

Fig. 1. Fuel system controls (pre Mod. 38 and 39)

RESTRICTED

Key to Fig.1

Push-switches, rate-of-flow

When pressed, the rate of flow is given on the flow indicator (second pilot's panel).

- 1 NO.4 ENGINE
- 4 NO.3 ENGINE
- 7 NO.2 ENGINE
- 10 NO.1 ENGINE

Cross-feed cock switches

Forward - SHUT
Rearward - OPEN

- 2 NOS.3 and 4 ENGINES
- 5 PORT and STARBOARD SIDES OF AIRCRAFT
- 8 NOS.1 and 2 ENGINES

Cross-feed indicators

- 3 NOS.3 and 4 ENGINES
- 6 PORT and STARBOARD SIDES OF AIRCRAFT
- 9 NOS.1 and 2 ENGINES

Auto/manual switches

Forward - AUTO - energises sequence timer

Rearward - MANUAL - stops sequence timer

- 21 NO.1 TANKS GROUP
- 22 NO.2 TANKS GROUP
- 33 NO.3 TANKS GROUP
- 34 NO.4 TANKS GROUP

Tank pump switches

Forward - ON
Rearward - OFF
(These switches control)

PORT

- 12 NO.6 TANK PUMP
- 14 NO.7 TANK PUMP
- 16 NO.5 TANK PUMP
- 18 NO.4 TANK PUMP
- 20 NO.3 TANK PUMP
- 26 NO.2 TANK PUMP
- 27 NO.1 TANK PUMP

STARBOARD

- 28 NO.2 TANK PUMP
- 29 NO.1 TANK PUMP
- 35 NO.3 TANK PUMP
- 37 NO.4 TANK PUMP
- 38 NO.5 TANK PUMP
- 41 NO.7 TANK PUMP
- 43 NO.6 TANK PUMP

Tank contents push-switches

When pressed, indicate individual tank contents on outer ring of contents gauges (items 45, 46, 47 and 48).

PORT

- 11 NO.6 TANK
- 13 NO.7 TANK
- 15 NO.5 TANK
- 17 NO.4 TANK
- 19 NO.3 TANK
- 24 NO.2 TANK
- 25 NO.1 TANK

STARBOARD

- 30 NO.1 TANK
- 31 NO.2 TANK
- 36 NO.3 TANK
- 39 NO.5 TANK
- 40 NO.4 TANK
- 42 NO.7 TANK
- 44 NO.6 TANK

C.G. transfer pump switches

Forward - NOSE - starts No.7 tank transfer pump and opens No.1 tank refuelling valve.

Centre - OFF

Rearward - TAIL - STARTS No.1 tank transfer pump and opens No.7 tank refuelling valve.

- 23 - Port side
- 32 - Starboard side

Contents gauge panel

Outer ring - individual tank contents
Inner ring - tank group contents

- 45 Contents gauge - No.1 engine group (Nos. 1,4,5 and 7 tanks)
- 46 Contents gauge - No.2 engine group (Nos.2, 3 and 6 tanks)
- 47 Contents gauge - No.3 engine group (Nos.2, 3 and 6 tanks)
- 48 Contents gauge - No.4 engine group (Nos.1, 4, 5 and 7 tanks)

DESCRIPTION

Introduction

1. This chapter contains a description of the low pressure fuel system, together with servicing details and the method of removal and assembly of certain components; the high pressure system, contained within the engine, is described in the A.P.4501 series. A description and details of servicing the fuel pumps are given in A.P.4343D, Vol.1; the construction of the fuel tanks and details of their servicing is given in A.P.4117B, Vol.1, Part 2, Sect.1. Since the fuel system is electrically controlled, this chapter should be read in conjunction with Sect.5, Chap.1 in Vol.1, Book 2 of this Air Publication.

General

2. Fuel is carried in fourteen tanks, five being in the port and five in the starboard main plane, with the remaining four tanks in the fuselage above and aft of the nose-wheel bay. The arrangement of the tanks is shown on fig.2.

3. On each side of the aircraft the tanks are divided into two groups; the No.1, 4, 5 and 7 tanks provide fuel for the outboard engines and the No.2, 3 and 6 tanks, the inboard engines. Normally, the two tank groups function independently; electrically-operated cross-feed cocks are provided which allow all engines to be supplied from any selected group. They consist of an engine cross-feed cock between each inboard and outboard engine and an aircraft cross-feed cock between the port and starboard sides of the aircraft; the control switches are on the cockpit centre console (fig.1).

4. Due to the configuration of the aircraft, the fuel tanks are disposed forward and aft of the aircraft centre of gravity. It is, therefore, important that fuel balance is maintained throughout a flight. This is achieved by an electrically-

operated sequence timer which allows a measured quantity of fuel to be pumped from each tank in turn. The quantity of fuel pumped from each tank during one cycle of the sequence timer is proportional to the tank capacity, which maintains the fuel centre of gravity reasonably constant. Similarly, when refuelling, each tank is filled proportionally in relation to its capacity to give even fuel loading.

5. An electrically-operated fuel pump is mounted in the base of each tank to supply low pressure fuel to the engines. These pumps (except those in the fuselage tanks) are each contained in a reservoir within the fuel tank, the reservoir fuel level being maintained by an auxiliary pump also mounted in the tank and at the opposite end to the main feed pump. In addition, the No.1 and No.7 tanks, which are the tanks farthest from the aircraft C.G., have transfer pumps to convey fuel forward or aft should the aircraft become tail or nose heavy.

6. Nitrogen purging is used to minimise fire risks, the nitrogen also being used to pressurise the tanks. All tanks are pressurised to prevent vaporisation and consequent loss of fuel at altitude; a description of the nitrogen system is given in Chap.6 of this section. The nitrogen purge system is deleted from aircraft with Mod.171 embodied and an explosion protection system installed in the fuel tanks. Full details of the explosion protection system are given in Vol.1, Book 2, Sect.5, Chap.1, Group 9A of this publication.

CONTROLS AND INDICATORS

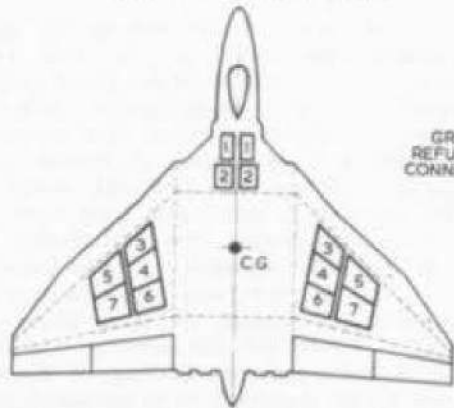
7. The fuel delivery system controls are on the aft portion of the centre console in the cockpit, which contains the fuel delivery pump, transfer pumps and cross-feed cock switches. Fourteen

push switches are also housed on the console, those adjacent to the fuel pump switches select individual tank contents readings; a further four push switches, one to each engine, select the fuel flow gauge reading of a particular engine. The controls, as grouped on the console, represent a plan view of the aircraft fuel system, enabling the pilot to see at a glance, how to control the system manually. The groups are outlined in colour on the control panel as indicated on fig.1. Four contents gauges, one to each group of tanks are mounted on the forward portion of the console. The contents gauges indicate, on the inner ring, the weight of fuel, in pounds, in each of the tank groups; the contents of an individual tank in a particular group can be obtained by pressing the associated push-switch on the centre console and the tank group gauge outer ring will then indicate the fuel content of that tank. A fuel flow indicator (Ref.No.6A/4252) is fitted on the second pilot's instrument panel to indicate the rate of flow for any one engine when the associated push-switch on the fuel control panel is pressed. The remaining controls consist of four low-pressure cock switches and magnetic indicators on the cockpit coaming. The engine high-pressure cocks are controlled by the throttle levers. Warning indicators, which show when the fuel pressure falls below 5 p.s.i. are mounted on the pilot's central instrument panel.

8. Fuel contents gauges, one to each group of tanks, are also provided on the navigators panel. An integrating gallons-gone counter (Ref.No.6A/4254) is also mounted on this panel; this registers the total rate at which fuel is being consumed by all engines and the total weight of fuel consumed.

