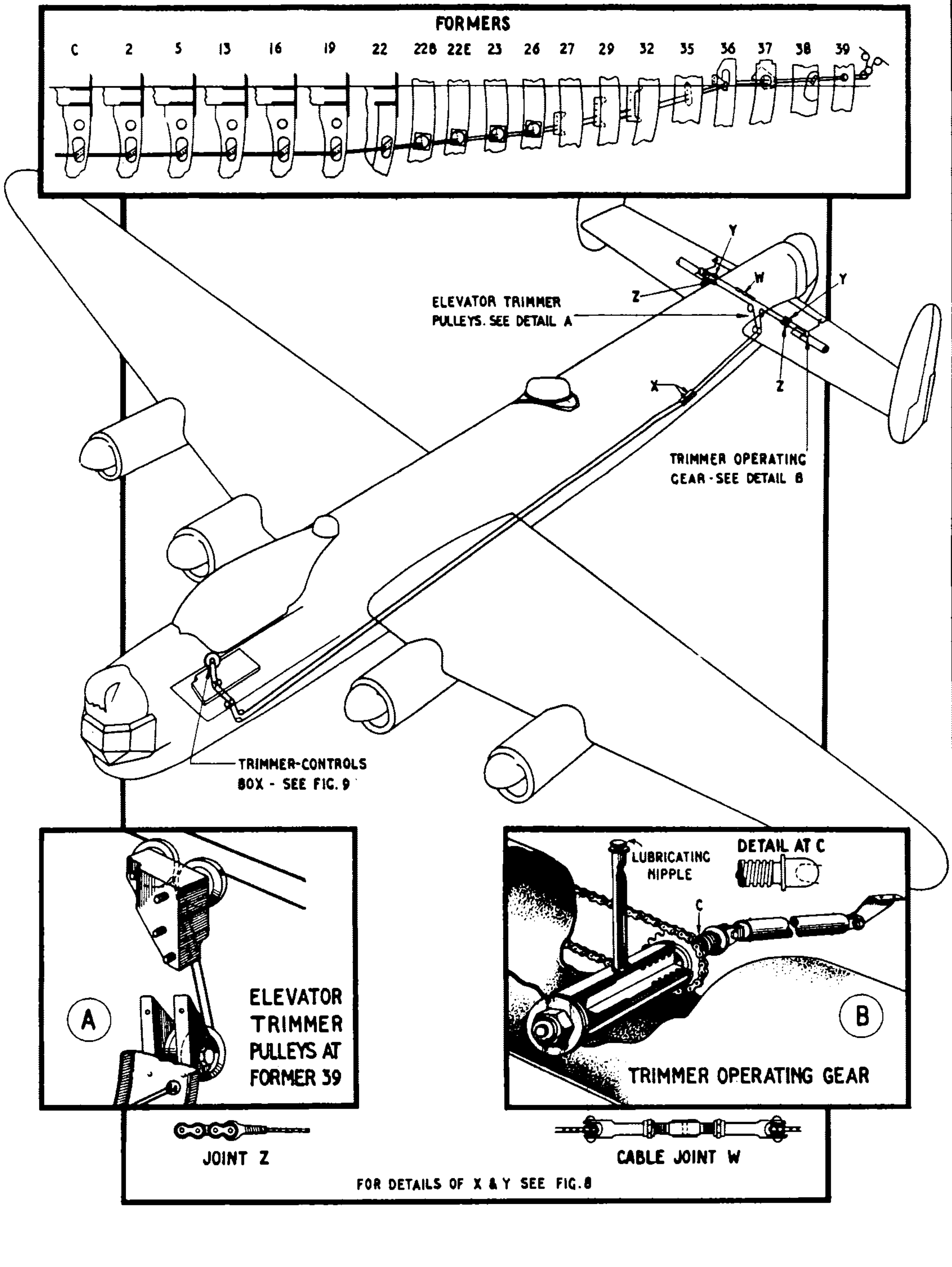

FIG. 7 — ELEVATOR TRIMMING TAB CONTROLS — FIG. 7

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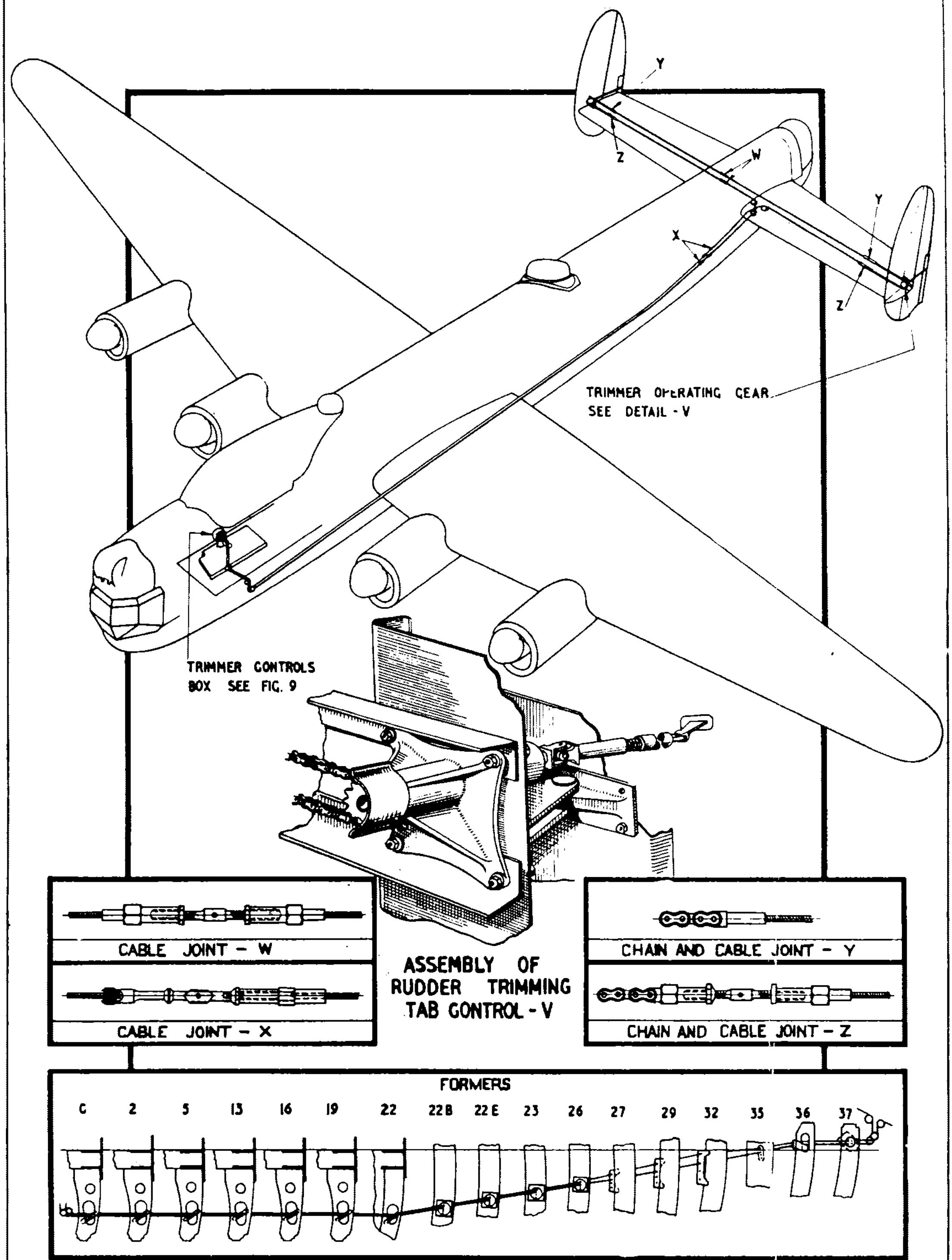


FIG. 8 RUDDER TRIMMING TAB CONTROLS. FIG. 8

ALIGHTING GEAR

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

Main wheel units

1. The structural basis of each main wheel unit is left- and right-hand shock-absorber strut, braced and aligned by an upper cross tube and diagonal tubing, with the wheel axle secured to the lower members of the struts. The upper end fitting of each strut is a light-alloy forging, milled to pick up in the forked end of the undercarriage beam, attachment being made by a high-tensile steel bolt through the undercarriage beam and through a steel bush in the strut top end-fitting. At the lower end of each strut is a hard-chrome plated high-tensile steel sliding tube. The bottom end of this tube enters the bore of the axle through U-shaped cut-outs and the tube and axle are pinned together by steel bolts. Brake torque reaction is taken by large-diameter light-alloy brake flanges bolted to the axle.

2. Retraction is effected by the pull of a pair of hydraulic jacks. The piston rod of the jack is connected to the knuckle joint of a two-piece radius rod. The upper end of the radius rod pivots in a bracket bolted to the bottom boom of the centre plane rear spar; its lower end is attached by a steel pin joining the eye end of the radius rod to lugs milled in the light-alloy forging which forms the radius rod attachment fitting at the base of the shock-absorber strut outer cylinder. The knuckle joint of the radius rod incorporates locking mechanism which secures the unit in its UP or DOWN position. The cylinder of the jack is hinged about a hollow shaft supported in split bearings on the top boom of the centre plane rear spar. Hydraulic fluid is supplied to the jack through this shaft. The lower ends of the jack piston rods are connected by a cross tube and diagonal bracing struts, bolt holes being drilled through the piston rods. A conduit stay connects the tops of each pair of jack cylinders and supports an emergency air non-return valve through which fluid (or air, in the event of emergency) is led to the jacks. An external balance pipe connects the two shock-absorber struts, equalising air pressure between them and ensuring synchronised action.

3. The initial movement of the jacks when raising the unit releases the DOWN latches of the knuckle joint. As the retracting movement continues the knuckle joint breaks and on completion of retraction the UP latch engages a cross pin suspended from a channel-section assembly attached to the ribs, at the top of the compartment (*fig. 1*) locking the unit in the retracted position. When either UP or DOWN latches are engaged micro-switches close an electrical circuit and register the position of the unit on an indicator in the cockpit. Engagement of the UP latch also contacts the plunger of a micro-switch which then makes electrical connection to the air cleaner. An access door is provided in the top skin of the centre plane directly above the UP catch mounting. (*See* also Sect. 10, Chap. 1).

4. ***Shock-absorber struts.***— The oleo-pneumatic struts (*see* Sect. 4, Chap. 3, fig. 25) absorb the shock and load of landing or taxying by further compressing air already under pressure in the struts. The outer cylinder (*A*) of the strut is secured to the aircraft through a light-alloy forging (*G*); an inner tube (*M*), to which the wheel axle is attached, slides inside the outer cylinder. Shock absorption is effected by a dashpot assembly consisting of an internal cylinder (*H*) containing compressed air, and a lower cylinder (*K1*) containing a measured quantity of fluid. The top end of the cylinder (*H*) is attached to the outer cylinder and top end-fitting by means of shear-bushes or ferrules (*S 1*); the inner or sliding tube (*M*) is attached to the lower dashpot cylinder, the attachment being allowed an appreciable degree of flexibility so that bending loads are not transmitted to the dashpot assembly. When any load forces

Alighting Gear

the axle, and with it the sliding tube, upward, the lower dashpot cylinder slides over the top internal cylinder; fluid is forced through the damping valve (*H 1*) and enters the cylinder (*H*), further compressing the air. The piston (*Y*), with synthetic rubber ring (*Z*), is simultaneously driven up inside cylinder (*H*) by the piston rod (*Y 1*). A synthetic rubber gland ring (*J*) forms a fluid-tight joint between the top internal and lower cylinders.

5. When the load is reduced or relieved the initial downward movement causes the damping valve (*H 1*) to seat, so that the passage of fluid expelled from the cylinder (*H*) is restricted, being confined to a series of small holes in the damping valve (*H 1*). As the piston (*Y*) moves with the lower dashpot cylinder, it must pass through the column of fluid in the top internal cylinder. This fluid can escape in two directions—through the damping valve and through two small holes in the piston, thus controlling the speed of recoil of the strut. The flanged shoulders of the cylinder (*K 1*) connected to the sliding tube (*M*) abut on rubber rings (*J 1*) at the end of its downward travel, the cylinder and sliding tube being retained in the outer cylinder by these rubber rings supported by a cylindrical distance piece (*J 2*) which makes end contact with internal ring (*K*) abutting on the upper end of a sleeve which forms a bearing for the sliding tube (*M*), which sleeve is itself retained by steel collar (*W 1*) screwed to the end of the outer cylinder (*A*). The balance pipe (*F*) connects the two oleo-struts through a union (*G 1*) for which the strut top end fitting (*G*) and outer cylinder (*A*) are drilled and the cylinder (*H*) drilled and tapped. Split bearings (*B*) are secured, by countersunk screws, to the strut bracing fitting to which the diagonal bracing tubes are attached. These bearings are embraced by a light-alloy collar pivoted to the connecting tube which operates the undercarriage doors.

6. ***Retracting struts (radius rods) and latches.***—Each main wheel unit has a retracting strut (or radius rod) at each side. The arrangement of the knuckle joint and latch assembly is shown in fig. 1, and in the relevant illustration in Sect. 4, Chap. 3. The UP latch (*J*) and DOWN latch (*E*) pivot on a pin (*F*) in the lugs (*G*) to which the jack piston rod is attached, both latches having elongated holes through which passes the jack attachment pin (*H*). The UP latch engages a locking pin on the airframe (*see* para. 3), and the DOWN latches engage a pin (*B*) carried on lever (*K*), attached to pin (*L*) pivoted in the upper section of the strut. The lever (*K*) is attached also to the lower section of the strut by adjustable tie-rods (*C*), and two levers (*S*) are secured on either side of the pin (*L*) so that they move in unison with the lever (*K*) as the strut folds. Each lever (*S*) is connected to a spring plunger (*R*) in a spring assembly, of which the housings (*Q*) are joined by a pin (*T*) passing through elongated holes in the two latches. A stop (*M*) is secured to the face of lever (*K*) to ensure alignment of the two strut sections when the DOWN latch engages.

7. The initial stage of retraction movement by the jack piston rod pulls the DOWN latches off pin (*B*) until the limit of the slots is reached; further movement results in breaking the strut and raising the unit. Lever (*K*) and pin (*B*) are simultaneously pulled round in an arc, away from the latches, by the tie rods (*C*). The UP latch can now drop back on to pin (*T*) which is moving toward the end of the slots in the DOWN latches against the action of levers (*S*). With the pin (*T*) at the end of the slots, the levers then force plungers (*R*) to compress springs (*P*). Just before the end of the retraction operation, the UP latch makes contact with the locking pin on the aircraft structure (*see* para. 3), pressing the latch back to further compress springs (*P*). As the retracting movement is completed, these springs force the catch over the pin to lock the unit in the UP position.

8. When the unit is lowered, the initial movement of the piston rod disengages the UP latch (*J*) from its locking pin. When the latch is clear, the unit drops by gravity, the continued extension of the piston rod then completing the straightening of the retracting struts. During this operation, lever (*K*) and pin (*B*) describe an arc towards the latches and the consequent movement of levers (*S*) withdraws plungers (*R*) from spring housings (*Q*), relieving the springs (*P*). The pin (*T*)

Alighting Gear

is then drawn to the ends of the slots in the latches, and the latches pulled forward until restrained by bolts (*H*). In the final stages of lowering, pin (*B*) strikes the curved heads of the DOWN latches (*E*) and these are forced back against the springs (*O*) in housings (*Q*). As the movement approaches its end the springs (*O*) pull the latches (*E*) over the pin (*B*), locking the unit.

9. The last phases of movement of the UP and DOWN latches operate micro-switches which are wired to an undercarriage position indicator in the cockpit. (*See* para. 3.)

Tail wheel unit

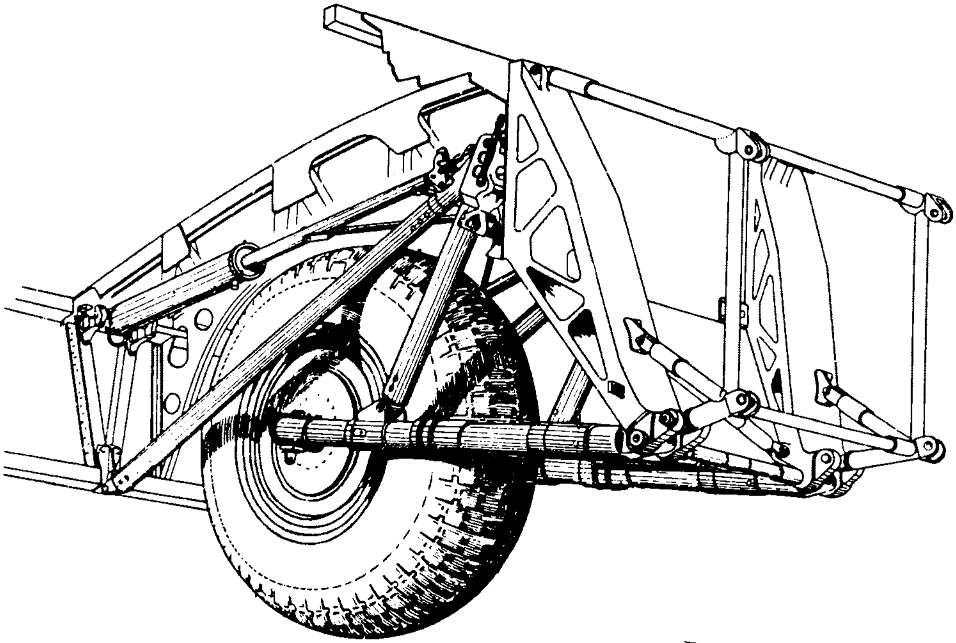
10. The tail wheel unit is pivoted on a mounting beam installed longitudinally on the centre line of the aircraft between formers 35 and 38. The upper end of the shock-absorber unit is spigoted for location by an anchorage plate behind the forward attachment bracket for the two halves of the tail plane. The wheel fork is fitted in the lower, or sliding, tube of the shock absorber. (*See* Sect. 4, Chap. 3, fig. 26.) The axle is mounted in U-section cut-outs in the base of the fork, and prevented from turning by two blocks with transverse bolts. The fork is extended to form towing or steering lugs.

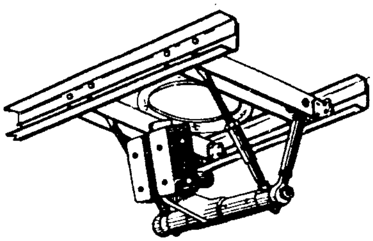
11. ***Shock-absorber strut.***—The assembly (Sect. 4, Chap. 3, fig. 26) comprises a main outer tube (*M*), lower sliding tube (*L*), air chamber (*F*), damping valve assembly (*N*), and wheel fork (*W*). The air chamber (*F*) is secured in the top of the main outer tube (*M*) by means of an end cap (*D*) and pins (*B*) and (*C*). The damping valve assembly (*N*) is fitted in the lower end of the air chamber (*F*); the sliding tube (*L*) moves up and down between the outer tube (*M*) and the air chamber (*F*). Attachment to the aircraft is by peg or spigot (*A*) (*see* para. 10), and sleeve with attachment lug (*S*). The lower sliding tube is filled with fluid and has gland rings (*J*) and (*A 1*) to render it fluid-tight. Air chamber (*F*) is inflated through valve (*M 1*).

12. Landing or taxying loads cause the sliding tube (*L*) to move upward over the air chamber, thus forcing fluid in the lower cylinder through the damping valve (*N*) and small holes in the diaphragm and increasing the pressure in the air chamber. As soon as compression is arrested, the damping valve closes so that fluid forced back into the sliding tube by the compressed air in the air chamber as the strut extends can pass only through the small holes in the diaphragm; this restriction on the return flow of fluid controls the recoil action.

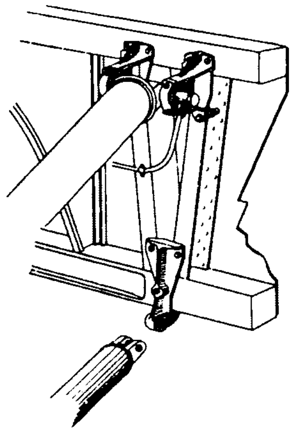
13. The sliding tube and fork are free to rotate in the assembly but, to ensure that the fork and wheel assume a true fore-and-aft position when the aircraft is airborne, self-centring cams (*J 1*) and (*G 1*) are secured to the air chamber (*F*) and the sliding tube (*L*), respectively. When the strut is compressed, the cams are separated and the wheel has free castoring action. When the strut is extended, as when airborne, the cams meet and the contours of their mating faces bring the sliding tube with fork attached into a position where the fork and wheel are correctly aligned fore-and-aft.

P9038 M /G2739 12/45 1050 C & P Gp. 1

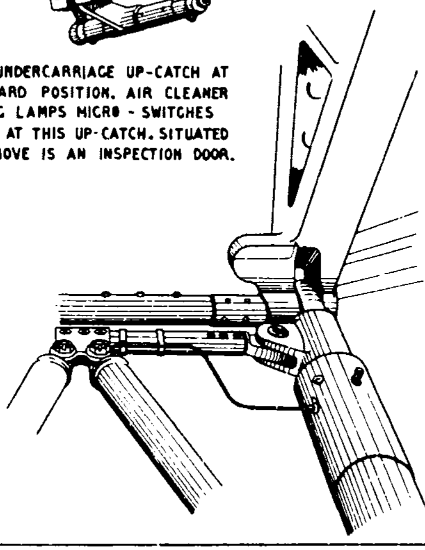




DETAIL OF UNDERCARRIAGE UP-CATCH AT PORT OUTBOARD POSITION. AIR CLEANER AND WARNING LAMPS MICRO - SWITCHES ARE FITTED AT THIS UP-CATCH. SITUATED DIRECTLY ABOVE IS AN INSPECTION DOOR.



VIEW ON REAR SPAR LOOKING AFT. THE UPPER END OF THE RETRACTING STRUT IS SHOWN DISCONNECTED FOR CLARITY. BOTH THE HYDRAULIC JACK AND THE RETRACTING STRUT HAVE BEEN SHOWN IN THEIR POSITIONS WHEN RETRACTED.



VIEW BEHIND FIREWALL, LOOKING ON ATTACHMENT POINTS OF SUPPORT BEAM AND UNDERCARRIAGE - SHOCK ABSORBER UNIT ATTACHMENT FOR PORT AND STARBOARD IS IDENTICAL.

FIG. 1 MAIN WHEEL UNIT FIG. 1

PP4029 M /G2287 10/45 1050 C & P Gp. 959 (4)

• ENGINE INSTALLATION 8

(11065) T14574/G2588 1050 11/44 M20691 C & P 752

ENGINE INSTALLATION

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

Introduction

1. Lincoln aircraft are fitted with four Merlin power plants, incorporating Merlin 85 engines for the Mk. I and Merlin 68 engines for the Mk. II. The Merlin 68 differs from the 85 in the following respects:—

(a) The carburettor is the American Bendix with a D chamber vent which increases the amount of fuel vented back to the tank;

(b) The boost control has a pilot-operated cut-off;

(c) The supercharger changeover is operated by solenoid instead of by ram; and

(d) An adaptor is fitted to the air intake-to-carburettor flange.

Both types of power plant embody two-stage, two-speed superchargers with inter-coolers, and have Hamilton constant-speed propellers. Either type of power plant can be installed in the standard airframe. The mounting frame and firewall of each power plant is attached to a tubular steel sub-frame; the two inboard sub-frames connect to the undercarriage support beams on the front spar and the outboard sub-frames connect to the main plane spars. Cowlings and fairings are a combination of hinged and quickly detachable panels, giving easy access to engine controls and auxiliaries. Fuel supply is from six tanks mounted between the main plane spars. Each engine has one oil tank, the inboard tanks being located behind the centre section front spar and the outboard tanks fitted inside the sub-frame members.

Fuel system

2. ***General.***—The port and starboard fuel systems (*see relevant illustrations in this Section*

Engine Installation

and in Section 4, Chap. 3) are interconnected by a cross-feed pipe, the cock for which is normally in the "closed" position so that the two systems are basically independent. Fuel tanks are numbered 1, 2, and 3, outboard, port and starboard. The No. 1 tanks are between the spars of the main plane centre section and No. 2 and 3 are in the intermediate plane, each tank feeding separately by gravity to a small distributor tank behind the inboard nacelle firewall (*see fig. 10*). Fuel is drawn by the engine-driven pumps, or pumped by the electrically-operated Pulsometer pumps at the base of each distributor tank, through individual supply line and filter, to each engine and delivered to the carburettor by the engine-driven pump. The Pulsometer pumps are used for priming, for maintenance of fuel pressure at altitudes exceeding 17,000 ft., and to assist in re-starting an engine during flight. An electric transfer pump is fitted in each auxiliary tank, when these are installed, to transfer fuel to tank No. 1.

3. The Bendix-Stromberg carburettor is of the pressure-injection type with vapour vent connection which returns any condensate to the fuel tank vent pipe common to the three fuel tanks on each side. This pipe does not vent directly to atmosphere, but a separate vent pipe, terminating in three branches, each fitted with a nitrogen valve, provides an external vent through No. 3 tank (*see fig. 8*). Fire risk is minimised by the introduction of nitrogen to replace fuel as it is withdrawn. A priming pump in each inboard nacelle is connected to the two engines on the same side. Electrical fuel contents gauges, boost gauges, fuel pressure warning lamps, oil dilution switches, and switches for the Pulsometer pumps are provided in the cockpit. A drain valve assembly for the whole system is mounted on the front spar in the port inboard nacelle (*see Sect. 4, Chap. 3*). Fuel consumption by each engine is recorded by flowmeter on the flight engineer's panel. (*For details of the fuel system forward of the firewall, see A.P.2861A and A.P.1590P, S and U, Vol. I*).

4. Provision is made for fitting long range auxiliary tanks. Either one or two tanks, each of 400 gall. capacity, can be slung in the bomb cell (*see relevant illustrations in Sect. 4, Chap. 3*), connecting to a T-piece and to Flexatex pipes already installed in the standard aircraft so that either of, or both, the No. 1 tanks can be re-fuelled from the auxiliary tanks. For this purpose, two control cocks are fitted as standard behind the front spar.

5. ***Pipe system.***—The pipes in the system, with the following exceptions, are of Flexatex flexible hose:—

(a) Vent connections between fuel tanks; vent pipes to atmosphere from the No. 3 tanks; No. 1 tank filler drains; lower sections of No. 2 and No. 3 tank filler drains—all these are light alloy.

(b) Priming pipes and boost pipes are of copper to the firewall, but forward of the firewall the connection is by flexible, metal-braided Superflexit tubing.

(c) Vent pipe is connected to elbow on No. 2 tank by a 16½ in. length of P.R. hose.

6. The delivery pipes run from the outboard bottom rear corner of each No. 1 tank, and from the inboard bottom rear corner of each of the four outboard tanks, into the inboard and outboard valances respectively of the main wheel compartment (*see fig. 8*), and thence forward in the valance walls to the distributor tank (*see fig. 10*). A manually-operated stop-cock for ground servicing is provided in these pipe lines in the valances, access being through detachable doors which cannot be replaced while the cock is in the "off" position.

7. The inboard engine delivery pipe from the distributor tank passes forward to an A.G.S. type filter mounted on the forward face of the firewall. Delivery to the outboard engine is by pipe from distributor to front spar and outboard along that spar behind the leading edge to a filter mounted on the outboard engine firewall.

8. The vent pipes connecting the tanks lie between the spars, inclining downward towards the No. 1 tanks. Any liquid fuel returned through the vapour vent pipes of the outboard engines will flow to the No. 2 tanks, and from the inboard engines to the No. 1 tanks. The distributor tanks are included in the vapour vent circuit by a pipe from the upper union

Engine Installation

on the distributor tank to the common vent pipe. The nitrogen system is connected to the vent pipes on each side.

9. ***Nitrogen system.***—This system provides for the introduction of nitrogen into the fuel tanks, replacing the fuel as used, and minimising fire risk. The nitrogen is stored at 1,800 lb. per sq. in. in bottles similar to those used for oxygen. Seven bottles are mounted vertically on the forward face of the rear spar in the fuselage, and four on the port wall and six on the starboard wall of the centre section. Above the starboard bottles is the control valve and a pressure gauge. Nitrogen is led at high pressure through brass tubing to a filter and then to a Palmer reducing valve on the outboard rib of each inboard nacelle, to bring the pressure down to 15/25 lb. per sq. in. Pressure is further reduced to 0·25 lb. per sq. in. by a nearby Amal valve, and the gas is then introduced to the vent pipes of the six fuel tanks through light-alloy and Flexatex tubing. To prevent ingress of air to the fuel tanks—unless the nitrogen supply fails to compensate for the volume of fuel used—and to prevent loss of nitrogen, a pressure control valve operating in both directions at 0·25 lb. per sq. in., is fitted in each of the three vent outlets of the No. 3 tanks. Nitrogen is turned on whilst the engines are running and, as the tank fuel level decreases during flight, any remaining air is diluted with nitrogen beyond the point at which the proportion of oxygen still present is sufficient to support combustion. After re-fuelling, nitrogen flow can be turned on for a few minutes, with the tank filler caps slackened, to allow residual air above the level of the fuel to be diluted with nitrogen as far as possible.

10. The charging point in the starboard bomb door valance of the fuselage centre section is fitted with a special extension differing from that used for oxygen system charging, to prevent any possibility of confusion when charging oxygen and nitrogen systems.

11. ***Priming system.***—A priming switch, motor switch, and warning lamp on the pilot's panel connect with solenoid-operated priming valves in each inboard nacelle and to the adjacent motor-driven pump (*fig. 9*). This pump draws fuel from the distributor tank through a flexible pipe and delivers through copper piping to the doper or priming connections on the firewall of each engine, from which flexible, metallic-braided pipes run to the induction unions. An alternative, manually-operated, system is fitted to earlier aircraft. This incorporates a Ki-Gass pump, Y-piece and non-return valve mounted near the port and starboard fuel distributor tanks in the inboard nacelles. Fuel is drawn from that tank and pumped to either inboard or outboard engine, a separate cock being provided between the pump and each engine. A 3-way selector cock, for use when priming with high volatility fuel, is fitted in the pipe line between the distributor tank and the pump.

12. ***Fuel cocks.***—Four separate levers at the base of the pilot's instrument panel control the fuel cocks (*fig. 1*). In each of the connections on the distributor tanks for fuel delivery to the engines is a rotary valve (*fig. 10*) with external lever and Teleflex control, which in turn is moved by chains and tie rods linked to the pilot's fuel cock control levers. It should be noted that whilst the inboard delivery pipe of the starboard distributor tank feeds the inboard engine, the inboard delivery pipe of the port distributor tank is connected across the spar to the outboard engine. Six stop-cocks (for servicing only) are provided in the inboard nacelles (*see para. 6*) for individual isolation of tanks; one drain cock on the port inboard nacelle; one cock for the cross-feed line forward of the front spar, and two cocks for use when fuselage auxiliary tanks are fitted.

13. ***Fuel tanks.***—The No. 1 tanks are of light-alloy sheet, seam welded, with top-hat section stringers spot welded to the shell and baffles bolted to the stringers (*fig. 11*). Self-sealing protective covering is cemented over the surface of the shell, and clamped by flanged rings at the edges of areas cut out to accommodate filler cap, vent elbow, inspection doors and similar fittings. Access doors are covered by doped-on rip patches. The filler cap is located in a well or drip tray from which a drain tube passes aft. In the base of the tank is an hydraulically operated jettison valve with which is incorporated an extensible rubber pipe. This valve is controlled from a lever on the pilot's floor. Mod. 1445

Engine Installation

introduced an access door, to enable the valve to be serviced without removal of tank being necessary. Tank capacities are 580 gall. each.

14. No. 2 and No. 3 tanks are of flexible construction, reinforced by internal partitions and having removal straps which, when not in use, are folded down on top of the tanks. A filler cap with splash tray, a drain pipe lying in a groove across the tank and three manhole covers are located on the upper surface of each No. 2 tank. The capacity of No. 2 tank is 545 gall. (*see A.P.1464D, Vol. I*). No. 3 tanks follow the same general construction but have a nitrogen vent elbow at the forward outboard corner. Each of these tanks is of 300 gall. capacity. The cork float valve in No. 3 tank for fuel level indication is metal lined in aircraft in which Mod. 1474 is embodied.

15. All the tanks have a drain sump, vent connection, and an electrical connection between the fuel gauge transmitter and its appropriate gauge on the pilot's panel. A vapour separator is fitted in the elbow at the bottom of the auxiliary tanks.

16. ***Pulsometer pumps.***—The four Pulsometer pumps are located in pairs at the base of the fuel distributor tanks (*fig. 10*) and controlled by independent switches on the flight engineer's panel, on which panel are also grouped the fuel pressure indicators, fuel pump test switches and tank contents gauges. Each Pulsometer pump has its own filter.

17. ***Boost gauges.***—The four boost gauges on the pilot's instrument panel are connected to the engines by copper pipes which run down the starboard wall and pass through the forward bulkhead (former E) and then below the floor on the starboard side to the front spar to continue to their respective unions on the firewalls, from which point final connection is made by Superflexit pipe.

Oil system

18. ***General.***—Each engine has an independent oil system, provided by a separate tank in each nacelle (*fig. 12*). The inboard tank is mounted behind the front spar and the outboard tank between the sub-frame tubing. The main feed pipe from each tank connects at the filter union in the base of the tank, passes through the firewall and then forward to the engine oil pump. Return flow is through the cooler, on the starboard side of the coolant radiators below the front of the engine, to the top of the partial circulation compartment in the oil tank. A vent pipe runs to the top of the tank from a connection on the starboard side of the engine. The propeller feathering motor is mounted at the base of the sub-frame and is fed from the base of the oil tank; a flexible pipe from the pump outlet leads to a union forward of the firewall and thence to the operating unit at the forward end of the engine. Pipes are of copper, with flexible couplings, and supported by bolted split-rings where they pass through the firewall.

19. Oil temperature gauges are mounted on the flight engineer's panel, but the oil pressure gauges are on the pilot's instrument board. Also on the flight engineer's panel are the oil dilution switches and push-button. The oil dilution system operates through the medium of a solenoid control valve on the engine mounting, the valve introducing a supply of fuel from the pump into the oil feed pipe when the circuit is energised from the push-button control (*see also A.P.2095—Pilot's Notes, General*).

20. ***Oil tanks.***—Inboard and outboard tanks are of the same capacity, although different in shape. Each contains 37½ gall. of oil (of which two gallons are reserved for the hydromatic propeller feathering unit) and space for 4½ gall. air. Tanks are of light-alloy sheet with welded joints. The partial circulation compartment is a circular member of two gallons capacity extending the full depth of the tank, the top portion opening out to form a de-aerating ramp and diffuser ring. Oil returning from the cooler passes through a nozzle into this ring and is dispersed over the ramp as it flows into the compartment. The circular member and ramp are welded as one unit, but the bottom of the compartment is formed by a separate ring into which the upper portion fits and which leaves an annular space. The upper edge of this ring governs the hydromatic oil level, below which oil cannot enter the filter. The two lower sections are riveted together with distance pieces to maintain the annular space. Bottom ring and oil filter are attached to the tank shell by studs.

Engine Installation

21. The oil filler screwed cap of the inboard tank is reached through a door in the main plane upper surface immediately aft of the leading edge. The dipstick is stowed inside the filler neck. The drain plug and filter in the base of the tank are accessible from the undercarriage compartment; the filter element can be withdrawn completely. On the inboard side of the starboard tank and on the outboard side of the port tank is an inspection door, and there is an inspection cover above the vent compartment of each tank. The outboard oil tank has its filler neck and screwed cap projecting outboard, an inspection door on the inboard side, and an inspection cover above the vent space. The dipstick is clipped inside the filler neck. In the tail-down position the oil level corresponds to the bottom edge of the filler opening. Bottom surface connections are similar to those on the inboard tank:—filter assembly, drain cock and plug, and union for feathering motor pump pipe.

22. Self-sealing covering is applied over the whole area of oil tanks fitted to aircraft prior to the introduction of Mod. 1203, and where the covering is cut for connections and fittings, the edges are clamped by flanged rings which pick up on the projecting studs attaching those fittings and connections. In aircraft embodying Mod. 1203, the covering is of felt and rubberized fabric and the area surrounding the clamping rings is built up to $\frac{11}{32}$ in. thickness, the normal thickness of covering being $\frac{3}{16}$ in.

23. The inboard tank is secured by two steel straps, the upper section looped to a cross tube at the rear of the tank, and the lower section bolted to the bottom boom of the front spar. The straps are tensioned by turnbuckles and the tank is thus held firmly, with its upper shoulders located against the contour of the engine intermediate ribs. The outboard tank is cradled in two steel straps extending fore and aft between two cross members of the sub-frame tubing, and partly supported by the foremost tube. The straps run from the same cross members, up and over the tank, the tensioning turnbuckles being on the top surface.

24. ***Oil filter.***—The filter projects below the bottom of the tank but the inlet ports are above the level of the tank bottom and are surrounded by a baffle ring below which the oil must pass. The body is a light-alloy casting, to the lower end of which the cleaning element is secured by means of a hand screw in a special nut fitting. Two arms forming part of this nut engage in a groove in the base of the body and are then turned through 90 deg. The hand screw is then tightened and both hand screw and nut arms locked with wire. When the element is withdrawn for cleaning, a spring-loaded piston, previously held by prongs on the element, is forced down to seal off the inlet ports.

Engine controls

25. ***General.***—The pilot's throttle and propeller control levers are grouped in positional sequence in gated quadrants on the central control pedestal, with the boost control cut-out lever and the four master fuel cock levers arranged at each side on an extension of the pedestal (*fig. 1*). The boost control cut-out lever is connected only when Merlin 68 engines are installed and can be retained in either "normal" or "cut-out" position. The throttle and propeller speed control levers have hand-operated knobs to tighten friction discs and retain the control levers in any selected position.

26. Control movement is transmitted by a system of tie-rods linked by chains, passing down the control pedestal to countershafts at the front end of the fuselage floor (*fig. 2*), then by similar combination of rods and chains to and through sprocket boxes mounted on the front spar, thence outboard to the engines (*fig. 1*). The control tie-rods run aft from the forward countershafts through fairleads below the main floor to connect with chains on the sprockets of a countershaft under the rear of the fuselage front centre section (*fig. 5 and 6*) from the duplicate sprockets of which assembly vertical chains and tie-rods convey the motion through two sets of sprocket boxes on the front spar—inner and outer boxes for throttle and propeller controls and similar boxes for fuel cock controls (*fig. 4*). Tie-rods travel outward in each direction, supported by fairleads, to control boxes on the front spar in each nacelle (*fig. 7*); outboard engine and propeller control rods are linked by chains which pass over sprockets on a layshaft on the undercarriage

Engine Installation

support beam, the outer lengths of rod continuing through fairleads mounted on the ribs of the main plane leading edge and then to chains in the control box on the spar in the outboard nacelle. The levers on the upper shaft of this box are connected by rods with ball-and-socket joints to the relative levers on a countershaft at the forward face of the firewall; the angular motion of the countershaft levers operates, in a fore-and-aft direction, rods connected to the engine (*see also relevant illustrations in Sect. 4, Chap. 3*). A cover shields the centre part of the countershaft assembly.

27. Two cam-and-lever-operated switches are incorporated in the linkage of the inboard engine throttle connections in the control pedestal (*fig. 3*). The switches make contact when the throttles are less than one quarter open and complete an electrical circuit which causes a warning horn to sound unless the main wheels are locked in their "down" position.

28. ***Boost control cut-out.***—This control although fitted on all aircraft is connected only on Mk. II aircraft with Merlin 68 engines. Linkage from the lever on the left-hand side of the pedestal extension is by chains and tie rods to the rear control countershaft under the floor on the port side of the fuselage front centre section, then to cables which divide at a sprocket box on the fuselage front spar (*fig. 4*). The cables pass outboard through fairleads on the fuselage wall and on the front spar, and ride over free pulleys mounted below the inboard nacelle spar sprocket boxes (*fig. 7*). The inboard engine control cable passes forward to the appropriate engine lever and the outboard control cable is guided, through fairleads in the ribs of the main plane leading edge, to a pulley on the spar web inboard of the outboard engine control box. Cables terminate in a turnbuckle and link, for connection to the engine lever. The cable to the inboard engine has a coil spring interposed between cable end and turnbuckle; the coil spring for the outer cable forms a connector between the ends of cable lengths between main plane nose ribs 5 and 6, inboard of which—between ribs 4 and 5—is a strainer spring which is set with a dimension of 5·4 in. between its attachment pin centres.

29. ***Fuel cock controls.***—The fuel cock controls are similar in type and layout to those for the throttle and propeller controls, using chains and tie rods linked up through port and starboard sprocket boxes on the fuselage front spar (*fig. 4*). From these two boxes, tie rods continue outward through fairleads on the front spar to connect with chains at a sprocket bracket assembly (*fig. 7*) between the inboard engine and the fuselage wall. The chains partly rotate upper and lower sprockets with integral arms which, in turn, make final contact with the levers controlling the rotary valves at the base of the fuel distributor box by means of Teleflex controls.

30. ***Supercharger control.***—On Mk. I aircraft the two-speed, two-stage, liquid-cooled supercharger is controlled through an electro-pneumatic ram; the switch is on the pilot's instrument panel. The Mk. II model has a solenoid-operated control. A warning lamp on the pilot's instrument panel lights when the supercharger control is at F.S. (*For details of the pneumatic system see Sect. 9, and for the routing chart and circuit see Sect. 6 and 10 respectively*).

31. ***Slow running cut-out.***—The slow running cut-out for each engine is operated by pneumatic ram, controlled by separate switches on the upper right-hand side of the pilot's panel. (*For details of the pneumatic system see Sect. 9, and for the routing chart and circuit see Sect. 6 and 10 respectively*).

32. ***Air cleaner.***—An air cleaner on each engine normally comes into operation when the undercarriage is down, but can be made operative in flight by electric control of the spring-return pneumatic ram. A switch for this purpose is provided on the pilot's panel. (*See Sect. 6, 9 and 10 for descriptive details of pneumatic and electrical systems*).

33. ***Hot and cold air intakes.***—The shutters governing the hot and cold air intakes (when fitted) for each engine are operated by pneumatic ram electrically controlled from a switch on the pilot's instrument panel. This switch, and airframe wiring, is fitted whether

Engine Installation

or not the intake shutters and ram are installed on the power plant. (*For the pneumatic layout see Sect. 9, and for the electrical circuit see Sect. 6 and 10*).

34. ***Radiator shutters.***—These are governed by thermostat and controlled by electro - pneumatic rams. By use of the switches on the flight engineer's panel, the control can be over-ridden to open the shutters.

Cooling system

35. Coolant for each engine is circulated through a header tank mounted behind the front cowling diaphragm and a secondary surface radiator suspended below the forward end of the engine mounting. The supercharger has an inter-cooler, the radiator of which is curved to harmonize with the semi-circular contour of the radiator group, fitting between the oil cooler and the main radiator. Pressure in the system is controlled by a thermostatic relief valve in the header tank. Air flow through the radiator is regulated by thermostatically controlled shutters with electro-pneumatic ram. (*For details of the pneumatic system see Sect. 9, and for electrical data see Sect. 6 and 10*).

36. The inboard engine cooling systems are of greater capacity than those of the outboard engines, to cater for the cabin heating system. The radiator connected to the port inboard heating supply is on the starboard side of the fuselage, aft of the rear spar, while the cockpit is supplied with warm air from a radiator in the leading edge of the starboard main plane, fed from the starboard inboard engine. The flow pipe to each cabin heater radiator is taken from an outlet at the top of the engine, and the return is by connection to the return pipe of the main radiators. Pipes are coupled by flexible connections and pass through the sub-frames and the leading edge of the main plane to the heater radiators. Piping from the port engine continues across the fuselage to the starboard side and then below the fuselage floor to link up with the radiator mounted on the starboard wall. Stop-cocks are fitted in the coolant pipe lines, forward of the front spar. Pet cocks are provided in the top of each radiator and at the highest point of the return pipe, with a drain plug in the base of each radiator.

Engine nacelle cowling and fairings

37. The inboard engine nacelle comprises the engine cowling, cowlings extending fore and aft of the firewall, undercarriage doors and valances, and two fairings below the trailing edge of the main plane. The outboard nacelle consists of the engine cowling, fairing panels enclosing the sub-frame and a rear section fairing below the main plane.

38. ***Engine cowling forward of cowling ring.***—Hinged duralumin top panels give access to the intercooler header tank filler; top front panels cover the main header tank filler; exhaust panels with louvres shield the manifolds and flame dampers; air intake and radiator scoop are one assembly; contoured side panels are hinged and have retaining cables so that they can be used as servicing platforms; and an air cleaner fairing panel and bottom panel with radiator flap complete the cowling of the power plant. Dzus fasteners are used throughout. (*For descripion of cowlings, radiator flaps, and hot and cold air-intakes, see A.P.2861A, Vol. I*).

39. ***Engine cowling aft of cowling ring—inboard.***—Four detachable panels of light-alloy sheet enclose the engine sub-frame, and consist of top and bottom panels, two side panels and a hinged fairing between the top panel and the front spar. The detachable panels have stiffeners at their edges and intermediate stiffeners of top-hat section. The bottom panels extend from the engine cowling ring to the forward edge of the undercarriage doors; the side panels extend further aft—to the forward edge of the undercarriage doors; the rearmost top panel is hinged to the front spar top boom, and the top detachable panel is contoured to cover the remaining area, its rearmost edge overlapping the hinge panel, to which it is attached by Dzus fasteners. Both the upper panels are supported on the nacelle nose ribs, the hinged panel secured by clips on the sub-frame tubing by means of two Oddie fasteners fitted to brackets at the forward edge of this panel. Dzus fasteners are used for all other cowling attachments. On aircraft prior

Engine Installation

to Mod. 1276, the inboard side panel of the port inboard engine is provided with aperture and louvre for the auto-pilot oil cooler. Mod. 1276 re-positioned the louvre to the leading edge. The port outboard and starboard inboard side panels of inboard engines have louvres registering with ducts for air flow to the generators.

40. ***Engine cowling aft of cowling ring—outboard.***—The sub-frame is enclosed by two top, one bottom, and two side panels, secured by Dzus fasteners. The top rear panel is not hinged. An access door for the oil tank filler cap is located in the outboard side panel. The panels are of light-alloy sheet, reinforced by angles at the edges, and by top-hat section stiffeners. A fairing rail for the upper panels is bolted between the nacelle nose ribs.

41. ***Undercarriage doors and valances.***—The valance is of channel section formers and stringers riveted to attachment channels at the top and to a channel section hinge beam at the bottom. The upper channel is mounted to the engine ribs by bolts and anchor nuts. The doors swing on piano hinges and are constructed with channel-section hinge beams and lower edge members, with intercostals and stringers. Valances and doors are plated with light-alloy sheet. Door operation is mechanical, through a connecting rod attached at one end to a ball-bearing eyebolt at the lower edge of the door and to a collar on the oleo leg at the other end. The valance hinge beam is extended forward beyond the doors, fitted with two bolts to the undercarriage support beams and forming a cowling attachment rail.

42. ***Nacelle trailing-edge fairings.***—The inboard nacelle fairing for the underside of the trailing edge, rear of the undercarriage doors, is divided into two sections. The front section is based on four light-alloy frames, the foremost forming a bulkhead for the rear of the main undercarriage bay, and is plated with light-alloy. Attachment is by its flanged edges to the underside of the main plane trailing edge, and by bolts through the forward frame to the valance channel. The rear section is of three channel-section light-alloy frames and four L-section stringers over which light-alloy plating is riveted. This section is bolted to the inner flap and moves through an arc, partly entering the forward section when the flap is lowered. Fairing of the outboard nacelles is completed by a fairing member made of light-alloy sheet over seven light-alloy formers. From the upper edges of this member are tapering, contoured fillets attaching to the underside of the main plane by Dzus fasteners. The forward end is bolted, at the top of the former, to clips on the sub-frame tubing.

Undercarriage support beams

43. The inboard engine sub-frame and undercarriage unit are supported by a pair of beams with diagonal bracing. The beams are light-alloy castings, with integral lugs for engine sub-frame attachment and for the diagonal tube. The lower end of each beam is milled to form a fork in which pivots the top end fitting of the oleo leg; the shouldered bolt on which the leg pivots also screws into a socket in the ends of a cross strut tying the lower ends of the beams. These support beams are bolted to the front spar and to the engine ribs between the spars. On top of the beams are pads to allow engine changing gantry attachment sockets to be fitted.

Engine sub-frames

44. Both inboard and outboard sub-frames are of steel tubing with welded joints. The engine mounting frame picks up on four lugs extending forward from the sub-frame. The inboard sub-frame engages in lugs at both top and bottom of the undercarriage support beams, and also to inverted T-section brackets on the lower forward face of each beam (*fig. 7, 9 and 14*). The gear box and engine auxiliaries (*fig. 13*) are mounted on a panel clipped to the sub-frame tubing aft of the firewall, with the feathering motor pump installed below. The outboard sub-frame is mounted below the main plane and bolted at four points to reinforced steel channels on the front spar, tapering to a single fork end attachment to pick up on a mounting channel on the rear spar. Two detachable diagonal struts in the bottom plane of the outboard sub-frame allow for installation or removal of the oil tank.

Engine Installation

Firewall

45. The circular firewall is of three plates, made either from 22G mild steel or tinned steel, comprising a central vertical plate flanked by side plates, the vertical butting edges joined by top-hat section stiffeners riveted at their flanges to the adjacent plates. In addition, there are five lateral stiffeners of similar section, two across the starboard side panel, one at the lower portion of the port side panel and two on the centre panel. Further reinforcement is given by the two extruded sections which form the mounting for the engine and propeller control lever assemblies. All these stiffeners and the extruded sections are on the forward face of the firewall. Attachment is by clips and bolts to the forward face of the sub-frame tubing. The inboard firewall has also a flanged plate bolted to the lower rear face and connecting to the sub-frame cross tube tying the lower ends of the undercarriage support beams. Sealing plates with asbestos packing are fitted at the points where the engine attachment fork ends pass through the firewall. Light - alloy angles, carrying Dzus fastener springs for cowling attachment, are riveted to both front and rear edges of the firewall plates. At the lower forward face of the bottom plate is a small oil collector tank to which the engine drain manifold is connected.

Armour plating

46. Armour plate guards at the base of the outboard sub-frame rear cross member, and at the front of the rear nacelle fairing, protect the oil tank and oil filter. The forward armour plating is attached by clips and bolts to the tubing; the rear armour plating has top and bottom cross tubes with welded brackets which are clipped to the rear tubular members of the sub-frame. All firewalls have a small area of armour plating on the aft face, immediately rear of the fuel filter. This plating is attached direct by four 2 B.A. bolts.

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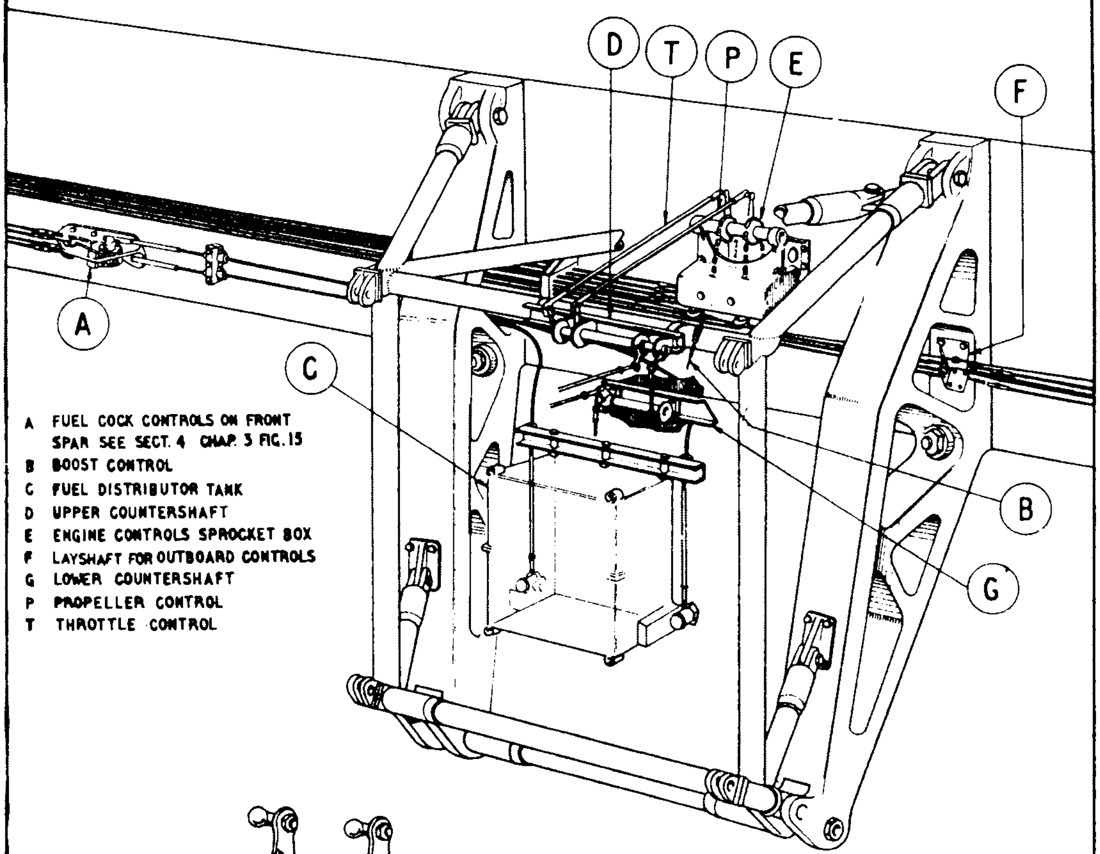
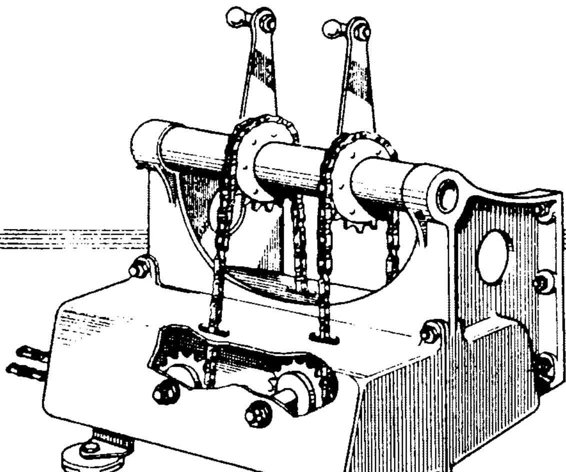
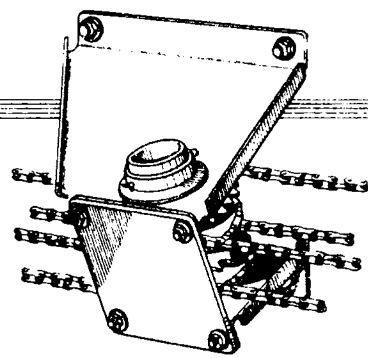




ENGINE CONTROLS SPROCKET BOX-E



LAYSHAFT-F

FIG. 7 ENGINE AND SECONDARY CONTROLS-MAIN PLANE FIG. 7

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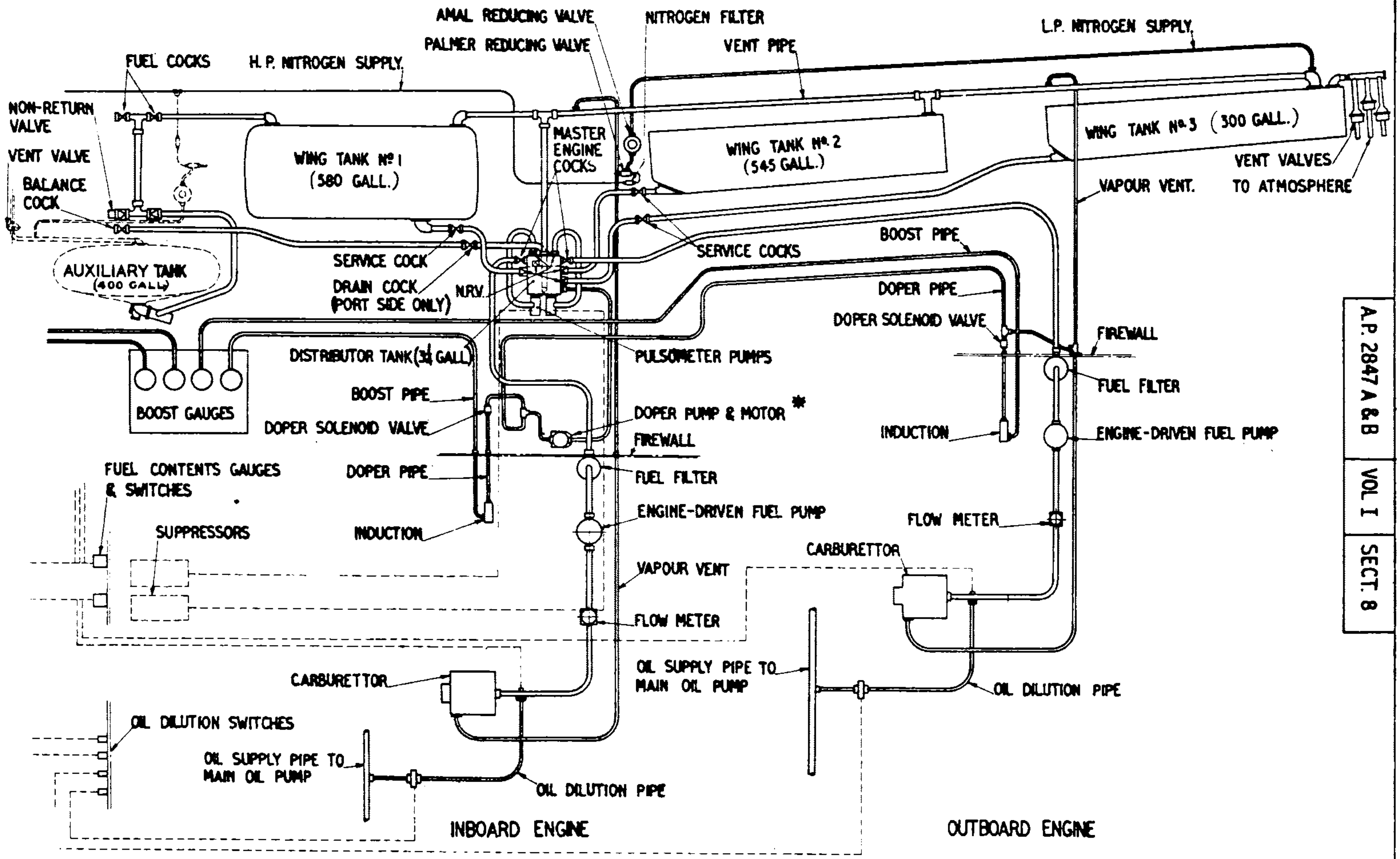
FIG. 8

FUEL SYSTEM



* WHEN A HAND PRIMING PUMP IS FITTED A STOP COCK IS PROVIDED IN THE INBOARD NACELLE IN THE DELIVERY PIPE TO EACH ENGINE, AND THE DOPER SOLENOID VALVES ARE OMITTED.

FIG. 8

PP4029 M G2286 9-45 1050 C & P Gp. 959 (4)

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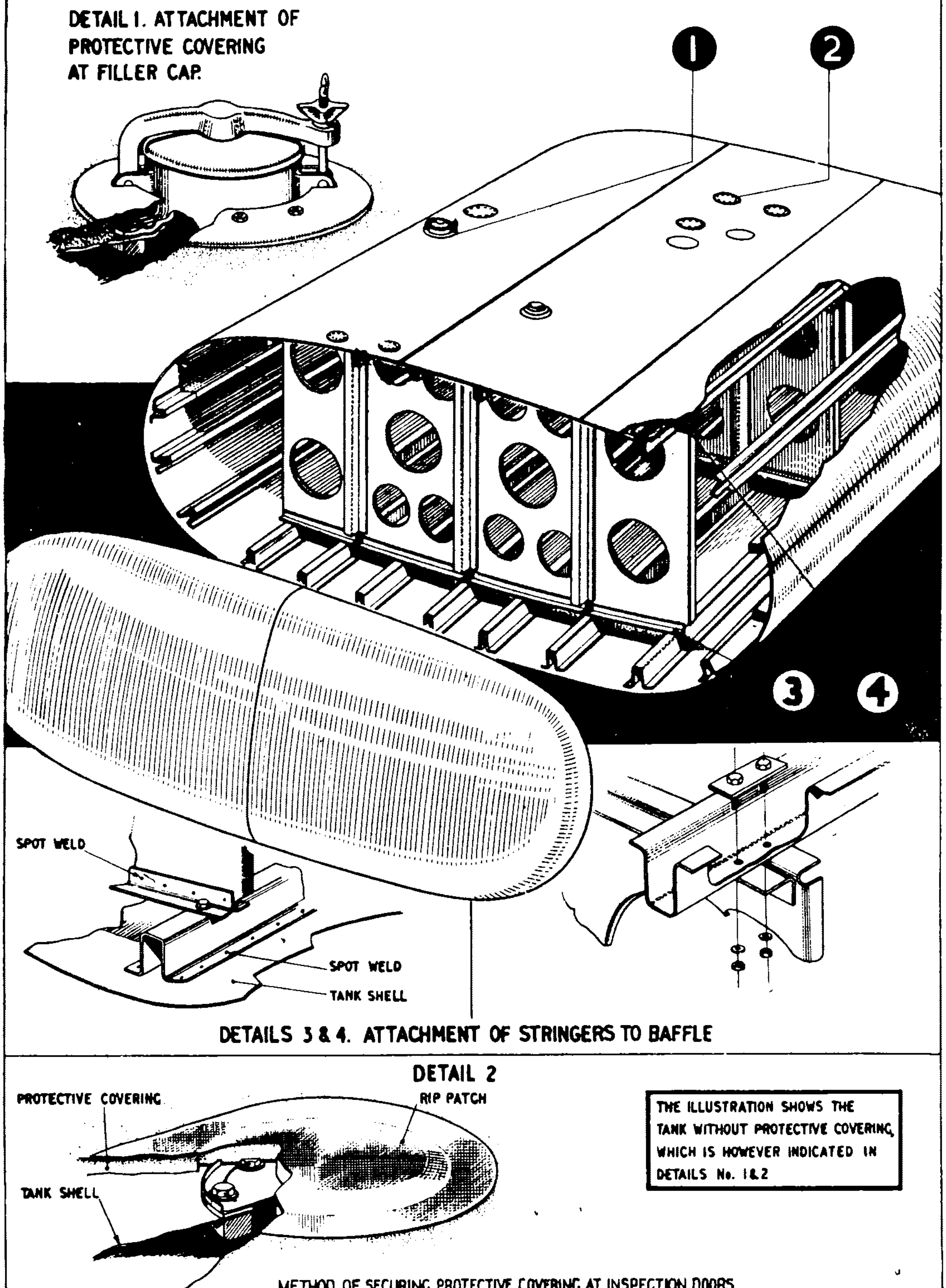

FIG. 11 — **FUEL TANK No. 1** — FIG. 11

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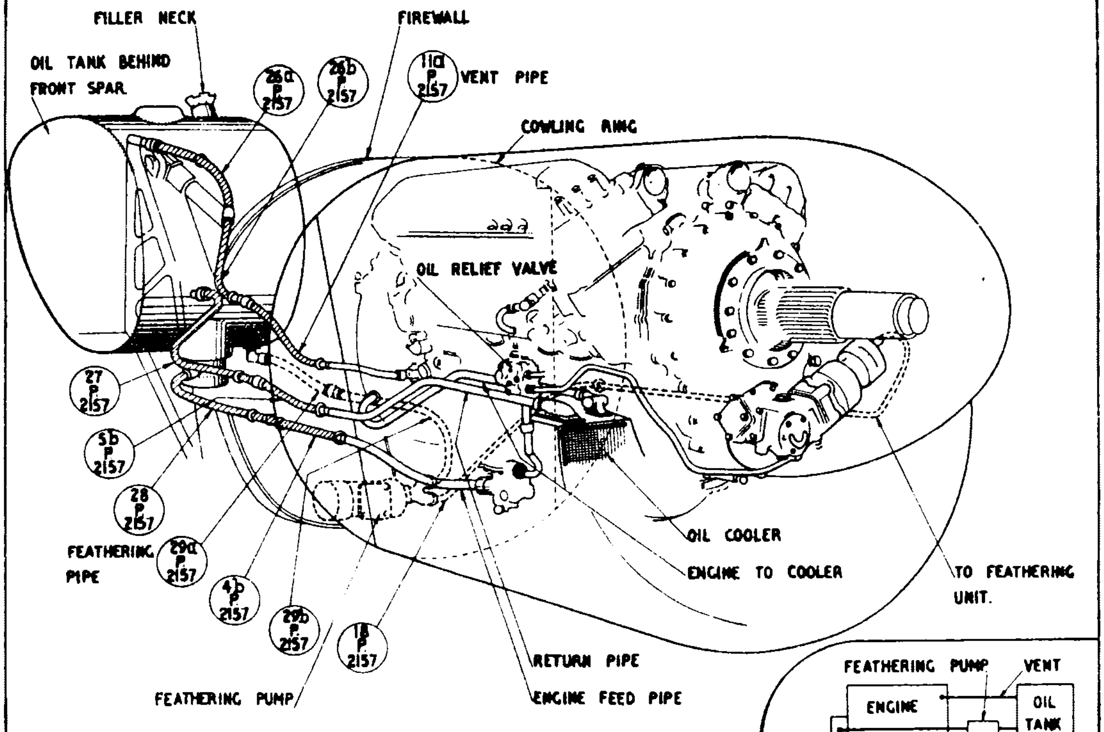
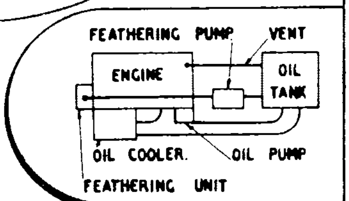
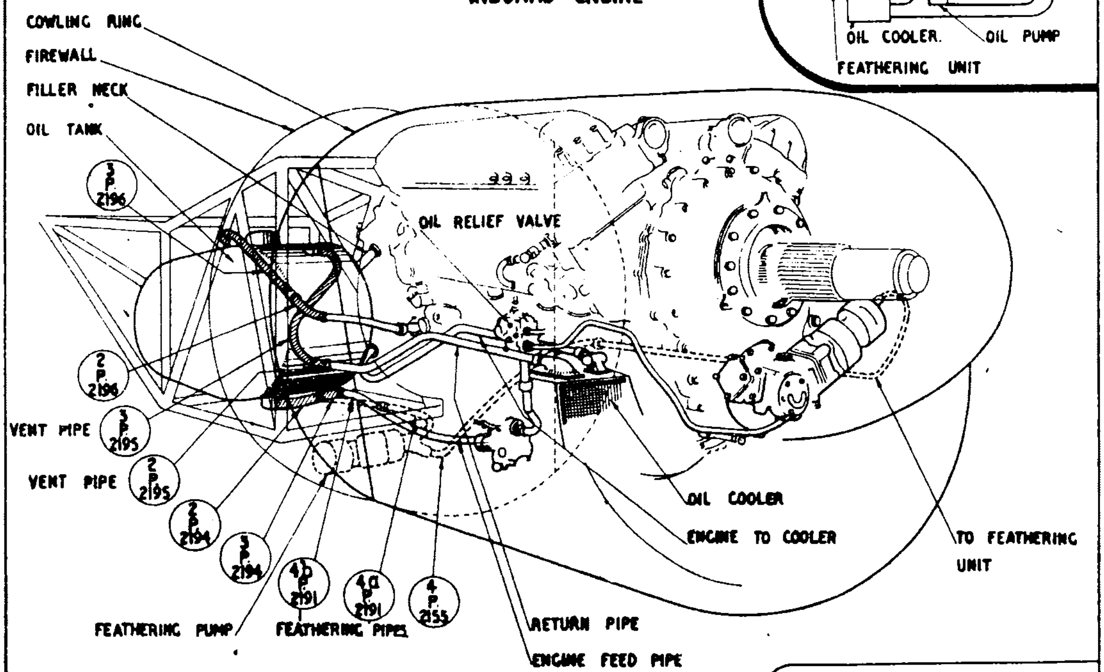


INBOARD ENGINE





OUTBOARD ENGINE

PIPES AFT OF COWLING RING SHOWN SHADED

FIG. 12 | OIL SYSTEM - INBOARD AND OUTBOARD ENGINE | FIG. 12

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HYDRAULIC AND PNEUMATIC SYSTEMS 9

(11065) T14574/G2588 1050 11/44 M20691 C & P 752

HYDRAULIC AND PNEUMATIC SYSTEMS

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

Hydraulic system— General services

1. The hydraulic system operates the main wheel units, bomb doors, flaps and fuel jettison valves. An engine-driven pump is mounted on the auxiliaries gearbox at the rear of the firewall of each inboard engine. Fluid supply to the jacks of the systems concerned is controlled by lever-operated valve boxes in the cockpit (*see Sect. 1*). A hand pump is mounted in a vertical position on the port wall of the fuselage centre section, between the front spar and the fuselage doors, immediately aft of the reservoir and distributor block. The hand pump incorporates a pressure-relief valve set to blow off at 850 ± 25 lb. per sq. in. and is in circuit with No. 1 fuel tank jettison and air vent valves, bomb door jacks, flap jacks, and undercarriage main wheel jacks, but in flight its practical use is limited to emergency operation of the fuel jettison system. It is possible to operate the bomb doors by means of the hand pump, but the large capacities of the jacks make it virtually impossible to operate the other services by this method. The engine-driven pumps idle, circulating fluid at low pressure through a filter and automatic cut-out and back through a by-pass to the reservoir, until any of the system control valves are opened. The cut-out closes at 180 lb. per sq. in. pressure and opens at 800/850 lb. per sq. in. pressure (*see para. 3*). Fig. 1 is a circuit diagram of the hydraulic system. The layout of the pipe lines and system components is illustrated in Sect. 4, Chap. 3. (For description of components *see* A.P.1803D, Vol. I.)

Supply circuit

2. The supply and return lines from each pump incorporate Avery self-sealing couplings which seal the pipes when the aircraft pumps are disconnected, as for example when it is desired to connect a ground test rig to the system. The self-sealing couplings are mounted on the cross stay between each pair of undercarriage beams. Reaction of either engine-driven pump upon the other is prevented by a non-return valve in each supply line.

3. When any circuit is operated, initial pressure is supplied from an accumulator connected to the pump delivery line and to the automatic cut-out valve. The accumulator is on the delivery side of the cut-out valve; selection of any circuit by the appropriate control valve results in immediate response to the pressure in the accumulator, and the pistons of the related jacks start to move. When the pressure in the accumulator decreases to 180 lb. per sq. in., the automatic cut-out valve operates and directs the fluid from the engine-driven pumps to the circuit then functioning. This condition obtains

Hydraulic and Pneumatic Systems

until the jacks have reached the end of their travel, after which the continued delivery of fluid from the pumps builds up a pressure of 800/850 lb. per sq. in. in the circuit. The cut-out valve then operates and diverts the fluid delivery through a by-pass to the reservoir and the pumps again idle.

4. An emergency air-operating valve connected to a remote-control knob mounted forward of the flight engineer's panel releases the supply of compressed air for lowering the main wheel units and flaps in the event of failure of the hydraulic system. Two emergency air bottles, of a type similar to those used for oxygen and inflated to 1,200 lb. per sq. in., are mounted at the rear of the front spar.

Main wheels circuit

5. Control of the main wheels is from a two-position selector valve box on the right of the pilot's seat. The manually-controlled lever moves in natural sense. A spring-loaded bolt, mounted transversely, prevents inadvertent movement of the lever to the UP position. When the UP position is selected, fluid is delivered through a non-return valve and through the undercarriage control valve to the under-surface of the jack pistons, and raises the undercarriage. The reverse movement, with the control lever in the DOWN position, entails a similar sequence but the fluid, now directed to the upper area of the jack pistons, is taken through valve units on the rear spar, in the undercarriage compartment, which incorporate the emergency air non-return valves. Fluid displaced from the reverse side of the pistons has a free flow through the selector valve box to the distributor-block at the base of the reservoir, and so to the reservoir itself, which is mounted above the front spar, on the port side of the fuselage.

Flaps circuit

6. The control unit for flap operation is mounted below the pilot's floor, its handle projecting above the floor to the right of the pilot. The handle is moved vertically and can be set in one of three positions—UP, DOWN and NEUTRAL, the last-named being its normal position. Fluid from the main delivery pipe passes through a flap flow valve and a non-return valve to the control unit. The single flap jack mounted transversely on the main aircraft floor at the forward end of the rear centre section has one piston, located in its midway position when the flaps are half open, and a piston rod emerging from each end of the jack, to attach to the flap-operating tubes. When the control unit is in the DOWN position, fluid is delivered to the starboard side of the jack, moving the piston and rods to port, and sending the fluid on the other side of the piston back through the UP connection and pipe lines to the reservoir. The sequence is reversed when the UP position is selected. The neutral position of the control lever enables the flaps to be retained in any desired intermediate position. A flow valve is included between the control valve and the UP line to the jack, and a one-way restrictor valve in the DOWN line.

Emergency system—flaps and main wheels

7. In the event of failure of the engine-driven pumps or the main wheels circuit, the main wheels and flaps can be lowered by compressed air (*see para. 4*). The system is operated by means of the remote control knob forward of the flight engineer's panel; the main wheels lower at once, irrespective of the position of the main wheel control valve lever, but the flaps do not operate until the control lever is moved to the DOWN position. Air to the main wheel jacks is admitted to the upper side of the pistons through a non-return valve, near the compressed-air bottle then through an emergency air valve and a transfer valve. A pressure-relief valve set to blow off at 1,200 $\pm$ 50 lb. per sq. in. is in circuit with both the emergency air and hydraulic lines.

8. The air is locked in the main wheel system by the non-return valve, as soon as the wheels are down. Through the emergency air valves the compressed air passes to relief valves which are opened by the air pressure and allow the fluid displaced from the underside of the jack pistons to vent to atmosphere.

Hydraulic and Pneumatic Systems

Concurrently, two emergency air non-return valves admit air, and blank off the normal fluid supply, to the jacks.

9. Emergency air passes to the flap control unit by an independent pipe line and then makes use of the existing hydraulic pipes to pass through the control unit and a one-way restrictor to the DOWN union of each jack. Two non-return valves are included; one prevents hydraulic fluid entering the air line, the other prevents the air escaping into the hydraulic lines. Fluid displaced from the other side of the flap jack returns to the reservoir through the normal return pipe.

Bomb door circuit

10. The bomb doors are opened and closed by hydraulic pressure controlled from a selector valve and lever on the left-hand side of the pilot's seat. The lever is operated in the natural sense; to open the bomb doors it is pushed down, to close them it is raised. This valve is of a type similar to that for the main wheel units and has no neutral position. Fluid flow is through a non-return valve to the control valve and then direct to the upper or lower sides of the four bomb door jacks for OPEN and CLOSED positions respectively, and fluid from the reverse side of the jack piston is exhausted to the reservoir via the selector valve box.

11. ***Emergency opening of bomb doors.***—The bomb doors can be opened by operation of the hand pump, should the engine-driven pumps fail. The doors will partly open by gravity when the control lever is placed in the OPEN position, and, provided that the relative pipe-lines are intact, subsequent use of the hand pump will complete the operation.

Fuel jettison system

12. The contents of the two inboard (No. 1) tanks can be jettisoned. Operation of the circuit lifts a jettison valve, through which fuel is discarded, off its seating in the base of the tank, and opens a disc-type air valve in the top of the tank to compensate for the sudden reduction in volume (*see fig. 2*).

13. The upward movement of the jettison valve spindle operates a cable which withdraws a pin, releasing a small door in the tank access panel, immediately below the jettison valve. The opening of this hinged door releases a double-walled extensible rubber stocking which directs the jettisoned fuel clear of the aircraft; some of the fuel passes between the double walls of the stocking, stiffening this member.

14. Control of the jettison system is by a valve which is remotely operated by a control handle on the port side of the pilot's floor. There are two positions: NORMAL and JETTISON. When the control is moved to JETTISON, fluid is delivered under pressure from the hydraulic accumulator through the selector valve to the jettison and air valves of No. 1 tanks. The accumulator pressure must exceed 650 lb. per sq. in. for efficient operation of the system. If the pressure is below this figure, temporary actuation of one of the main hydraulic services—such as bomb doors—will cause the pumps to cut in and restore it. The pressure drop consequent upon operation of the jettison control is not sufficient to cause the automatic cut-out to respond.

15. By returning the control lever to NORMAL position, the pressure to the supply lines of the jettison and air valves is released, the valves are seated by return springs, and the fluid is exhausted to atmosphere through the control valve. No return line to the reservoir is fitted in the jettison system.

16. ***Emergency operation of jettison system.***—If the pressure in the accumulator is below 650 lb. per sq. in., and, owing to failure of the supply system cannot be built up by the method suggested in para. 14, it may still be possible to do it by operating the hand pump.

Pneumatic System

17. The pneumatic system (*see fig. 3 and Sect. 4, Chap. 3, fig. 22*) operates the wheel brakes and provides air pressure for the electro-pneumatic operation of the following

Hydraulic and Pneumatic Systems

units:—the thermostatically-controlled rams for the radiator flaps, the slow-running cut-out rams, the hot and cold air-intake rams (not fitted to some early aircraft), the rams for supercharger change-speed control on Mk. I aircraft (the supercharger change-speed is solenoid-operated on Mk. II aircraft) and the air cleaner rams.

17A. Compressed air for these services is supplied from a bottle in the fuselage nose. Pressure in the bottle is maintained at 450 lb. per sq. in. by a Heywood compressor on the starboard inboard engine. A pressure-maintaining valve, set to 160 lb. per sq. in., is fitted in the supply line to all services except brakes, ensuring that there is always sufficient pressure in reserve for brake operation by cutting off the air supply to the other services should the pressure fall to the minimum. Wheel brake working pressure is 125 lb. per sq. in. If the compressor supply should fail, several applications of the brakes can still be made from the residual pressure in the bottle, and the supercharger control will automatically engage M.S. gear.

18. ***Supply circuit.***—All piping in the pneumatic system is of 20 G light-alloy, except for the flexible hose connections in the nacelles, from the union on the firewall to the manifold on the engine diaphragm, and the flexible hose attached to the undercarriage struts for the wheel brake connections. The supply from the compressor is by pipe to an oil-water trap, type OWT/46, and thence to a pressure-regulating valve, type AR5/450/1, in the outboard side of the nacelle, from which fitting pipes continue across the front spar and below the floor in the starboard side of the fuselage to connect to the air bottle, mounted in the fuselage roof between formers F and G. An A.G.S.1200 air-charging valve is mounted on a cross tube between the undercarriage mounting beams at the rear of the starboard inboard firewall and connects by pipe and T-piece to the piping between the compressor and the oil-water trap. Air is delivered from the bottle through a filter to the brake and other services. Between the two short lengths of piping connecting the filter with a pressure-reducing valve—set to 220 lb. per sq. in.—is a T-piece from which a pipe branches to a pressure gauge, calibrated in three segments, below the pilot's instrument panel. The pressure-reducing valve is connected to a differential control valve by a pipe with a T-piece connecting to the pressure-maintaining valve, from which unit piping is led through the forward bulkhead (former E) and under the fuselage floor on the port side. The pipe line rises at the rear of the fuselage front centre section and extends outboard from a T-piece just forward of the front spar and through the wing root panels to supply the various pneumatic services in all four nacelles. The air filter, pressure-reducing valve and pressure-maintaining valve are grouped on a common panel mounted between formers F and G on the port wall of the fuselage nose section.

19. ***Brakes system.***—Brake operation is controlled by a curved lever hinged to the pilot's handwheel; motion is conveyed by Bowden cable to the differential control relay valve mounted on nose former F and linked by rod to the port rudder pedal arm. Air from the bottle passes through a filter and is distributed by the differential control valve to the wheel brake units. The triple pressure gauge below the pilot's instrument panel is connected to each of the two pipe lines leading from the differential valve to the port and starboard wheels, and thus registers the pressure in each of the brake supply pipes. (For description, operation and servicing of the units included in the brake system, *see* A.P.1519, Vol. I and A.P.2337, Vol. I).

20. ***Radiator flap system.***—The radiator flaps are thermostatically-controlled and are operated by electro-pneumatic rams supplied with air by a pipe line in circuit with the brakes system supply, through a connection between the pressure-maintaining valve and the pressure reducing valve. The piping runs aft in the port valance of the bomb cell and outboard, port and starboard, along the front spar. A light-alloy pipe which terminates at an adaptor on the firewall is connected by flexible pipe to a 5-way manifold on the forward face of the engine cowling ring or diaphragm. From this manifold, flexible pipes lead to the appropriate jacks, that for the radiator flap operating ram being on the port side of the

Hydraulic and Pneumatic Systems

power plant. (For details of operation and thermostatic control of these rams, *see* A.P. 2861A, Vol. I.)