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NOTE - PORT AND STARBOARD SIDES OF THE SYSTEM ARE IDENTICAL. THE PORT SIDE IS ILLUSTRATED.



ARRANGEMENT OF FUEL TANKS

- REFUELLING
- ENGINE FEED
- TRANSFER
- DEFUELLING
- COMPRESSED AIR
- NON-RETURN VALVE
- FILTER
- RESTRICTOR
- PRESSURE RELIEF VALVE
- RECUPERATOR
- TANK SERVICING COCK
- LOW PRESSURE COCK
- DEFUELLING COCK
- REFUELLING VALVE
- TRANSFER PUMP
- TANK PUMP
- ELECTRICALLY OPERATED
- RECUPERATOR BLEED LINE

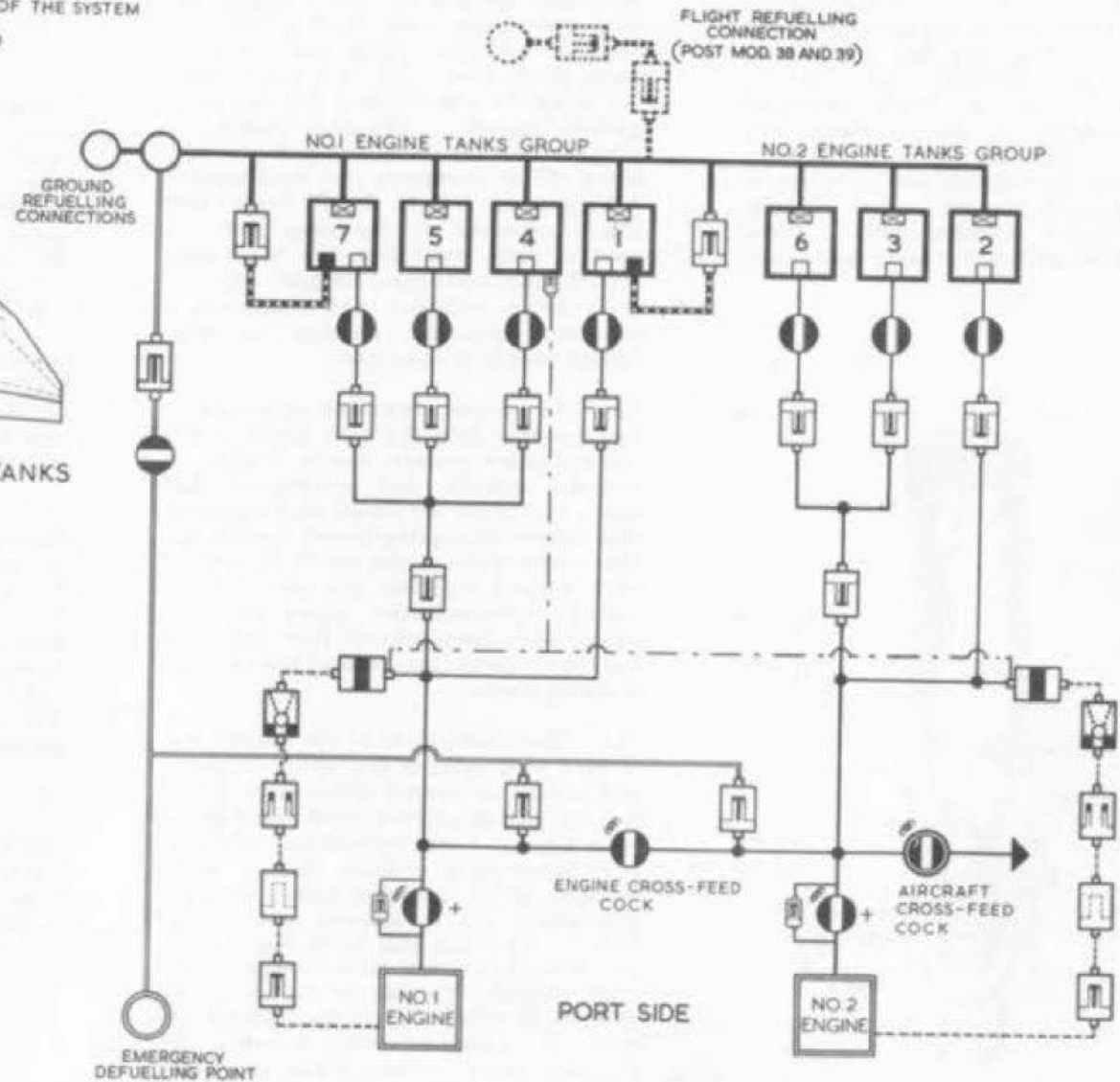


Fig. 2. Fuel system diagram.

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FUEL TANKS

9. Light alloy fuel tank compartments in the main planes and the front of the centre fuselage are an integral part of the structure. Bag type fuel tanks, constructed of Hycatrol H.P. 257/40, D.T.D.1124, 0.04 in. thick reinforced with Terylene in the fuselage, and Hycatrol H.P.257/30, D.T.D.1132, 0.03 in. thick reinforced with Terylene in the wings, are secured in the compartments by metal, colletted studs. These studs are secured to the tanks by vulcan-

ised rings and pressed into holes in the compartment skin plating. The bottom surface of each tank is reinforced around an access aperture to carry a magnesium-alloy sump plate upon which a reservoir, housing the fuel pump and refuelling valve, is mounted. On No.1 and 7 tanks, the reservoir also houses the fuel C.G. transfer pumps. The upper surface is strengthened to accommodate a vent elbow and an emergency fuel level switch. A Vickers Mk.A ¼ in. B.S.P. drain valve (fig.3), mounted on the sump plate, is used to drain water from the fuel tanks. An inhibitor cartridge, integral with the drain valve assembly and containing a chromate compound, protects the magnesium sump from corrosion.

10. To prevent excessive quantities of fuel passing into the vent pipes of the pressurisation system, due to changes in aircraft attitude and consequent fuel swirl, the tanks are fitted with combined float valves and spring-loaded inward/outward vent valves at the points of entry of each inboard pipe into the tanks. The outboard pressurisation pipes and vent valves have been deleted from the tanks and the connection points sealed with blanking plates.

11. The float valve, at the inboard end of each wing tank, is cylindrical in shape and houses an inward relief valve set at ¼ p.s.i. and an outward relief valve set at ¼ to 1 p.s.i. The cylindrical body contains a series of orifices, through which nitrogen or air pressure normally enters the tanks, and is sleeved with a cork float. When the fuel level rises above the float valve due to a change in aircraft attitude, the sleeve floats up the cylindrical body to cover the orifices and fuel is prevented from entering the pressure lines. Should the cork float stick and cause the orifices in the valve housing to remain covered, the inward vent valve will be opened by the pressurisation supply and nitrogen or air will continue to flow into the tanks. Con-

versely, should the pressure in the tanks exceed ¼ to 1 p.s.i. differential, the outward relief valve will open to release the excess pressure into the pressurisation lines.

12. A stop in the top of the valve restricts the travel of the inner valve body. If the stop were not fitted and the emergency fuel level switch failed to close the refuelling valve when refuelling a tank was completed, continued introduction of fuel into the tank would lift the cork float and valve body until the tank pressurisation line was blanked off and the tank sealed. The pressure built up in the tank would eventually burst it and damage the surrounding tank bay. Restricted movement of the inner valve body prevents sealing of the tank and allows excess fuel to escape through the tank pressurisation pipes.

13. The tanks are each equipped with two tank contents gauge transmitter units, an emergency level float switch and an S.P.E., bottom-mounted fuel pump; the No.1 and 7 tanks also have a transfer pump. Manually-operated cocks are interposed in the delivery pipes from the tanks to obviate tank draining when pipes are to be disconnected for servicing purposes.

14. To prevent fuel vaporisation, due to either high temperature or high altitude, and also to minimise fire risk, the tanks are provided with a pressurisation system. This enables a predetermined nitrogen or air pressure to be maintained throughout the altitude range of the aircraft. Refer to Sect.4, Chap.6.

TANK RESERVOIRS

15. The wing tank main fuel pumps are each housed in a rectangular, light-alloy reservoir, situated within each wing tank. For ease of servicing, the

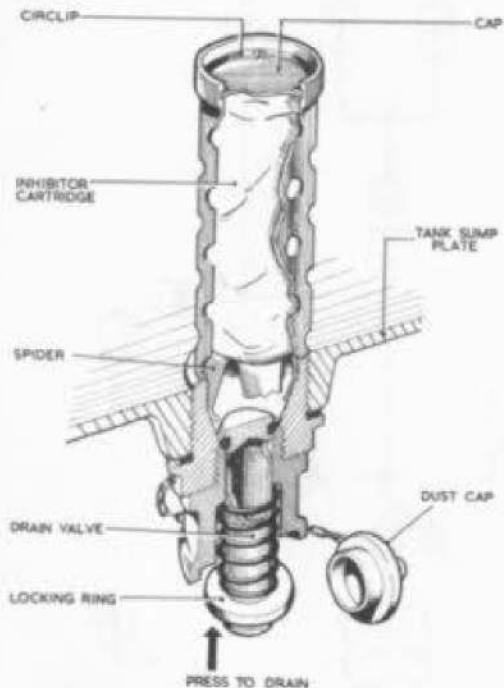


Fig.3. Fuel tank drain valve

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reservoirs of No.3, 4 and 6 tanks are constructed in three tiers secured together, on installation, with 2B.A. bolts and anchor nuts; the No.5 and 7 tank reservoirs are similarly constructed, but in two tiers. Flap valves, mounted in each reservoir and acting as non-return valves, are normally in the open position. In a diving attitude the flap valves close due to the head of fuel in the reservoir, this head being maintained by an auxiliary pump (para.32).

SYSTEM INSTALLATION

DELIVERY LINES

16. The fuel system installation on each side of the aircraft is similar, therefore, to avoid repetition, only the port side is described in subsequent paragraphs.

17. From the No.1, 4, 5 and 7 tank pump elbows, $1\frac{1}{2}$ in. dia. delivery pipes lead, through Vickers, Type R, manually-operated servicing cocks and non-return valves to prevent re-circulation to the tanks, into a common 2 in. dia. pipe. This line, which leads through the electrically-operated low-pressure cock, supplies the No.1 engine. A recuperator (para.21) is interposed in the common line.

18. Similarly, $1\frac{1}{2}$ in. dia. pipes lead from the No.2, 3 and 6 tanks and combine at a common 2 in. dia. pipe, also fitted with a recuperator, leading through a low-pressure cock to the No.2 engine. The common lines to each engine, on one side of the aircraft, are connected by a cross-feed line incorporating an engine cross-feed cock; the port and starboard sides of the system are combined by an aircraft cross-feed line and cross-feed cock.

19. Mod.262 introduces modified non-return valves in No.1, 2 and 3 tank pipes.

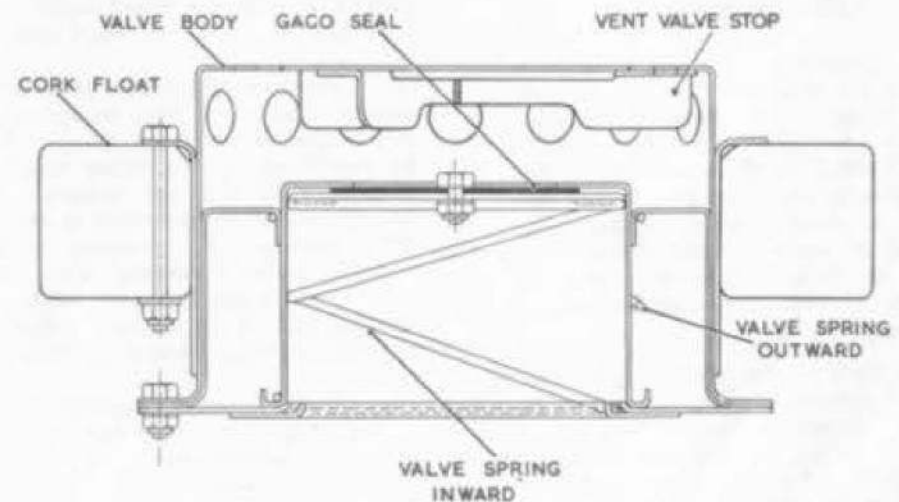
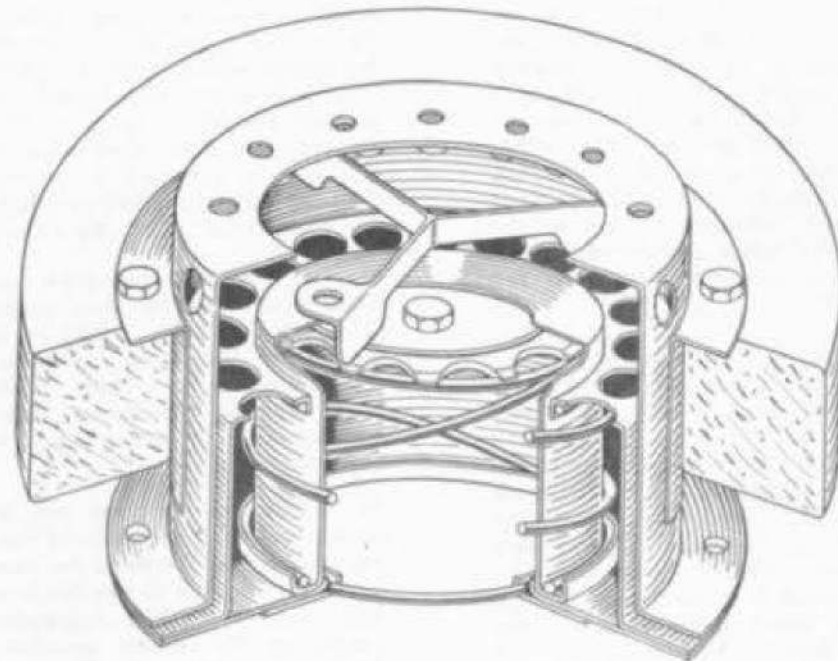


Fig.4. Float valve

The spring loading in these valves has been adjusted to compensate for differences in head of pressure (due to variations in fuel level between the tanks in a group) and also to equalize engine suction effect between tanks in a group when the pumps have been selected or following a pump failure. Otherwise, should a failure occur in the lowest tank the fuel remaining in it could not be used since the back pressure caused by the difference in the heads of fuel would hold the associated non-return valve in the closed position.

20. When Mod.185 is embodied a ¼ in. O.D. pipe, with a non-return valve, is fitted in the fuel line to each engine and by-passes the L.P. cock. The purpose of the by-pass is to prevent damage to the pipes, due to expansion of fuel trapped between the L.P. cock and the engine when a cock is closed. The by-pass allows excess pressure to pass the L.P. cocks and return to the tanks through 1/16 in. dia. bleed holes drilled in the non-return valves to No.1 and No.2 fuel tanks.

RECUPERATORS

21. To maintain the fuel supply pressure to the engines when the aircraft is being flown under negative 'G' conditions, a recuperator, Type P.R.C. 25A, Mk.1A, Mk.2 or Mk.3, is fitted in the delivery line to each engine. The recuperator, a double-walled, cylindrical, metal tank of approximately 2½ gallons capacity, is divided internally into an upper and lower compartment by a synthetic rubber bag.

22. Two main connections are provided on the recuperator. The upper end is connected, through a diaphragm-operated fuel control valve, to the fuel delivery line. Air is fed to the lower end from the engine compressor casing through a non-return valve and a pressure com-

pensating relief valve, relieving at pressures between 6 and 10 p.s.i. depending upon the supply pressure; servo air is also taken from this line between the double walls of the recuperator to the diaphragm of the fuel control valve. To prevent excessive loss of fuel through the pressure relief pipe, when a recuperator bag is damaged, a restrictor is introduced into the pressure-relief valve of the Type P.R.C. 25A, Mk.1A recuperator.