21. ***Supercharger two-speed control.***—The air supply for the electro-pneumatic ram (Mk. I aircraft only) operating the super-charger control is taken by flexible pipe from the 5-way manifold on the engine diaphragm (*see para. 20*). On Mk. II aircraft the super-charger control is operated by solenoid. For the electrical installation, *see* Sect. 6 and 10, and for details of control *see* A.P.2140B, C, and D, Vol. I.

22. ***Slow-running cut-out control.***—The ram operating the slow-running cut-out is electro-pneumatically controlled; the air supply is from a connection on the manifold at the port side of the engine diaphragm. For electrical data *see* Sect. 6 and 10 and for details of control *see* A.P.2861A, Vol. I.

23. ***Hot and cold air intakes.***—Hot and cold air intake shutters, when fitted, are operated by an electro-pneumatic ram controlled by a switch on the pilot's instrument panel. Air supply is from a manifold, common to all the power plant pneumatic services, mounted on the engine diaphragm and connected by flexible pipe to a union on the firewall. The outlet union on the manifold is blanked off when these shutters are not fitted. (For electrical wiring *see* Sect. 6 and 10; for control *see* A.P.2861A, Vol. I.)

24. ***Air cleaner.***—This, also, has an electro-pneumatically controlled operating ram, mounted on the engine and with air supply connected from the 5-way manifold on the engine diaphragm (*see para. 20*). The valve which controls the ram is electrically connected, through micro-switches, to the main wheel units UP latches. The cleaners come into operation when the main wheels are locked DOWN and, with the switch at its OUT position, will retract when the main wheels are locked UP. The cleaners can, however, be extended in flight by moving the switch to IN. (For electrical data, *see* Sect. 6 and 10, and for operating details *see* A.P.2861A, Vol. I.)

Air charging

25. A pressure-regulating valve at the rear of the inboard starboard firewall controls the charging of the compressed air bottle in the fuselage nose. When the pressure rises to 450–470 lb. per sq. in. the resultant back pressure opens a valve which releases the air in the delivery line, and the compressor idles while the valve remains open. When the pressure in the bottle falls to 390–410 lb. per sq. in., the valve closes and charging is re-started. The bottle may be charged from the ground from an external supply, for which purpose an A.G.S.1200 air-charging valve is fitted on a cross tube between the undercarriage beams of the starboard nacelle.

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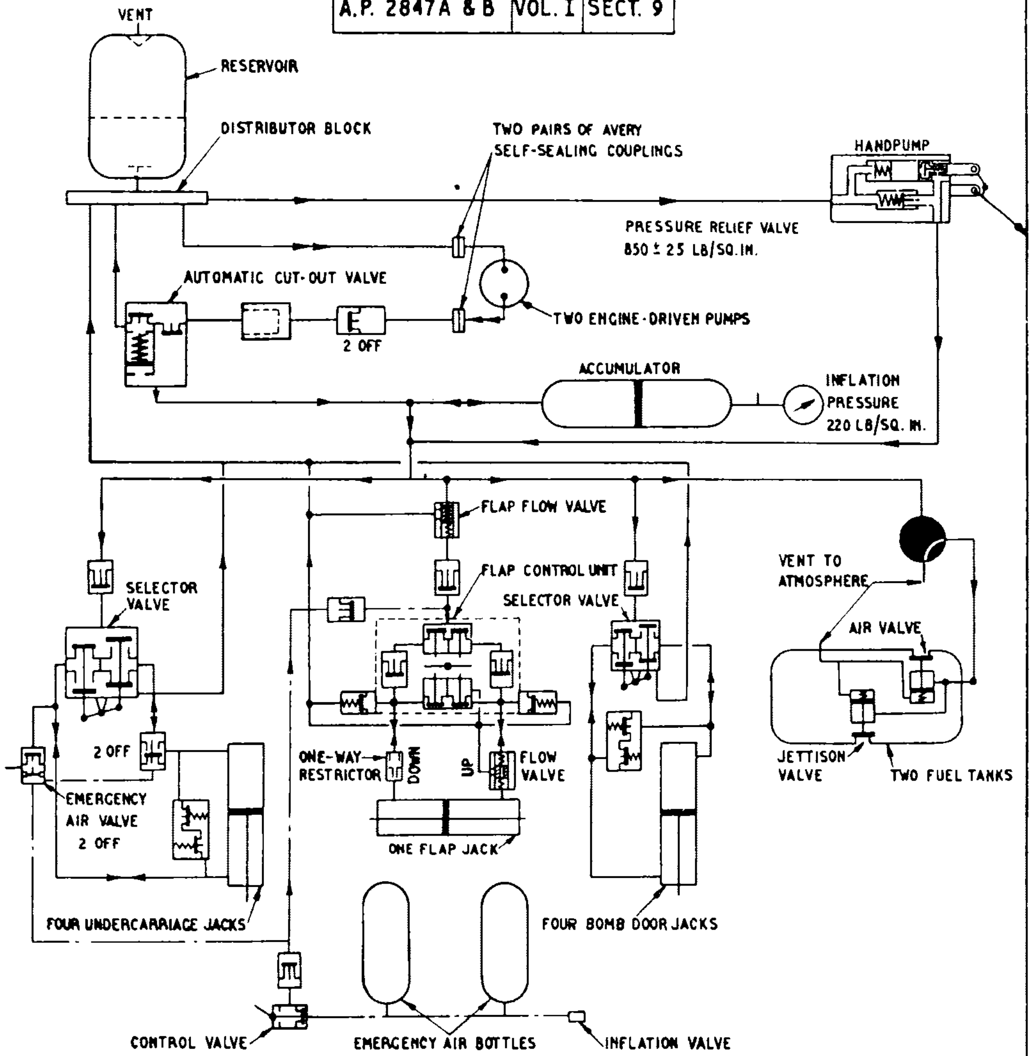


INTERPRETATION OF DIAGRAM.

1. WHERE A NUMBER OF SYMBOLS IS ENCLOSED IN A DOTTED FRAME, THE COMPONENTS REPRESENTED BY THE SYMBOLS ARE ACTUALLY BUILT IN ONE UNIT.
2. WHERE TWO OR MORE SIMILAR COMPONENTS ARE CONNECTED IN PARALLEL, ONLY ONE IS DRAWN, BUT THE No. OFF IS INDICATED.
3. SINGLE ARROWS ON PIPE LINES INDICATE THE DIRECTION OF FLOW, BUT DO NOT MEAN THAT FLOW IS ALWAYS TAKING PLACE. DOUBLE ARROWS POINTING IN THE SAME DIRECTION INDICATE THAT FLUID IS ALWAYS FLOWING WHEN THE ENGINE-DRIVEN PUMP IS WORKING. TWO ARROWS POINTING IN OPPOSITE DIRECTIONS INDICATE THAT FLOW TAKES PLACE IN BOTH DIRECTIONS. ARROWS ARE NOT DRAWN INSIDE A FRAME ENCLOSING A NUMBER OF SYMBOLS.

KEY

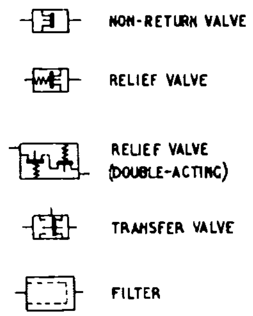
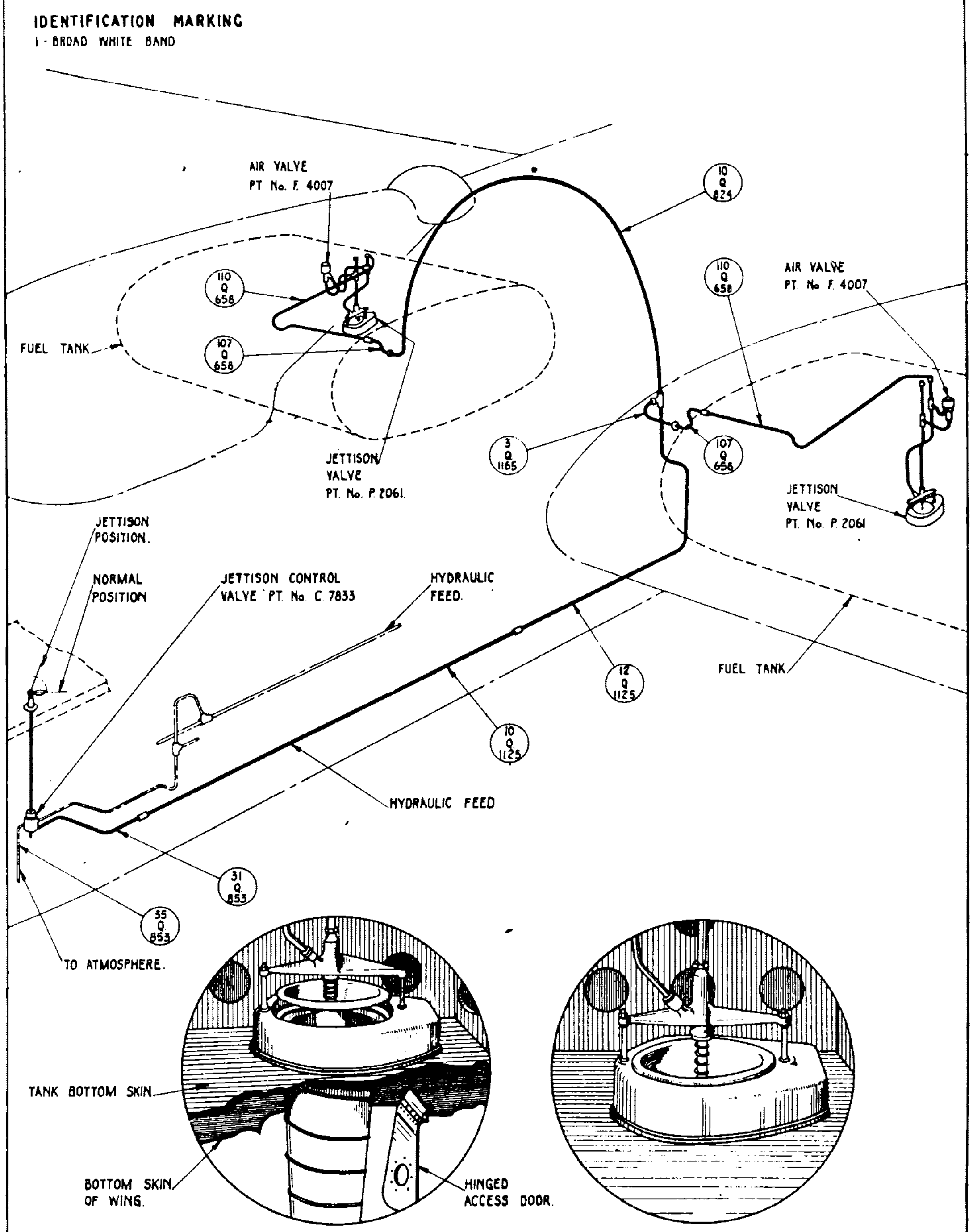


FIG. 1 — HYDRAULIC CIRCUIT DIAGRAM — FIG. 1

PP4090 M /G2884 10/45 1050 C&P Gp. 959 (4)



JETTISON VALVE OPEN — PIPE EXTENDED

JETTISON VALVE NORMAL POSITION

FIG. 2

FUEL JETTISON SYSTEM

FIG. 2

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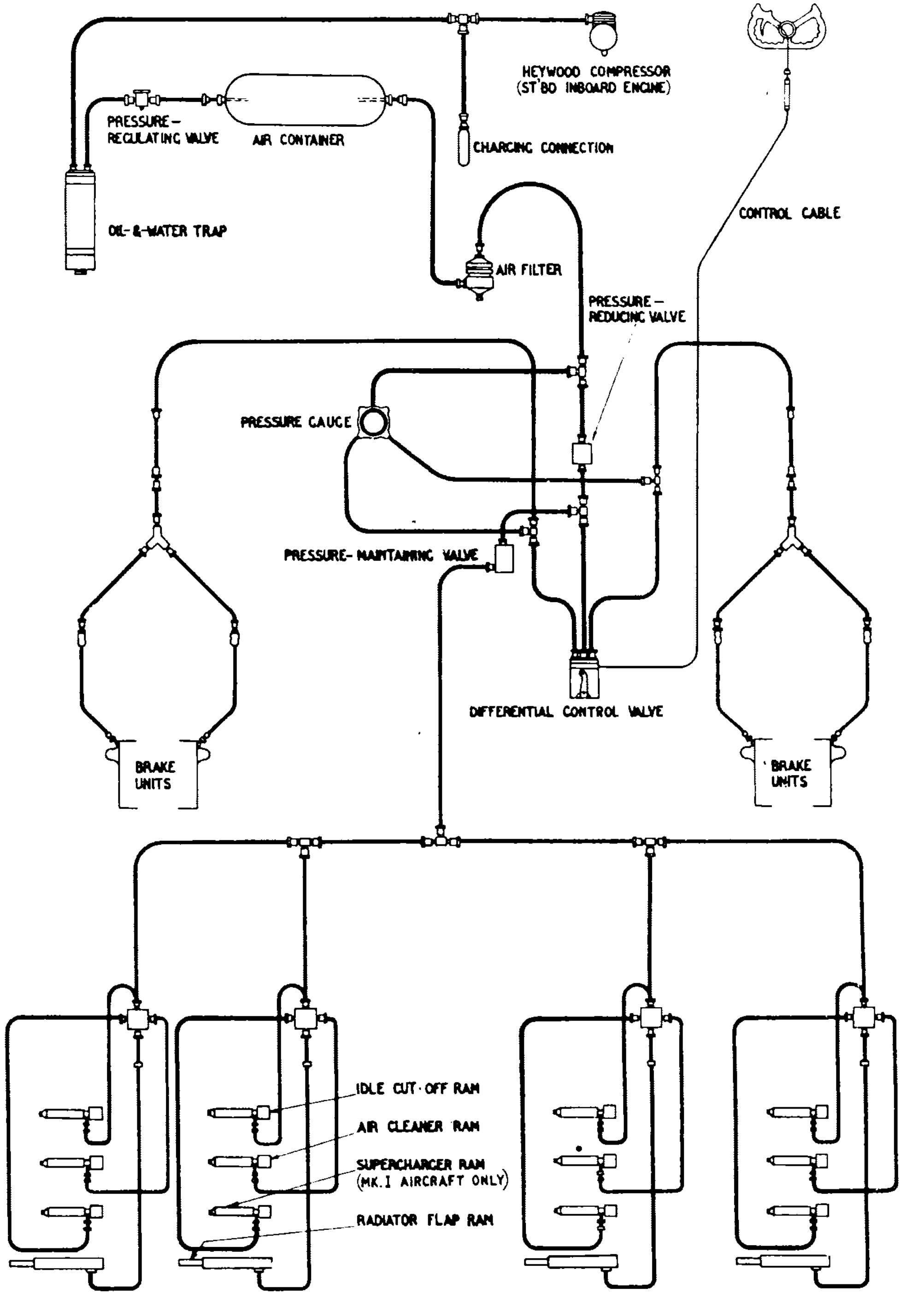

FIG. 3 DIAGRAM OF PNEUMATIC SYSTEM FIG. 3

PP4090 M /G2884 10 45 1050 C & P Gp. 959 (4)

SECTION 10

ELECTRICAL INSTALLATION

Note . . . The information previously contained in this Section is now included in Section 6, Chapter 1.

P12955 M2445/G444 6/48 800 C & P **Gp. 1**

• ELECTRICAL AND RADIO INSTALLATIONS 10

(11065) T14574/G2588 1050 11/44 M20691 C & P 752

ELECTRICAL INSTALLATION

LIST OF CONTENTS

Introduction

1. This Section gives a description of items of electrical equipment and of the installation generally. Routing charts, location diagrams, and notes on servicing are given in Sect. 6, Chap. 1. Description of standard items of equipment not covered in this Section are referenced in the appropriate paragraph and the specialist Air Publications concerned are listed at the beginning of this volume.

General

2. The installation consists primarily of panels, distribution boxes and junction boxes. The wiring between each of the boxes or panels is covered with polyvinal sheathing constituting a conduit; attached to each end are Breeze sockets which fit into plugs built in the junction or distribution box. Multi-pole plugs and sockets are so designed as to prevent incorrect mating, thus preventing either cross-connection or short circuit. To ensure good installation and to exclude dampness the wiring between 1DB and 2DB has been enclosed in a trough. The number of plug and socket connections has been reduced to a minimum. A single-pole earth return system is employed, the negatives being connected to the airframe at various points.

Services

D.C. power supply and distribution

3. The d.c. power is supplied from two type P 6 Kw. shunt wound generators (Stores Ref. 5U/2730) and charges four 12V–40 amp.hr. accumulators connected in series-parallel; the negative is connected to the airframe adjacent

Electrical Installation

to the accumulators. The generators are mounted on each inboard engine gearbox at the rear of the firewalls. Connected in series with each generator are suppressors, type "X" (Stores Ref. 5C/2100). The suppressor terminals G $-$ are connected to earth on the unscreened or the regulator side.

4. G + and F terminals of the suppressors are connected to terminals 1 and 3 of the voltage regulators, type 23 (Stores Ref. 5U/2844) and are mounted on panels 2P and 3P, respectively. Connections from terminal 4 of the regulators are made to terminals 3 of the master regulator, type 32 (Stores Ref. 5U/2899) and trimmer resistances for regulating the regulator voltage are utilised in place of the adjusting screw used on the carbon pile. The master regulator is set at 29 volts after both type 23 regulators have been set. For further information see A.P.1095C, Vol. I, Sect. 6.

5. Two type J cut-outs are mounted on panels 2P and 3P, each connected in the port and starboard generator charging circuits. These cut-outs have both voltage and current coils but do not disconnect the main supply line from the generator, but complete the circuit for the "pull in" coil of the circuit breaker to earth, through a type B switch (operated by the handle of the Ground/Flight switch) to TB.68 in 3P. The Londex relay supplies are taken from fuse VV8 in 3P, and WW3 in 2P, fuse WW3 being connected from terminal 8 of the port generator circuit breaker type D, and fuse VV8 connected to terminal 8 of the starboard generator circuit breaker. For further information see A.P.1095C, Vol. I, Sect. 7.

6. Two type D circuit breakers (Stores Ref. 5C/2853) are mounted on panels 2P and 3P, each circuit breaker having three pairs of contacts. The main line contacts are connected across terminals 1 and 2 and protected by a thermal strip, and if overloaded, will trip the circuit breaker. It may then be re-set by the push-button on 1DB. The second pair of contacts are connected across terminals 3 and 5 and disconnected when the main line contacts are closed, thus breaking the generator power failure warning lamp circuit. The third pair of contacts are connected across terminals 4 and 7 and are also disconnected when the main line contacts are closed. When the main line contacts are tripped by the thermal strip due to overload, the second and third pair of contacts close, the second pair completing the circuit of the power failure warning lamps mounted on 1DB to earth terminal No. 2 in 1DB. The third pair short out a 200-ohm coil, leaving the 8-ohm coil in circuit which constitutes the pull-in coil of the circuit breaker. When the main line contacts are closed the 200-ohm coil is no longer shorted but is brought in series with the 8-ohm coil; at the same time, there is still sufficient current passing to hold the circuit breaker once it has been pulled in. For further information see A.P.1095A, Sect. 9.

7. The generators are controlled by two isolation switches, two re-set push switches, and an emergency switch mounted together with the power failure warning lamps on 1DB. With the Ground/Flight switch in the GROUND position the generators will not supply the aircraft services, but with the Ground/Flight switch to the FLIGHT position the generators can be isolated by means of the isolation switch on 1DB, which by this means disconnects the type D circuit breaker "pull-in" coil. The emergency switch is required only when it is necessary to run the generators without the accumulators in circuit, or should an open circuit occur in the type B switch of the Ground/Flight switch. For normal running the emergency switch must be placed in the OFF position.

8. The Ground/Flight switch is mounted on panel 3P and allows the aircraft services to be supplied by either aircraft or ground accumulators. The type B switch lever is mechanically linked to the handle (see para. 5). The following circuits are operated by the Ground/Flight switch and have no independent circuit switches:—

L.T. and H.T. supply.
Oil temperature gauges.
Radiator temperature gauges.
Oil pressure indicators.
Fuel pressure warning.
Fuel contents gauges.
Fuel contents gauges (long range).
Undercarriage indicator.
Fuel flowmeter.
Flaps indicator.

Electrical Installation

When the aircraft is grounded the switch must be placed in the GROUND position or the circuits which are not independently switched will be a constant load on the accumulator.

9. Radial feeders are connected to the +VE bus-bar in 3P and consist of ten 45 amp. type A circuit breakers (Stores Ref. 5C/2564). Each circuit breaker controls a bank of fuses, and may be identified by its label as follows:—

Circuit breaker		*Panel*	*Fuse banks*		
1D–1	feeds fuses in	1DB,	AA1 to AA8;	BB1 to BB8	
1D–2	„ „ „	„	CC1 „ CC8;	DD1 „ DD4	
1D–3	„ „ „	„	DD5 „ DD8;	EE1 „ EE8	
1D–4	„ „ „	„	FF1 „ FF8;	GG1 „ GG4	
1D–5	„ „ „	„	GG5 „ GG8;	HH1 „ HH4	
2D–1	„ „ „	2DB,	JJ1 „ JJ8;	KK1 „ KK8;	LL1 to 4
2D–2	„ „ „	„	LL5 „ LL8;	MM1 „ MM8;	NN1 „ NN8
BA–1	„ „ „	„	Air Bomber's Panel Starb.		RR1 „ RR8
BA–2	„ „ „	„	„ „	„ „	SS1 „ SS8
3D–1	„ „	„ 3DB,	TT1 to TT8;	UU1 to UU8	

The circuit breakers are protected from overload by a thermal strip; to re-set, depress push-button.

Engine starting

10. Four engine starting push-buttons mounted on the pilot's instrument panel are supplied from fuse MM1 10 amp. in 2 DB. Each switch is labelled for its respective engine and is of the double-pole type (Stores Ref. 5C/540); these are connected in parallel. To start the selected engine, depress the starter switch, thus energising the starter relay, and master relay coils, which automatically closes the heavy duty side of the relays. The positive supply to the starter is from terminal BB on the Ground/Flight switch through the master relay to TB 71B in 1DB to which the heavy duty relay contacts, and the starter relay contacts are connected. Each starter relay coil is connected to earth, port outer to earth in 6P, port inner in 4P, starboard inner in 5P, starboard outer in 7P, the master relay being mounted in 3P and the coil earthed on TB 68B. The starter motors are series wound and earthed to the —VE bus-bar on the engine diaphragm.

Ignition and booster coils

11. Four single-pole push-button switches (Stores Ref. 5C/898) are mounted on the pilot's instrument panel and are connected in parallel. The positive supply is fed from a fuse 10 amp. KK7 in 2DB and connects to the port outer switch, each switch being labelled for the appropriate engine. The booster coils are of the low tension type and are mounted on the engine diaphragm; the H.T. connections are taken to the starboard magnetos of each engine, coils supplying the L.T. current (24 volts) to the primary of the magneto, through an isolating spark gap. Each coil is independently operated and the ignition switch for the required engine must be selected with that of the booster coil switch for starting.

Propeller feathering

12. Four 10 amp. fuses, KK1 and KK2 for port engines, MM2 and MM3, for starboard engines, provide the supply to four hydromatic feathering switches mounted on the pilot's instrument panel. For the terminal designation of this switch see fig. 1A, Sect. 6, Chap. 1. Four relays operating the pump motors are mounted on panels 6P port outer, 4P port inner, 5P starboard inner, 7P starboard outer. The motors are series wound and the supply is provided by the heavy duty side of the relays from terminal R11 in 6P, 4P, 5P and 7P respectively, and the motor negatives are connected to earth on a —VE bus-bar on the

Electrical Installation

engine diaphragms. Pressing the feathering switches operates the relays, the supply being taken from terminal S of the feathering switch; the other end of the coil connects to the earth terminal in the same panels as R11. A master relay disconnects the supply to terminals R11 when starter and feathering motors are not in use.

13. The corresponding propeller speed control lever must be back beyond the gate before the feathering switches are pushed. The feathering switches are retained in the closed position until the propeller is fully feathered, when the pressure builds up and breaks the pressure cut-out releasing the button. To unfeather, ensure that the propeller speed control lever is forward of the gate, and push the feathering button (hold button in).

Fire extinguisher (lamps)

14. Four 5 amp. fuses in 1DB supply the circuit +VE to six flame switches mounted on each engine, AA1, CC1 port inner and outer engines, DD5, FF1, starboard inner and outer engines. The flame switches of each engine are connected in parallel, ensuring that the operation of any one switch completes the circuit. Four warning lamps are mounted on the pilot's instrument panel, or embodied on the push face of the propeller feathering switches, and a relay mounted in each engine nacelle. In the event of fire the flame switch, or switches, close automatically and operate the relay coil, closing two pairs of contacts. Contacts A and B of the relay complete the circuit for the warning lamps, while the second pair, D and E, complete the bottle circuit (see para. 15).

Fire extinguisher (bottles)

15. A two-bottle methyl bromide system is employed, incorporating a time delay switch in each engine nacelle. When the red lamp, which is mounted on the pilot's instrument panel, lights, the feathering switch is pushed to feather the engine propeller. The supply to the extinguisher air intake bottle is taken from the feathering relay to terminal E of the second pair of relay contacts (operated by the flame switches in the warning lamp circuit, see para. 14). The air intake bottle is then fired direct, and the time delay switch gives a 15 seconds delay before firing the engine spray bottle. A 20 amp. fuse in 2DB connects to terminal 5 of an inertia switch mounted in the aircraft nose, also four double-pole push switches mounted on the pilot's panel may be pressed in the event of a crash which operates both air intake, engine spray bottles simultaneously, or should a fault occur on the feathering circuit for the time delay firing. The push switches are required to fire both bottles direct.

Radiator flaps

16. Electrically controlled double-acting pneumatic rams operate the radiator flaps and are controlled by thermostatic switches. Four switches are connected to four 5 amp. fuses in 1DB; fuses DD4 and BB8 operate the flaps of the starboard engines, GG4 and E8 operate the flaps of the port engines. The four override switches when closed short-circuit the thermostatic switch mounted on the engine diaphragm and open the flaps. These override switches are also used for ground testing at excessively high engine speeds, and for taxying, thus reducing overheating of the engine and minimising the cooling period. A test button mounted on the engine diaphragms, which is connected in parallel with the override switches and thermostatic switches, is used for testing flap operation when the aircraft is grounded. For further information see A.P.2861A, Vol. I, Sect. 2.

Slow-running cut-off

17. Slow-running cut-offs are operated by electrically controlled pneumatic rams (single acting). Each ram is operated by a switch type 170, mounted on the pilot's instrument panel. Four 5 amp. fuses in 2DB feed each circuit, LL5 and LL6 starboard engines, KK1 and KK8 port engines. The pressure of the pneumatic system must exceed 160 lb. per sq. in. before it can be operated. For further information see A.P.2861A, Vol. I, Sect. 2.

Air cleaner control

18. Embodied in the carburettor air intake are filters to protect the carburettor from dust,

Electrical Installation

etc., when taxying or engine testing. A master switch mounted on the pilot's instrument panel labelled IN and OUT operates the four cleaners, one for each carburettor; the switch should normally be in the IN position, except when testing. Two micro switches are mounted on the undercarriage *UP* locks and connected in series with the master switch. The positive supply to the circuit is fed from a 5 amp. fuse MM6 in 2DB.

19. When the undercarriage is in the *UP* lock position the two micro switches are closed, completing the circuit of the pneumatic ram, and moving the air cleaner filter to a position where it will not impede the air flow to the carburettor. For further information see A.P.2861A, Vol. I, Sect. 2.

Hot and cold air intake

20. Electrically controlled pneumatic rams, operated by a master switch mounted on the pilot's instrument panel, enable hot air to be directed to the carburettor when icing conditions prevail. The positive supply to the switch is fed from a 5 amp. fuse MM8 in 2DB connects to the master switch which operates all four engine solenoid valves. Before attempting to operate the system the reading on the pressure gauge must exceed 160 lb. per sq. in. For further information see A.P.2861A, Vol. I, Sect. 2.

Engine priming

21. Two compound wound motors mounted, one on each inboard engine firewall, supply fuel for engine priming through solenoid-operated valves. The master switch controlling the motors is mounted on the pilot's instrument panel together with four single-pole push-switches (Stores Ref. 5C/898) and a warning lamp. When the priming motors are switched on the warning lamp lights and until the solenoid valve is opened, fuel will flow round the idling circuit of the pumps or through a 0·013 in. restrictor in the carburettor vent system. To extinguish the lamp move the master switch to the OFF position, rendering both motors inoperative. A strap link connects the red and blue coloured terminals.

Supercharger control

22. A selector switch (Stores Ref. 5C/930) together with four warning lamps and test switch are mounted on the pilot's instrument panel. The selector switch is labelled supercharger MS or automatic AUTO. In the AUTO position the circuit is controlled by an aneroid pressure switch mounted just forward of the flight engineer's panel and operating at about 12,000 ft. When closed the circuit for the four relays (single-acting) mounted in panel 3P, connects the heavy duty side of the relays through a 20 amp. fuse in 2DB to the solenoid rams. When the rams are operated (retracted position) the micro switches mounted on the engine frames complete the warning lamp circuit. For ground testing a push-switch will give full supercharge and light the warning lamp with the master switch in MS or AUTO position. For further information see A.P. 2861A, Vol. I, Sect. 2.

Oil dilution

23. A push-button master switch and four selector switches are mounted on the flight engineer's panel. Each engine oil dilution solenoid valve can be selected, but the master push-button must be depressed before the solenoid operates.

Oil pressure indicator

24. This provides a means of indicating to the pilot the pressure at which the oil is being supplied to the engine without the necessity of running a branch pipe from the oil system to the pilot's instrument panel. Four 3-phase, Desynn type indicators mounted on the pilot's instrument panel; with four standard Desynn type transmitters connected in the oil pipe line. The circuit is controlled by the Ground/Flight switch. Four 5 amp. fuses in 1DB feed the supply to terminal 6 of each transmitter; BB1, BB6, for port engines, FF5, and EE2 starboard engines.

Fuel pressure warning

25. Four fuel pressure warning lamps mounted on the flight engineer's panel indicate to the pilot if the fuel pressure to the carburettor falls below a pre-determined value. Four

Electrical Installation

resistance units mounted on panels 6P, 4P, 5P and 7P respectively, prevent a dead short to earth should the warning lamp be short-circuited when the pressure switch is closed. The switch is located in the fuel line between the engine-driven fuel pumps and the carburettor. The circuit is controlled by the Ground/Flight switch. The positive supply is fed from the same fuses as the oil pressure indicator circuit (see para. 24). For further information see A.P.1275A, Vol. I, Sect. 1.

Fuel flowmeter

26. Two dual dial fuel flowmeter indicators are mounted on the flight engineer's panel, each dial calibrated in gallons and $\frac{1}{10}$ gallons gone. Cams, operating switch units, are mounted on the engine sub-frame adjacent to the firewall and connect direct to the appropriate meter through a type P suppressor. The positive supply is taken from four 5 amp. fuses in 1DB, AA2, CC2, port engines, DD6, FF6 starboard engines, which are connected to the cam-operated switch. The circuit is controlled by the Ground/Flight switch. For further information see A.P.1275A, Vol. I, Sect. 3.

Fuel pumps

27. Four single-pole switches (Stores Ref. 5C/543) together with four test push switches (Stores Ref. 5C/540), and a test ammeter are mounted on the flight engineer's panel. The current consumption of each pump (4–7 amps. for normal running) can be checked by operating the test switches. Four fuel pumps are fitted to the collector boxes, two to each box in the port and starboard inboard nacelles. For further information see A.P. 2241, Vol. I, Sect. 3.

Fuel pumps (long-range tanks)

28. Two type B switches (Stores Ref. 5C/543) and a test switch to measure the current consumption by means of the test ammeter (see para. 27), are mounted on the flight engineer's panel. These switches control two fuel pumps, one on each of the long-range fuel tanks which can be fitted when required in the bomb bay.

Fuel contents gauges

29. Six Desynn type indicators mounted on the flight engineer's panel measure the amount of fuel of No. 1, 2 and 3 tanks port, and No. 1, 2, and 3 tanks starboard. A float arm in each tank operates the transmitter which is connected to its respective indicator. Two 5 amp. fuses FF8 and AA6 in 1DB protect the circuits and are connected to terminal 4 of each indicator. The circuit is controlled by the Ground/Flight switch. For further information see A.P.1275A, Vol. I, Sect. 3.

Fuel contents gauges (long-range tanks)

30. Indicator and transmitter circuits for long-range tanks are similar to those for the main tanks (see para. 29).

Radiator temperature gauges

31. Four Mk. II electrical indicators mounted on the flight engineer's panel register radiator temperature and are coupled to resistance bulbs on the appropriate engine outlet. The positive supply is from four 5 amp. fuses in 1DB, AA4 and CC5, for port engines, DD8, FF4 for starboard engines. The circuit is controlled by the Ground/Flight switch. For further information see A.P.1275A, Vol. I, Sect. 4.

Oil temperature gauges

32. Remarks on radiator temperature gauges are applicable to oil temperature gauges, except that the resistance bulbs are inserted in the engine oil pipelines. Four 5 amp. fuses in 1DB, AA7 and CC3 port engines, GG3 and DD7 starboard engines supply the positive feed to the indicators.

Undercarriage indicator

33. An indicator mounted on the pilot's instrument panel provides UP (red) and DOWN (green) lamps operated by micro switches mounted on the undercarriage legs, and up locks. A warning horn with a test button and lamp, is mounted on the port side cockpit tail just rear of the pilot to give audible warning of the undercarriage position.

Electrical Installation

Two micro switches connected in parallel are operated by the two inboard engine throttle levers (when more than two-thirds closed). When the undercarriage is *UP* and *LOCKED*, all lights on the indicator are extinguished, the circuit being broken by terminal A and C, of the up lock micro switches. Terminals A, B and E of the *DOWN* lock micro switches are made with the undercarriage *UP* and *UNLOCKED*. Terminals A and B are made on the *UP* lock switches, completing the circuit for the red warning lamps. With the undercarriage in the *DOWN* position and *LOCKED* position, terminals A, B and E on the *DOWN* lock micro switches are broken and A, C and D are made, completing the circuit to the green warning lamps. The test switch is used when the undercarriage is in the locked *DOWN* position and operates the warning horn and lamp. The positive terminal on the indicator is connected to earth at TB 47B and a 10 amp. fuse AA6 in 1DB supplies the positive to the *DOWN* lock micro switches. The circuit is controlled by the Ground/Flight switch.

Flap indicator

34. A 3-phase connected indicator mounted on the pilot's instrument panel, with the transmitter mounted on the port inboard trailing edge. The transmitter is controlled by a rod connected to the flap. The positive supply is from a 5 amp. fuse HH3 in 1DB and connects to terminal 6 of the transmitter. The circuit is controlled by the Ground/Flight switch. For further information see A.P.1275A, Vol. I, Sect. 1.

Engine speed indicator

35. Four self-starting synchronous motors mounted on the pilot's panel with the indicators calibrated: REVOLUTIONS PER MINUTE, provide continuous indication of the engine speed. A 3-phase a.c. generator is driven by each engine; the installation being self-contained with three wires connecting the star windings of the transmitter to indicator. For further information see A.P.1275A, Vol. I, Sect. 1.

Interior lamps

36. Lamps are mounted at various stations in the aircraft fuselage and are of dimmer controlled or on–off type. The following list gives the position and duty of the lamps:—

	Lamp	*Position*	*Duty*
Supplied from fuse SS2			
1	Cabin lamp	Rear of front turret	Illuminating the nose
2	Cockpit lamp and dimmer	Adjacent to bomb sight	Illuminating the bomb sight
3	Cockpit lamp	At auto control panel	Illuminating auto control panel
4	Cockpit lamp and dimmer	Air bomber's panel, starboard	Illuminating panel, starboard
5	Cockpit lamp and dimmer	Air bomber's panel	Illuminating air bomber's panel
Supplied from fuses MM7 and KK6			
1	Cockpit lamps and dimmers	Port and starboard of canopy	Illuminating pilot's instrument panel
2	Compass lamp and dimmer	Adjacent to P.4 compass	Illuminating compass
3	Compass lamp and dimmer	Adjacent to D.R. compass repeaters	Illuminating D.R. compass repeater
Supplied from fuse EE1			
1	Cockpit lamps and dimmers	Flight engineer's panel	To illuminate flight engineer's panel
2	Cockpit lamps and dimmers	Navigator's panel	To illuminate navigator's panel
3	Anglepoise lamp and dimmer	Navigator's panel	To illuminate chartboard

Electrical Installation

	Lamp	*Position*	*Duty*
Supply from fuse GG6			
1	Cockpit lamp and dimmer	Roof near D.F. loop	To illuminate D.F. loop
2	Cockpit lamp and dimmer	Roof near 1DB	To illuminate 1DB
3	Cockpit lamps and dimmers	Roof port and starboard of Former 6	To illuminate wireless operator's table
Supplied from fuse TT1			
1	Cabin lamp	Roof at centre section between formers 8 and 9	To illuminate centre section
2	Cabin lamp	Roof of rear centre section between formers 15 and 16	To illuminate rear centre section
3	Cabin lamp	Port side, between former 22C and 22D	To illuminate rear centre section at scanner
4	Cabin lamp	Port side of roof between formers 29 and 30	To illuminate rear section (switch operated by fuselage door)

Exterior lamps

37. The external lamps master switch, mounted on the pilot's panel together with the warning lamp must first be placed in the ON position to operate resin, identification, navigation, glider tug and head lamp. The red warning lamp will provide visual warning to the pilots that external lamps are *ON*.

38. The landing lamps selector switch mounted on the pilot's instrument panel, selects OFF, LOW, and HIGH for the landing lamp type J mounted at the rear of the front spar on the port main plane rib 14B. For further information see A.P.1095A, Vol. I, Sect. 8.

39. The identification switch box (Stores Ref. 5C/372) on the pilot's instrument panel, controls the lamps through a colour selector switch, also on the instrument panel. The three identification lamps red, green and amber, are located on the underside of the fuselage. The identification switch also provides morse for the head lamp.

40. The navigation lamps selector switch on the pilot's instrument panel provides for OFF, DIM and BRIGHT for navigation lamps. When the switch is in the DIM position, a resistance is inserted into the lamp circuit and so reduces the brilliance of the lamps.

41. The resin lamps are controlled by two switches, one on–off type and a colour selector switch for either red, green or clear for port and starboard lamps. The glider tug lamp at the rear of the aircraft is controlled by an on–off switch from the same fuse.

42. The main 20 amp. fuse KK5 in 2DB feeds through the external lamp master switch to four 5 amp. fuses and one 20 amp. fuse, all of which are connected in parallel. PP1 supplies glider tug and resin lamps, PP2 identification and head lamps, PP3 navigation and head lamp, PP4 landing lamp (motor), NN9 landing lamp (filament).

Call lamps

43. Call lamps are situated at the following stations:—

Air bomber's port panel.

Pilot's auxiliary panel.

Navigator's panel.

W/T. panel.

Under defence station.

Dorsal turret.

Tail turret.

Elsan station.

All lamps will light if the button of any unit is pressed.

Electrical Installation

Heated pressure head

44. An electrically-heated head, Mk. VIIIB or Mk. VIIIH, is mounted on the port longeron and is operated by a switch on the flight engineer's panel. The test ammeter on the flight engineer's panel is used for checking the current consumption by pressing the test button provided.

Camera supply and heating

45. An F.24 camera is mounted on the port side immediately in front of the forward bomb compartment bulkhead, it is operated by a control panel mounted on the forward end of the air bomber's panel port. A warning lamp mounted on the pilot's instrument panel and connected to the camera control provides indication to the pilot when the camera is in operation. This installation is mainly connected with the flare chute (see para. 63). A 10 amp. fuse RR5 in the air bomber's panel starboard, supplies the camera heaters through a type B switch mounted on the air bomber's panel port; the heater sockets are mounted on a panel on the port side of the fuselage forward of the camera, and the camera muffs are plugged at these points.

Heated clothing

46. Provision is made for heating the air bomber's suit by a 3-pole socket on a trailing lead on the air bomber's panel port. Mounted on the air bomber's panel starboard are two type B switches, one for hands and feet and the other for body; these are connected in parallel with the supply from a 10 amp. fuse SS3, which is also mounted on the panel and is connected to the body switch.