23. Secondary connections consist of a bleed line from the fuel control valve, to the No.4 tanks - this is to release the air in the upper compartment when the recuperator is initially filled - and a bleed line to atmosphere from the fuel control valve to prevent fluid locking of this component.

24. When the engines are started air passes to the lower side of the bag and, simultaneously, between the double walls of the recuperator to the diaphragm of the fuel control valve (normally spring-loaded to the closed position) causing the valve to open and allow fuel into the upper compartment of the recuperator; air contained initially in the recuperator passes through the bleed outlet, near the fuel control valve, to No.4 tank (fig.6).

25. Passing the servo air through the double walls of the recuperator is a safety precaution since, should the walls be punctured, the servo air supply to the diaphragm of the fuel control valve exhausts through the puncture to atmosphere. This releases the pressure on the fuel control valve diaphragm and the valve closes under the influence of its spring-loading to shut off the fuel supply line to the recuperator, preventing loss of fuel.

26. Under normal conditions the air pressure is about half the fuel delivery pressure, consequently, the rubber bag remains in the lower half. When the fuel pressure falls, due to a negative 'G' attitude of the aircraft, the air pressure

raises the bag and forces the fuel from the recuperator, through the fuel control valve, into the fuel delivery line to the engine; sufficient fuel is available for approximately ten seconds of negative 'G' flying.

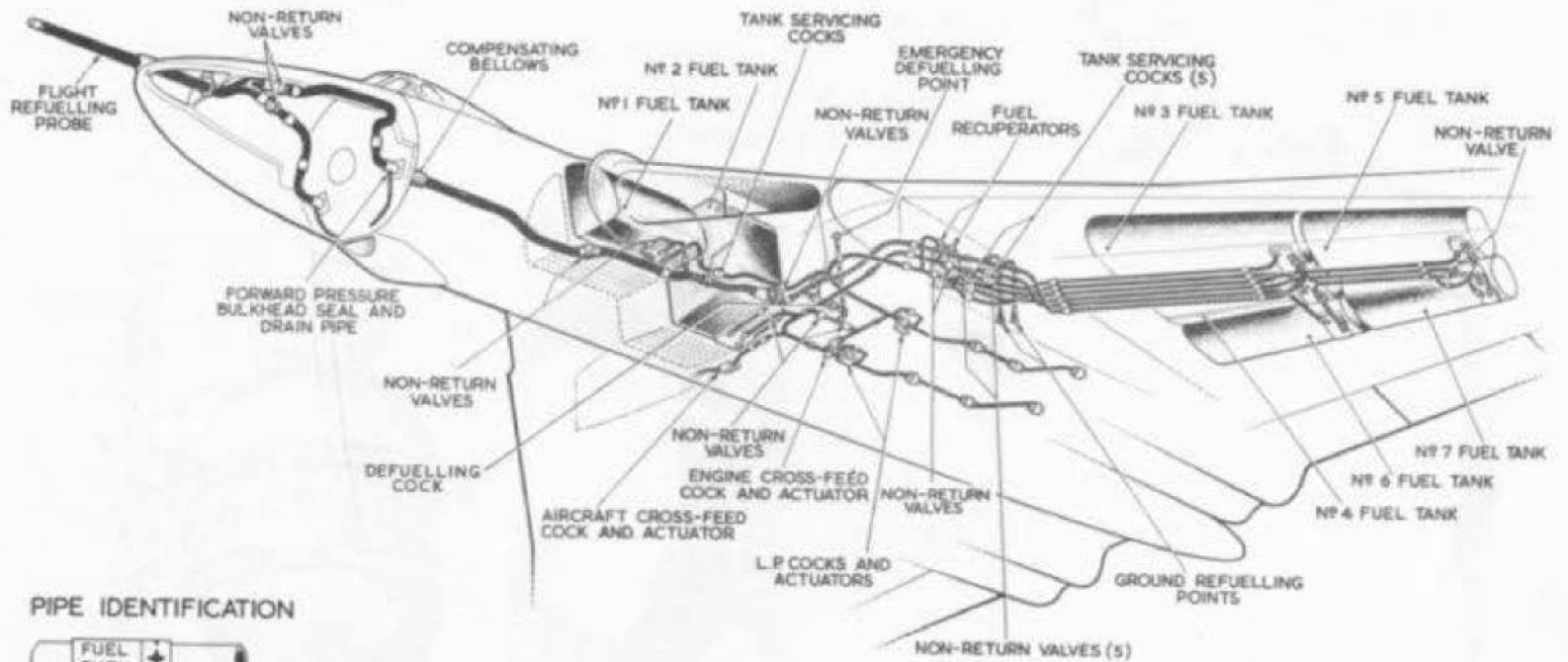
27. Incorporated in the air inlet connection at the bottom of the recuperator is a water drain and an air relief valve. Both components have screwed couplings to which pipes are connected. The air connection leads to atmosphere and the water drain line to the front pressure bulkhead where the end is blanked by a removable A.G.S. plug. The air relief valve will relieve excess pressure as soon as the normal fuel supply is again available to charge the accumulator.

REFUELLING AND TRANSFER LINES

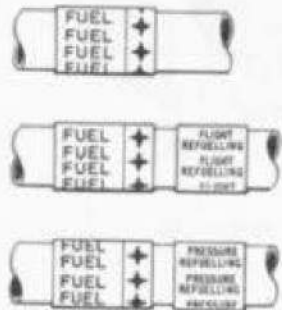
28. Pressure refuelling lines of 1½ in. dia. and 3½ in. dia. lead from ground refuelling points in each main-wheel bay to the wing and fuselage tanks respectively. An extension to the ground refuelling system of 4 in. dia. pipes, leads from No.1 tanks to a flight refuelling point in the nose metal fairing. Transfer lines between the No.1 and No.7 tanks are connected to the refuelling lines, the refuelling lines also being used for transfer purposes. Further pipes, for emergency defuelling, consist of a 1½ in. dia. pipe in which non-return valves are interposed, between the engine cross-feed line and the refuelling line, to which the emergency defuelling point in each main plane upper surface is connected.

FUEL PUMPS

29. An electrically-operated, immersed fuel pump is mounted in each tank. The fuselage forward (No.1) tanks and the main plane rear (No.7) tanks have a second pump for the transfer of fuel; the types of pumps are quoted in Leading



PIPE IDENTIFICATION



NOTE
THE PORT AND STARBOARD SIDES OF THE SYSTEM ARE IDENTICAL THE PORT SIDE IS ILLUSTRATED

- FLIGHT REFUELLING
- ENGINE FEED
- GROUND REFUELLING
- TRANSFER
- DEFUELLING

Fig. 5. Fuel system installation.