Scanner heater units

47. Three heating elements situated inside on the wall of the scanner platform are controlled by a type B switch on the port side of the fuselage at the scanner position. The positive supply is fed from a 20 amp. fuse TT3 in 3DB and negative is connected to a common earth point at the same panel.

Dinghy release

48. The dinghy is situated in the starboard centre section trailing edge of the main plane, to which a connection is made by a 3-pole plug and socket. Pins L and M are connected together for positive and pin E to the common earth connection in 5P. The dinghy is controlled by an immersion switch situated in the nose of the aircraft and receives supply from a 20 amp. fuse SS4 in the air bomber's panel starboard.

L.T. and H.T. supplies

49. The general purpose sets T.1154 and R.1155 supplies are provided by L.T. and H.T. convertor units situated beneath the navigator's table on the floor. The L.T. convertor unit is interconnected with a resistance unit at T.B.106, from which the positive supply connects to a 20 amp. fuse GG1 in 1DB. The amount of resistance to operate the convertor is controlled by the Londex relay situated near the convertors. The supply to the relay coil is fed from terminal D.1 in 1DB, which is a common point for the W/T connections from the generator circuit breakers on 2P and 3P. The H.T. convertor supply is fed direct from a 40 amp. type L fuse GG2 in 1DB. The earth connection from the relay is made at a common point with the L.T. and H.T. convertors earths through TB106 and T.B.107 to the aircraft structure adjacent to the convertors. The circuit is controlled by the Ground/Flight switch. For further information see A.P.1186D, Vol. I.

Radio supplies and demolition

50. The I.F.F. set is the only one provided with a demolition charge. This charge can be detonated direct by means of double push-buttons mounted in each of the pilot's, navigator's, and wireless operator's positions. Also on the navigator's panel is mounted a switch type B and two warning lamps connected in parallel. An inertia switch is mounted in the nose on the port side of the fuselage, and when the master switch is at ON the inertia switch will detonate the charge. In the OFF position only the warning lamps will light to show the circuit operates. The supply to the pilot's and navigator's position is through a 20 amp. fuse GG7, and to the wireless operator's position through a 20 amp. fuse AA5, both in 1DB. To prevent failure if one circuit is disrupted, duplicate wiring is provided. Supplies are

Electrical Installation

taken through a 10 amp. fuse FF8 to the TR.1196 2-pole socket, through 20 amp. fuse EE4 to the R.3090 3-pole socket, and through 20 amp. fuse GG5 to the 2-pole radar socket.

Beam approach supply

51. The supply to the junction box situated behind the pilot's seat is fed from fuse TT1 (20 amp.) in 2DB, and the earth from the junction box is connected to terminal 4 in 2DB; for further information on the installation see A.P.1186, Vol. I, Part IV, Sect. 3.

D.R. compass and bomb sights

52. The master compass is mounted on the starboard side of the fuselage forward of the main entrance door, and is plugged into the compass junction box on the aft side of the transport joint at former 27. The transport joints of cables are formed by double-ended plugs and sockets at formers 6 and 12 and at former E. The supply for the electrical services is from panel 1DB, with a 10 amp. fuse AA3 through a type B suppressor to a distribution box type D, both mounted forward of the panel. The variation setting corrector is located in the fuselage roof at the navigator's station between formers 2 and 3. A 3-way junction box type A in the cable to the pilot's repeater is mounted on the starboard side of the fuselage near the forward end of the main floor, and from the main distributor box connections are run to a 5-way junction box type A below the air bomber's starboard panel, making provision for bomb sight attachment.

53. A mounting is provided in the front of the fuselage nose for any of the three bomb sights—Mk. XIV, Mk. III low level, and Mk. IIA stabilised automatic. When the Mk. XIV bomb sight is fitted it is controlled by a switchbox (Stores Ref. 5C/2799) situated forward of the air bomber's seat. Positive supply is from fuse SS1 5 amp. in the air bomber's starboard panel to the switchbox. Used in connection with this bomb sight is a computor which is situated on the port side in front of the auto pilot panel. A cable from the computor connects to a 5-way junction box type A and D.R. compass wiring, then through to a 3-way junction box type A on the air bomber's panel. All three bomb sights are fed from this common 3-way junction box type A, and the supply to this junction box is from fuse RR6 5 amp. in the air bomber's starboard panel through a suppressor type P. When a Mk. III bomb sight is fitted it is controlled by a control panel type E (Stores Ref. 5C/2486) situated in place of the Mk. XIV switchbox forward of the bomb aimer's seat. Its supply is from the 3-way junction box type A on the air bomber's panel. The Mk. IIA bomb sight, when fitted, is controlled by a control panel, Mk. II, situated in the nose, its supply being taken from the 3-way junction box type A on the starboard air bomber's panel. A further connection from this panel through two 3-way switchboxes (Stores Ref. 5C/930), and a solenoid switch, type P (Stores Ref. 5C/1722) all mounted together on the air bomber's starboard panel, gives inter-linking with bomb gear, flare chute and camera (see para. 62 and 63). From the Mk. IIA sighting head there is also a supply to a plug and socket into the aircraft wiring at the air bomber's starboard panel which connects to a warning lamp mounted on the pilot's instrument panel. This lamp gives indication to the pilot that the aircraft is not steady on its bombing run. For further information on D.R. compass, see A.P.1275B, Vol. I, Sect. 3.

Automatic pilot

54. The positive supply to the Mk. VIII auto pilot is provided from a 5 amp. fuse JJ4 in 2DB, and connection is made to a type B rotary switch mounted on the pilot's instrument panel, giving positions OFF, COURSE and JINK. The wiring to the relay box, mounted on the air bomber's panel port breaks at T.B. 35 on the panel. The wiring from the relay connections is taken to a suppressor, type F2, also on the panel, to interconnect with pilot's repeater of the D.R. compass installation. For further information see A.P.1469C, Vol. I.

A.M.U., A.P.I and G.P.I.

55. The supply to the A.M.U. is fed from a 5 amp. fuse BB4 in 1DB through suppressor type P, situated at the navigator's position, and the negative is connected to earth on T.B.43 on the panel. The ground position indicator

Electrical Installation

and air mileage unit are interconnected to the air position indicator, all of which are located at the navigator's station. A further connection is then taken to the D.R. compass. For further information, see A.P.1275B, Vol. I, Sect. 1.

Turret supplies

56. Supply to the front turret (Boulton Paul, type F) is controlled by a type B circuit breaker mounted in panel 3P. This circuit breaker is operated by STOP and START switches which, together with an economy resistance for the circuit breaker coil, are mounted in the air bomber's panel starboard. For further information, see A.P.2796H, Vol. I.

57. At the dorsal position, Glenn Martin turrets or Bristol B17 turrets can be fitted. Interchangeability is facilitated by the connections to either turret being made by means of three plugs and sockets mounted on a panel on the port side of the fuselage at the turret position. One plug provides for intercommunication (*see* Sect. 6, Chap. 2). The supply to the dorsal turret is controlled by another type B circuit breaker, also mounted on panel 3P. This circuit breaker is operated through a 5 amp. fuse VV4 on panel 3P by STOP and START switches which, together with an economy resistance for the circuit breaker coil, are mounted on the turret control panel on the port side of the fuselage at the turret position. On this panel is also connected a type B switch, which is closed for Glenn Martin and open for B17 turrets. For further information on these turrets, see A.P.2768E, Vol. I, and T.O. 11–45, BB–1, dated 14th August, 1945.

58. The under-defence gun is installed when the scanner installation is not fitted. The gun firing solenoid, gun firing button or reflector sight are all connected through a plug and socket to the under defence gun control panel which is mounted on the starboard side of the fuselage at the gun position. The electrical control on this panel consists of a type B switch, a type P relay and a 5 amp. fuse, and supply for these controls is fed from a 10 amp. fuse TT2 in panel 3DB.

59. An alternative installation is provided for the rear turret (F.N.121 and 81 or Boulton Paul type D). With the F.N.121 fitted, the heavy duty supply is taken from a type A 45 amp. circuit breaker mounted on panel 2P. The light duty supply is fed through a 20 amp. fuse TT3 in 3DB, and the turret connections made to these supplies at TB119 and TB165, which are mounted on a panel on the floor of the fuselage forward of the turret position. Two ammunition assisters motors are mounted one on each track at formers 33 and 34, and these are automatically controlled from two assister panels mounted on the port and starboard sides of fuselage of this position. The equipment on each panel consists of a type P relay, a type B suppressor, a 5 amp. and a 25 amp. fuse, the relays in each case being controlled by a micro switch mounted in the ammunition tracks. The supply to these panels is taken through a type A circuit breaker on panel 3P to the commoning point T.B.117 mounted on the port side of the fuselage and then connects to the panel. For further information on these turrets, see A.P.2799F, Vol. I, and A.P.2799Q, Vol. I.

60. With the Boulton Paul type D turret fitted, all connections to the turret are made through 14 slip rings. The positive supplies are taken to T.B.'s 117 and 119, and are connected at slip ring A; two earth leads connect to slip ring P, and are connected to earth at the terminal block panel. Two ammunition assister motors, suppressor, relay micro switch and fuses are installed as for the F.N.121 turret. The supply is fed through a 40 amp. type L fuse TT3 in 3DB to a commoning point T.B.119, fitted in the roof on former 34, port side. The relays for the assister motors are controlled by the firing button in the turret through slip ring N. A supply, taken from the assister motors supply at T.B.95 in 8P, connects through a push-button switch on former 41 to slip ring N for casualty evacuation. For further information see A.P.2796J, Vol. I.

Bomb fuzing and release

61. The following units are mounted on the air bomber's starboard panel: automatic distributor, type 6 (16-point), selector switchbox type F, three switchboxes type B, and interlock unit for the firing switch, a pre-selector (16-point) switch unit and a main supply fuse

Electrical Installation

box (40 amp. fuse), a 2-pole flat socket for the plug on the bomb sight, and two 6-pole plugs for the socket on the air bomber's firing switch for bombs-and-day camera or bombs-and-night camera, as required. The firing switch is locked in the inter-lock switch when not in use and cannot be removed until nose or tail fuzing has been selected. From the bank of fuses mounted on the panel, supplies are taken for nose and tail fuzing from RR1 and RR2 (20 amp.), distributor heating from RR3 (5 amp.), and heavy bomb slip heaters from RR4 (5 amp.). A switchbox, type E, is also mounted on the panel to control the supply to the heavy bomb slip heaters. A firing switch is incorporated on the left-hand side of the pilot's control column (hand wheel). The supply to the switch is broken at T.B.177, which is mounted at the base of the control column, and a further supply is taken to a plug and socket at the navigator's table for a bomb switch which is used in connection with radar equipment. A jettison switch, type H, and a jettison pull handle for operating the selector box jettison bars, are mounted on the starboard side of the pilot's instrument panel.

62. There is only one junction box in the bomb fuzing and release gear, and this is referenced JBA and situated at the front end of the bomb compartment. Fifteen plug and socket outlets from the junction box connect to each of the bomb positions. The release positive terminals in the junction box are referenced with the number on the bomb position to which they connect, and these numbers are also referenced to the respective number of the switches of the selector switchbox and pre-selector switch unit. To prevent the release of bombs when the bomb doors are closed, two push switches are provided in the positive supply. They are mounted on the rear face of the bulkhead at the front end of the bomb compartment and remain in the *OFF* position while the bomb doors are closed. For further information on bomb fuzing and release equipment, see A.P.1095B, Vol. I, Sect. 3.

Flare chute

63. A single cell flare chute (for flash flare) is mounted in the rear of the aircraft, and a Mk. VI chute fitted in the forward compartment of the bomb aimer's position. A micro switch operated by the bomb door lever controls the reversible motor in the aft flare chute which raises or lowers a deflector plate. Micro switches are provided in the chute at the *UP* and *DOWN* positions to limit the travel of the deflector plate. When the deflector plate is in the *DOWN* position, the *DOWN* micro limit switch completes the circuit, so that when the air bomber's firing switch (in bombs-and-night camera plug) is operated a flash is released at the same time as the bomb is dropped. A lanyard micro switch is mounted in the flare chute and is operated by the flare when released, completing the circuit to the camera in night bombing. With the air bomber's firing switch in the bombs-and-day camera plug, when the switch is depressed the supply is taken direct to the camera at the same time as the bombs are released.

64. The Mk. VI chute is controlled by a type A 3-way switchbox mounted on the auto pilot panel. The internal arrangement is the same as the Mk. V, so that when the switchbox is in the *DOWN* position, supply is taken to the reversible motors lowering the deflector plate. When the deflector plate reaches the down position it operates the *DOWN* micro limit switch giving direct supply to release, and also lights a warning lamp on the auto control panel. To retract the deflector plate the switchbox type A is switched to the *UP* position.

65. As a summary of the functioning of the flare chutes, the following sequence of operations has been listed. It is assumed that all switches have first been moved to the OFF position:—

Bombs and day camera, aft chute

OPERATION	EFFECT
A. Charge auto distributor and select bomb doors down.	A. Deflector plate descends.

Electrical Installation

Bombs and day camera, aft chute—continued

OPERATION	EFFECT
B. Press air bomber's firing switch.	B. No action on flash chamber, bombs drop.
C. Close camera master switch and press firing switch.	C. Camera starts immediately.
D. Select No. 16 on selector switchbox.	D. Flash released by opening of chute door on bomb No. 16. If lanyard switch is operated, camera starts.
E. All switches OFF, select bomb doors closed.	E. Deflector plate withdraws.

Bombs and night camera, aft chute

F. Repeat A.	F. Deflector plate descends.
G. Close camera master switch and press firing switch.	G. Flash released. If lanyard switch is operated camera starts.
H. Repeat E.	H. Deflector plate withdraws.

Function flare chamber

A. Select flare ON.	A. Deflector plate descends, and on reaching lower limit, opens flash door and lights warning lamp.
B. Select flares OFF.	B. Deflector plate withdraws and warning lamp is extinguished.

P8697 M /G2077 11/45 1050 C & P **Gp. 1**

• EQUIPMENT INSTALLATIONS 11

(11065) T14574/G2588 1050 11/44 M20691 C & P 752

EQUIPMENT INSTALLATIONS

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

Automatic pilot

1. The aircraft is equipped with a Mk. VIII automatic pilot (*see fig. 1*). The aileron and elevator gyro is mounted on the port side of the fuselage nose at the rear of the air bomber's compartment. The servo motors are mounted between the pilot's floor and the main floor, the elevator servo motor on the underside of the pilot's floor and the aileron servo motor on the top of the main floor just aft of the elevator cross shaft.

2. Compressed air is supplied to the gyro unit by an Arrow compressor which is driven from the port inboard engine auxiliaries gearbox. A reservoir mounted on the firewall supplies oil to lubricate the compressor and is also interconnected with an oil cooler on rib 1 of the port main plane leading edge.

3. The supply and return pipes pass along the front spar and the port side of the fuselage into the nose. A silica gel container, located just aft of the pilot's chair, dries the air in the supply pipe before it passes through the control cock into the gyro and servo motors. The control cock, clutch lever, air pressure gauge and pitch control are mounted on the left of the pilot's station. The air throttle is fixed on the fuselage side adjacent to the bulkhead at the rear of the air bomber's compartment. For detailed information regarding automatic pilot Mk. VIII see A.P.1469C, Vol. I. For setting of automatic pilot see Sect. 4, Chap. 3.

4. Air is also supplied from this system to the bomb sight computor. A second air drier, which is connected to the computor, is fixed on the bulkhead at former E and a control cock is provided on the port side of the nose. For further information on the bomb sight equipment see Sect. 12, Chap. 1.

Vacuum system

5. A vacuum system (*see fig. 2*) is provided to operate the artificial horizon, turn indicator and direction indicator on the instrument flying panel, and is also connected to the bomb sight computor, sighting head and H2S scanner. Three pumps are used, one on the accessory gearbox of the starboard inboard engine and twin pumps on the gearbox of the port inboard engine. The pipe lines from these pumps pass through a suction relief valve, along the front spar and the starboard side of the fuselage to a change-over cock mounted on the right-hand side of the pilot's instrument panel. From the change-over cock one pipe leads to the instrument flying panel with a branch to a vacuum gauge, and a second pipe is taken to the bomb sight equipment (*see Sect. 12, Chap. 1*). A branch connection runs off along the starboard side of the fuselage to the H2S scanner and a test cock with an external access door is provided at former 22C. When the change-over cock is set at NORMAL, the single pump is connected to the instrument flying panel and the two pumps to the bomb-sight equipment. At EMERGENCY these connections are reversed.

Equipment Installations

Air speed indicator system

6. The air speed indicator system (*see fig. 3*) consists of two pipe systems, one conveying the air pressure, caused by the movement of the aircraft, from the pressure head to the instruments, and the other connecting the instruments to two static vents.

7. The pressure head (Mk. VIII), which is electrically heated to prevent icing, is situated externally on the port longeron of the fuselage front centre section and is connected to the air speed indicators on the pilot's and navigator's panels. The pressure head heater switch is located on the left-hand side of the flight engineer's panel. Two static vents, mounted one on each side of the fuselage rear centre section, convey static pressure to the air speed indicator, the altimeter and rate of climb meter on the pilot's panel and to the air speed indicator and altimeter on the navigator's panel. The bomb sight computor is also connected to the pressure head and to one of the static vents.

8. Drain pipes are provided at the lowest point of all descents in the pipe runs. These consist of short detachable lengths of pipe which can be removed and shaken out. For further information about the air-speed indicator *see* A.P.1275B, Vol. I.

Cabin-heating system

9. Hot air is delivered from radiators connected to the cooling systems of the inboard engines. One radiator mounted in the leading edge of the starboard main plane and connected to the starboard inboard engine, heats the cockpit and nose by means of a perforated duct on the starboard side. The other, mounted on the starboard side of the fuselage just aft of the rear spar, is connected to the port inboard engine and delivers hot air through a duct on the starboard side to the dorsal and tail turrets and to the cupola of the H2S scanner.

10. On the forward system, air enters a nostril in the starboard main plane leading edge and is delivered to the radiator by a short duct. When the hinged leading edge is closed the ends of the nostril and duct make contact through a sponge rubber seal. The cold air inlet duct is mounted on the radiator and one of the front spar brackets; the hot air duct leads inboard from the radiator and is bolted to a control valve box. The radiator is connected to the inboard cooling system by supply and return pipes lagged with asbestos (*see fig. 4*).

11. The control valve box, which is a light-alloy casting bolted to the fuselage side, has two outlets, one at the inboard end to supply hot air into the fuselage, the other at the bottom connected to the by-pass duct, by which hot air can be discharged through the louvre below the main-plane leading edge. The valve consists of a shutter, operated by a worm gear control from a knob adjacent to the inlet in the cabin and arranged to close the inlet as the by-pass is opened. The passage of air through the ducts is therefore uninterrupted. Felt strips are fitted to the side edges of the shutter and felt packing in the top of the casting to form a seal. The by-pass duct is formed of upper and lower light-alloy castings, the upper casting being bolted to the valve box, and the lower, together with the exit louvre, attached to the bottom of the hinged leading edge. A sponge rubber seal forms the joint between the two castings.

12. A square-section duct, fixed to the fuselage floor by means of brackets, leads from the control valve box into the nose. The duct is perforated along its length on the inboard side and is open at the forward end.

13. The forward heating system is operated independently of the rear system and in order to retain the heated air in the front cabin two plywood doors, mounted on a central post, are provided at former 8 in the fuselage centre section. To assist the circulation of the air an adjustable extractor louvre is provided on the port side of the fuselage nose.

14. The rear heating system is similar in principle. The radiator is installed on the starboard side of the fuselage aft of the rear spar and is connected to the cooling system of the port inboard engine by supply and return

Equipment Installations

pipes which run through the bomb compartment and outboard along the front spar (*see fig. 4*). Control cocks are provided in the fuselage under the front spar cover.

15. The radiator is covered by a light-alloy guard which has a flanged hole in the top surface to allow access to the pet cocks. Externally, the air intake and the by-pass outlet are formed in one fairing, a short duct connecting the radiator to the intake. Hot air is delivered through the asbestos lagged duct which runs along the starboard side of the fuselage to the rear turret. Two branch pipes lead from the main duct, one to the port side of the mid upper turret and the other into the H2S scanner. A rotary sleeve valve control is provided at the H2S unit and a butterfly valve at the rear turret, but no separate control is provided at the mid upper turret.

Oxygen supply system

16. The oxygen equipment consists of twenty-one bottles connected by a high pressure pipe to a regulator on the pilot's instrument panel, and then by medium pressure pipes to four manifolds. From these manifolds low pressure pipes carry the oxygen to the economisers at the various crew stations (*see fig. 5*).

17. Fifteen of the bottles are stowed in a crate in the fuselage centre section and the remaining bottles are mounted in the centre section on the starboard side of the fuselage. A charging connection in the bomb compartment is connected to a pipe feeding all the bottles and thus enables the bottles to be charged without removal. A stop valve is mounted on the oxygen crate from which a high pressure pipe passes oxygen at a pressure of 1,800 lb. per sq. in. to the master control on the pilot's instrument panel. Oxygen leaving this regulator at a reduced pressure passes through light-alloy pipes to four manifolds. From here the pressure is further reduced and the oxygen passes through aluminium pipes to the economisers. From each economiser a flexible pipe connects the supply to the oxygen socket. When the oxygen is not being used the sockets are stowed in special cut-off clips. The operation of these clips is such that when the socket is inserted a small plunger is depressed and the oxygen supply is cut off. Cut-off valves are interposed in the low pressure supply to the turrets.

18. Seven portable oxygen bottles are stowed in wire mesh containers at the following positions:—

(i) Under the starboard side decking of the nose turret installation.

(ii) On the back of the pilot's seat.

(iii) One on each of the two vertical stays just forward of the astrodome.

(iv) On the starboard side of the fuselage just forward of the rear spar.

(v) On the face of the bulkhead at the rear end of the bomb compartment.

(vi) On the starboard side of the fuselage just forward of the tail turret.

Photographic equipment

19. The F.24 camera is mounted in the nose of the aircraft on the port side, in front of the bulkhead at former E and directly above a circular window (*see fig. 6*). The camera rails fit into two brackets, in which they can slide horizontally at right-angles to the centre line of the fuselage. The brackets slide vertically on mounting tubes which are braced to the bulkhead by tubular struts. Six holes are drilled in the mounting tubes to receive screw pins for locking the camera at different heights. The camera is mounted so that the optical axis is normal to the line of flight.

20. An electric motor mounted at the top of the bulkhead operates the camera by means of a flexible drive and is controlled from a unit on the air-bomber's port panel. A camera control switch and heater switch are also mounted on this panel. The camera heating muff and lens cover are plugged into the sockets on the camera heating panel fitted on former F on the port side of the fuselage.

21. For further information on photographic equipment, see A.P.1355.

Equipment Installations

22. ***Positions for F.24 camera.***—The camera may be set in any of the following four positions, which are indicated by numbered holes in the tubes:—

5 in. lens	position No. 6
8 in. lens	position No. 5
14 in. lens	position No. 1
20 in. telephoto lens	position No. 1

B.B.P. equipment

23. The equipment for the balloon barrage protection consists of light-alloy plates riveted along the leading edge of the main plane (*see fig.* 7) in which are mounted steel containers for the cable cutters. There are eight cutters on the port plane and six cutters on the starboard plane. A double cutter is mounted in each main plane root.

24. The reinforcing plates are riveted to the nose ribs and to the two foremost stringers in the nose and extend the whole length of the centre and outer planes. At several points along their length the plates are jointed, the joint being cut in the form of an arc to prevent the cables from fouling.

25. The containers into which the cutters are fitted consist of a mild steel body with an attachment flange welded at one end and a dished end cover at the other. The end cover is fitted with a special retaining nut which is brazed on. The containers are secured to the reinforcing plates by countersunk-head screws and anchor nuts riveted to the flange in the containers. Details of the cutters and their operation and loading are contained in A.P. 2051A, Vol. I.

P9594 M00964/G3460 2/46 1050 C & P **Gp. 1**

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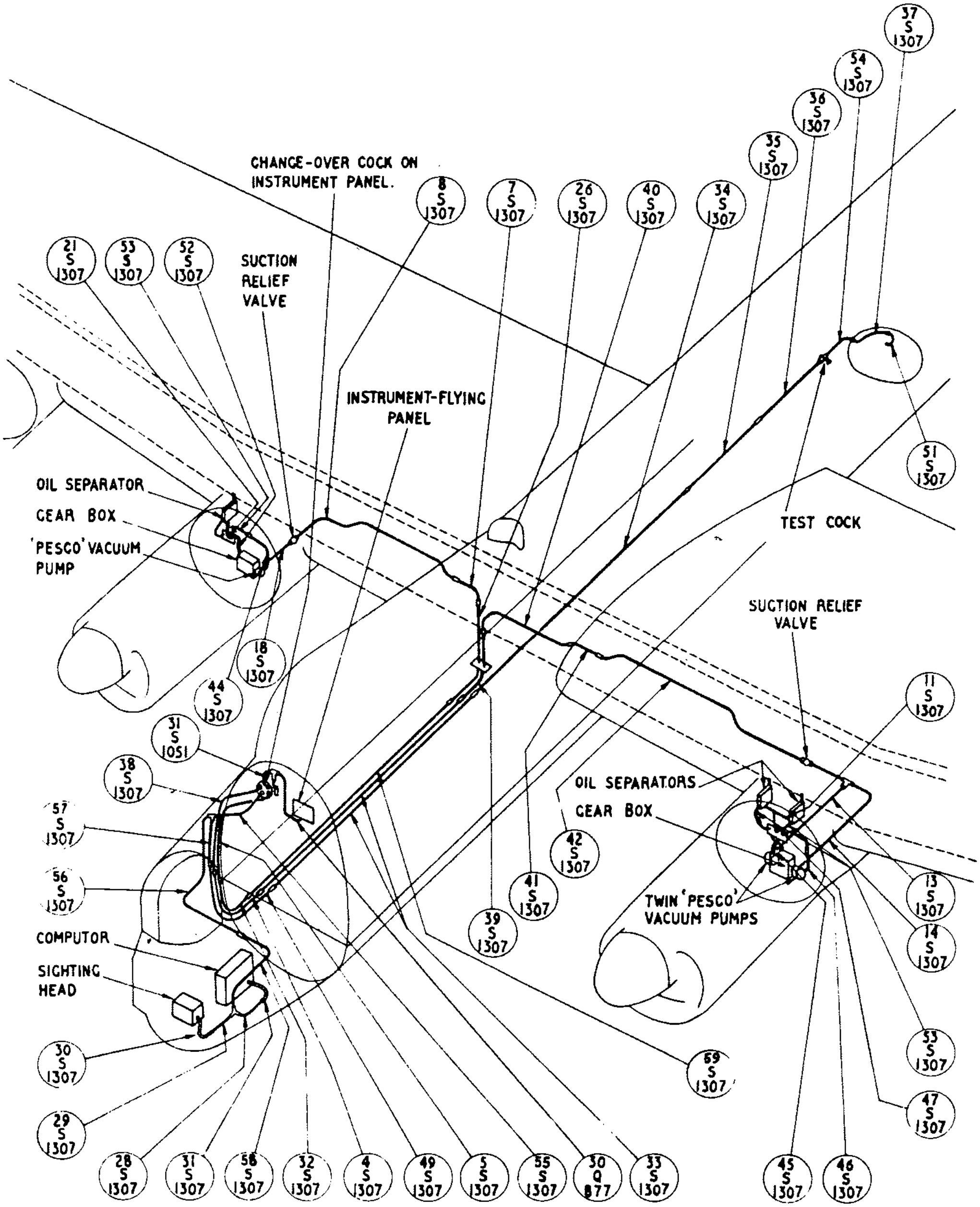

FIG. 2 VACUUM SYSTEM FIG. 2

PP4221 M965/G3461 1 46 1050 C&P Gp.959 (4)

A.S.I. SYSTEM

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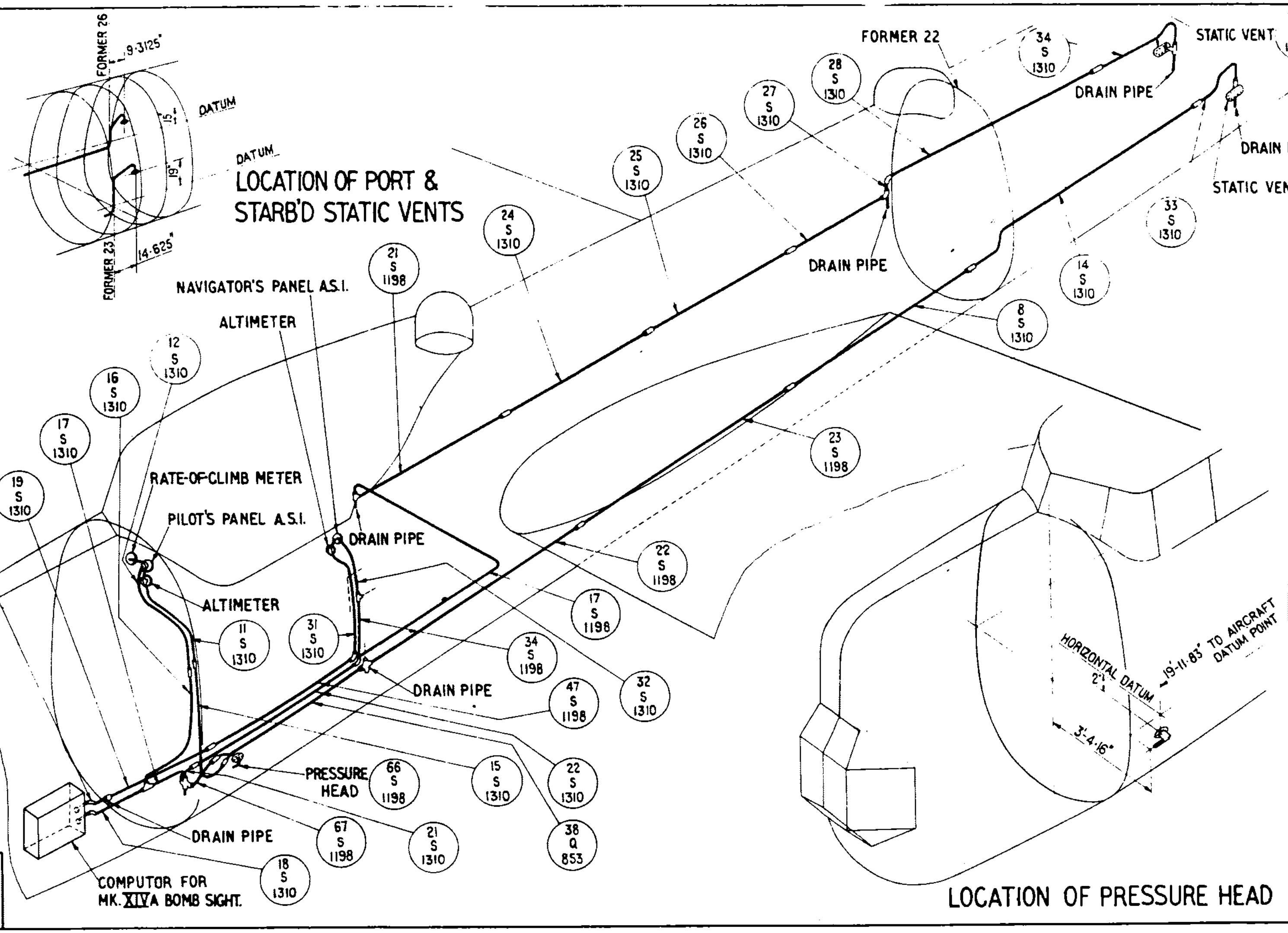

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CABIN HEATING

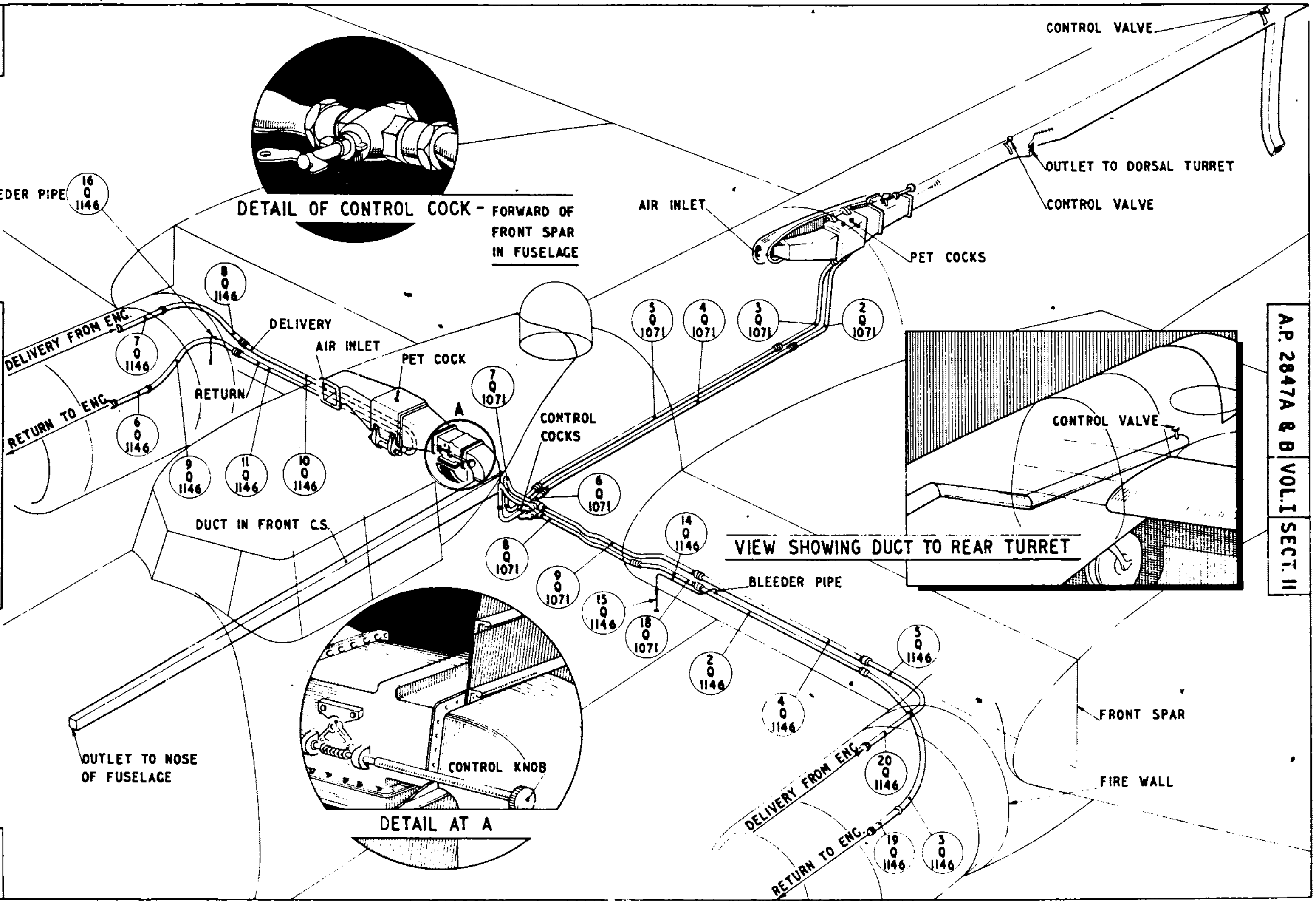

FIG. 4

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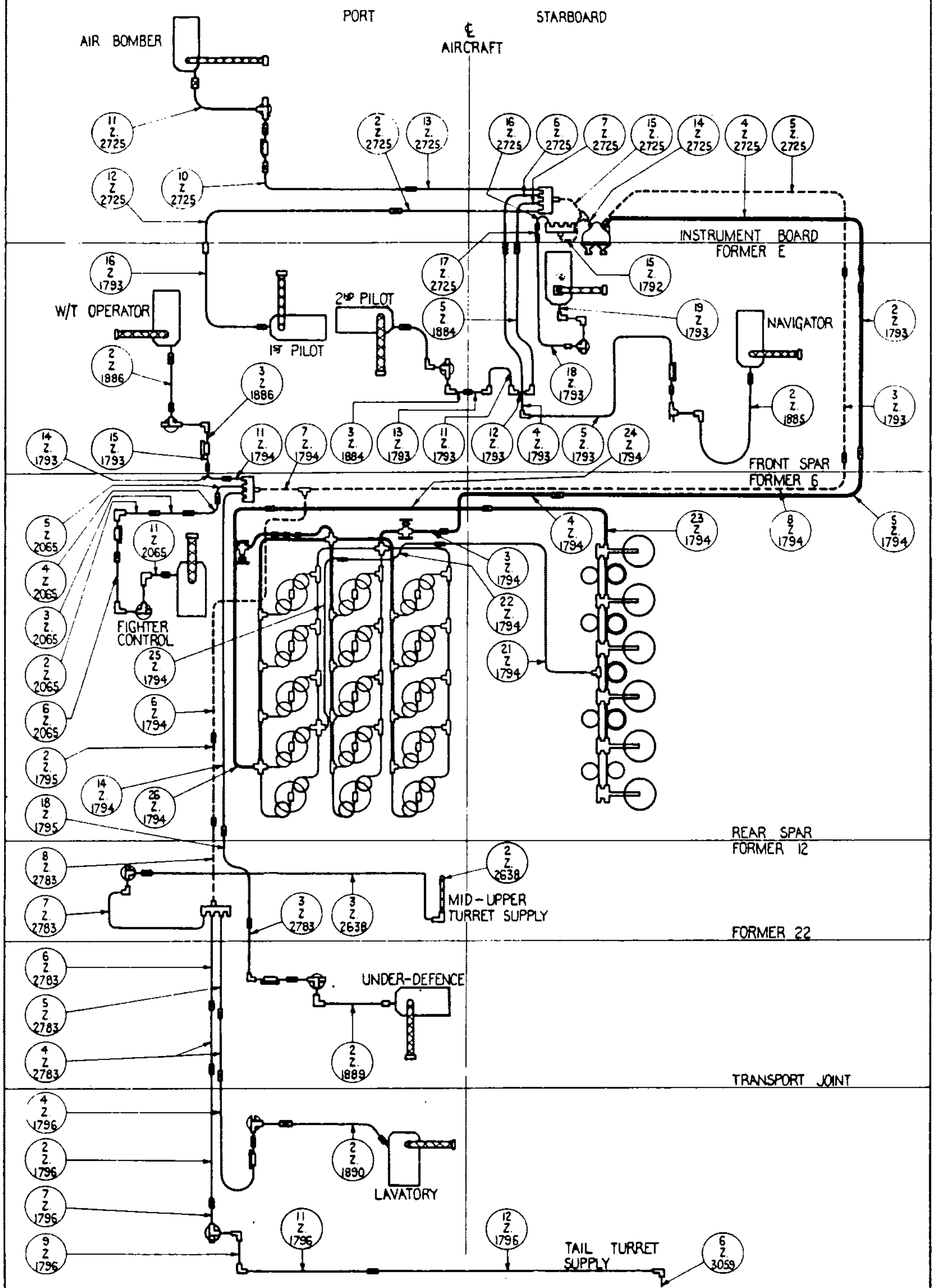
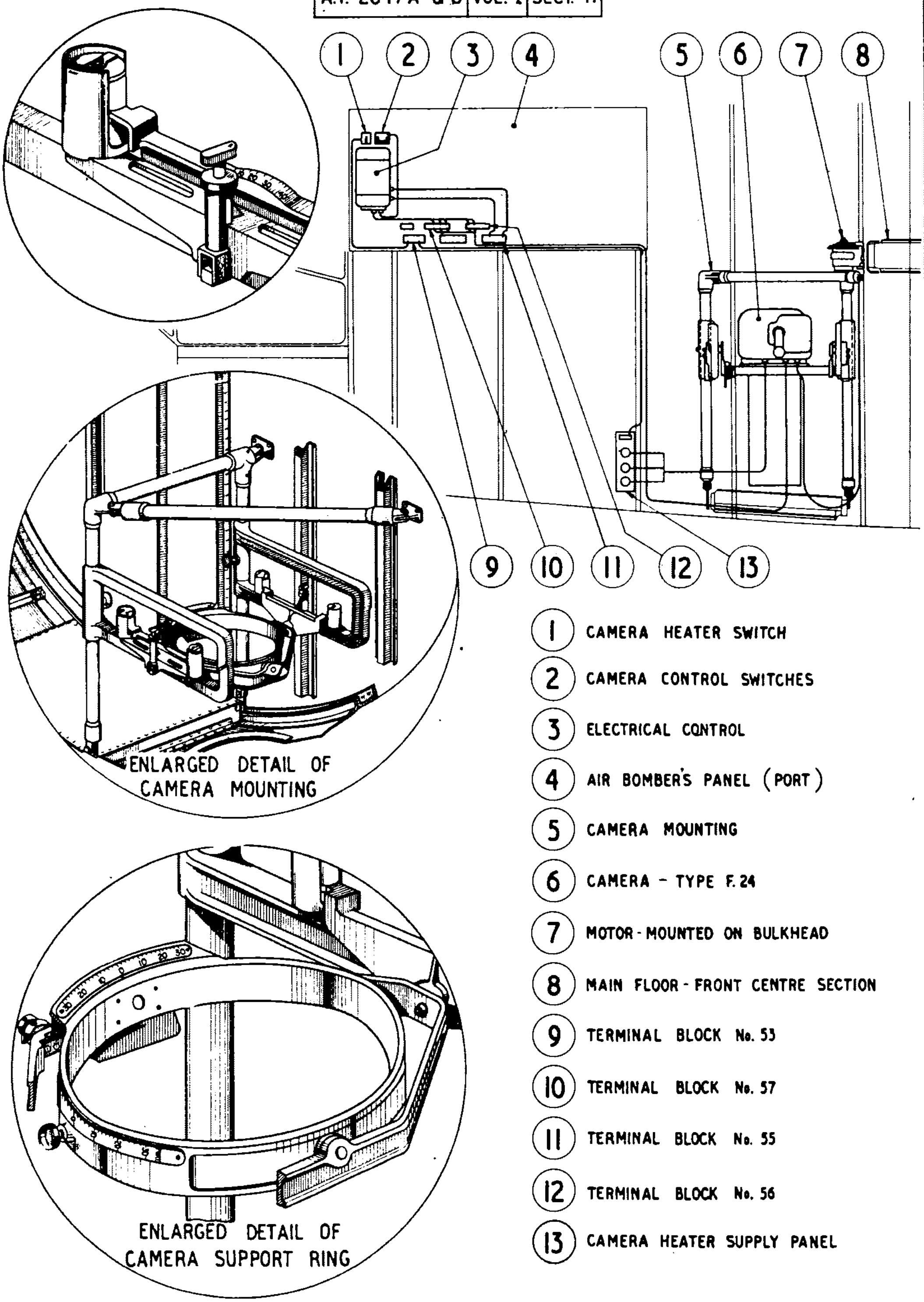


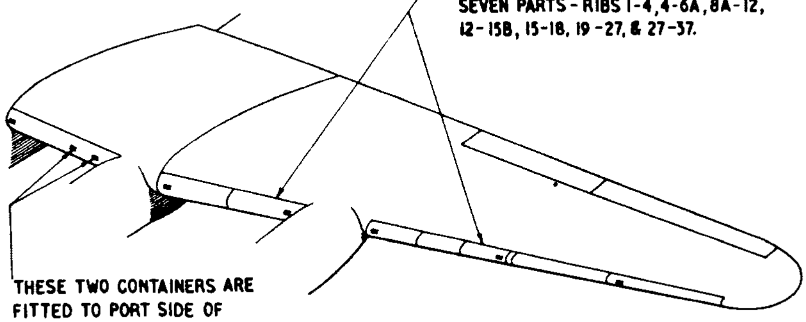
FIG. 5 OXYGEN SUPPLY SYSTEM. FIG. 5

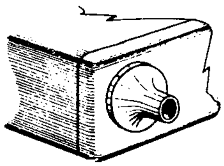
PP4221 M965 G3461 1·46 1050 C & P Gp. 959 (4)



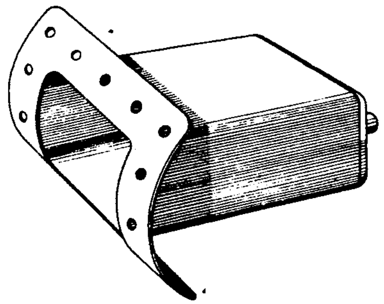
1. CAMERA HEATER SWITCH
2. CAMERA CONTROL SWITCHES
3. ELECTRICAL CONTROL
4. AIR BOMBER'S PANEL (PORT)
5. CAMERA MOUNTING
6. CAMERA - TYPE F.24
7. MOTOR - MOUNTED ON BULKHEAD
8. MAIN FLOOR - FRONT CENTRE SECTION
9. TERMINAL BLOCK No. 53
10. TERMINAL BLOCK No. 57
11. TERMINAL BLOCK No. 55
12. TERMINAL BLOCK No. 56
13. CAMERA HEATER SUPPLY PANEL

FIG. 6 — PHOTOGRAPHIC EQUIPMENT — FIG. 6

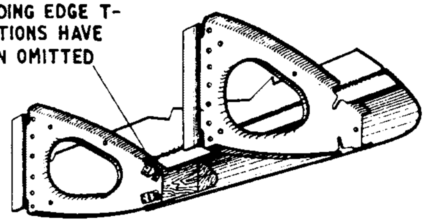




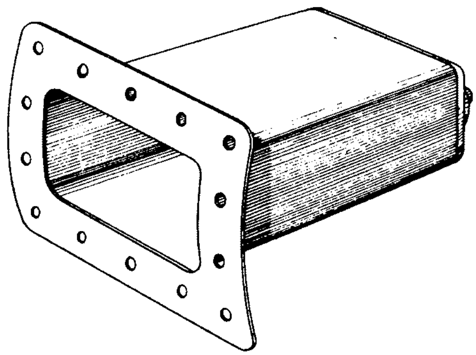
DETAIL OF SPECIAL NUT BRAZED TO CONTAINER.



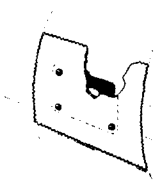
VIEW OF CONTAINER BETWEEN RIBS 29 AND 30 - OUTER PLANE



VIEW SHOWING HARDWOOD PACKING PIECE ADJACENT TO RIB № 37. THREE CSK. HD. WOODSCREWS ATTACH PACKING PIECE TO NOSE PLATE AND FLANGES OF RIB № 37



VIEW OF CONTAINER FITTED ADJACENT TO RIBS 1, 5A & 10



DETAIL OF FABRIC PATCH WHICH IS DOPED TO LEADING EDGE WHEN B.B.P. INSTALLATION IS NOT FITTED IN CONTAINER

FIG 7

B.B.P. INSTALLATION

FIG. 7

PP4221 M965 G3461 1 46 1050 C&P Gp.959 (4)

12 • ARMAMENT INSTALLATIONS AND SERVICING

(11065) T14574/G2588 1050 11/44 M20691 C & P 752

CHAPTER I

BOMBING EQUIPMENT AND PYROTECHNICS

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

**To be issued later*

Bombing Equipment and Pyrotechnics

1. This chapter covers the description, operation, servicing, and the installation and removal of all bombing and pyrotechnic equipment, and gives detailed instructions for the bombing-up and de-bombing of Lincoln aircraft. Where detailed information exists in separate publications only installation and removal instructions are given in full, with references to the relevant publications. As much information as possible has been given in the form of diagrams, which appear at the end of the chapter.

2. The bombing equipment is made up of the sighting and electrical equipment at the air bomber's station in the fuselage nose, and the bomb carrier housings, crutching gear and fuzing units in the main floor above the bomb bay, etc. The pyrotechnic equipment includes flare chute, flares, seamarkers, signal pistol and cartridges, and demolition incendiary bombs.

3. The following is a list of Associated Publications to which reference should be made:—

	Description A.P.	*Servicing A.P.*
Bomb sight and computor, Mk. XIVA ...	1275D, Vol. I	1275D, Vol. I
Bomb sight, T.1.	*1730A, Vol. I	*1730A, Vol. II, Part 3
Selector and pre-selector switches; Automatic distributors, E.M. fuzing and release units; Release unit type F, and attachment type G	1095B, Vol. I	1095B, Vol. I
Bomb carriers, flare chutes	1664, Vol. I	1664, Vol. II
Winches	1664C, Vol. I	1664C, Vol. II
Trollies, etc.	1664D, Vol. I	1664D, Vol. II

*Being superseded by British Supplement to Tech. Order A.N.11-30-63

Bombing Equipment

Air bomber's station

4. A general view of the equipment at the air bomber's station is given in fig. 1. A sliding seat for the air bomber enables him to sit immediately behind the bomb sight in the forward end of the nose. The seat, which slides in a fore-and-aft direction, may be locked in any one of five positions by a small lever in each side of the front of the supporting frame. Below the seat is a map stowage, and on the starboard side, at floor level, is a stowage for the bomb-firing switch and bomb sight lead. The Mk. XIVA bomb sight computor is on the port side of the nose, with the bomb sight cock above on the automatic pilot panel. The arrangement of the pipe lines connecting the computor and the sighting head with the automatic pilot, vacuum and A.S.I. systems is shown in fig. 2. The bomb selector, fuzing and release controls are carried on a panel on the starboard side (*see fig. 3*).

Bomb sights

5. Provision is made for fitting either the Mk. XIVA bomb sight or the Mk. III low-level bomb sight. A flexible drive (Service fit) from the latter is taken aft along the port side and under the main floor, passing upward to a computor stowage above the forward end of the navigator's table. The bomb sight control panel is located centrally at the extreme forward end of the nose, below the bomb sight.

6. Mod. Lincoln/1226 introduces fixed fittings for the installation of the stabilised automatic bomb sight, Mk. 11A (Special Order only, Mod. Lincoln/1227).

Bomb bay and equipment

7. The bombs are carried in a single compartment 33 ft. 5 in. long and the full width of the fuselage, extending from a bulkhead at

Bombing Equipment and Pyrotechnics

former E, at the rear of the fuselage nose, to a second bulkhead at former 22 (*see fig. 6*). An inspection door in the starboard side of the forward bulkhead enables the air bomber to examine the bomb compartment from the nose, and a round inspection window is also provided in the rear bulkhead. Hydraulically-operated doors, each the full length of the compartment, are hinged to the sides. The standard doors allow sufficient depth for a 4,000 lb. bomb. Larger doors, deep enough to enclose an 8,000 lb. bomb, are introduced by Mod. No. Lincoln/1381, when fitted.

8. The bomb carrier housings are fitted between the cross beams of the main floor, which forms the roof of the bomb compartment. There are fourteen standard housings, located as shown in fig. 6, and one convertible heavy bomb slip at the centre station between the main plane spars. The sizes and weights of the bombs which can be carried at the various stations can be determined by reference to fig. 6 and 7. For details and installation of the bomb gear housings and the crutching gear incorporated with them *see* fig. 13. Similar additional crutching gear is fitted to floor beam 2, and between floor beam 11 and the rear spar, to crutch the longer carriers required for 2,000 lb. bombs, carried at stations 8, 10 and 12, and 7, 9 and 11. The numbers of the bomb gear housings are stencilled above and under the floor.

9. The bomb gear crutching handles are stowed in a pouch on the port side of the fuselage between the main plane spars. A special crutching arrangement exists at the crutching points on the starboard side and on the centre line just forward of the rear spar, where the nitrogen bottles prevent the use of the handle. A projecting square-ended adapter is permanently fitted at each of these positions and is turned by means of an open 2 B.A. spanner.

10. The heavy bomb slip incorporates release unit type F, which can either be fitted alone, using adapters at the sides, or with attachment, type G (*see fig. 12*). The special crutching and fuzing units required for very heavy bombs are illustrated in fig. 11.

Bomb carrier adapters

11. The following adapters may be used:—

(i) The Lancaster Adapter No. 1, Mk. I, with two standard Avro carriers Mk. I, can be fitted at stations 1, 2, 11 and 12, enabling two bombs of up to 500 lb. weight each to be carried at each of these stations. This adapter was originally known as the Whitlock Adapter.

(ii) The Lancaster Adapter No. 1, Mk. II, with two standard Avro carriers Mk. II.

(iii) The Lancaster Adapter No. 4 can be fitted at station 13, enabling a bomb up to 1,000 lb. weight to be carried at this station.

Bomb carriers

12. Avro standard carriers Mk. I (Stores Ref. 11A/1015), or Mk. II (Stores Ref. 11A/2568) are used for bombs up to 1,000 lb. weight. For 2,000 lb. bombs the Avro 2,000 lb. heavy bomb carrier (Stores Ref. 11A/1054) is used.

Electrical system

13. The location of the air bomber's electrical controls and equipment is illustrated in fig. 1, 2 and 3. For information on the electrical supply to the bomb sights and Mk. XIVA computor, bomb release circuits and the inter-connection with the D.R. compass circuit, *see* Sect. 6, Chap. 1. Details of the fuzes on the air bomber's starboard panel are tabulated in fig. 3, including those for distributor heating, bomb-release heating (station No. 13) and heated clothing. Switches for the two last are also on the starboard panel, and the heated clothing socket is on the port panel. A junction box reference JBA is fitted at the forward end of the bomb compartment. The release positive terminals in the junction box are referenced with the number of the bomb station to which they connect, and these references agree also with the switch numbers on the selector switch box and the pre-selector switch unit.

14. The pilot's controls consist of a bomb-firing switch on the rim of the aileron control handwheel, and a container jettison switch and bomb jettison pull handle on the main

Bombing Equipment and Pyrotechnics

instrument panel. A bomb-firing switch is provided on the navigator's table for use when bombing on Radar.

15. The circuit to the automatic bomb sight plug and socket, to the fuzing switches and to the firing switches is made through two plunger-type switches wired in series, which are closed as the bomb doors are opened (*see fig. 6*). The circuit is completed before the doors are fully open, and the fact that the bombs can be released does not necessarily mean that the doors are open wide enough to allow them to fall clear.

16. The air bomber's firing switch is locked in an interlock when not in use, and cannot be removed until nose or tail fuzing has been selected. It can be plugged into one of two sockets: BOMBS AND NIGHT CAMERA, or BOMBS AND DAY CAMERA. In the first position, provided the linked master switches on the air bomber's port side panel have been closed, release of the bombs causes the simultaneous release of a photo flash, and starts the camera. If the pilot's or navigator's bomb-firing switches are used the photo flash release circuit is not closed by the switch, but an alternative circuit is made through terminal 16 of the preselector switchbox, if selected, and the photo flash is released by the action of the auto-distributor. In the BOMBS AND DAY CAMERA position, the air bomber's firing switch starts the camera when the bombs are released, but the other firing switches do not operate the camera. When the master switches are closed to enable the camera to be used in the DAY position, then position No. 16 must not be selected on the bomb release controls or the photo flash release will operate also.

Miscellaneous Equipment

17. The air bomber's intercommunication socket, PRESS-TO-TRANSMIT switch, oxygen supply pipe and cut-off valve, and hand pump for glycol spray, are all on the port side of the fuselage nose, and are illustrated in fig. 1. The location of miscellaneous armament stores, i.e. signal pistol, cartridges, demolition incendiary bombs, flares and seamarkers, is shown in fig. 10.

Operation

Bomb sight equipment

18. The bomb sight cock on the port side of the air bomber's station controls the air supply from the automatic pilot to the computor. The Arrow compressor, which is driven by the port inboard engine, is capable of maintaining an air supply sufficient to operate both the automatic pilot and the bomb sight equipment at the same time.

19. The vacuum system connections to the computor and the sighting head are controlled by a vacuum change-over cock on the right-hand side of the pilot's instrument panel. At NORMAL, two vacuum pumps on the port inboard engine operate this section of the vacuum system, which includes a connection to the special equipment, when fitted, in the fuselage rear centre section. At EMERGENCY, the two pumps are connected to the instrument flying panel.

Bomb release equipment

20. The electrical operation of the bomb release equipment is covered in the brief descriptive notes on the electrical system (*see para. 12*).

Emergency mechanical release

21. It is possible to jettison bombs mechanically from the heavy bomb slip or the Avro Standard Carrier, Mk. I or Mk. II, if the electrical release fails to operate. Mechanical jettisoning is not possible from the Avro 2,000 lb. heavy bomb carrier. The heavy bomb slip at station 13 is provided with a mechanical release lever (*see fig. 13*). In the standard bomb gear housing a loose hook is stowed under the detachable cover, and is used to jettison bombs from the standard carrier by inserting it through the bomb gear housing adjacent to the electrical plug and hooking it under the mechanical release

Bombing Equipment and Pyrotechnics

lever on the carrier, which can then be pulled up to release the bomb.

Servicing

Bomb gear housings

22. The moving parts require to be lubricated with anti-freezing oil (*see fig. 13*). The crutching gear operation should be tested, and the functioning of the slip hook, trip catch and safety pawl checked to ensure that the return springs are in order.

Removal and installation

Mk. XIVA bomb sight and computor

23. Instructions will be found in fig. 4.

Mk. III low-level bomb sight

24. Instructions to be issued later.

Standard bomb gear housing

25. Instructions will be found in fig. 13.

Bombing-up

General notes

26. The information given in the following paragraphs deals with the handling and loading of stores to Lincoln aircraft, and the equipment necessary to carry out these operations, from the time when these arrive at the aircraft until take-off. The attachment of fuze-setting control links to the stores, and into the E.M. fuzing units in the aircraft, is dealt with in an appendix to A.P.2852A, Vol. I, Sect. 14. Reference must also be made to the general notes on bombing-up aircraft in A.P.2852A, Vol. I, Sect. 14, Chap. 1.

27. When the bomb loads, pre-selector settings, bomb stations, and distributor settings have been determined by the responsible officers, and the Station Armament Officer is in possession of all details, the Warrant Officer i/c daily servicing squad, or Senior Armament N.C.O., will detail his bombing-up crews.

28. A bombing-up crew should consist, where possible, of an N.C.O. and four airmen. This arrangement, however, is subject to variation due to local conditions, such as the amount of equipment and the number of airmen available. If the amount of equipment makes it possible to have more crews, the number in each crew may be reduced to a total of four men, two of whom will work in the aircraft and two on the ground. In this chapter there is a typical example of the division of duties for a bombing-up crew of five airmen, including an N.C.O.

29. Bombing-up will only be carried out under the supervision of an armament N.C.O. or senior airman of the trade of fitter armourer, fitter armourer (bomb), armourer, or armourer (bomb), who is responsible for ensuring that the following procedure is carried out.

30. Prior to bombing-up, the N.C.O. i/c crew is to ensure that the daily inspection of the aircraft bomb gear has been carried out in accordance with the aircraft maintenance schedule, and signed for on Form 700.

31. Should carriers be required, other than those tested during the daily inspection, for a particular bomb load, the requisite number of serviceable carriers will be obtained from the daily servicing armoury. These carriers are to be inspected for serviceability. Functioning tests on the E.M. release units, fuzing units, and release slips have to be applied with the carriers plugged into the bomb stations on which they are to be used.

32. To obviate the danger of accidental release of photo-flashes or flares from the twin-cell launching chute, it may be found in some aircraft that a 5-pin plug has been fitted in the launching chute circuit which, when disconnected, completely isolates the flare chute from the electrical circuit.

33. Where a 5-pin plug has been fitted, no compartment of the flare chute is to be loaded while the aircraft is on the ground, before the 5-pin plug has been removed from its socket.

Bombing Equipment and Pyrotechnics

34. The correct procedure for cocking all E.M. release units is as follows:—

(i) Cock the E.M. release unit by exerting pressure on the thumb piece of the cocking lever.

(ii) Operate the test plunger.

(iii) Re-cock the E.M. release unit.

This procedure ensures positive engagement of the armatures, and should become automatic to all bombing-up crews.

35. Before loading bombs to aircraft, or carrying out any settings of the pre-selector unit, the N.C.O. i/c is to ensure that the electrical controls are in the safe position.

36. The N.C.O. will then set the pre-selector unit in accordance with instructions given by the Station Armament Officer.

37. During bombing-up operations, the N.C.O. i/c bombing-up crew will personally see that the twin-cell launching chute is unplugged after functioning tests have been carried out (if a 5-pin plug has been fitted), and that armament personnel only are allowed to plug and unplug bomb carriers. He will also ensure that no personnel are allowed under the store which is being, or has been, loaded.

38. All suspension lugs should be thoroughly cleaned prior to loading bombs on to carriers.

39. All carriers must be correctly positioned and crutched down.

40. All crutching of the carriers to the bombs should be finger-tight only. When bombs are carried on a 2,000 lb. carrier the strainer attachment should be tightened in accordance with instructions in para. 82. Check that the elastic retraction gear is correctly attached to the sling.

41. Plug the 5-pin plug into the stowage on top of the carrier to ensure that the electric cable on the carrier is not damaged during loading, and does not foul the release mechanism.

42. When small bomb containers are carried, the container is to be inspected as soon as the weight is taken on the winch, by operating the test plunger on each E.M. release unit, and re-cocking, ensuring that the cocking plunger returns freely under the action of its own spring.

43. After loading the stores, the N.C.O. will post an airman in front of the aircraft to warn all personnel against passing under the bomb bay whilst the N.C.O., together with the electrician, carries out the appropriate tests.

44. The removal and replacement of safety pins is to be carried out as stated in the appendix to A.P.2852A, Vol. I, Sect. 14.

45. The N.C.O. will be detailed for the loading of all photo-flashes which are to be placed in the twin-cell launching chute as a last operation after bombing-up.

46. A percentage check of aircraft bombed-up will be made by the duty armament officer.

47. Fig. 6 shows the positions of the bomb stations, and the loads which can be carried at each one. The dimensions of the bomb bay including intermediate sectional dimensions can be obtained from fig. 6 and 7.

Opening the bomb doors

48. If the bomb doors are not already open, and the inboard engines (which drive the general services hydraulic pumps) are not running, it will be necessary to use the hand hydraulic pump on the port wall of the fuselage aft of the front spar to open the doors. The control lever must be placed in the OPEN position before starting to use the pump. Safety brackets (Stores Ref. 26EA/3873) should be fitted to the bomb door jacks to prevent inadvertent closing of the doors while bombing-up is in progress. For remaining bomb carriers, making final adjustments and checking, step-ladder (Stores Ref. 4C/86), will be required.

49. Standard loading winches (*see* A.P.1664C) are used. For heavy bombs, at station 13, two safety holes are provided, one forward and one aft of the bomb slip. The adjustable crutches for these bombs are removed when other bomb loads are carried. Fig. 11 gives

Bombing Equipment and Pyrotechnics

instructions for adjusting the crutches and positioning the special fuzing bracket for 4,000 and 8,000 lb. bombs, and fig. 12 illustrates the method of fitting release unit type F (and, when required, attachment type G) at station 13.

Instructions for all bomb loads

50. The following instructions are common to all types of loads. Attention must be given to them first, then reference made to the additional instructions peculiar to each store.

(i) Ensure that all items of equipment are available and have been prepared and tested as laid down.

(ii) Prior to bombing-up, the N.C.O. i/c bombing-up crew must ensure that the Daily Inspection of the aircraft bomb gear has been carried out in accordance with the aircraft maintenance schedule, and signed for on Form 700.

(iii) Ensure that the aircraft has been parked on level ground before commencing bombing-up.

(iv) Ensure that the safety switch (usually located on or near the navigator's table) is switched to "OFF".

(v) Remove the main fuse from the bomb release circuit.

(vi) Set the GROUND/FLIGHT switch to "GROUND".

(vii) Ensure that the starter trolley is not plugged in.

(viii) Ensure that the jettison bars on the selector box are set to SAFE with the safety clip in position. When checking the jettison bars before bombing-up, the safety clip must be removed, the jettison bars moved as far as possible to the right, and the safety clip replaced. If the newer type of selector switch box is fitted ensure that the jettison knob has been set.

(ix) Set all selector switches at "OFF".

(x) Ensure that the bomb firing switch is stowed in the electro-magnetic stowage.

(xi) Set the fuzing switches to "OFF".

(xii) Ensure that the camera switch is at "NEUTRAL".

Special bombing-up orders for bombs fuzed long delay

51. The N.C.O. i/c bombing-up will receive bombs fuzed long delay from the bomb dump, *after* all other bombs have been loaded on the aircraft. On arrival of the L.D. bombs he will check each one as follows:—

(i) Ensure that the appropriate long delay identification marking is stencilled on the bomb body, e.g., "L.D.37" or "L.D.37A", and the letters "F.D.", together with the appropriate detonator number, are chalked on the bombs.

(ii) Ensure that the safety clip or safety wire, as applicable, is correctly assembled to the tail of the bomb.

(iii) Ensure that the arming vanes are locked to the tail unit by locking wire, and that the locking wire retains the pre-prepared label.

52. The N.C.O. i/c all bombing-up will then allot the bombs to the bombing-up crews.

53. The N.C.O.'s i/c crews will be re-briefed on the aircraft carrying L.D. bombs which they are required to bomb up, the number of bombs per aircraft, and the positions to which they are allotted.

54. The bombs will then be loaded on to the aircraft in the normal manner.

55. The N.C.O. i/c each crew will remove the locking wire and pre-prepared label from each L.D. bomb, and secure the safety pins, locking wires, and safety plates to a prominent part of the aircraft structure near the air bomber's position.

56. The N.C.O. i/c all bombing-up will check each aircraft and ensure that locking wires have been removed from L.D. bombs and stored as instructed above. He will also sign and forward to the Armament Officer a certificate or *pro forma*, that locking wires, and safety pins, and pre-prepared label have been removed and stored, in accordance with instructions.

Bombing Equipment and Pyrotechnics

Composition of the bombing-up crew

57. The bombing-up crew should consist of five men, as follows:—

No. 1, N.C.O. i/c bombing-up crew.
No. 2 in the aircraft—Winch operator.
No. 3 in the aircraft—Winch operator.
No. 4 in the aircraft—Winch operator.
No. 5 on the ground—i/c trolleys.

Duties of the bombing-up crew

58. To ensure maximum speed and efficiency in bombing-up, the duties of the bombing-up crew should be portioned out as follows:—

(i) The N.C.O. i/c will

(*a*) Ensure that all tests have been carried out on all ancillary equipment, and aircraft bomb gear, and that Form 700 has been signed.

(*b*) Ensure that all electrical controls are in the "safe" position before commencing bombing-up.

(*c*) Supervise the positioning of the trolleys and stores relative to the bomb stations.

(*d*) Fit the carriers and/or adapters to the stores; crutch down the stores; fit the electrical connections from the small bomb containers to the bomb carriers.

(*e*) Attach the cable ball-end to the ball-end adapters on the carrier and/or twin adapter.

(*f*) Guide the stores into position in the bomb stations.

(*g*) Supervise the light-testing in conjunction with the armament electrician and ensure that the correct settings are set on the pre-selector.

(*h*) Attach the fuze-setting control links and remove safety devices.

(*i*) Ensure that the aircraft is loaded as specified by the Armament Officer.

(*j*) Sign Form 700 and Form 1826.

(ii) No. 2 will

(*a*) Remove all cover plates and 5-pin plugs.

(*b*) Screw all crutches up to their full extent.

(*c*) Release all bomb carriers which are received by No. 5 of the team.

(*d*) If stores can be raised to Station 3, 1 and 5 with a 500 lb. winch, he will proceed to load those stations while the 4,000 lb. H.C. is being raised.

(*e*) Load stations 7, 9 and 11 (if incendiary stores are to be carried).

(*f*) Assist the N.C.O.

(iii) No. 3 will

(*a*) Put the winch in position, and the re-action pads (if necessary).

(*b*) Start the petrol motor of the hydraulic bomb-loading trolley.

(*c*) Connect the hydraulic bomb-loading trolley to the winch.

(*d*) Assist No. 4 of the team with the 4,000 lb. H.C. (at the front).

(*e*) Raise stores to stations 2, 4, 6, 8, 10 and 12.

(iv) No. 4 will

(*a*) Put the winch in position, and the re-action pads (if necessary).

(*b*) Assist No. 3 of the team to start the petrol motor of the hydraulic bomb loading trolley.

(*c*) Connect the hydraulic bomb-loading trolley to the second bomb winch.

(*d*) Assist No. 3 of the team with the 4,000 lb. H.C. (at the rear).

(*e*) Raise stores to stations 14 and 15.

(*f*) Plug the 5-pin plugs to the aircraft supply, remove the re-action pads, replace the cover plates, and remove winching equipment from the aircraft.

(v) No. 5 will

(*a*) Receive the carriers released by No. 2. If twin adapters No. 1 are fitted, he will require to use the aircraft ladder.

(*b*) Position the trolleys convenient to the appropriate bomb stations.

(*c*) Assist the N.C.O. as necessary.

Bombing Equipment and Pyrotechnics

4,000 lb. H.C. bombs, and incendiary bombs in small bomb containers

59. ***Table of loads.***—The following table gives the commonest loads and stations for 4,000 lb. H.C., and incendiary bombs. The use of brackets ( ) indicates that the twin Adapter No. 1 is used on those stations.

Load	Stations
1 × 4,000 10 × 12 × 30 6 × 150 × 4 2 × 60 × 4	13 (1) (2) (12) 3 4 5 6 7 8 9 10 14 15 (11)
1 × 4,000 10 × 12 × 30 6 × 150 × 4 1 × 60 × 4	13 (1) (2) (12) 3 4 5 6 7 8 9 10 14 15 11
1 × 4,000 9 × 12 × 30 6 × 150 × 4 1 × 60 × 4	13 (1) (2) 3 4 5 6 12 7 8 9 10 14 15 11
1 × 4,000 8 × 12 × 30 6 × 150 × 4 1 × 90 × 4	13 (2) (12) 3 4 5 6 7 8 9 10 14 15 1
1 × 4,000 8 × 12 × 30 6 × 150 × 4	13 (1) (2) 3 4 5 6 7 8 9 10 14 15
1 × 4,000 7 × 12 × 30 6 × 150 × 4	13 (2) 12 3 4 5 6 7 8 9 10 14 15
1 × 4,000 4 × 12 × 30 1 × 8 × 30 4 × 150 × 4	13 3 4 5 6 2 7 8 9 10
1 × 4,000 6 × 12 × 30 5 × 150 × 4 1 × 60 × 4	13 3 4 5 6 14 15 2 7 8 9 10 11
1 × 4,000 6 × 12 × 30 5 × 150 × 4	13 3 4 5 6 14 15 12 7 8 9 10
1 × 4,000 8 × 8 × 30 5 × 150 × 4	13 (2) 3 4 5 6 14 15 1 7 8 9 10
1 × 4,000 5 × 12 × 30 5 × 150 × 4	13 1 3 4 5 6 2 7 8 9 10

Load	Stations
1 × 4,000 5 × 12 × 30 4 × 150 × 4 1 × 60 × 4	13 2 3 4 5 6 7 8 9 10 11
1 × 4,000 7 × 8 × 30 4 × 150 × 4 1 × 60 × 4	13 2 3 4 5 6 14 15 7 8 9 10 11
1 × 4,000 6 × 8 × 30 4 × 150 × 4	13 3 4 5 6 14 15 7 8 9 10

60. ***Equipment (for first of tabled loads).***

(i) Four twin adapters No. 1 (Stores Ref. Mk. I—11A/2615, Mk. II—11A/2893).

(ii) Six standard (Avro) 250/1,000 lb. bomb carriers, Mk. I—for use with twin adapter No. 1, Mk. I.

(iii) Two standard (Avro) 250/1,000 lb. bomb carriers—shortened for use with twin adapter No. 1 on No. 11 bomb station.

(iv) Ten standard (Avro) bomb carriers, Mk. I or II.

(v) Crutches for the 4,000 lb. H.C.

(vi) Fourteen small bomb containers.

(vii) Two small bomb containers modified for Station 12.

(viii) Two small bomb containers shortened for Station 11.

61. ***Ancillary equipment (for first of tabled loads).***—

(i) Two × 2,000 lb. hand-operated bomb winches.

(ii) One hydraulic bomb loading trolley (Stores Ref. 4F/1522).

(iii) Two 500 lb. standard hand-operated bomb winches.

(iv) Two connectors, Type B (Stores Ref. 4G/2327) for the 4,000 lb. H.C.

(v) Eight special crutching blocks (1½ in. × 2 in., to be made locally); two for each container on Stations 14 and 15; one for each container on Stations 7, 8, 9, 10, to off-set the containers from the 4,000 lb. H.C.

Bombing Equipment and Pyrotechnics

(vi) Fuzing links as necessary.

(vii) Two crutching keys.

(viii) One 4 ft. length of pole to assist positioning of the store in the forward bomb stations.

(ix) One set of re-action pads.

62. ***Bombing-up procedure.***—

(i) Reference must first be made to the general notes above and para. 50.

(ii) Ensure that the crutch adjusting screws in Station 13 have been placed in the top hole in the steadying crutches. If they have not, remove the quick-release pin from the lower end of the steadying crutch and the crutch adjusting screw, place the hole in the crutch adjusting screw opposite the upper hole in the steadying crutch, and insert the quick-release pin. By rotating the adjusting handle on the crutch adjusting screw, raise the steadying crutches to their highest position. ***Note . . .*** Ensure that the special quick-release pins function properly. The N.C.O. i/c bombing-up crew should ensure that his crew are instructed in the proper use of these pins. To release these pins they should be pulled by means of the ring, and no attempt should be made to push them from the other end, as this results in jamming the balls inside the pins.

(iii) Position the trolley underneath Station 13, ensuring that the nose of the bomb faces the nose of the aircraft.

Note . . . Station 13 must be loaded before Stations 14 and 15.

(iv) Remove the cover plates from the bomb hoisting stations.

(v) Place the re-action pads in position over the bomb hoisting stations.

(vi) Place the two 2,000 lb. hand-operated winches in position.

(vii) Fit the two connectors, type B, to the hoisting lugs of the store.

(viii) The N.C.O. i/c must carry out a manual test on the type F release unit to ensure that it can be cocked and released.

(ix) Ensure that the type F release unit is in the FIRED position and that the red firing plug has been removed from the release unit.

(x) Plug in the heating switch on the type F release unit.

(xi) Pull out the cable from both hand-operated winches and insert the cable ball-ends into the connectors on the bomb hoisting lugs.

(xii) Take up the slack cable by hand on the quick-wind side of the winch.

(xiii) Attach the hydraulic bomb-loading trolley V.O.M. attachment, to the driving shaft of the winches.

(xiv) Before giving the signal to hoist the carrier and store, the N.C.O. i/c is to check that the bent of the operating lever on the release slip is in full engagement with the step on the rear of the slip, and also that there is no disengagement of the bent, or fouling of the linkage between the slip and the E.M. unit during hoisting.

(xv) On receipt of the signal from the N.C.O. both airmen in the aircraft will operate the winches and raise the store. Care must be taken to keep the store parallel to the line of the fuselage. The N.C.O. will give corrections as necessary.

(xvi) As the store is raised it must be guided into the release unit, but personnel must not stand underneath the store.

(xvii) Cock the release unit by means of the cocking lever. Test to ensure that the unit is fully cocked by depressing the test plunger. Ensure that the test plunger indicator is felt.

(xviii) Slacken off the rear winch. When the weight of the store is off the rear winch, slacken off the front winch. Ensure that the weight of the store is held by the hook of the release unit, then remove the connectors and the winches.

(xix) Crutch down, using the aircraft ladder to reach the crutch adjusters.

63. To load incendiary bombs, in small bomb containers, proceed as follows:—

(i) Ensure that all items of equipment are available and have been tested and that Form 700 has been signed.

(ii) Set the winch socket in the upright position.

Bombing Equipment and Pyrotechnics

(iii) Cock the carrier securing hook on the bomb station; engage the safety catch over the trip pawl in the bomb station.

(iv) Place the winch in position with the locating piece of the winch in the winch socket, and pull out slack.

(v) To enable small bomb containers to be carried on the twin adapter No. 1 it is necessary to fit an adapter box, Type D. Remove the front fuzing unit from the bomb carrier, insert an adapter box, Type D, on the fuzing slide and replace the front fuzing unit. Adjust the connections as follows:—

(*a*) Remove the 5-pin plug from the socket in the twin adapter, and insert the 5-pin plug from the adapter box into the socket of the twin adapter.

(*b*) Insert the 5-pin plug which was taken from the socket in the twin adapter into the socket in the adapter box.

(*c*) Ensure that all loose connections are wound round the bomb carrier to prevent fouling.

(vi) Fit the carriers to the small bomb containers, crutch down, and insert the ferrules into the spring-loaded socket of the adapter box.

(vii) Fit the cable ball-end into the ball-end adapter on the carrier or twin adapter.

(viii) Hoist the assembly into position. If a single small bomb container filled with 4 lb. incendiary bombs is being loaded use the 500 lb. winch, but the 2,000 lb. winch must be used with a twin adapter and two small bomb containers.

(ix) When using the twin adapter No. 1 with two loaded small bomb containers engage the cable ball-end in the ball-end adapter on the carrier or twin adapter, take the weight of the loaded twin adapter on the winch, then crutch down evenly on the small bomb containers.

(x) Guide the rollers into position in the bomb station.

(xi) Ensure that the carrier securing hook on the bomb station engages properly with the suspension point in the bomb carrier, and that the trip pawl falls forward. Push the safety catch forward into position to lock the trip pawl.

(xii) If difficulty is experienced in engaging the store in the aircraft bomb station, lower the load slightly, pull down on the rear of the store to keep it parallel to the line of the fuselage, and push forward, at the same time winding in the winch.

(xiii) Slacken the cable and ensure that the carrier is securely locked in the bomb station, then remove the cable ball-end from the ball-end adapter on the carrier or twin adapter.

(xiv) Swing the winch socket down clear of the cover plate hole.

(xv) Crutch down on the carrier.

Note . . . If a 4,000 lb. H.C. store is loaded on Station 13 it is necessary to use blocks to offset the small bomb containers on Stations 14, 15, 8, 10, 9 and 7; one block under each inside crutch on 14 and 15, one under the rear inside crutch on 8 and 10, and one under the front inside crutch on 9 and 7.

8,000 lb. H.C. or 12,000 lb. H.C. bombs, and other stores

64. ***Table of loads.***—The following table gives some of the stores which may be carried along with 8,000 lb. or 12,000 lb. H.C. bombs, and the Stations on which they are loaded.

Load	Stations
1 × 8,000 lb. 8 small bomb containers	13 (1) (2) 3 4 5 6
1 × 8,000 lb. 8 × 500 lb.	13 (1) (2) 3 4 5 6
1 × 8,000 lb. 8 × No. IV clusters	13 (1) (2) 3 4 5 6
1 × 8,000 lb. 6 × 1,000 lb.	13 1 2 3 4 5 6
1 × 8,000 lb. 6 J type clusters	13 1 2 3 4 5 6

65. ***Equipment.***—

(i) Two twin adapters No. 1.

(ii) Eight standard (Avro) 250/1,000 lb. bomb carriers.

Bombing Equipment and Pyrotechnics

(iii) Crutches for the 8,000 lb. H.C.

(iv) Eight small bomb containers.

66. ***Ancillary equipment.***—

(i) Two × 4,000 lb. modified Standard hand-operated bomb winches.

(ii) One hydraulic bomb-loading trolley.

(iii) One set of re-action pads.

(iv) Two connectors, type B (Stores Ref. 4G/2327) for the 8,000 lb. H.C.

(v) One type F release slip plus G attachment.

(vi) Fuzing links for the 8,000 lb. H.C.

(vii) Two crutching keys.

(viii) One 4 ft. length of pole to assist positioning the forward stores.

67. ***Bombing-up procedure.***—The procedure is identical with that for bombing-up with 4,000 lb. H.C. bombs, and 4 lb. and 30 lb. incendiary bombs in small bomb containers described in para. 50, 62 and 63, except that the crutch adjustment for the 8,000/12,000 lb. H.C. bombs in Station 13 must be moved into the upper holes before loading commences.

1,000 lb. H.E. and 500 lb. H.E. bombs

68. ***Table of loads.***—The following table gives the loads including 1,000 lb. H.E. and 500 lb. H.E. bombs and the stations on which they are loaded.

Load	Stations
11 × 1,000 lb. H.E. 4 × 500 lb. H.E.	1 2 3 4 5 6 7 9 11 14 15 8 10 (12)
1 × 1,000 lb. M.C. 1 × 500 lb. M.C. 8 × 12 × 30 6 × 150 × 4 1 × 60 × 4	13 12 (1) (2) 3 4 5 6 7 8 9 10 14 15 11
1 × 1,000 lb. M.C. 1 × 500 lb. M.C. 7 × 12 × 30 6 × 150 × 4	12 11 (2) 1 3 4 5 6 7 8 9 10 14 15
18 × 500 lb.	(1) (2) 3 4 5 6 7 8 9 10 (11) (12) 14 15

69. If the Lancaster adapter No. 4 is fitted in Station 13, the following loads may be carried.

Load	Stations
15 × 1,000 lb. H.E.	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
12 × 1,000 lb. H.E. 4 × 500 lb. H.E.	1 2 3 4 5 6 7 8 9 10 11 12 (13) 14 15
9 × 1,000 lb. H.E. 8 × 500 lb. H.E.	1 2 3 4 5 6 13 14 15 7 8 9 10 (11) (12)

70. ***Equipment.***—

(i) One (or two) twin adapter No. 1—if required for Station 13 (or 11 and 12).