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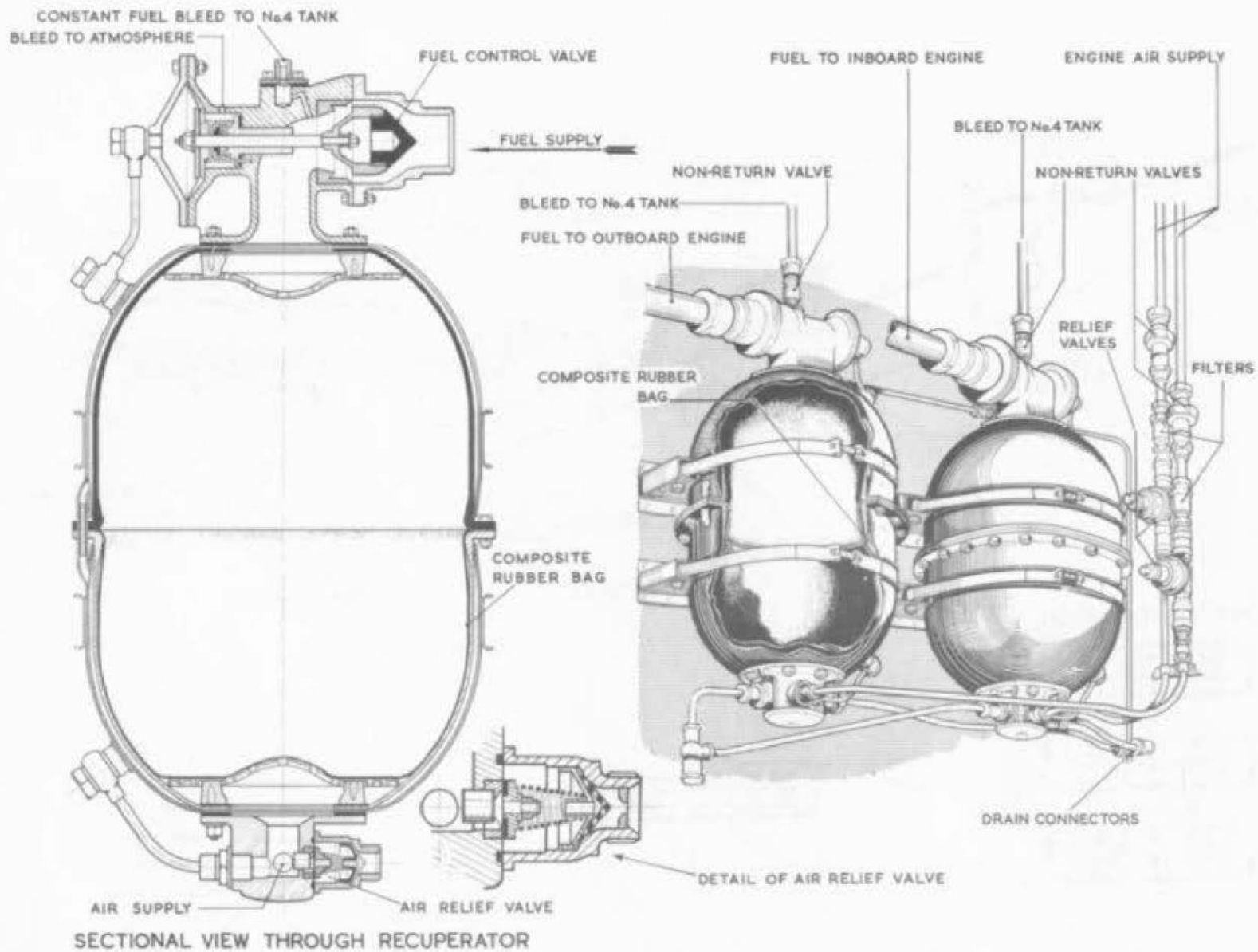


Fig. 6. Recuperator installation.

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Particulars. Controls for the pumps, on the cockpit centre console, consist of a toggle switch for each of the fourteen pumps, an AUTO - MANUAL switch for each of the four tank groups and the two transfer switches. When the AUTO - MANUAL switch is placed to AUTO the tank pumps are selected electrically by a sequence timer (para.31) which ensures that fuel is pumped from each tank in the correct sequence and thus the fuel centre of gravity maintained reasonably constant throughout a flight. Any further load trimming which may be required can be accomplished by transferring fuel from the No.1 tanks to the No.7 tanks, or vice versa, using the pumps provided in those tanks for this purpose. It should be noted that during automatic conditions, as a safety precaution, all fuel pumps are rotating, the pump selected by the sequence timer running at full speed, at a rate of 800 gallons per hour, and the remaining pumps at half this speed. Should the pump at full speed fail, sufficient fuel is delivered by the pumps running at reduced speed to prevent engine failure.

30. For take-off, landing and all normal flying, all pumps are switched ON and the AUTO - MANUAL switches are placed at AUTO. It has been established that even with a 'full-speed' pump failed, engine fuel requirements are adequately maintained at take-off r.p.m. by the "reduced speed" pumps. It will, therefore, only be necessary to use the MANUAL position in cases requiring specific fuel handling; e.g., to balance the fuel loading.

31. Full details of the sequence timers are given in Vol.1, Book 2, Sect.5, Chap.1 of this publication. Briefly, a timer consists of a series of irregularly-profiled cams driven by a constant-speed induction motor. As the cams revolve, they energise, in sequence, the change-speed relays to the fuel pumps.

AUXILIARY PUMPS

32. A constant supply of fuel to the main pumps, housed within the tank reservoirs (para.15), is maintained during all aircraft attitudes, by an internal transfer auxiliary pump, Type SPE.106 Mk.1, mounted in each tank at the opposite end to the main pump and inside the fuel level switch tubular units (fig.7). Normally the main pumps obtain their supply from the tank through the reservoir flap valve aperture. In an appreciable dive, or side slip the auxiliary pump maintains the supply by pumping fuel from the opposite end of the tank, through an internal transfer pipe into the reservoir, and the head of the fuel thus created causes the flap to close.

GROUND REFUELLING SYSTEM

33. Pressure refuelling is effected through two refuelling points in each main-wheel bay which lead to a refuelling valve, Type F.R. Mk.32 (post-mod.274) or Type F.R. Mk.40 (post-mod.858) in each tank. The Mk.32 and the Mk.40 are rated at 50 gallons per minute. Even distribution of the fuel load is accomplished by utilising the electrical output from the contents gauge transmitter units. Selection from 0 per cent to 100 per cent of the tank capacity is possible. Refuelling procedure is described in Sect.2, Chap.2 of this book; the equipment is illustrated in fig.8.

34. In this paragraph the operation of the refuelling system is briefly explained; reference must be made to Book 2, Sect.5, Chap.1, for more detailed information on the electrical equipment involved. A control panel and refuelling points are provided in each main-wheel bay. Each panel houses two master ON - OFF switches, a start switch with adjacent No.1 and No.2 group indicator lamps and an indicator lamp for each tank. Each master ON - OFF switch

controls the electrical supply for the refuelling system for one group of tanks. Adjacent to the port refuelling panel is a stabilized voltage supply panel which contains refuelling selectors, graduated from 0 - 100 per cent. This supply panel is energised by a control lever situated adjacent to the port pair of refuelling points. An indicator lamp on the refuelling panel is illuminated when the supply panel is warmed up. The START switches are operative until both rotary auto-selectors (Book 2, Sect.5, Chap.1) are in the starting position. The warning indicators at the top of each panel light up when the associated refuelling valve is energised. The contents selector applies a voltage to a resistance network which determines the percentage of fuel contents at which the tank refuelling valve is closed. Refuelling must always commence at the No.1 tank in the No.1 and No.4 engine group or in No.2 tank in the No.2 or No.3 engine group. As fuel enters the first tank, the current output from the No.1 tank contents gauge amplifier passes through one coil of a current-sensitive relay; the other coil of the relay is connected to the resistance network. When the difference of the currents from the No.1 tank amplifier and the resistance network reaches a certain value, the relay operates the rotary auto-selector which closes the refuelling valve of the No.1 tank and opens that to the No.4 tank. At the same time the No.1 tank amplifier is shut off and the No.4 tank amplifier is connected to the sensitive relay and contents gauge transmitter. Refuelling then commences on the No.4 tank and when the selected capacity is reached, No.5 tank, (followed by No.7 tank) is refuelled. When No.7 tank is refuelled, the master switches will return to OFF and the indicator lamps will extinguish, only the power pack will now be operating. Selection of the control lever between the port pair of defuelling points is now required to switch off the power pack.