(ii) One single adapter No. 4 (Stores Ref. 11A/2761)—if required for Station 13.

(iii) Maximum of 17 × 250/1,000 lb. Standard (Avro) bomb carriers.

71. ***Ancillary equipment.***—

(i) Two × 2,000 lb. hand-operated bomb winches.

(ii) One hydraulic bomb-loading trolley.

(iii) Fuzing links as necessary.

(iv) One 4 ft. length of pole to position the stores in the forward bomb stations.

72. ***Bombing-up procedure.***—

(i) The general notes, especially para. 50, must be consulted before proceeding with the loading of 1,000 lb. and 500 lb. H.E. Stores.

(ii) The N.C.O. i/c will fit the carriers to the stores and attach the fuzing links to the pistol or the fuze and to the fuzing units before pushing the trolley under the aircraft.

(iii) Crutch down carriers on to the bombs if they are of British manufacture.

Note . . . If the bombs to be loaded on to Stations 8, 10 and 12 are of American manufacture, it is advisable not to crutch down the carriers until the store is in position on the aircraft. This enables the stores on Stations 8 and 10 to be pushed slightly outwards, and permits the hoisting of the loaded twin adapter into Station 12.

Bombing Equipment and Pyrotechnics

(iv) Push one trolley under the rear of the bomb bay, and another under the front, and commence loading operations. There is no particular sequence for loading the bomb stations, except that the bombing-up crews should maintain the balance of the aircraft fore and aft, and laterally.

(v) As soon as the weight of the store is taken on the bomb carrier hook (and before the store leaves the trolley), press the test plunger and re-cock the E.M. release unit.

(vi) The remaining procedure is identical with that for loading incendiary bombs described in para. 64.

73. The following additional points should be noted with regard to 500 lb. and other H.E. stores.

(i) It is impossible to load American 500 lb. H.E. stores on a twin adapter No. 1 between American 1,000 lb. G.P. bombs.

(ii) When bombing-up with a load of 18 × 500 lb. H.E. stores, the carrier should not be crutched-down on the bombs for Stations 4 and 6, 10 and 8, 9 and 7, 5 and 3, if American bombs are used, until the stores are in position on the aircraft. One 2,000 lb. hand-operated bomb winch is required to hoist the adapters and stores to Stations 1, 2, 11 and 12.

(iii) With a 4,000 lb. H.C. and 16 × 500 lb. H.E. load, Station 11 must be left empty owing to the length of the 4,000 lb. H.C.

Clusters

74. ***Table of loads.***—The following table gives some of the loads which may be carried and the stations on which they are loaded:—

Load	Stations
1 × 4,000 lb. H.E. 14 × No. 14 clusters (106 I.B. bombs)	13 (1) (2) 3 4 5 6 7 8 9 10 14 15
1 × 2,000 lb. H.E. 14 × No. 4 clusters	13 (1) (2) 3 4 5 6 7 8 9 10 14 15
1 × 4,000 lb. H.E. 6 × No. 4 clusters (14J bombs)	13 12 3 4 5 6 The remaining stations may be loaded with small bomb containers, or H.E. stores

75. ***Equipment.***—Standard (Avro) 250/1,000 lb. bomb carriers as necessary.

76. ***Ancillary equipment.***—

(i) Two 2,000 lb. Standard hand-operated bomb winches.

(ii) One 500 lb. Standard hand-operated bomb winch.

(iii) One hydraulic bomb loading trolley.

77. ***Bombing-up procedure***—The procedure for loading clusters into the bomb stations is identical with that for loading incendiary bombs in small bomb containers. Reference must be made to para. 50, 62 and 63.

Mines and 2,000 lb. H.C. bombs

78. ***Table of loads.***—The following table gives the loads and the stations on which the stores are loaded.

Load	Stations
6 × 2,000 lb. H.C. bombs	7 8 9 10 11 12
6 × Mk. I, II, III, IV, or VI mines 14 × Mk. VIII mines	7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 14 15

79. ***Equipment.***—

(i) Six 2,000 lb. Lancaster special Mk. II bomb carriers for the 2,000 lb. H.C. bombs, of the Mk. I, II, III, IV, or VI mines.

(ii) 14 Standard (Avro) 250/1,000 lb. bomb carriers.

80. ***Ancillary equipment.***—

(i) Two 2,000 lb. Standard hand-operated bomb winches.

(ii) Two 500 lb. Standard hand-operated bomb winches for the Mk. VIII mine.

(iii) One hydraulic bomb loading trolley.

(iv) Fuzing links as necessary.

81. Equipment must be tested as follows:—

(i) Ensure that the aircraft bomb release electric circuit has been properly connected, and that all bomb, selector, fuzing and release

Bombing Equipment and Pyrotechnics

switches are in the OFF position. Ensure that none of the indicating lamps is alight.

(ii) Cock and test and re-cock each E.M. release unit.

(iii) Place the appropriate selector switch in the ON position and ensure that the indicating lamp lights up.
Operate the firing switch when the release unit should become uncocked and the indicating lamp should go out.

(iv) Insert the loop of a fuze-setting control link in the aperture of each E.M. fuzing unit and try to engage the hook, which should not be possible.

(v) Energise the fuzing units with the fuze-setting control links in position, and try, without excessive force, to withdraw the links. This should not be possible.

82. ***Bombing-up procedure.***—

(i) The N.C.O. must check the assembly number and type of mine to be loaded on each bomb station.

(ii) The N.C.O. must ensure that the instructions in para. 50 have been carried out.

(iii) Remove the carrier housing cover, disconnect the 5-pin plug from the carrier housing socket, and secure it on the plug stowage bracket.

(iv) Raise the carrier stabilizing levers to their highest position.

(v) Turn up the pivoting socket into position to receive the winch-locating piece. Withdraw a short length of cable from the winch. Push the cable ball-end down through the pivoting socket, and engage the cable ball-end in the ball-end adapter.

(vi) Push the winch locating piece into the pivoting socket, and wind in the cable until it is just beginning to take the weight of the carrier.

(vii) Raise the safety catch, and release the bomb carrier by turning the trip pawl clear of the carrier securing hook, and lower the bomb carrier.

(viii) Place the carrier on top of the store, adjust the crutches so that the key or suspension lug of the store fits in the aperture of the locating plate, and ensure that the sling is the correct one for the store.

(ix) Slacken the sling as far as possible by rotating the strainer attachment handle until the lugs on the sling tension screw are at the bottom of the slots on the gear casing.

(x) Cock the E.M. release unit by pressing sharply upwards on the thumb-piece of the trigger. Ensure that the release slip is uncocked. Operate the test lever of the E.M. release unit by turning it gently towards the rear of the carrier. If the unit is correctly cocked it will not be affected by operation of the test lever. If the unit is not correctly cocked it will release and must then be cocked and tested again. After the unit has been correctly cocked, press upwards on the thumb piece again to relieve undue pressure between the levers.

(xi) Pass the T-piece of the sling under the store and engage it in the sling hook, simultaneously engaging the sling hook with the intermediate lever. Press the end of the intermediate lever upwards against the upper face of the jaw of the release slip bomb hook, thereby cocking the release slip. The completion of these operations is indicated by distinct clicks. Ensure that the release slip operating lever has engaged its safety catch.

(xii) Turn back the crutch adjusting screws until the pads are clear of the store, tighten the sling by rotating the strainer attachment handle until the sling is as tight as it is possible to get it by hand without exerting exceptional force, then rotate the handle back three complete revolutions to slacken the sling slightly. Ensure that the sling is kept straight round the diameter of the store.

(xiii) Turn the crutch adjustment screws down, using only the hands, and taking care that the carrier girder is maintained parallel to the longitudinal axis of the store, and that the pressure on each of the four pads is the same. Tighten the lock-nuts on the adjusting screws against the adjusting screw mounting.

(xiv) Ensure that the fuzing units are properly secured and that bights of cable are securely fastened.

83. To raise the store, proceed as follows:—

(i) Set the carrier securing hook to the cocked position and ensure that the trip pawl is released from the safety catch.

Bombing Equipment and Pyrotechnics

(ii) Wind the winch to raise the carrier until it engages in the housing, taking care that the rollers enter the carrier roller guides, and the spigots enter the holes in the top of the carrier beam. Ensure that the electric lead is not trapped between the carrier and the fuselage. The carrier is fully raised when the carrier securing hook turns to the locked position, and this is indicated by a loud click as the trip pawl springs over the tail of the hook.

(iii) Ensure that the trip pawl is locked by the safety catch. If the safety catch will not lock the trip pawl, the load must be slightly lowered and raised again into position.

(iv) After the carrier is secured, slacken the winch cable and stabilize the carrier by winding down the carrier stabilizing levers.

(v) Disengage the cable ball-end and remove the winch.

(vi) Rotate the pivoting socket into the stowed position.

(vii) Secure the lanyard from the parachute to the eye-bolt in the rear of the bomb station.

(viii) Insert the 5-pin plug into the aircraft socket, and replace the housing cover plate.

(ix) Additional items for the Mk. VI mine.—Remove the detonator placer wires and cover, before raising the carrier, and place them as for the safety pins near the air bomber's position.

Testing when loading operations are completed

84. (i) Plug in the carriers and release units to the aircraft supply.

(ii) Check that the settings on the pre-selector agree with the settings laid down for the operation.

(iii) Set the GROUND/FLIGHT switch to "FLIGHT".

(iv) Fit the bomb circuit fuse.

(v) Check that both earth indicator lamps on the main electrical panel are alight when the button is pressed.

(vi) Set the drum switch to "SINGLE AND SALVO".

(vii) Select each switch in turn and ensure that the light is on when the switch is down, and off when the switch is up.

(viii) Set the time interval as laid down for the operation on the type 6 distributor.

(ix) Set the arm of the distributor to 1.

(x) Turn the drum switch to "DISTRIBUTOR".

(xi) Set all selector switches down.

(xii) Press the test plunger on the distributor, and ensure that a light is indicated for each switch selected on the selector switch box.

(xiii) Put all selector switches off.

(xiv) Turn the drum switch to "SINGLE AND SALVO".

(xv) Remove the safety pins.

(xvi) Close the bomb doors.

(xvii) Put the master switch in the bomb release circuit to "OFF".

(xviii) If the aircraft is not due to take off at once, remove the fuse from the bomb circuit and set the GROUND/FLIGHT switch to "GROUND".

Note . . . It is the responsibility of the N.C.O. i/c bombing-up team to ensure that the bomb circuit fuse is replaced before flight.

Loading the twin-cell launching chute

85. These instructions will be issued later.

86. These instructions will be issued later.

87. These instructions will be issued later.

Instructions for all P.F.F. loads

P.F.F. stores—250 lb. T.I., and H.E. stores

88. ***Table of loads.***—The following table gives a few of the loads which may be carried and the stations on which the stores are loaded.

Load	Stations
4 × 250 Long burning T.I. 4 × 250 T.I. 6 × 1,000 lb. H.E.	11 12 14 15 7 8 9 10 1 2 3 4 5 6

Bombing Equipment and Pyrotechnics

Load	Stations
4 × 250 Long burning T.I. 4 × 250 T.I. 1 × 4,000 H.C. 4 × 1,000 H.E.	7 8 9 10 1 2 14 15 13 3 4 5 6
6 × 250 lb. T.I. 6 × 250 Long burning T.I. 2 × 250 T.I.	1 2 3 4 5 6 7 8 9 10 11 12 14 15
7 × 250 lb. T.I. 7 × 250 Long burning T.I.	1 2 3 4 5 6 14 7 8 9 10 11 12 15
10 × Cluster Projectile No. 3 4 × 1,000 H.E.	3 4 5 6 7 8 9 10 14 15 1 2 11 12
1 × 4,000 lb. H.C. 13 × 250 lb. T.I.	13 1 2 3 4 5 6 7 8 9 10 12 14 15
15 × 250 lb. T.I. if the Lancaster Adapter No. 4 is fitted in Station 13	1 — 15

89. ***Equipment.***—

(i) Standard (Avro) 250/1,000 lb. bomb carriers as necessary for the P.F.F. stores.

(ii) Equipment for the other stores will be found elsewhere in this chapter under the appropriate heading.

90. ***Ancillary equipment.***—

(i) Two × 500 lb. Standard hand-operated bomb winches for the P.F.F. stores.

(ii) One (or two) × 2,000 lb. Standard hand-operated bomb winches according to the H.E. store.

(iii) Extra crutch pads are required below the inboard crutches on Station 14 and 15, if a 4,000 lb. H.C. bomb is carried in Station 13.

(iv) One hydraulic bomb loading trolley.

91. ***Bombing-up procedure.***—At all times when handling P.F.F. stores extra precautions must be taken. Cluster projectile No. 3 must be handled carefully to avoid denting the casing, as dents cause non-ejection. Before commencing to bomb-up, the N.C.O. i/c will personally carry out the procedure detailed in para. 50.

92. The N.C.O. will then set the pre-selector settings as laid down for the operation, and chalk on each T.I. the number of the bomb station on which the T.I. is to be loaded.

93. The procedure for loading P.F.F. stores is identical with that for loading small bomb containers fitted to Standard (Avro) bomb carriers, as detailed in para. 63.

94. There is no particular sequence for loading the stations, except that one winch operator should commence on the forward stations while the second winch operator works on the rear stations. This preserves the balance of the aircraft, and prevents the airmen getting in each other's way.

95. If a 4,000 lb. H.C. bomb is carried on station 13, it should be loaded before Stations 14 and 15.

P.F.F. stores—1,000 lb. T.I., and H.E. stores

96. ***Table of loads.***—The following table gives some of the mixed P.F.F. and H.E. loads which may be carried and the stations on which they are loaded:—

Load	Stations
12 × 1,000 lb. T.I. 2 × 1,000 lb. H.E.	1 2 3 4 5 6 7 8 9 10 14 15 11 12
1 × 4,000 lb. H.C. 4 × 1,000 lb. T.I. 10 × 500 lb. H.E. One small bomb container (filled with flares)	13 7 8 9 10 (1) (2) 4 5 6 12 14 15 3
4 × 1,000 lb. T.I. (must be tail fuzed) 4 × 250 lb. T.I. 6 × 1,000 lb. H.E.	3 4 5 6 1 2 14 15 7 8 9 10 11 12
1 × 4,000 lb. H.C. 8 × 250 lb. T.I. 4 × 1,000 lb. T.I. (must be tail fuzed)	13 1 2 7 8 9 10 14 15 3 4 5 6
1 × 4,000 lb. H.C. 1 × 1,000 lb. H.E. 1 × 500 lb. H.E. 7 × 250 lb. T.I. One small bomb container (filled with flares)	13 2 1 3 5 7 8 9 10 15 6

Bombing Equipment and Pyrotechnics

Load	Stations
1 × 4,000 lb. H.C. Four small bomb containers (filled with flares) 4 × 250 lb. T.I. 4 × 500 lb. H.E.	13 1 3 5 6 2 4 14 15 7 8 9 10
1 × 4,000 lb. H.C. 4 × 1,000 lb. T.I. (Nose or tail fuzed) 2 × 1,000 lb. T.I. (must be tail fuzed)	13 1 2 3 5 4 6
7 × 1,000 lb. T.I. (must be nose fuzed)	1 2 8 10 7 9 13 (with a Lancaster adapter No. 4)

97. ***Equipment.***—

(i) Standard (Avro) 250/1,000 lb. bomb carriers for the P.F.F. stores as necessary.

(ii) Equipment for the accompanying stores will be found detailed under the appropriate heading.

98. ***Ancillary equipment.***—

(i) Two × 500 Standard hand-operated bomb winches for the P.F.F. stores.

(ii) Ancillary equipment for the accompanying stores will be found detailed under the appropriate heading.

99. ***Bombing-up procedure.***—These stores must be handled carefully at all times.

100. To ensure that each T.I. is loaded on the correct bomb station, the N.C.O. i/c will chalk the number of the bomb station on each T.I.

101. Before commencing to load P.F.F. stores the N.C.O. i/c must personally carry out the instructions detailed in para. 50.

102. The loading is identical with that for small bomb containers fitted to the Standard (Avro) bomb carrier, detailed in para. 63.

Testing when the mixed load of P.F.F. and H.E. stores is in position

103. (i) Plug in the carriers and the release units to the aircraft supply.

(ii) Set the GROUND/FLIGHT switch to "FLIGHT".

(iii) Fit the bomb circuit fuse.

(iv) Set the master switch on the bomb firing circuit to "ON".

(v) Check that both earth indicator lamps on the main electrical panel light up when the button is pressed.

(vi) Set the drum switch to "SINGLE AND SALVO".

(vii) Carry out a light test.

Note . . . The wiring to the pre-selector box on the aircraft modified to carry P.F.F. stores is the reverse of the usual wiring system in Lincoln aircraft, i.e. the fixed row of figures represents the bomb stations, and the figures on the movable discs represent the selector switches.

Where several stations are to be fired from the same selector switch, each circuit must be tested individually. Set one disc to the number of the selector switch which is intended to fire the corresponding station, and the other discs to any other numbers. Select that switch and ensure that a light is obtained. Set the second disc to the number of the selector switch which is intended to fire the corresponding station, and the other discs to any other number, and repeat the test. Repeat this procedure for all the stations which are wired to that particular selector switch number, e.g.:—

Stations	1	2	3	4	
Selector switches—					
	1	1	1	1	To be the final setting
	1	H	H	H	Test setting No. 1
	H	1	H	H	Test setting No. 2
	H	H	1	H	Test setting No. 3
	H	H	H	1	Test setting No. 4

(viii) Put the final settings on the pre-selector.

(ix) Set the time interval as laid down for the operation on the type VI distributor.

Bombing Equipment and Pyrotechnics

(x) Set the arm of the distributor to "1".

(xi) Turn the drum switch to "DISTRIBUTOR".

(xii) Set all selector switches down.

(xiii) Press the test plunger on the distributor and ensure that a light is indicated for each switch selected.

(xiv) Put all selector switches up.

(xv) Turn the drum switch to "SINGLE AND SALVO".

(xvi) Remove the safety pins from the bombs, and stow them in the drawer of the navigator's table.

(xvii) Close the bomb doors.

(xviii) Put the master switch on the bomb release circuit to "OFF".

(xix) If the aircraft is not due to take-off at once, remove the fuse from the bomb circuit, and set the GROUND/FLIGHT switch to "GROUND".

Note . . . It is the responsibility of the N.C.O. i/c bombing-up team to ensure that the bomb release circuit fuse is replaced before flight.

De-bombing

104. The following paragraphs deal with the de-bombing of Lincoln aircraft due to a change of load, cancellation of operations, or to bombs having been brought back from operations. Reference must also be made to A.P.2852A, Sect. 15, Chap. 1—"General Notes on de-bombing aircraft".

105. If the necessity for de-bombing arises from a change of load, or from the cancellation of operations, the bomb doors may not have been closed. Even if the bomb doors have not been closed it is essential to carry out the relevant instructions detailed in para. 107, under the heading "Before opening the bomb doors", and in para. 108, before commencing to de-bomb.

106. If the necessity for de-bombing arises from the fact that the bombs have been brought back from operations, the N.C.O. i/c de-bombing must consult with the air bomber to ascertain if a hang-up has occurred. If there has been no hang-up the N.C.O. i/c will follow the instructions detailed for de-bombing the appropriate bomb load.

Before opening the bomb doors

107. Before opening the bomb doors the following instructions must be observed at all times and for all classes of stores. These instructions must be carried out by the N.C.O. i/c de-bombing along with the electrician:—

(i) Consult the air bomber's report and, ensure that a hang-up has not occurred.

(ii) Set the GROUND/FLIGHT switch to "GROUND".

(iii) Remove the main fuse from the bomb release circuit.

(iv) Set the master switch in the bomb circuit to OFF.

(v) Ensure that the starter trolley is not plugged in.

(vi) Remove the bomb station cover plates and disconnect the 5-pin plugs.

(vii) Ensure that the jettison bars are in the "safe" position and secured by the safety clip.

(viii) Ensure that all selector switches are OFF.

(ix) Ensure that the fuzing switches are OFF.

(x) Ensure that the bomb-firing switch is stowed in the E.M. stowage.

(xi) Remove the photo flash as follows:—

(*a*) Remove the 5-pin plug from the launching chute circuit (if fitted).

(*b*) Replace the safety pins.

(*c*) Remove the dog-lead clip from the fuzing wires.

(*d*) Remove the photo flash.

After opening the bomb doors

108. (i) Ensure that all safety devices have been replaced (*see* Appendix to this Section).

(ii) Remove the fuze-setting control links from the E.M. fuzing units.

Bombing Equipment and Pyrotechnics

Instructions for all loads

109. (i) Ensure that the instructions in para. 107 and 108 have been carried out.

(ii) Raise the crutches or stabilizing levers to their full extent.

(iii) Place the winch socket in the upright position.

(iv) Slacken off approximately 6 in. of cable, insert the locating piece of the winch in the winch socket, and the cable ball-end into the ball-end adapter of the carrier or twin adapter. Ensure that the cable ball-end is securely positioned in the carrier or adapter.

(v) Wind in the cable until the clutch slips, thus taking the strain of the load off the E.M. release hook.

(vi) Raise the bomb station locking piece, pull back the release lever, and allow the locking piece to engage in and hold back the release lever.

(vii) Using either the handle, or the hydraulic bomb loading trolley V.O.M. attachment, on the "slow wind" side of the winch, unwind the winch slowly, and lower the store on to a bomb trolley placed directly underneath. Disconnect the carrier from the store, if necessary, snap down the 5-pin socket covers on the aircraft, wind in the winch, turn down the winch socket and replace the bomb station covers. Remove equipment from the aircraft.

(viii) Remove the fuze-setting control links from the bombs.

110. ***Bombs, fuzed long delay.***—

(i) Ensure that the instructions detailed in para. 107 have been carried out.

(ii) Open the bomb doors, and ensure that the locking wires securing the arming vanes to the tail units are securely replaced, together with the pre-prepared label.

(iii) Replace the safety devices as detailed in the appendix, taking care to lower the store gradually, as detailed in para. 6, and ensure that it comes to rest gently on the trolley.

(iv) Remove the fuze-setting control links from the bombs.

(v) Strap the store on to the trolley.

(vi) The N.C.O. i/c de-bombing will prepare a certificate which he will forward to the Station Armament Officer stating that all locking wires have been replaced.

111. ***4,000 lb. H.C. and incendiary bombs.***—

(i) Ensure that the instructions in para. 107 have been carried out.

(ii) Open the bomb doors and complete the instructions detailed in para. 108.

(iii) Lower the small bomb containers from stations 14 and 15 as described in para. 109.

(iv) Raise the special crutch adjustment on station 13 to its highest extent.

(v) Having removed the bomb station cover plates, and disconnected the 5-pin plugs, insert the re-action pads in line with the fore-and-aft axis of the fuselage, fit the connectors to the bomb lugs, and the cable ball-end to the connectors and wind in the winch by hand until the clutch slips.

(vi) Release the hook on the Type F E.M. release unit by pulling back on the manual release lever on the starboard side of the unit.

(vii) Connect the hydraulic bomb loading trolley to the winches, wind the winches in slightly to relieve the pressure on the winch pawls, free the pawls, then lower the store slowly on to the trolley, ensuring that all personnel stand clear of the store.

112. Lower the remaining small bomb containers as described in para. 109 and park the adapter box leads.

113. ***2,000 lb. H.C., 1,000 lb. H.E., and 500 lb. H.E. bombs.***—The procedure for de-bombing the above stores is identical with that detailed in para. 109.

114. ***Clusters.*** — The procedure for de-bombing clusters is identical with that detailed in para. 109, except that each cluster should be lowered on to a half packing case or corselet placed on the trolley.

115. ***Mines.***—

(i) Ensure that the instructions given in para. 107 are carried out.

Bombing Equipment and Pyrotechnics

(ii) Remove the bomb-station cover plates and the 5-pin plugs.

(iii) Fit the detonator placer wires (if accessible, and if these are required on the store).

(iv) Remove the safety wire from the E.M. fuzing unit.

(v) Remove the lanyard from the eye-bolt in the rear of the bomb station.

(vi) Insert the winch and lower the load as detailed in para. 109.

(vii) Remove the dog-lead clip from the end of the sling, and allow the elastic cord of the sling retraction gear to swing back.

116. ***P.F.F. stores.***—To de-bomb P.F.F. stores the procedure detailed in para. 107, 108 and 109 should be followed. At all times these stores should be handled with great care.

Hang-ups

117. Hang-ups will be dealt with in accordance with Command or Group Instructions.

P9245 M48704/G3223 1/46 1050 C & P **Gp. 1**

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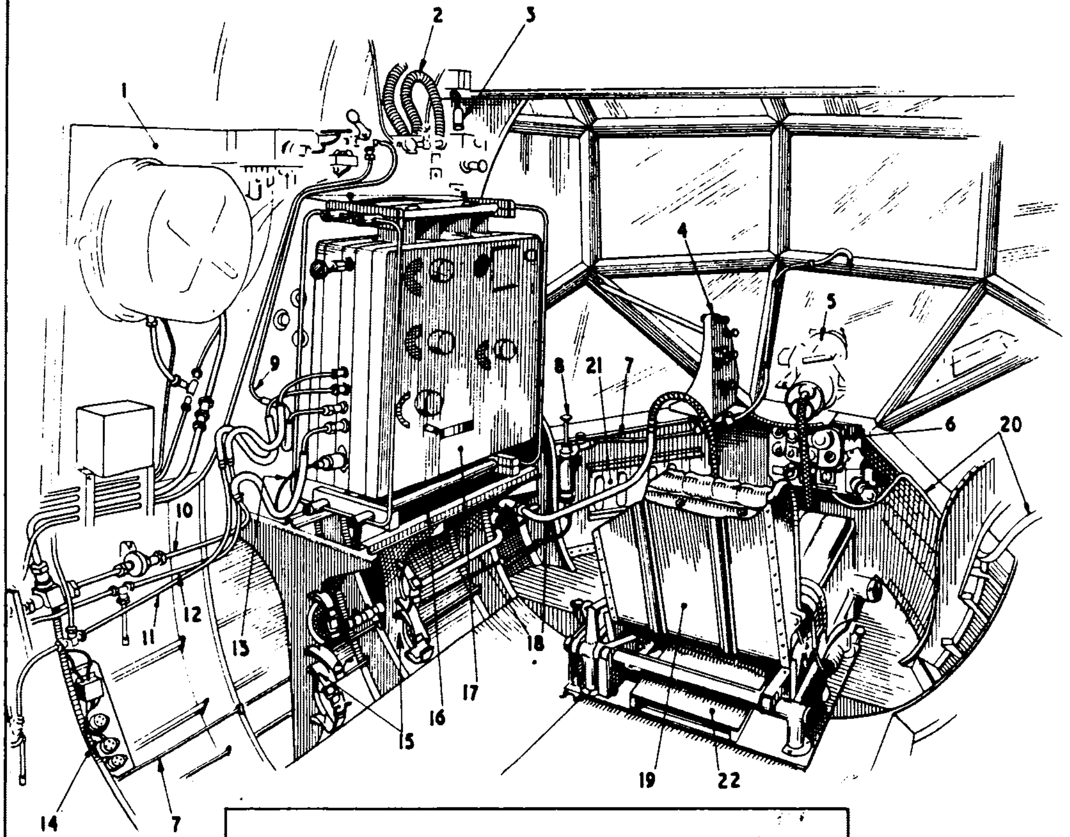


• KEY •

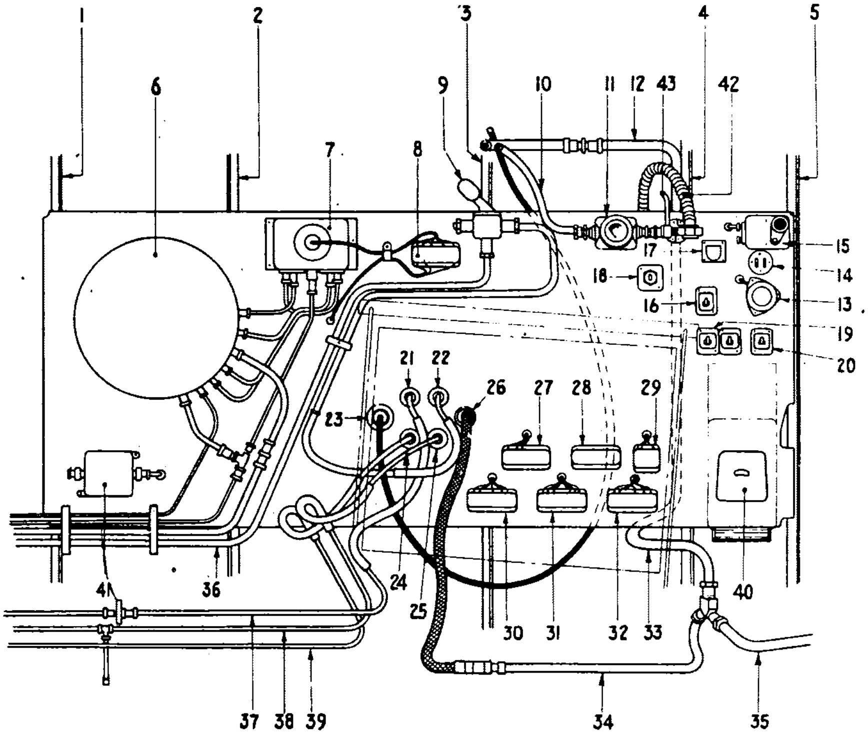
1 AUTO. PILOT PANEL	13 COMPUTOR ELECTRICAL
2 OXYGEN PIPE	14 CAMERA HEATER SUPPLY
3 INTER-COM.	15 FLARE STOWAGES
4 BOMB SIGHT MTG. BKT.	16 COMPUTOR MOUNTINGS
5 BOMB SIGHT (PART)	17 COMPUTOR
6 B.S. CONTROL PANEL	18 VACUUM PIPE
7 GLYCOL SPRAY-PIPE	19 AIR-BOMBER'S SEAT.
8 GLYCOL PUMP	20 A/B PANEL ST'BD TO BOMB SIGHT SUPPLY
9 AUTO. PILOT SUPPLY	21 LOUVRE
10 AUTO. PILOT EXH.	22 MAP STOWAGE
11 A.S.I. SYSTEM PITOT	
12 A.S.I. SYSTEM STATIC	

FOR DETAILS OF A/B PANEL - PORT - SEE FIG. 2

FOR DETAILS OF A/B PANEL - ST'BD. - SEE FIG. 3.

FIG. 1 — AIR BOMBER'S STATION — FIG. 1

PP4118 M48705/G3224 11/45 1050 C & P Gp. 959 (4)



· KEY ·

1	FORMER - F	18	SWITCH - PRESS TO TRANSMIT	35	VACUUM PIPE - BOMB SIGHT
2	FORMER - G	19	CAMERA CONTROL SWITCHES	36	AIR SUPPLY FROM AUTO. PILOT
3	FORMER - H	20	CAMERA HEATER SWITCH	37	EXHAUST TO AUTO. PILOT
4	FORMER - J	21	AUTO. PILOT - EXHAUST	38	A.S.I. SYSTEM - PIPE
5	FORMER - K	22	AUTO. PILOT - SUPPLY	39	A.S.I. SYSTEM - PIPE
6	GYRO UNIT	23	COMPUTOR ELECTRICAL	40	WEDGE PLATE
7	RELAY BOX	24	A.S.I. SYSTEM - PITOT	41	SUPPRESSOR
8	T.B.35 - 5-WAY	25	A.S.I. SYSTEM - STATIC	42	OXYGEN SYSTEM - PIPE
9	BOMB SIGHT COCK - MK.I	26	COMPUTOR GYRO	43	OXYGEN PIPE - ECONOMISER MK.II
10	OXYGEN SUPPLY	27	T.B.56 - 5 WAY		
11	FLOW INDICATOR - MK.II	28	T.B.57 - 5 WAY		
12	VACUUM PIPE - TO CH.OVER COCK	29	T.B.58 - 2 WAY		
13	DIMMER SWITCH TYPE E	30	T.B.55 - 5 WAY		
14	FILAMENT TYPE J - RED	31	T.B.54 - 5 WAY		
15	INTER-COM. - CALL LAMP.	32	T.B.53 - 5 WAY		
16	FLARE CHUTE SWITCH	33	SEE ITEM 12		
17	FLARE WARNING LAMP	34	VACUUM PIPE - COMPUTOR		

NOTE:- ITEMS 21 · 22 · 23 · 24 25 & 26 ARE STOWAGES WHEN COMPUTOR IS NOT INSTALLED. - SEE FIGURE I FOR CONNECTIONS TO COMPUTOR.

FIG. 2 AIR BOMBER'S STATION - PORT SIDE DETAILS FIG. 2

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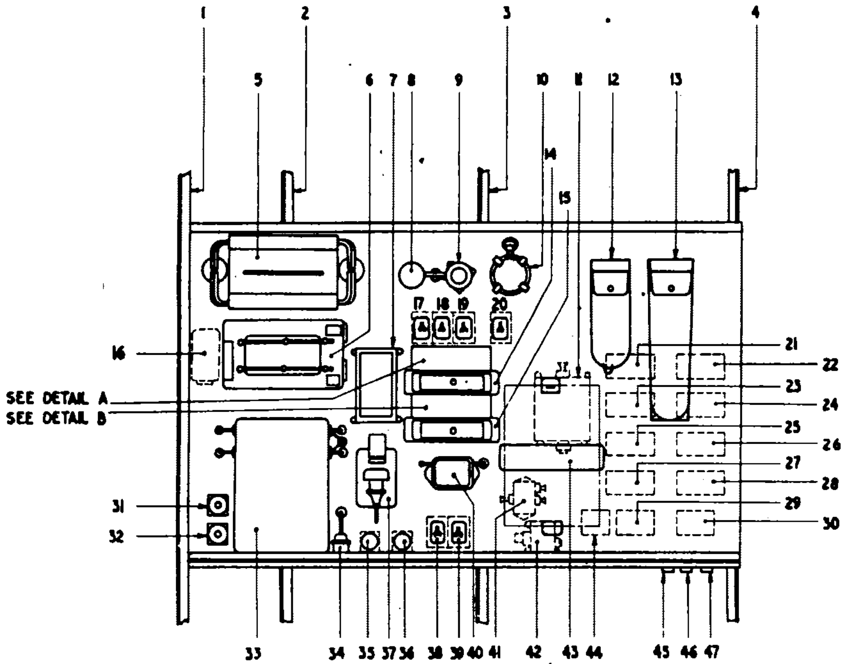


FUSE No.	FUSE SIZE	SERVICE	FUSE No.	FUSE SIZE	SERVICE
RR1	20A	NOSE FUSING	RR5	10A	CAMERA HEATER
RR2	20A	TAIL FUSING	RR6	5 A	AUTO BOMB SIGHT SUPPLY
RR3	5 A	DISTRIBUTOR HEATING	RR7	20A	FLARE CHUTE
RR4	5 A	BOMB SLIP HEATER	RR8	10A	CAMERA SUPPLY

DETAIL-A

FUSE No.	FUSE SIZE	SERVICE	FUSE No.	FUSE SIZE	SERVICE
SS1		BOMB SIGHT HEAD SUPPLY	SS5		
SS2		GENERAL LIGHTING	SS6		
SS3		HEATED CLOTHING	SS7		
SS4		DINGHY RELEASE	SS8		

DETAIL-B

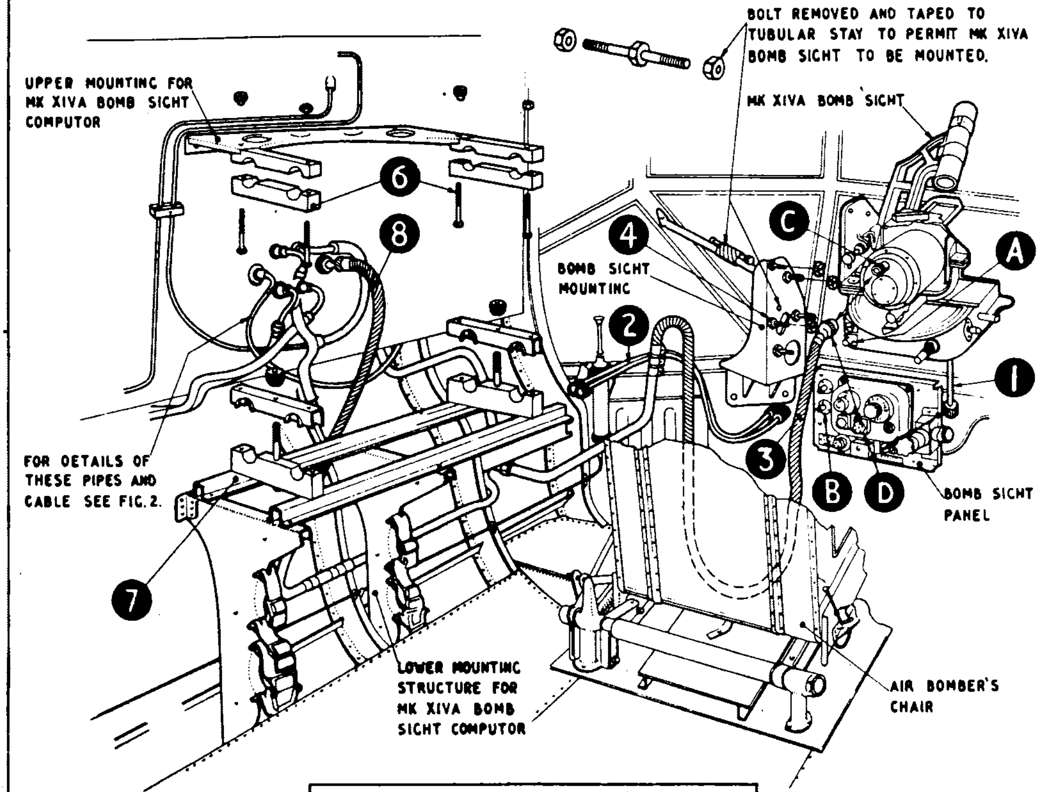
· KEY ·

1 FORMER · K
2 FORMER · J
3 FORMER · H
4 FORMER · G
5 PRESELECTOR
6 SELECTOR SWITCHBOX
7 B.S. D.R. REPEATOR CORR. CARD
8 COCKPIT LAMP MK.II
9 DIMMER SWITCH TYPE-E
10 WATCH & HOLDER.
11 SUPPRESSOR TYPE-P
12 LEAD EXTN. IN SATCHEL
13 INSPECTION LAMP IN SATCHEL
14 FUSE BOX TYPE G 8-WAY
15 FUSE BOX TYPE G 8-WAY
16 RESISTANCE UNIT
17 NOSE FUSING SWITCH TYPE-B
18 TAIL FUSING SWITCH TYPE-B
19 FUSING SWITCH
20 BOMB-RELEASE HEATING SWITCH
21 T.B. 102
22 T.B. 101
23 T.B. 100
24 T.B. 99
25 T.B. 79
26 T.B. 78
27 T.B. 81
28 T.B. 80
29 T.B. 83
30 T.B. 82
31 TURRET CONTROL SWITCH-START
32 TURRET CONTROL SWITCH-STOP
33 AUTO DISTRIBUTOR
34 PLUG, - 2 WAY.
35 PLUG - BOMBS & NIGHT CAMERA
36 PLUG - BOMBS & DAY CAMERA
37 FIRING SWITCH - STOWAGE
38 SWITCH - HEATED CLOTHING - BODY
39 SWITCH - H.C. HANDS & FEET
40 FUSE BOX
41 JUNCTION BOX 3-WAY TYPE A
42 JUNCTION BOX 5-WAY TYPE A
43 STOWAGE FOR COVER OF ITEM 33
44 T.B. 84
45 BREEZE PLUG
46 BREEZE PLUG
47 BREEZE PLUG

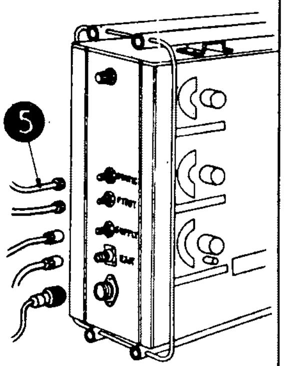
FOR OTHER DETAILS OF AIR-BOMBER'S STATION SEE FIGURES 1 & 2

FIG. 3 AIR BOMBER'S STATION - ST'BD SIDE DETAILS FIG. 3

PP4118 M48705/G3224 11/45 1050 C & P Gp. 959 (4)



DETAIL E



VIEW OF AFT END OF COMPUTOR SHOWING CONNECTIONS FOR SERVICES

REMOVAL INSTRUCTIONS

MK XIVA BOMB SIGHT

1 DISCONNECT ELECTRICAL LEAD.
2 DISCONNECT FLEXIBLE DRIVES AT A AND RE-CONNECT AT STOWAGE B
3 REMOVE VACUUM PIPE AT C RE CONNECT AT D
4 UNBOLT BOMB SIGHT AND REMOVE FROM MOUNTING

COMPUTOR FOR MK XIVA BOMB SIGHT

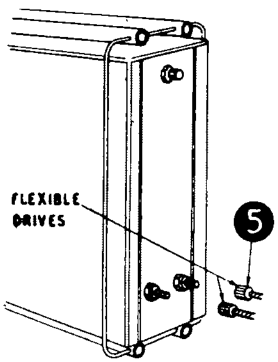
5 DISCONNECT ALL SERVICES TO AND FROM THE COMPUTOR. SEE DETAILS E AND F
6 UNBOLT THE TWO TOP SPLIT MOUNTING BLOCKS
7 UNBOLT THE TWO BOTTOM SPLIT MOUNTING BLOCKS AND REMOVE THE COMPUTOR
8 RECONNECT THE SERVICES TO THE COMPUTOR TO THEIR RESPECTIVE STOWAGE POSITIONS (SEE FIG. 2)

CAUTION

GREAT CARE MUST BE TAKEN NOT TO JAR THE COMPUTOR IN ANY WAY DURING ITS REMOVAL.

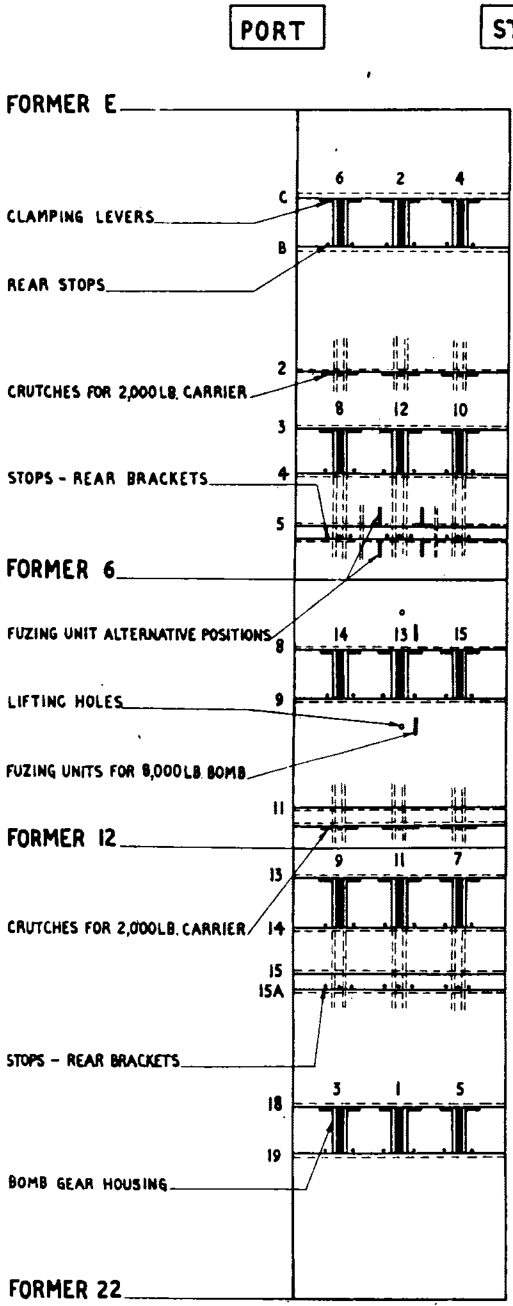
HANDLE LIKE EGGS

DETAIL F



VIEW OF FORWARD END OF COMPUTOR SHOWING FLEXIBLE DRIVE CONNECTIONS

FIG. 4 MK XIVA BOMB SIGHT INSTALLATION FIG. 4



BOMB POSITIONS.

BOMBS UP TO 1,000LB. WEIGHT (SHORT TYPE) AT ALL STATIONS EXCEPT No. 13. BOMBS REQUIRING THE USE OF AVRO 2,000LB. HEAVY BOMB CARRIER MAY BE CARRIED AT STATIONS 7, 8, 9, 10, 11 AND 12. ONE 4,000 LB. BOMB AT STATION No. 13. AFTER MOD. LINCOLN/1581 ONE 8,000LB. BOMB AT STATION No. 13.
USING No. 3 ADAPTORS, 2 - 500 LB. BOMBS AT EACH OF THE FOLLOWING STATIONS Nos. 1, 2, 11, AND 12.

WINCHES REQUIRED.

500LB. STANDARD
2,000LB. STANDARD-2 FOR 4,000LB. BOMB
HEAVY BOMB WINCH-2 FOR 8,000LB. BOMB

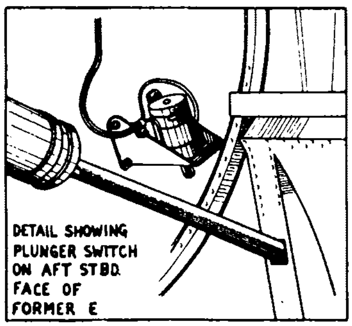
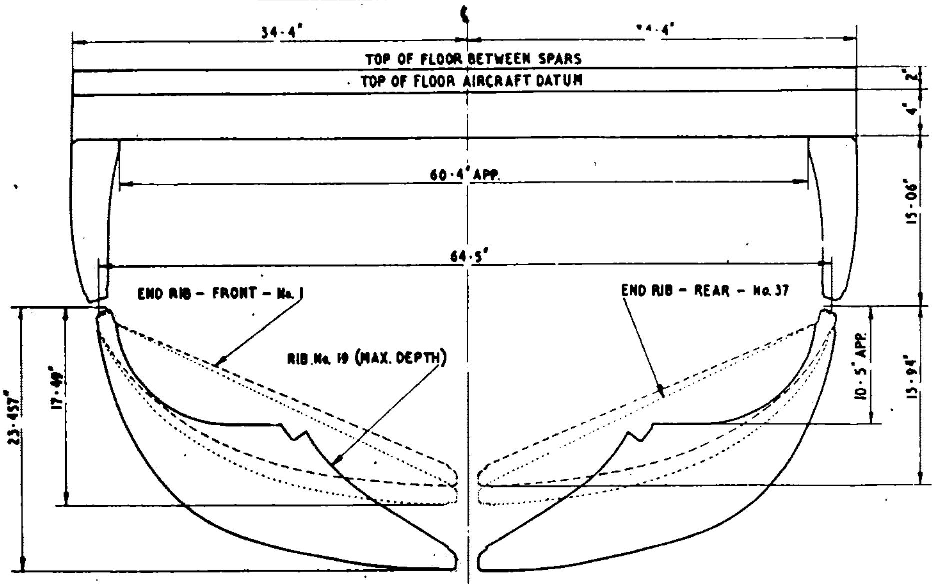
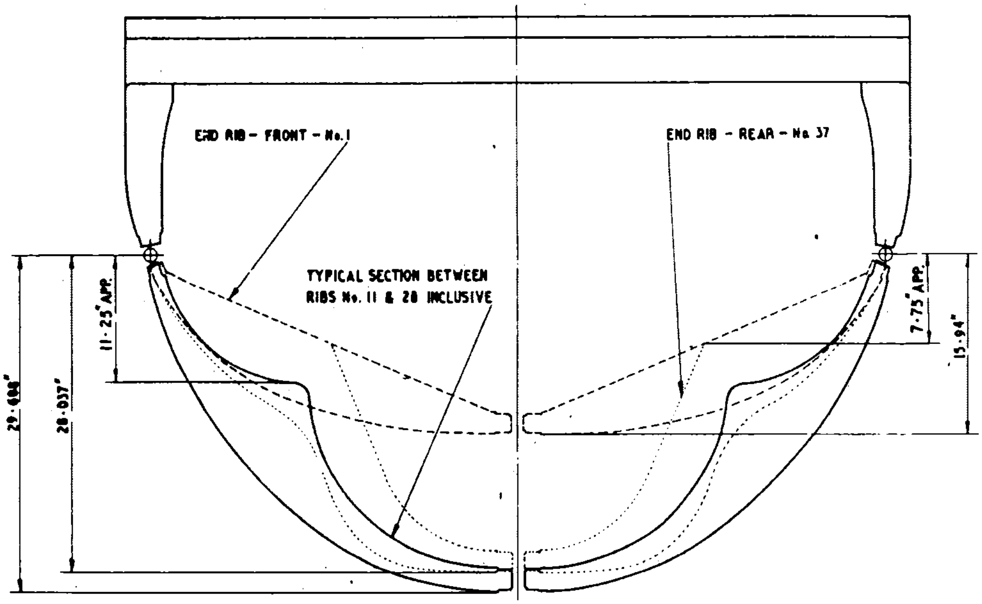

DETAIL SHOWING PLUNGER SWITCH ON AFT STBD. FACE OF FORMER E

FIG 6 **BOMB COMPARTMENT DATA (1)** FIG 6

PF4118 M48705/G3224 11/45. 1050 C & P Gp. 959 (4)



4000 LB. BOMB DOORS



8000 LB. BOMB DOORS

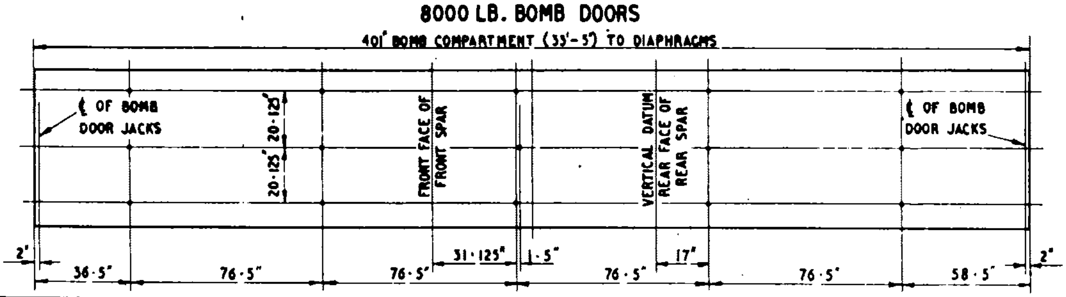
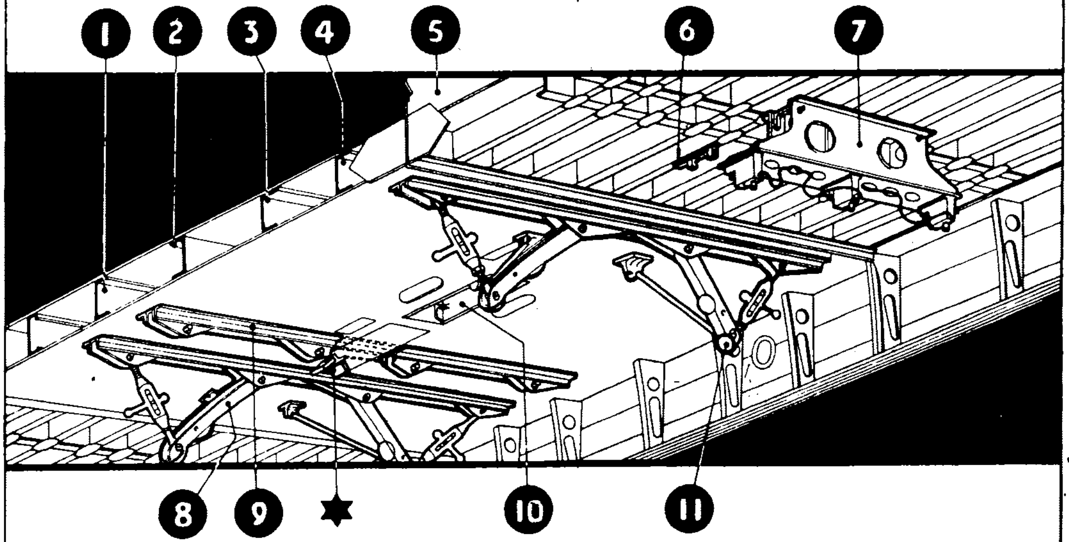
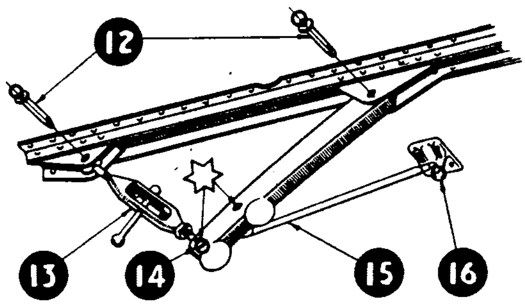
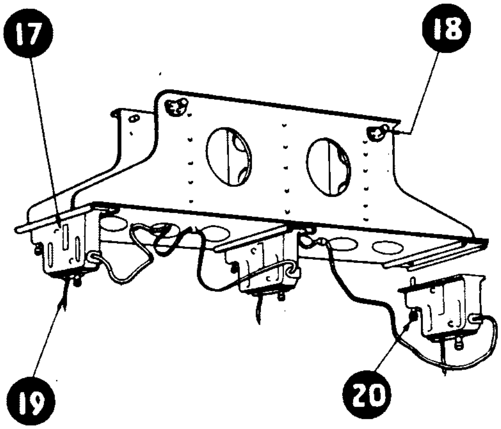


FIG. 7 BOMB COMPARTMENT DATA (2) FIG. 7





ENLARGED VIEW OF CRUTCHING UNIT



ENLARGED VIEW OF FRONT FUZING UNITS

1. No. 10 FLOOR BEAM
2. No. 9 FLOOR BEAM
3. No. 8 FLOOR BEAM
4. No. 7 FLOOR BEAM
5. FRONT SPAR
6. ALTERNATIVE POSITION FOR No. 7
7. FRONT FUZING UNITS
8. BOMB CRUTCHING UNIT – REAR
9. ALTERNATIVE POSITION FOR No. 8
10. BOMB SLIP
11. BOMB CRUTCHING UNIT – FRONT
12. QUICK-RELEASE PINS
13. TURNBUCKLE
14. QUICK-RELEASE PIN
15. TIE MEMBER
16. QUICK-RELEASE PIN
17. FUZING UNIT
18. QUICK-RELEASE BUTTONS
19. FUZING UNIT
20. QUICK-RELEASE BUTTON

✸ SIDE FUZING UNITS. SEE ALSO FIG. 6

✡ THE TURNBUCKLE IS SHOWN IN THE 8,000 LB. BOMB POSITION. THE ALTERNATIVE POSITION INDICATED IS FOR 4,000 LB. BOMBS.

FIG. 11 — CRUTCHING AND FUZING FOR HEAVY BOMBS — FIG. 11

PP4118 M48705 G3224 11/45 1050 C & P Gp. 959 (4)

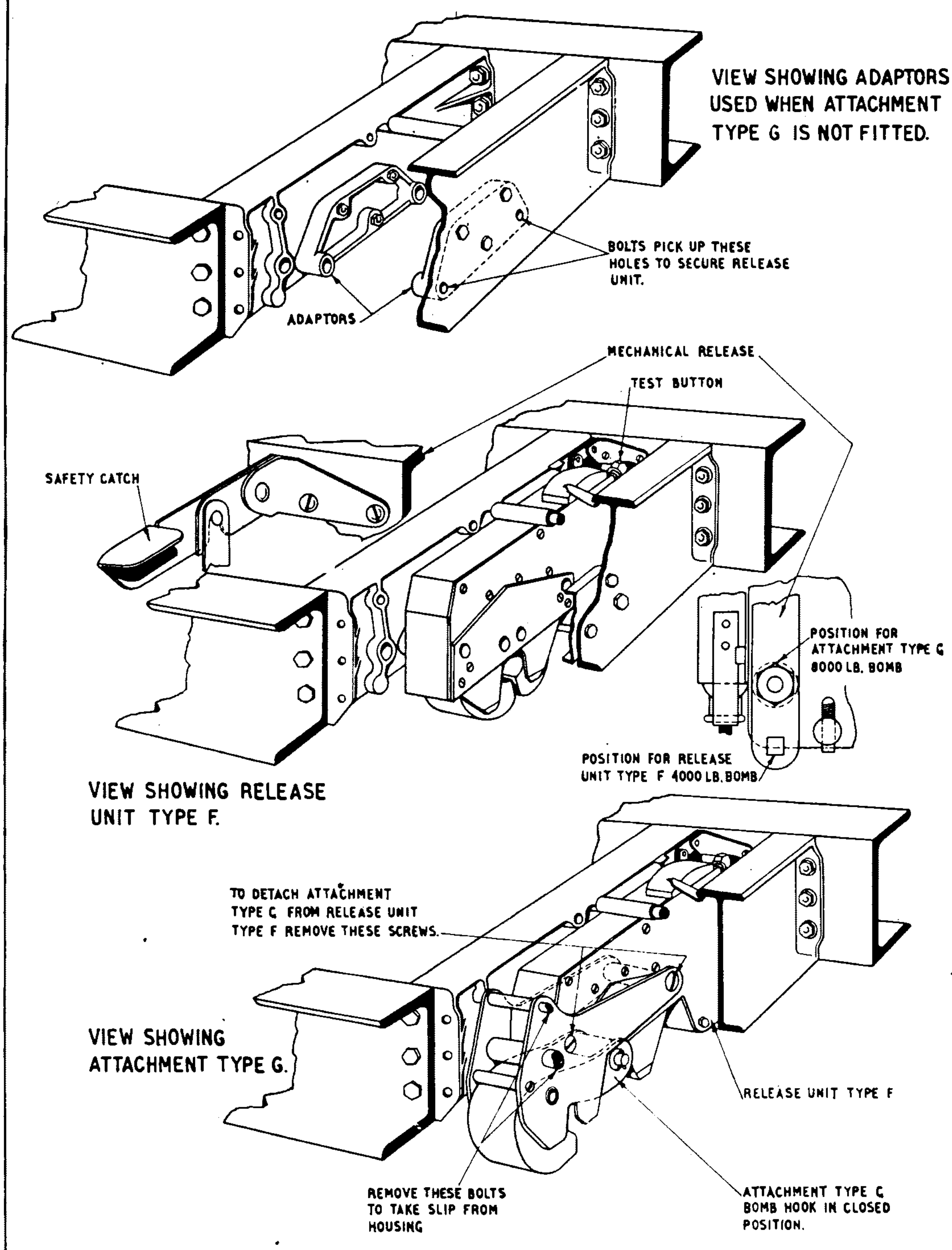


FIG. 12

RELEASE UNIT TYPE F
WITH ATTACHMENT TYPE G

FIG. 12

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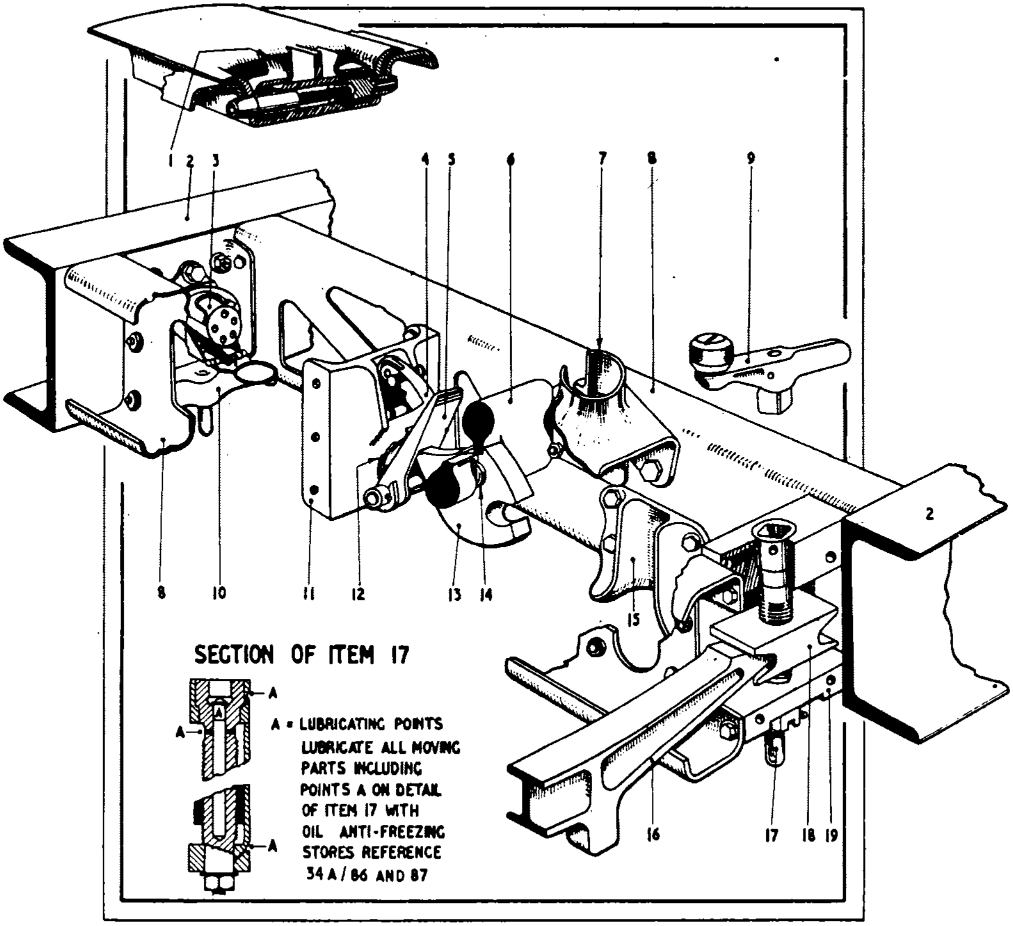

1	COVER - FINGER GRIP	11	BRACKET
2	FLOOR BEAMS	12	LEAF SPRING
3	SOCKET - 5 WAY	13	SLIP HOOK
4	PAWL AND TENSION SPRINGS	14	TORSION SPRING
5	TRIP CATCH	15	GUIDE
6	STIRRUP	16	CLAMPING LEVER
7	WINCH HOUSING	17	SCREW
8	SIDE MEMBER	18	CLAMP NUT
9	CRUTCHING HANDLE	19	CLAMP BODY
10	REAR BRACKET		

TO REMOVE HOUSING — DISCONNECT PLUG FROM SOCKET 3 - REMOVE FOUR BOLTS AT EACH END ATTACHING HOUSING TO FLOOR BEAMS AND WITHDRAW THE HOUSING.

FIG. 13 STANDARD BOMB GEAR HOUSING FIG. 13

PP4118. M48705/G3224 11/45 1050 C & P Gp. 959 (4)

CHAPTER 2

TURRETS

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

General

1. The aircraft is equipped with nose, mid-upper and tail turrets, electrically or electro-hydraulically operated, except that in a number of early aircraft an hydraulically-operated tail turret is installed as an interim measure. The electrical supply in each case is taken from the general services supply, and is therefore dependent on the generators driven by the inboard engines.

Nose turret

2. A Boulton Paul type F Mk. I turret (Stores Ref. 50A/142) is mounted in the fuselage nose above the air-bomber's station. This turret is electro-hydraulically operated, and is fitted with two 0·5 in. Browning guns with flash eliminators (Stores Ref. 107K/523). The installation is illustrated in fig. 1. The turret is mounted in a ball-bearing mounting ring, of which the fixed ring is bolted down to a supporting frame carried on the top ends of the nose formers. The controls, sight linkage and sight project into the air bomber's station, enabling him to operate the turret from his seat. The turret can be rotated to 45 deg. each side of the centre line of the aircraft and the guns elevated or depressed 40 deg. above or below the plane of the turret ring. The remainder of the turret structure and equipment, including the ammunition boxes (but excepting the lower portions of the empties containers) is above the level of the mounting ring. For full descriptive notes, and operating and servicing instructions *see A.P.2796H.*

3. Behind the turret the space above the rear edge of the deck plating (*see fig. 1*) is closed by a transverse draught screen. A door in the screen, in conjunction with doors in the rear of the cupola, provides access to the interior of the turret for servicing. A detachable fairing, secured at its bottom edges by screws to the aircraft nose, fits over the cupola and fairs the turret into the fuselage.

4. The electrical supply is taken from a contact breaker, type B, in panel 3P in the fuselage centre-section. From the starboard side of the nose the cable is carried along the supporting structure at the rear of the turret

Turrets

ring, and is connected, together with an earth lead, to a junction box on the rear end of the port empty cartridge container. Sufficient slack is left to allow for the rotation of the turret. START and STOP press-button switches, which are also connected through the same contact breaker, are provided on the air-bomber's starboard panel. All other switches and fuses are located on a panel in the lower forward part of the turret, within reach of the gunner. For the relevant routing chart *see* Sect. 6, Chap. 1. For inspection purposes a standard inspection lamp, stowed on the air bomber's starboard panel, is available.

5. It is not possible for the stabilised automatic bomb sight to be used when the nose turret is installed, and when this bomb sight is required the turret must be removed and a fairing and ballast weight substituted (*see fig. 9*).

Mid-upper turret

6. Either one of two types may be fitted:—

(i) Glenn Martin turret armed with two 0·5 in. Browning No. 2, Mk. II machine guns (Stores Ref. 107K/93).

(ii) Bristol turret armed with two 20 mm. Hispano No. 4 Mk. V guns (Stores Ref. 7G/791).

(For description and operation notes on American machine guns, *see A.P.1641L.*)

7. Both these turrets are electrically-operated, and are similarly mounted in the aircraft between formers 19 and 22, i.e., above the rear end of the main floor over the bomb compartment. The turret ring is bolted to an aircraft deck plate in which a circular opening allows the lower part of the turret to project into the fuselage. A longeron on each side, an arched cross member at formers 19 and 22, and diagonal channel stiffeners support the deck plate. Above the deck plate, bulkheads in the upper sections of formers 19 and 22 seal off the turret opening, and a draining outlet is provided on each side at the rear end of the deck plate. On the fuselage roof a small detachable fairing is fitted.

8. An outlet in the hot-air duct running aft on the starboard side of the fuselage is arranged to direct air into the turret when the control valve at the outlet is opened.

9. ***Glenn Martin.***—This turret, type 250CE 23A, Mk. I (Stores Ref. 150A/50) is electrically-operated and is fitted with foot-trigger mechanism and a gun sight incorporating mechanical foot control. The turret can be rotated continuously through 360 deg., a profile-type interruptor preventing damage to any part of the aircraft when the guns are fired.

WARNING—

Great care must be taken not to move the mechanical foot trigger when passing through the limited space under the turret.

10. Stowages are provided on the starboard side of the fuselage between formers 16 and 20 for four spare ammunition boxes, and above the box stowages are two stowages for spare empties bags.

11. The turret is connected to electrical power, intercommunication, call lamp and oxygen services, on the port side of the fuselage (*see fig. 2 and 3*). Except for the power services, the connections are made at the base of the turret, where the free section of the mounting, carrying the swivel joint of the oxygen supply and the slip rings of the electrical connections, is prevented from rotating by elastic tension cords. The power connections are made through a collector ring inside the turret ring by two brush assemblies, the power leads from the plugs being carried over the forward face of the sealing panel in the top section of former 19. The turret is earthed through the turret ring, and an earth connection is made to one of the holding-down bolts of the adaptor ring, under the forward port side of the deck plate, to ensure good contact. Use has been made in this instance of wiring primarily intended for the alternative fitting of a Bristol 17 Mk. I turret.

12. The power supply is taken from a contact breaker, type B, in panel 3P in the fuselage centre section, which is controlled by START and STOP buttons on the turret control panel (*see fig. 3* and the relevant routing chart in *Sect. 6, Chap. 1*). The

Turrets

supply to the START and STOP buttons is taken from a 5 amp. fuse VV4, also in panel 3P, the STOP circuit being controlled by a switch on the turret control panel. For economy a resistance unit is introduced in this circuit which passes only sufficient current to maintain the contact breaker in the "closed" position after it has been closed by the operation of the START button.

13. For a complete description of the turret *see Tech Order AN-11-45BB-4.*

14. ***Bristol.***—This turret is a type 17, Mk. I (Stores Ref. 50A/116). The turret, which is illustrated in fig. 4 and 5, can be fitted in all aircraft incorporating Mod. No. Lincoln/1407, by the addition of Mod. No. Lincoln/1461 (removable fittings). Due to the size of the sub-structure the passage way at the turret is restricted, and it is not possible to pass beneath it. The gangway on the starboard side should be used, in order to avoid the electrical and other service connections on the port side.

15. The turret is electrically-operated, with alternative hand operation, except for the pneumatic cocking system, and can be rotated continuously through 360 deg. in either direction. Interrupter gear prevents the guns from damaging any part of the aircraft. The ammunition, 361 rounds per gun, is carried 51 rounds in the lead-up to the gun and 310 in each of the two fixed ammunition boxes. The links and spent cartridges are collected in two containers (*see fig. 4,* and the relevant routing chart in *Sect. 6, Chap. 1*). No spare ammunition is carried.

16. The pneumatic cocking system is supplied with compressed air from a storage bottle at the bottom of the turret sub-structure. The system is independent of the aircraft pneumatic system, but can be charged from the latter in flight or on the ground. A supply from the aircraft system terminates, at former 20 on the starboard side, in a control valve and a flexible pipe which can be attached to a charging unit on the turret.

17. One half of the turret cupola is secured only by quick-release catches (*see fig. 4*), and can be used as an emergency escape exit and for servicing.

18. The electrical power, intercommunication and oxygen services are introduced at a rotating turret joint, mounted at the bottom of the turret concentrically with the turret ring (*see fig. 4 and 5*). The intercommunication socket is at the right of the gunner's seat. An external rotor contains the pick-up brushes which contact the slip rings on an internal stator, and the latter is prevented from rotating by a projecting fork which mates with a bracket mounted on the fuselage floor. The oxygen connection is made at the bottom of the stator, through which the turret supply pipe passes vertically to a swivel joint at its upper end.

19. The rotating service joint is made up of top, middle and bottom units (*see fig. 4*), with the connections numbered upward from the bottom.

Bottom unit: Power supply (1 and 1A positive, 2 and 2A negative). Turrent bonding (3 and 3A).

Middle unit: Start and stop switches (5, 7 and 9). Press-to-transmit switch (10 and 12). Call lamp (14). Spares (4, 6, 8, 11, 13 and 15).

Top unit: Intercommunication (Mic. 17 positive, 19 negative. Tel. 18 positive, 16 negative).

20. The power supply to the control panel on the port side adjacent to the turret is identical with that provided for the Glenn Martin turret, i.e. the main supply is taken from a contact breaker, type B, in panel 3P in the fuselage centre section, and the supply to the START and STOP control buttons from a 5 amp. fuse VV4, also in panel 3P (*see* relevant routing chart in *Sect. 6, Chap. 1*). START and STOP buttons are provided both in the turret and on the control panel, and it is, therefore, necessary for the circuits to be arranged as follows:—

(i) The START buttons wired in parallel, enabling either to make the circuit.

(ii) The STOP buttons wired in series, enabling either to break the circuit.

The switch on the control panel must therefore be OFF, as stated on the adjacent label (*see fig. 3*). The resistance unit in this circuit passes only sufficient current to maintain the contact breaker in the "closed" position after it has

Turrets

been closed by the operation of the START button, and is introduced to give economical use of power. The main fuse box is at the lower centre of a panel forward of the gunner's seat.

21. For a complete description of the Bristol turret, type 17 Mk. I, *see A.P.2768E.*

Tail turret

22. The tail turret, Boulton Paul type D Mk. I (Stores Ref. 50A/123), which forms the rear end of the fuselage, is armed with two 0·5 in. Browning guns with flash eliminators (Stores Ref. 107K/523) and is electro-hydraulically operated. The turret can be rotated to 85 deg. each side of the fore-and-aft centre-line and the elevation-depression range is 45 deg. above or below the plane of the turret ring. The mounting consists of a ring which projects aft from former 41 and is supported by tubular struts. A fuselage end fairing in which access doors are provided encloses the lower part of the turret below the ring (*see fig. 6*).

23. The turret is built up on a turntable which is free to rotate on a fixed ring attached to the fuselage. Enclosed in a glazed structure above the turntable are the guns with their mountings and sighting equipment, and the gunner's controls and seat. Below are the electric motor and hydraulic generator assembly, the hydraulic motors for turret rotation and gun elevation; and at the lowest point the slip ring unit. The latter includes the bottom roller unit to which the ammunition ducts in the fuselage are attached.

24. Ammunition is carried in two boxes (1,110 rounds each) and two ducts (350 rounds each) leading from the boxes to the guns. The total ammunition for each gun is therefore 1,520 rounds approximately, including 60 rounds per gun in the turret itself. The boxes are bolted to bearers in the fuselage roof at formers 22B and 22D, just aft of the bomb floor (*see fig. 8*), and the ducts extend aft on each side into the rear fuselage, passing above the main door on the starboard side and over the tail plane, before dropping down to the bottom roller unit at the base of the turret (*see fig. 7*). An auxiliary feed assister is fitted to each duct between formers 33 and 34, and is automatically controlled by the tightening or slackening of the ammunition belt in the duct.

25. The turret is provided with sliding doors behind the gunner, and the rear end of the fuselage is closed off by a pair of draughtproof doors. Hot air is introduced to the turret from the duct running down the starboard side of the fuselage, and is controlled by a butterfly valve just forward of the turret.

26. Oxygen, intercommunication, and electric power services are introduced at a rotatable slip ring unit at the base of the turret. The oxygen cut-off valve is on the port side of the fuselage adjacent to the turret, and is opened by removing a wooden plug from the clip which would normally receive the end of the delivery pipe. An oxygen economiser and flowmeter are provided in the turret. The fixed portion of the rotatable gland joint below the slip ring unit is prevented from moving by the fixed delivery pipe.

27. The fixed portion of the slip ring unit carrying the rings is prevented from moving by the attachment of the ammunition ducts to the bottom roller unit which forms part of the same assembly. The brush portion consists of two brush holders which rotate with the turret. The slip rings are identified by letters and connect the following circuits (*see fig. 6*):—

Main supply to turret (A positive, P negative)

Call lamps (C, E and G)

Intercommunication system (H, J, K and L)

Disengaging gear remote control, for casualty evacuation (M)

Auxiliary feed assister (N)

Available for position indicator but not used (B, D and F)

(*See* relevant routing chart in *Sect. 6, Chap. 1*).

28. The main supply is duplicated, separate supplies being taken from two circuit breakers, type A, one in panel 2P and one in panel 3P in the fuselage centre section (*see* relevant routing chart, *Sect. 6, Chap. 1*). Supplies to the auxiliary feed assisters and the casualty evacuation control are taken from 3DB on the port side of the fuselage rear centre section (40 amp. fuse Ref. TT3). The casualty

Turrets

evacuation control consists of a push-button on the port side of the rearmost fuselage former (No. 41). If the gunner should become a casualty with the turret partially rotated, the driving mechanism can be disengaged by pressing the remote control button, and it is then possible to sit on the walkway forward of the turret and pull it round by hand.

29. A full description of the installation of the B.P. type D turret in Lincoln aircraft is contained in A.P.1796J.

Servicing

General

30. The front and mid-upper turrets draw ammunition from direct-mounted boxes but the rear turret supply is by means of ducts, leading from ammunition boxes mounted in the fuselage roof. For detailed descriptions of turrets, *see:—*

A.P.2796H—Boulton Paul, type F

A.P.2768E—Bristol, type 17

Techn. Order AN-11-45BB-4 — Glenn Martin, type 250CE. 23A

A.P.2796J—Boulton Paul, type D

All the turrets are equipped with two guns of 0·5 in. calibre except the Bristol turret, type 17 Mk. I, which is fitted as an alternative in the mid-upper position and is armed with two 20 mm. Hispano No. 4 Mk. V guns (Stores Ref. 7G/791). For descriptive notes on:—

American machine guns, *see A.P.1641L*

Hispano guns, *see A.P.1641F.*

31. When an electrical supply is required in the course of ground servicing, an external supply should be connected to the ground socket on the starboard side of the fuselage just aft of the main plane. The capacity of the aircraft batteries is not adequate when the generators are not charging.

Ammunition supply and loading

32. ***General.***—Loading labels or stencilled notes which give instructions for loading ammunition into the boxes are provided on the boxes for the front and both types of mid-upper turret. Additional notes, and instructions for loading the rear turret ammunition boxes, are given in the following paragraphs.

33. A belt making and breaking tool (Stores Ref. 8D/2539) should be used for making and breaking the ammunition belts.

34. ***Ammunition boxes, nose turret.***—Each of the two guns in the Boulton Paul, type F Mk. I nose turret is supplied from a detachable box with capacity of 230 rounds, mounted outboard of the two vertical members of the turret frame. Each belt is stowed in its box in end-folded layers and fed to the side of the gun chassis through a duct which incorporates a feed roller and a conical roller which imparts a 90 deg. twist to the belt. Removal of a draughtscreen, attached by Oddie fasteners at the rear of the turret mounting, discloses two panels with Dzus fasteners. These panels form the rear contour of the turret cupola, and provide access for removal and replacement of ammunition boxes, and for loading the guns. Spent cartridge cases and links are ejected into fixed containers, the lower portions of which are below the mounting ring level. These are emptied through quick-release doors (*see fig. 1*).

35. ***Ammunition boxes, Glenn Martin mid-upper turret.***—Four spare ammunition boxes for the Glenn Martin type 250CE 23A, Mk. I mid-upper turret are stowed on the aircraft main floor, on the starboard side, between formers 16–17, 17–18, 18–19 and 19–20 (*see fig. 7*). Each box is radiused to conform to the contour of the armour plate on the lower assembly of the turret, and has a quick-release pin retained by a slave chain. Spare empties bag stowages are provided above the centre pair of boxes, with tension cords on fuselage stringer 9 and hooks in stringer 8.

36. The ammunition boxes are not interchangeable from left to right-hand guns after loading. Each box is installed by sliding the rollers at the top edge of the box into the channel track which is part of the turret structure and by engaging the guide at the bottom of the box with a retaining strip on the lower armour plating; the box is then moved

Turrets

along the track until it locks in position. When all four boxes are installed the adjoining belts of each pair of boxes are connected with an extra round of ammunition. The rear cover of the feed assister, between the two gun mountings, is opened and two 35-round belts lowered through the feed assister, so that one end of each belt can be connected to the end of the belt in the inboard ammunition box and the free end of the 35-round belt engaged with the retaining pawl of each gun. Removal of the ammunition boxes is accomplished by turning the latch handle (*fig.* 7) inboard of the box through one quarter turn and holding it in that position whilst disengaging the box rollers from the supporting track.

37. ***Ammunition boxes, Bristol mid-upper turret.***—One fixed ammunition box containing 310 rounds is provided for each of the two guns, 51 additional rounds being carried in the lead-up to each gun. No spare ammunition is carried. Spent cartridge cases and links are ejected into a container (*see fig. 4*). The empties container fits in sockets on the sub-structure of the turret, and its neck can be detached from the spent cartridge case chute by the latch-hooks at each side. The ammunition boxes are loaded from inside the turret. Raise the gunner's seat to the parked position, disengage the mouth plates of the spent cartridge case containers, and remove the lid of each ammunition box. The flaps hinged to the inner face of the outboard wall of each box should be raised. Load the front section of the box first, the first shell at the front of the box with its nose pointing outboard, placing the belt in layers. After loading three layers drop the lowest hinged flap to its horizontal position. This supports the noses of the next layers and prevents mis-alignment of the belting. Continue to load in layers, lowering a hinged flap between each set of two layers, until the belt is level with the top of the arched member which divides the box. Load the belt into the rear section and load from front to rear, but drop the lowest hinged flap after the first two layers and lower the upper flaps in turn between each succeeding pair of layers until the top layer is level with the arch, and with the belt leading forward. Lead the belt over the existing layers in the front section, lower the first long hinged flap, and load two more layers, then bring the free end back and up through the feed mouth of the box. Lower the shorter top hinged flap but do not load above it. The belt end must terminate with a double link.

38. ***Ammunition boxes, tail turret.***—Ammunition for each gun on the Boulton Paul type D Mk. I, Series 2 tail turret, is supplied from a box in the fuselage rear centre section (*see fig. 8*), through ducts leading from each box to the base of the turret. The two supply boxes are contained in a housing suspended from the fuselage roof between formers 22B and 22D. The outer side of each box is divided into panels by two horizontal piano hinges, the upper hinged panel being attached to the lower, enabling the opening section to be partially or completely folded down as required. Wing nuts retain the panels in the closed position. An ammunition loading door is located in the aircraft floor, on the centre line of the aircraft, between formers 22 and 22A (*see fig. 8*). The cartridge belts feed from the rear end of the boxes over rollers and a swan-neck fitting and are then guided along the channels of the ducts (*see para. 40*).