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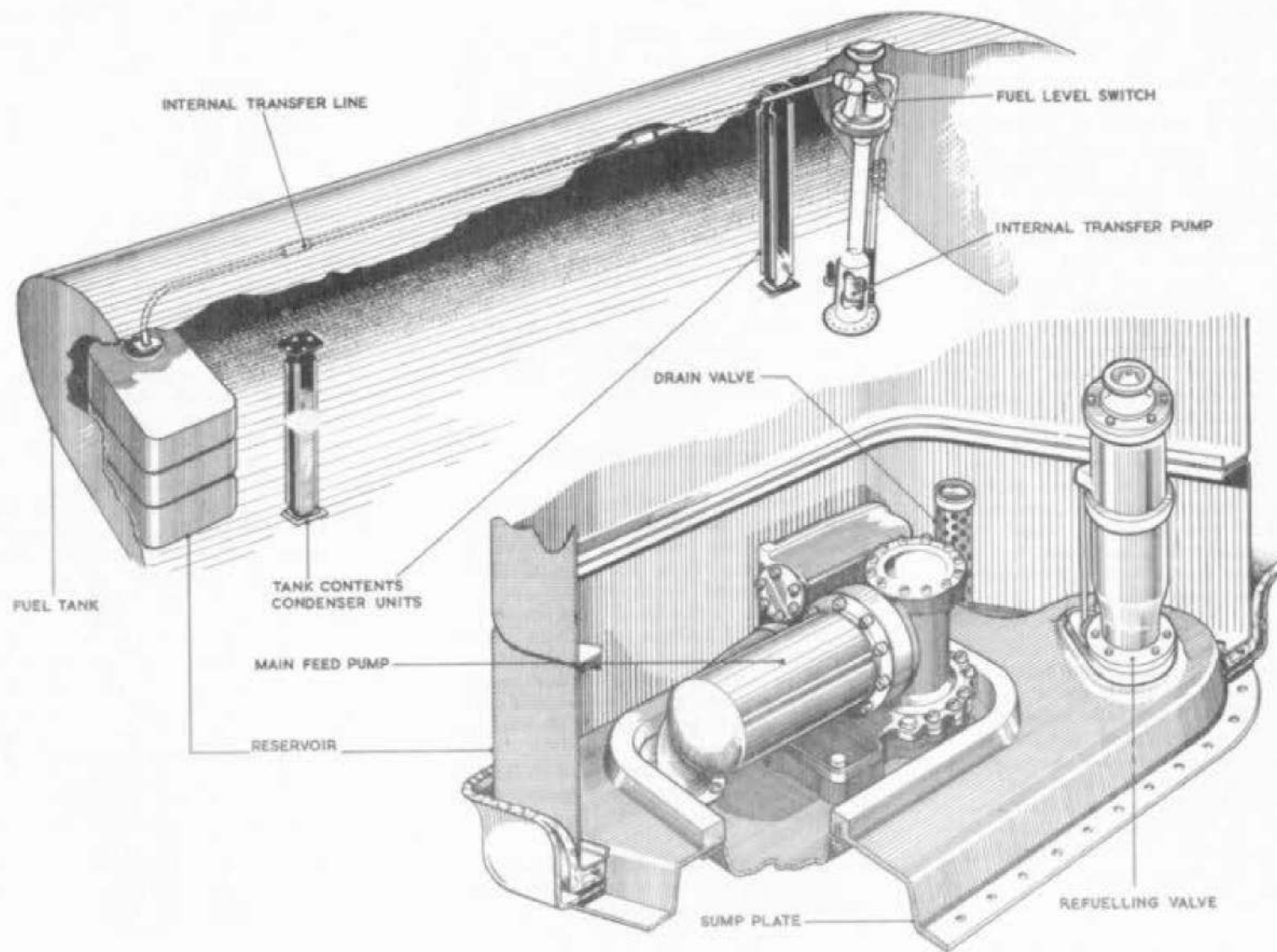


Fig. 7. Fuel tank equipment.
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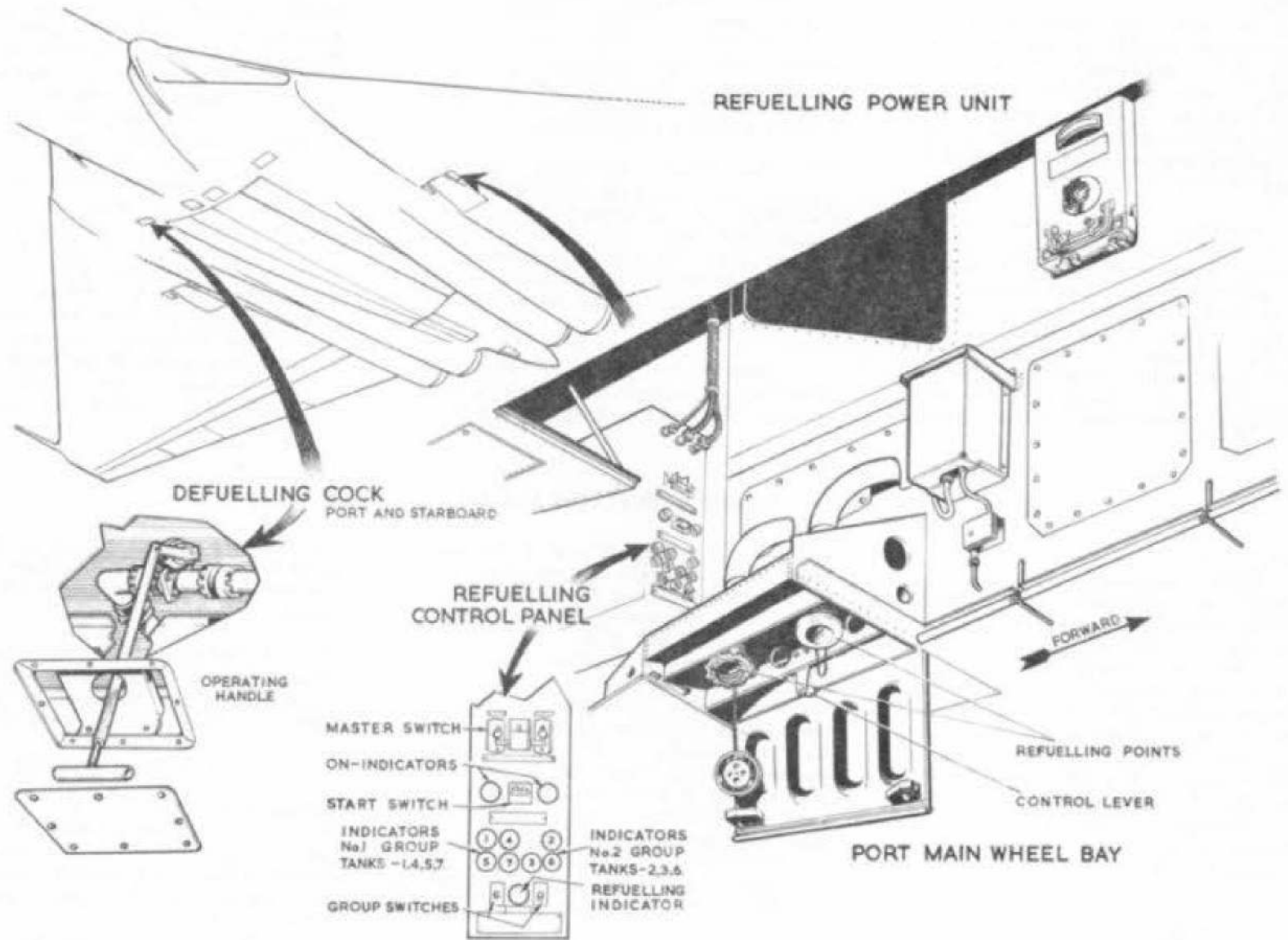


Fig. 8. Refuelling equipment.

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GROUND DEFUELLING SYSTEM

WARNING...

It is imperative that, during defuelling operations, No.7 tanks are drained before either No.1 or No.2 tanks. Tanks No.5, 6 and 7 must be defuelled before the No.1 and No.2 tanks. Unless this sequence is followed there is a danger of the aircraft over-balancing with possible serious damage as the result.

35. Defuelling under normal circumstances is effected by attaching a refuelling tanker to the refuelling connections in each main-wheel bay and extracting the fuel by suction, supplemented by use of the tank booster pumps as detailed in para.35A. Should the refuelling connections be inaccessible, defuelling is effected by suction only, through 2½ in. dia. bayonet-type connections, (Avery Hardoll

Part No.FC/246), positioned in the upper surface of the main plane. Access to the emergency defuelling connections is through panels labelled EMERGENCY DEFUELLING. When defuelling by suction only, the depression must not exceed 11 p.s.i. as indicated on the tanker gauge, depression in excess of this figure is liable to cause tank collapse.