39. Each box contains approximately 1,110 rounds. The ammunition belts are loaded in separate lengths which are joined up as the operation proceeds, and the lower section of the hinged side of the box is closed when loading has reached the level of its upper edge. In both boxes the ammunition should be layered with the bottom layer starting at the forward end and running aft, and the bullet noses pointing to starboard.

40. ***Ammunition ducts.***—Ammunition is drawn by the tail-turret guns from the ammunition boxes along channel-section ducts connecting the boxes with the turret. The two channel members comprising the ducting face inwards and are mounted on consecutive formers (22E to 31 inclusive) by suspension brackets, but from that point are supported by tubular stays on formers 32 to 36 inclusive. The ducts pass through slots in the supporting woodwork of the draught-exclusion doors at former 38, are supported by tubular stays at former 39, and converge downward to an aperture at the base of former 41, where the duct from the port side is uppermost (*see*

Turrets

fig. 7 and 8). The duct rear ends are flanged for attachment to the turret belt guides, the belt then being drawn upward over rollers. The twin channels forming the ducts are jointed between formers 26–27, 29–30, at former 33, between formers 34 and 35, and have their final joint forward of former 41. These joints are formed at the abutment of the channels by flanged plates bolted through the top and bottom faces of the channels. Access points are provided in the inboard channel of the starboard duct and the outboard channel of the port duct at the following stations:—between formers 28–29, 35–36, 36–37, and 38–39. Access is provided by a small door in the side wall of the channel, hinged at the forward end and retained by a looped pin at the rear. The channel structure is reinforced at such points by light gauge strip, making a box section spot welded around the channels. Approximately 350 rounds are contained in each duct and these are linked up, on loading, to 60 rounds (approximately) in the turret ducting for each gun.

41. ***Alignment of duct.***—Alignment of duct channels, and freedom from obstruction, can be checked by running a length of belt with dummy cartridges along the full length of the duct. Care should be taken to see that no internal obstruction is caused by distortion of the ends of the channel members where jointed (*see para. 40*). Any interference at these points must be rectified.

42. ***Feed assisters.***—The Glenn Martin and Bristol 17 mid-upper turrets and the Boulton Paul tail turret incorporate a feed assister unit, between the gun chassis supports, which lifts the ammunition belt to the gun breech. The basic principle is similar for each type, a motor-driven shaft carrying a pair of wide-pitch sprockets which engage the nose and case of each cartridge in turn and impel their travel when tension is applied to the belt, such tension causing a switch to close and thus start the motor. Independent fuses for each tail turret motor are mounted on each side above the control panel. The Boulton Paul tail turret supply is further assisted by a pair of auxiliary feed assisters (*see fig. 7*), mounted one in each duct between formers 33 and 34. On the port side the operating motor is above the duct but the starboard unit is below the duct channels. These auxiliary assisters have manually-operated "free" and "locked" position controls mounted in the units. The rate of feed of each ammunition belt adjusts itself to the pull of the gun. Each auxiliary feed assister has its own fuse mounted on the unit; removal is a simple matter of disconnecting the supply leads at each terminal block and removing nine nuts and bolts from each side of the mounting bracket.

Access to equipment

43. ***Nose turret.***—The detachable rear panels of the cupola give access to the electric motor and to the hydraulic jack for elevation and depression of the guns. (The flexible pipes and banjo connections of this jack can also be reached from below, looking up from the air - bomber's position.) The main electrical connections are made on the port side of the base; all switches and fuse boxes are located on a control panel in front of the air bomber; oxygen supply is independent of the turret, being installed with the intercommunication and call-lamp services in the air bomber's compartment.

44. ***Mid-upper turret.***—Power plugs and junction boxes for the Glenn Martin turret are positioned on the port wall of the fuselage between formers 19 and 20, and the control panel is nearby between stringers 8 and 9, forward of former 19 (*see fig. 3*). The power lead is attached to terminals on the port and starboard sides, forward, below the adaptor ring, and it should be noted that an earth connection is taken from one of the holding-down bolts of the adaptor ring (*fig. 3*). Oxygen supply is through a high-pressure swivel joint to a regulator on the right-hand side of the gunner, at which station is located an intercommunication junction box with leads and attachment plugs; the microphone switch is located on the left control grip. Intercommunication, call-lamp and oxygen services connect from the base of the turret to the aircraft supply lines on the port side of the fuselage.

45. ***Bristol Type 17 turret.***—Power, intercommunication, call-lamp, and oxygen connections are made at the base of the turret,

Turrets

on a stator-rotor assembly which forms a rotating joint (*fig. 5*). The oxygen pipe union is at the bottom of the assembly and Breeze connections are made on the body of the rotor housing. The gun cocking system employs compressed air supplied from a bottle mounted below the turret understructure. This bottle has two pipe connections, one to a filter and the other to a pressure gauge. From the latter pipe a T-piece provides connection to a charging union mounted with the gauge on a panel fixed to the rear vertical member of the turret structure. To charge the bottle from the aircraft compressed air services, centralize the turret with the guns pointing aft and couple to the bottle a flexible pipe which leads from a control valve mounted on the rear face of former 20, 32 in. above floor level, on the starboard side. Inflate the bottle to 450 lb. per sq. in.

46. ***Tail turret.***—Oxygen, power, inter-communication, and call-lamp connections are accessible through an inspection door in the base and sides of the aircraft fairing which extends aft, under the turret mounting, from former 41 (*fig. 6*). A fourth door, at the rear end of the aircraft, is uncovered when the turret is rotated to either side of the fore-and-aft position. These doors also give access to the electric motor, slip ring unit, hydraulic generator, and bottom roller unit to which the ammunition ducts are attached. The oxygen control valve is in the fuselage, on the port side, just outside the turret, but the economiser and flowmeter are inside the cupola.

Removal and refitting

47. ***Nose turret.***—The guns can be removed after a lever on the side of the chassis of each front mounting is unlocked. Before removing or refitting the turret, it is necessary to disconnect the control handles proper and to secure them to the control tubes to prevent fouling and possible damage. For detailed removal instructions *see fig. 1.* Replacement is a reversal of the removal sequence. The fluid used in the system is: Fluid, aircraft, hydraulic, mineral base (Stores Ref. 34A/159). Six pints approximately will be required if the system has been drained.

48. ***Nose fairing.***—The method of fitting a nose fairing and balance weight in place of the nose turret is illustrated in fig. 9.

49. ***Mid-upper turret, Glenn Martin.***—Instructions for the removal of this turret are given in fig. 3. The alternative method of slinging will be required on any aircraft on which provision has not been made on the turret for fitting sling Stores Ref. 50H/286. Re-installation is a reversal of either of the alternative removal methods.

50. ***Mid-upper turret, Bristol 17.***—Instructions for the removal of this turret are given in fig. 5. The following is the procedure for removing the guns as required therein:—

(i) After removing the emergency escape panel (*see fig. 4 and 5*), ensure that the gun is unloaded and detach the belt feed mechanism as described in A.P.1641F, Vol. I, Chap. 11.

(ii) Disconnect the banjo union of the gun cocking system from the adaptor on the gun body.

(iii) Detach the electric cable from the gun firing solenoid by unscrewing the knurled gland nut and removing the socket.

(iv) Detach the bridge piece from the gun mounting cradle by slackening the two knurled nuts.

(v) Unscrew the recoil spring buffer stops and slide the gun backward until the four splines on the gun body are disengaged from the slides in the gun mounting cradle.

(vi) Lift the gun clear of its cradle and draw it backward until clear of the draught excluder seal.

(vii) Replace the bridge piece on the gun cradle.

51. Instruction labels in the turret indicate the method of rotating the turret and elevating the guncradles manually. When the hand operation mechanism is no longer required the knob of each disengaging mechanism must be slowly returned to its IN position, and the hand operation handle moved in each direction until the clutch is fully engaged. When this occurs the hand operation handle will no longer operate the drive. The handle must then be removed and stowed in its spring clips at the rear of the turret mounting ring.

Turrets

52. Installation of the turret is a reversal of the removal sequence.

53. ***Tail turret.***—Auxiliary equipment is mounted at the rear of the turret. To remove the fairings of this auxiliary unit, detach the lowermost fairing first. This is held by four 2 B.A. bolts and anchor nuts, which can be reached through an access hole immediately aft. Detachment of the upper fairing, by removal of the three uppermost bolts through the armour plating, will disclose six Breeze plugs mounted, in two groups of three each, on angle brackets attached to the turret rear armour plating; also the three $\frac{5}{16}$ in. bolts each side, holding the castings forming the upper side members of the auxiliary unit to lugs formed at the base of the turret just above the mounting ring (*fig. 6*). Then withdraw the pip-pin and disconnect spring clip and tubular stay at port side of rear armour plate; disconnect aerial feeder aft of former 40 and withdraw it with great care from fuselage; then remove unit complete. The oxygen and electrical services and the ammunition ducts can then be disconnected and the turret removed as shown in fig. 6. Re-installation is a reversal of the above sequence. Fluid for the hydraulic system is: Fluid, aircraft hydraulic, mineral base (Stores Ref. 34A/159); the system contains 5 pints approximately.

P9753 M /G4066 3/46 1050 C & P Gp. 1

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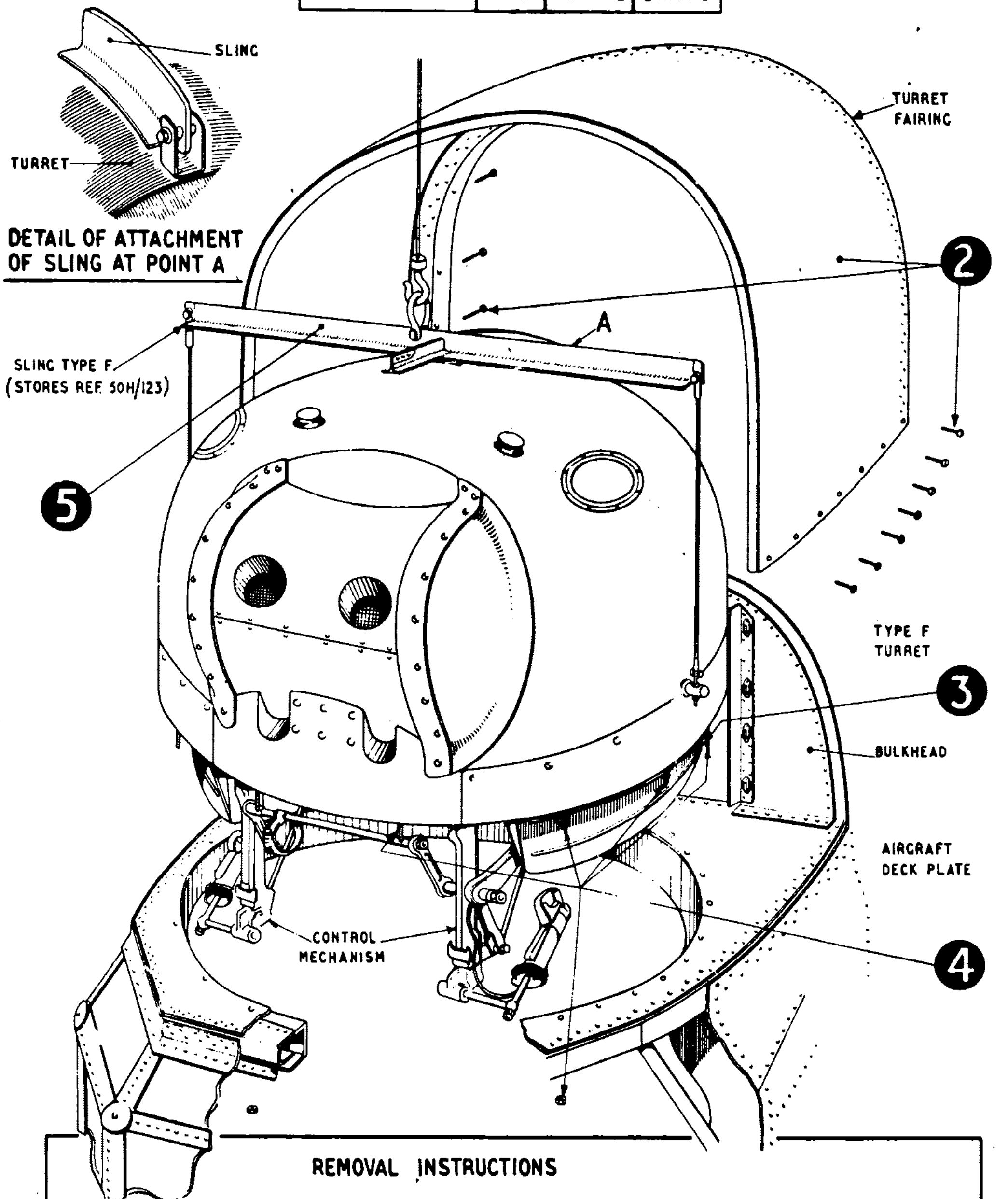


REMOVAL INSTRUCTIONS

1 SWITCH OFF POWER AT TURRET SUPPLY PANEL - STARBOARD SIDE OF AIRCRAFT.

2 UNSCREW, UNBOLT AND REMOVE FAIRING.

3 DISCONNECT TURRET SUPPLY LEADS AT TERMINAL BLOCK AFT OF PORT EMPTIES CONTAINER.

4 REMOVE NUTS FROM TWELVE HOLDING DOWN BOLTS ON TURRET RING (8 LONG BOLTS FORWARD AND 4 SHORT BOLTS AFT).

5 ATTACH SLING TYPE F (STORES REF. 50H/123) AND REMOVE TURRET FROM AIRCRAFT. GREAT CARE MUST BE TAKEN TO ENSURE THAT CONTROL MECHANISM DOES NOT FOUL SUPPORT STRUCTURE.

FIG. 1 NOSE TURRET-BOULTON PAUL TYPE F FIG. 1

PP4258 M /G4067 2/46 1050 C&P Gp. 959 (4)

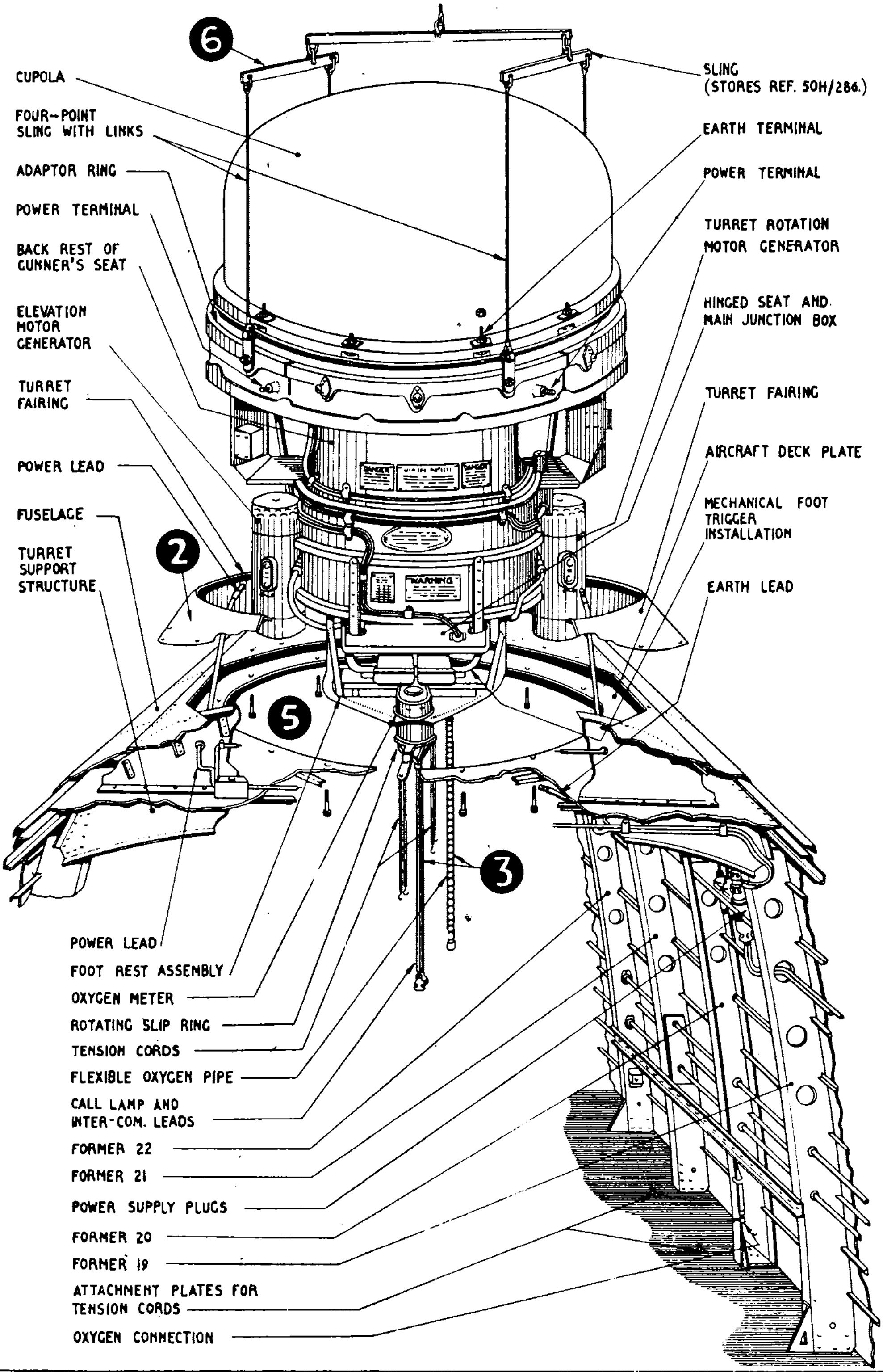
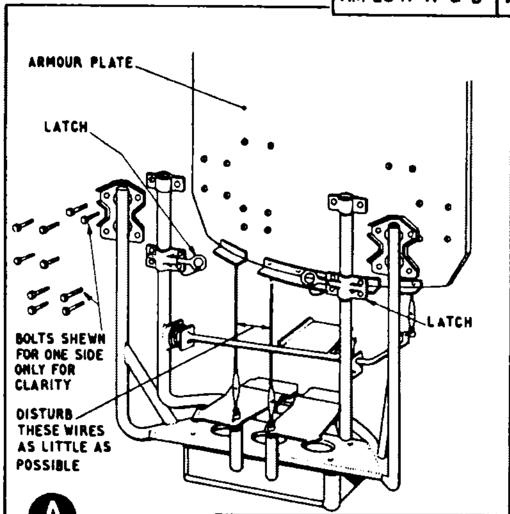
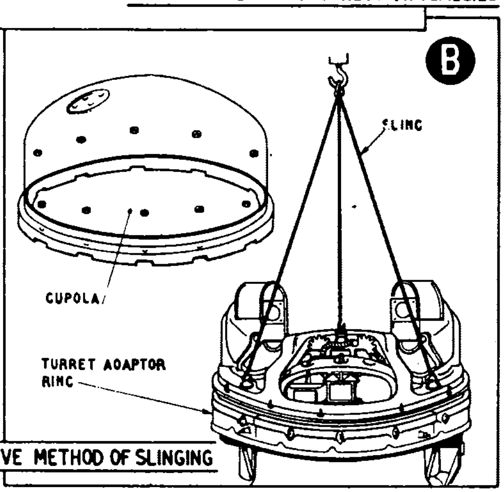


FIG. 2 MID-UPPER TURRET-GLENN MARTIN TYPE 250CE 23A, MK.I (1) FIG. 2



FOOT TRIGGER & FOOT REST ASSEMBLIES



ALTERNATIVE METHOD OF SLINGING

REMOVAL INSTRUCTIONS

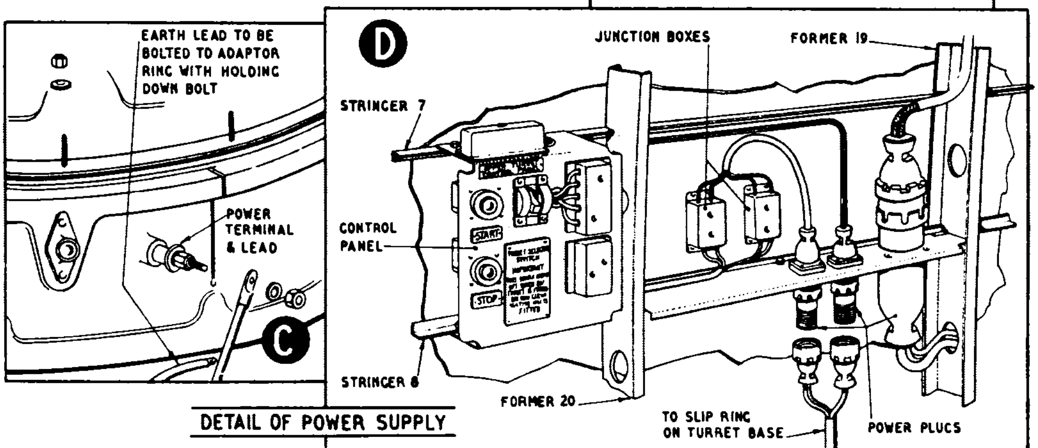
1. SWITCH OFF POWER SUPPLY TO TURRET (SEE DETAIL D).
2. UNSCREW 2 B.A. SCREWS & REMOVE FAIRING FROM FUSELAGE.
3. DISCONNECT ELECTRIC & EARTH LEADS FROM TURRET ADAPTOR RING. - SEE DETAIL C. DISCONNECT POWER SUPPLY LEADS & INTER-COM. LEAD FROM POWER PLUGS-SEE DETAIL D. DISCONNECT OXYGEN PIPE AT FORMER 20 & TENSION CORDS AT PORT SIDE OF AIRCRAFT.
4. AFTER MAKING CERTAIN THAT GUNS ARE UNLOADED REMOVE LOCKING WIRE FROM THE LATCHES ON FOOT REST ASSEMBLY UNBOLT FOOT TRIGGER & FOOT REST ASSEMBLIES & CAREFULLY EASE BOTH INSIDE TURRET. TEMPORARILY SECURE BOTH WITH WIRE TO SEAT.-SEE DETAIL A.
5. REMOVE TWELVE BOLTS SECURING ADAPTOR RING TO AIRCRAFT DECK PLATE.
6. ATTACH SLING STORES REF. 5OH/286 TO LINKS PROVIDED & LIFT TURRET CLEAR OF AIRCRAFT.

ALTERNATIVE METHOD OF SLINGING TURRET.

PROCEED AS ABOVE TO ITEM 5 THEN:-

6a ELEVATE GUNS TO APPROX. 60° BY HAND. REMOVE NUTS & WASHERS FROM TOP OF TEN STUDS PASSING THROUGH EXTERNAL RIB OF CUPOLA.
CAUTION.
STUDS MUST NOT BE ALLOWED TO TURN IN TURNTABLE OR MAL-ADJUSTMENT WILL RESULT.- SEE DETAIL B

6b SLIP OFF CUPOLA & ATTACH SLING.



DETAIL OF POWER SUPPLY

FIG. 3	MID-UPPER TURRET • GLENN MARTIN TYPE 250 CE 23A. MK.I (2)	FIG. 3

PP4258 M /G4047 2/46 1050 C&P Gp. 959 (4)

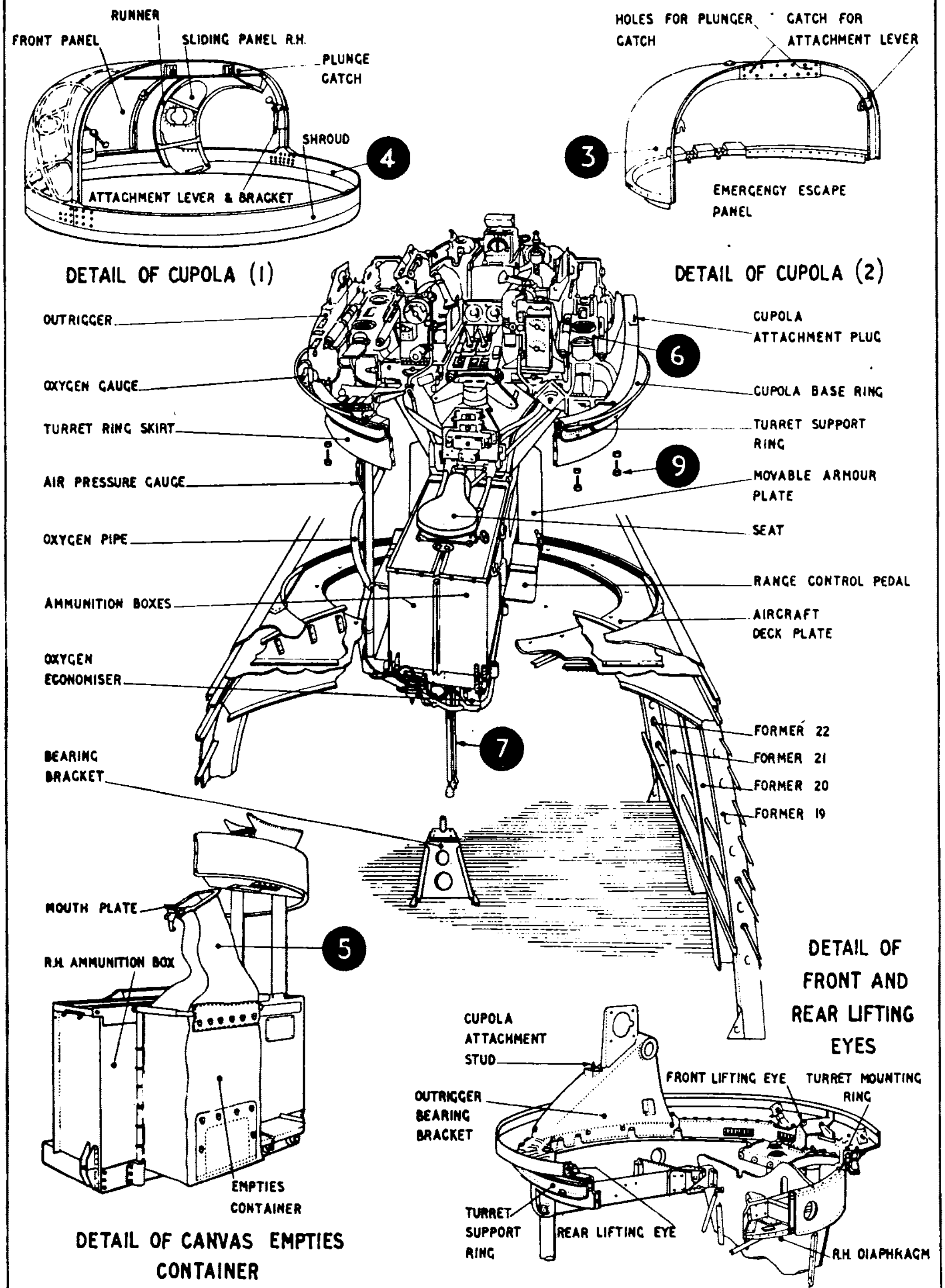


FIG. 4 MID-UPPER TURRET • BRISTOL TYPE 17 (1) FIG. 4

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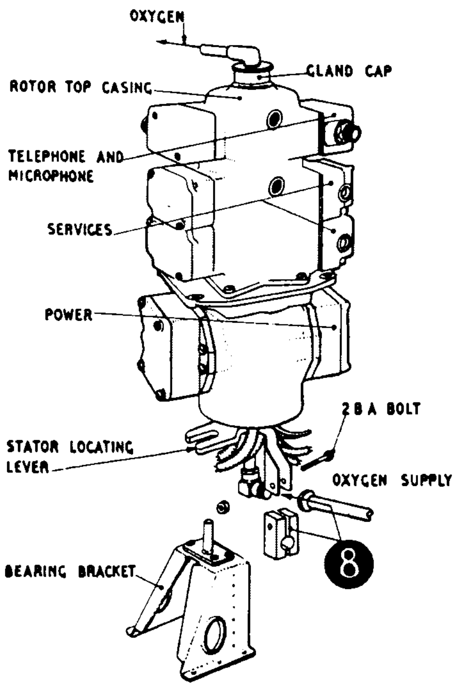
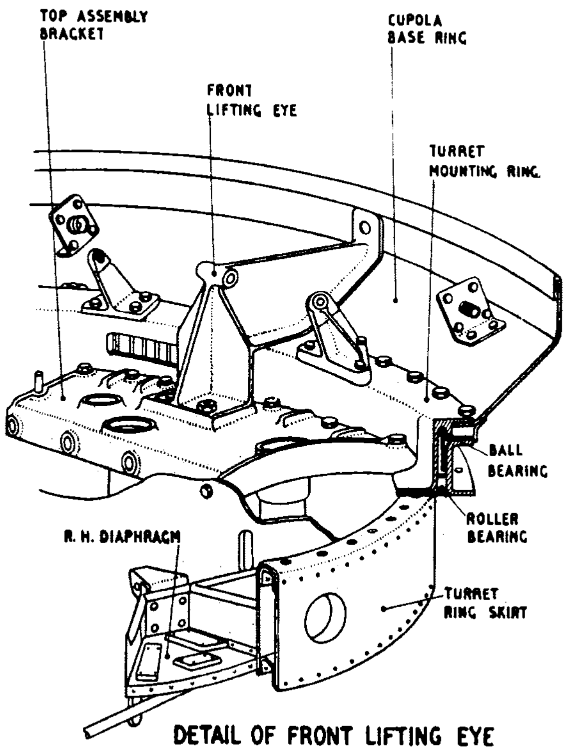


DETAIL OF ROTATING SERVICE JOINT.



DETAIL OF FRONT LIFTING EYE LOCATION. (REAR LIFTING EYE OPPOSITE).

REMOVAL INSTRUCTIONS.

1 IT IS PREFERABLE, THOUGH NOT ESSENTIAL, TO RAISE AND SUPPORT TAIL SO THAT AIRCRAFT IS IN FLYING POSITION BEFORE TURRET IS REMOVED.

2 REMOVE ALL AMMUNITION FROM TURRET AND REMOVE GUNS. (SEE PARAGRAPH 50 OF THIS CHAPTER).

3 REMOVE EMERGENCY ESCAPE PANEL FROM CUPOLA BY PULLING DOWN TWO KNOBS, ONE ON EACH SIDE, AND THEN PUSHING FORWARD TWO SIMILAR KNOBS AT TOP.

4 DETACH CUPOLA BY REMOVING TWO ½ INCH B.S.F. NUTS AND WASHERS FROM TWO CUPOLA ATTACHMENT STUDS, ONE ON EACH SIDE OF OUTRIGGER BEARING BRACKETS, AND TWO ¼ INCH B.S.F. BOLTS AT FRONT AND REAR OF CUPOLA BASE RING. RAISE AND REMOVE CUPOLA.

5 DETACH NECKS OF EMPTIES CONTAINERS BY PULLING BACK LATCH HOOKS ON EACH SIDE. REMOVE EMPTIES CONTAINERS BY LIFTING OUT OF ENGAGEMENT WITH SOCKETS ON UNDERSTRUCTURE.

6 FULLY ELEVATE GUN CRADLES BY HAND MECHANISM.

7 DISCONNECT THREE BREEZE PLUGS FROM THEIR SOCKETS (SEE FIG. 3).

8 DISCONNECT AIRCRAFT OXYGEN SUPPLY PIPE FROM ELBOW UNION ON TURRET OXYGEN PIPE BY UNSCREWING UNION NUT. ALSO DETACH PIPE CLAMP SUPPORT BRACKET FROM OXYGEN SUPPLY PIPE IN AIRCRAFT.

9 REMOVE TWELVE FIXING BOLTS SECURING TURRET TO AIRCRAFT DECK PLATE.

10 ATTACH SLING TYPE K (STORES REF. 50 H/227) RAISE AND REMOVE TURRET.

FIG. 5 MID-UPPER TURRET • BRISTOL TYPE 17 (2) FIG. 5

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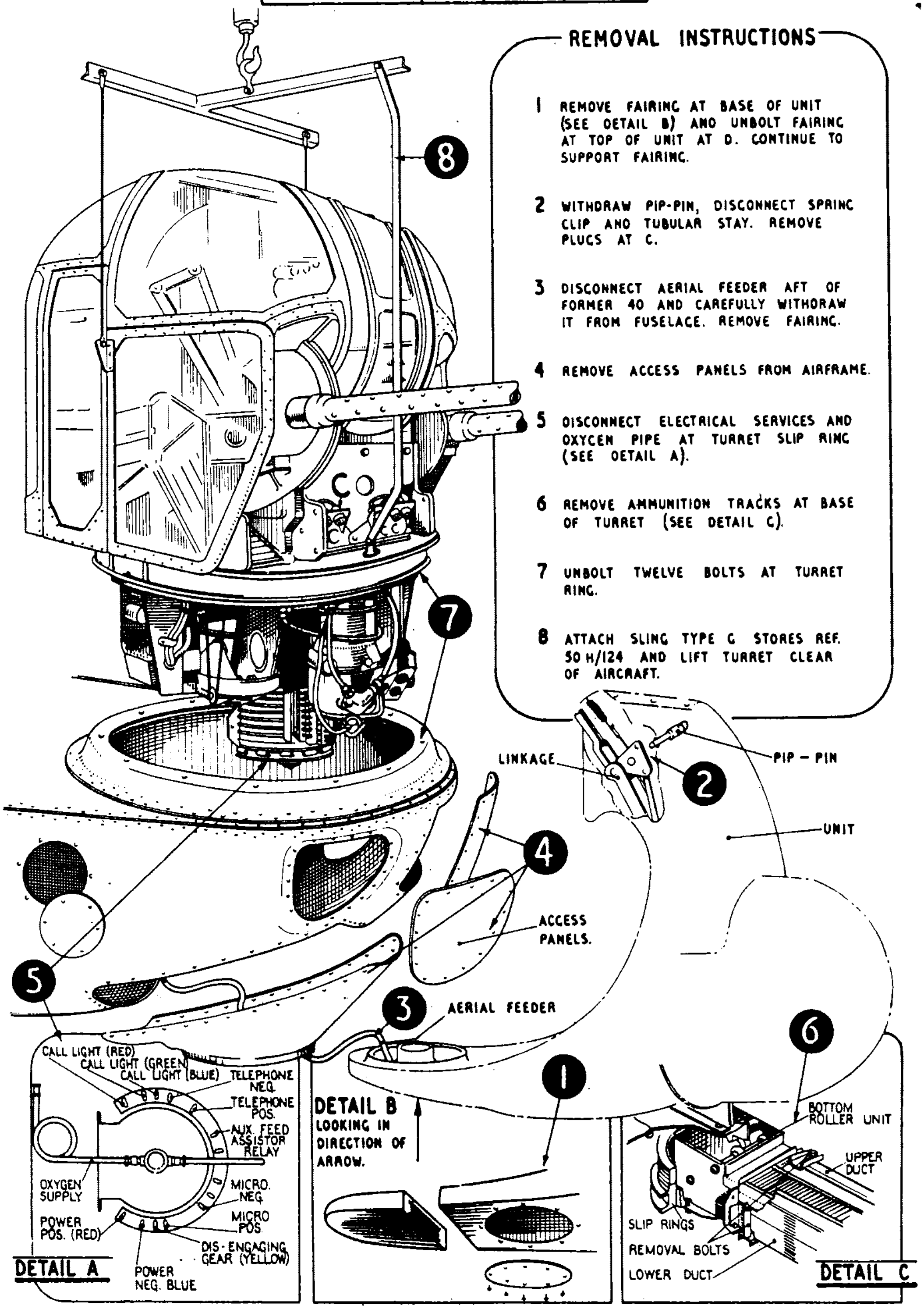

REMOVAL INSTRUCTIONS

1. REMOVE FAIRING AT BASE OF UNIT (SEE DETAIL B) AND UNBOLT FAIRING AT TOP OF UNIT AT D. CONTINUE TO SUPPORT FAIRING.
2. WITHDRAW PIP-PIN, DISCONNECT SPRING CLIP AND TUBULAR STAY. REMOVE PLUGS AT C.
3. DISCONNECT AERIAL FEEDER AFT OF FORMER 40 AND CAREFULLY WITHDRAW IT FROM FUSELAGE. REMOVE FAIRING.
4. REMOVE ACCESS PANELS FROM AIRFRAME.
5. DISCONNECT ELECTRICAL SERVICES AND OXYGEN PIPE AT TURRET SLIP RING (SEE DETAIL A).
6. REMOVE AMMUNITION TRACKS AT BASE OF TURRET (SEE DETAIL C).
7. UNBOLT TWELVE BOLTS AT TURRET RING.
8. ATTACH SLING TYPE G STORES REF. 50 H/124 AND LIFT TURRET CLEAR OF AIRCRAFT.

FIG. 6 REAR TURRET • BOULTON PAUL TYPE D FIG. 6

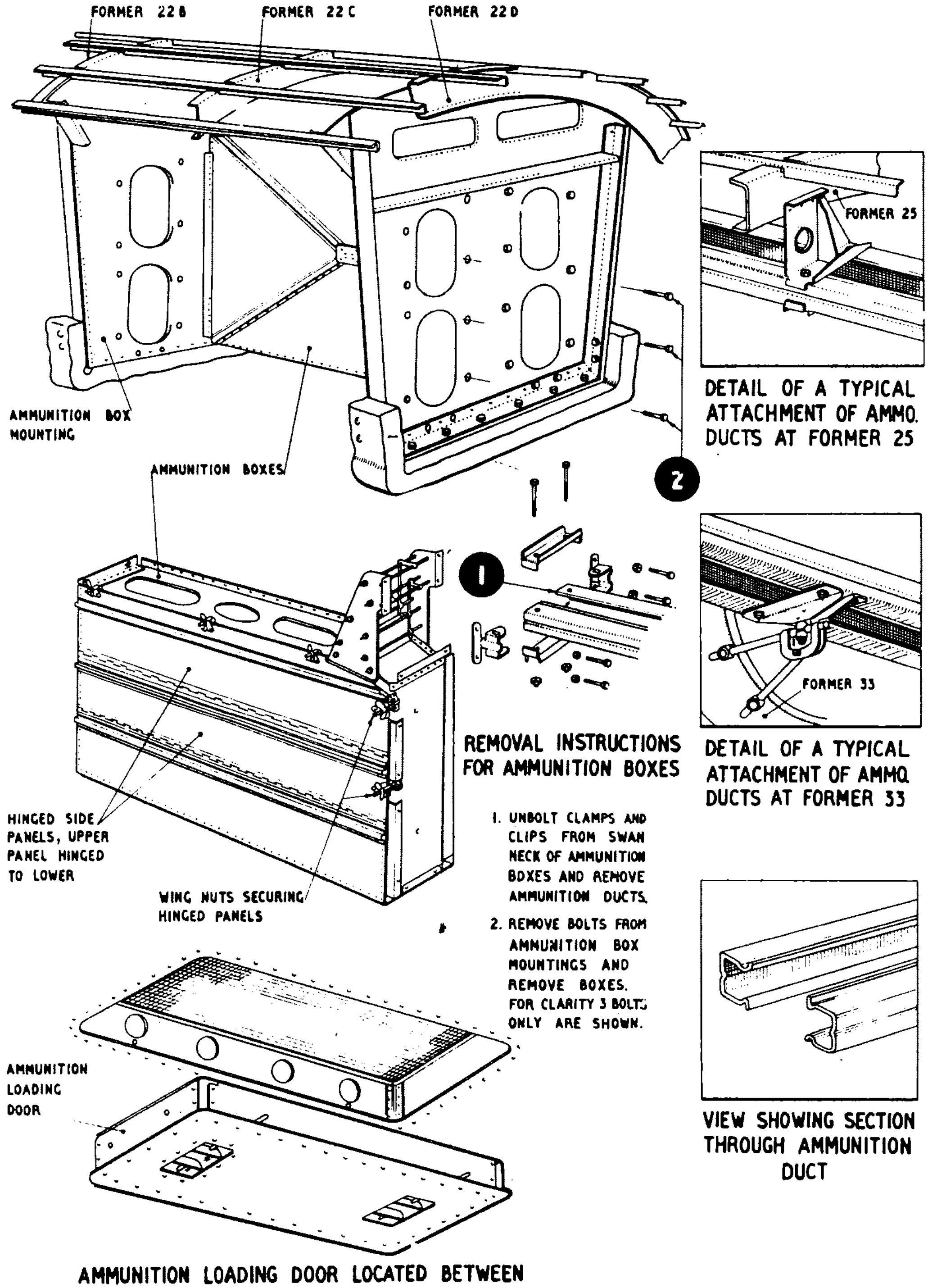

FIG. 8 AMMUNITION DUCTS & BOXES - TYPE D TURRET FIG. 8

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