35A. The normal defuelling operation given in this paragraph ensures that the possibility of introducing air into the engine feed lines is reduced. It is imperative that the warning inserted prior to para.35 is strictly adhered to during the defuelling operation which is carried out as follows:-

Connect the tanker to the ground refuelling points, open the defuelling cock and close the tank servicing cocks of No.1

to No.4 tanks. With an electrical supply connected to the aircraft set the AUTO-MANUAL switch, on the retractable centre console, to MANUAL. Set the tanker to suck, switch No.5, 6 and 7 tanks booster pumps ON and defuel the tanks to 500lb. indicated contents. As each tank reaches the 500lb. indicated contents, close the relevant tank servicing cock and switch the booster pump OFF. No.1 to 4 tanks are each defuelled to 500lb. indicated contents in a similar manner to No.5, 6 and 7 tanks, ensuring that, as each tank contents reaches the required level, the tank servicing cock is closed and the booster pump switched OFF. To defuel each tank from the 500lb. indicated contents to the unusable fuel level, open all the tank servicing cocks and with no suction being exerted by the tanker, switch ON all the tank booster pumps with the AUTO-MANUAL switch at MANUAL.

FLIGHT REFUELLING SYSTEM

General

36. Flight refuelling equipment is, basically, an extension of the ground refuelling system to a probe in the metal nose fairing. The equipment is in two parts; removable fittings (Mod.39) to be installed and removed as required, the permanent fittings (Mod.38) are part of the normal fuselage equipment. Probe nitrogen purge, part of Mod.39, is described in Sect.4, Chap.6 of this Book. A general description of flight refuelling and a detailed description of the probe nozzle is contained in A.P.4611, Vol.1, (Aircraft Refuelling in Flight).

REMOVABLE FITTINGS

Probe assembly

37. A probe assembly, consists of an outer light-alloy tube through which a light-alloy fuel pipe passes to a nozzle.

secured to the forward end of the outer tube. The outer tube is streamlined by a probe fairing attached to the metal nose fairing and is secured by mountings at bulkheads 510F and 470F. A 3/8 in.dia. light-alloy pipe, the nitrogen purge system feed pipe, is secured to and passes along the outer surface of the fuel pipe to enter the fuel pipe approximately eighteen inches from the nozzle. An additional pipe, connected to the bottom rear of the probe, runs aft along the starboard side of the metal nose fairing to connect to the drain pipe from the starboard flight refuelling line compensating bellows shroud. This additional pipe was connected to the probe vent on aircraft pre Mod.877.

Probe assembly mountings

38. A fillet in the outer probe tube engages a slot in the forward mounting and a spring-loaded plunger in the base of

the mounting engages a hole in the outer probe tube at former 510F. These fittings prevent the probe assembly revolving and moving fore-and-aft.

39. At bulkhead 470F, the assembly is secured by a guard, gripped by metal straps connected to the bulkhead by nuts and bolts and tightened by a tension bolt.

PERMANENT FITTINGS

System installation

40. Fuel is delivered from the probe to the refuelling pipe at the No.1 tanks through a fabricated branched pipe, aft of the probe, which incorporates two adapters, one of which is used as a test connection and drain and the other is connected to the fuel pressure transmitter by a flexible pipe. From the branched pipe two light-alloy pipes, each incorporating a 4 in. diameter non-return valve, pass

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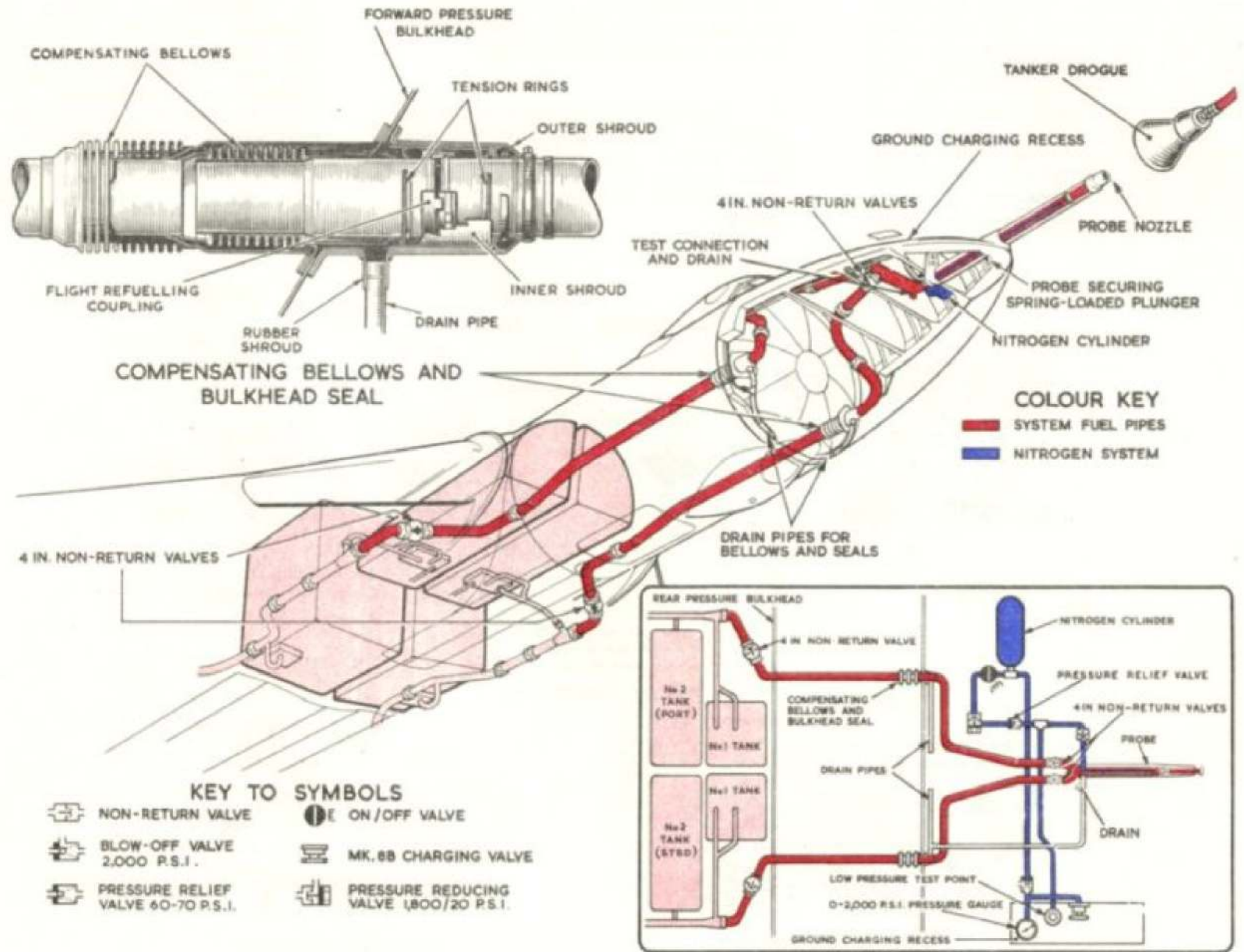


Fig. 9. Flight refueling system
(Probe vent deleted)
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rearward and downward to the front pressure bulkhead. Because the forces acting on the pipes in the pressurised cabin may vary considerably, the pipes which pass along both sides of the cabin are made of stainless steel and are connected to the front pressure bulkhead by compensating bellows which permit expansion and contraction of the pipes. Pressure seals are fitted to the forward and rear pressure bulkheads. From the rear pressure bulkhead light-alloy pipes

continue and turn between the front and rear false spars of the centre section wing stub and connect to the refuelling pipes at the No.1 tanks aft of the rear spar.

41. Four-in. diameter non-return valves, accessible through panels in the rear false spar of the centre section wing stubs, prevent the return of fuel to the pipes forward of them, after nitrogen purging.

Bulkhead pressure seals

42. Protection of the pipe couplings, contained in the front pressure bulkhead seal, from the results of pressurisation of the crew compartment pipes, has determined the seal's design. A conical, stainless steel, inner shroud grips reaction rings welded to the pipes on each side of the coupling, to reduce to a minimum the effects of tension and compression upon it. The inner shroud is

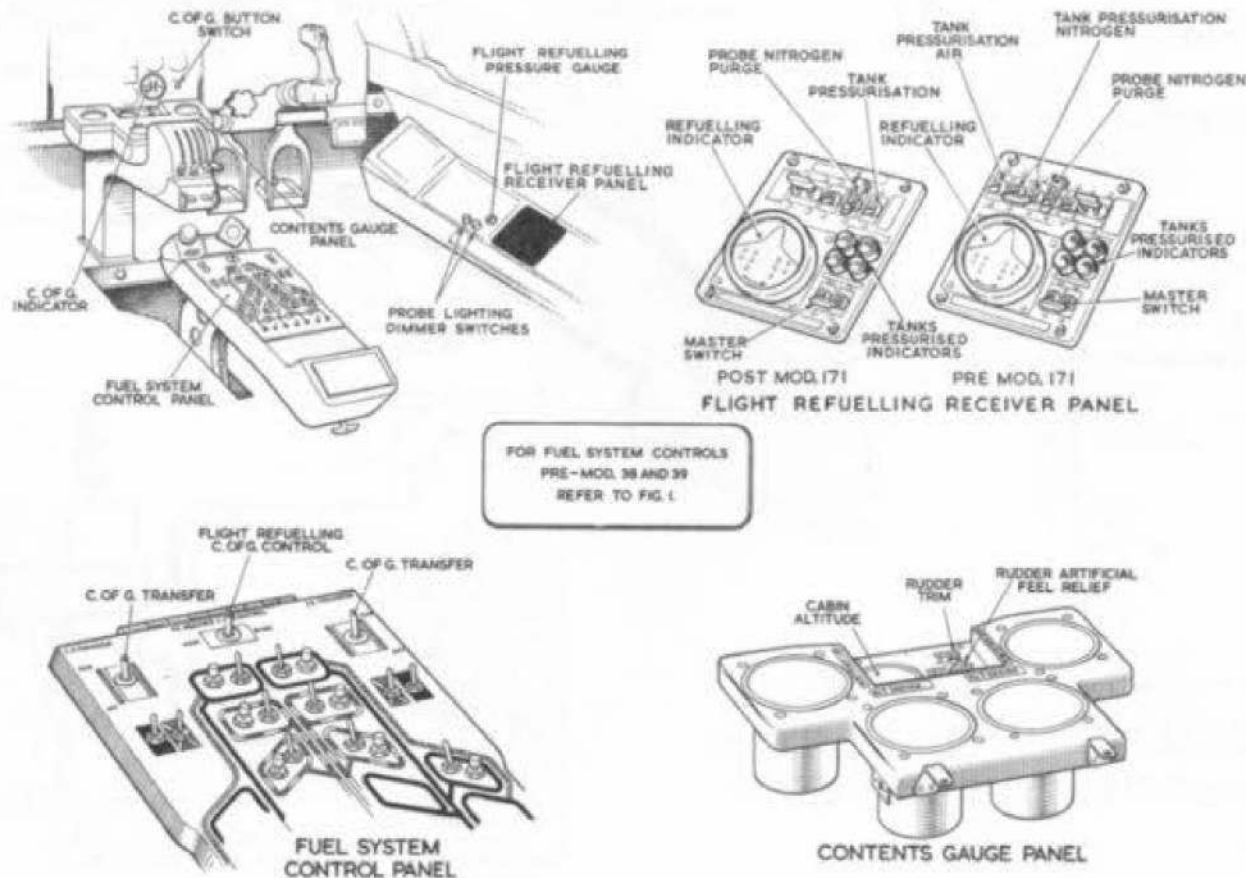


Fig.10. Flight refuelling controls

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surrounded by rubber and light-alloy shrouds, secured to the bulkhead by a stiffening ring and bolts and to the pipe by clips. Any seepage of fuel from the coupling or the compensating bellows escapes through drainage holes in the bottom of the inner shroud of the compensating bellows sealing sleeve to a drain pipe from the bottom of the seal to the radome under surface.

43. The rear pressure bulkhead seal consists of one to three rubber-bonded cork gaskets, as the installation requires, compressed between the bulkhead and a bolted bearing.

Probe lighting

44. During air to air refuelling, at night, the probe is illuminated by two lights, one on each side of the metal nose fairing centre line forward of former 484F. The lights are focussed to illuminate the outer third of the probe. Full details of the installation are given in Vol.1, Book 2 of this publication.

Controls

45. Refuelling, from a tanker aircraft through a hose and drogue coupled to the probe in the receiver aircraft, is controlled in the receiver aircraft by a switch, labelled MASTER SWITCH - ON - OFF, on the flight refuelling panel which is part of the starboard console. Adjacent to, and forward of the master switch is the flight refuelling contents indicator, and above are four dolls eye indicators labelled TANK PRES. IND - 1, 2, 3 and 4. These four indicators operate to show that the four fuel tank groups are depressurised when the master switch is selected to ON. Situated on the top of the panel directly above the flight refuelling indicator on aircraft pre Mod.171 are, a TANK PRES-

SURISATION - AIR switch, a TANK PRESSURISATION - NITROGEN switch and a switch labelled NITROGEN PURGE which operates the probe nitrogen purge system. On aircraft post Mod.171 a switch labelled TANK PRESSURISATION is positioned directly above the TANK PRES. IND. and directly forward of it is the probe nitrogen system switch labelled NITROGEN PURGE.

46. Forward of the flight refuelling receiver panel is the heating and ventilation control panel on the bottom rear corner of which are positioned two dimmer switches which control the probe lighting. Aft and slightly above the dimmer switches is a gauge, labelled FLIGHT REFUELLING PRESSURE, which is connected to the fuel pressure transmitter fitted to the branched refuelling pipe in the nose section (para.40).

Operation

47. The MASTER SWITCH is switched on before the probe enters the drogue coupling as their union opens flow control valves to allow an automatic flow of fuel. Operation of the MASTER SWITCH opens the tank refuelling valves, illuminates the lights on the flight refuelling indicator and depressurises the fuel tanks which is indicated by the dolls eye indicators on the flight refuelling receiver panel. All tanks are refuelled at the same time, and as each tank is filled, a float level switch closes the refuelling valve and extinguishes the tank content filament on the flight refuelling indicator. Designed rate of flow is 500 gall. per min. When all tanks are full, all the indicator lights will be out, and great care must be taken to ensure that the master switch is switched OFF.

48. A C.G. indicator, in the right-hand

SERVICING

DRAINING THE FUEL SUMPS

52. A drain valve is mounted on a sump plate in the base of each fuel tank, to

bottom corner of the pilots' centre instrument panel, registers as soon as the master switch is ON. When the aircraft is not refuelling and the master switch is OFF, a button switch, adjacent to the indicator, must be pressed before the C.G. indicator will register.

49. Correction of the C.G. is controlled by three switches situated at the top of the centre retractable console. They are C.G. control switch and two C.G. transfer switches. The C.G. control switch is labelled PORT-OFF-STARBOARD and is spring-loaded to the centre OFF position. Operation of the switch to PORT stops refuelling on tanks 6 and 7 on the starboard side. Operation of the switch to STARBOARD stops refuelling on tanks 6 and 7 on the port side. The two C.G. transfer switches normally control the transfer of fuel between No.1 and 7 tanks, but when the flight refuelling master switch is ON, the normal circuit is isolated and an alternative engaged. If FWD is then selected refuelling will cease on tanks 6 and 7 and continue on tanks 1 to 5. If AFT is selected, refuelling will cease on tanks 1 and 2 and continue on tanks 3 to 7.

BLANKING ACCESSORIES

50. A blanking assembly, stowed on the forward face of former 475F, when not in use, seals the fabricated branch pipe if the probe is not installed. A clamp, Part No. 11/27648, used to couple the blanking plate to the branch pipe is also used to make the joint between the pipe and the probe when the latter is used.

51. When the probe is not installed a blanking panel is fitted over the probe aperture in the nose metal fairing.

remove any accumulation of water in the tanks (fig.3). Access to the tank sumps is through panels in the lower surface of the main planes. The method of draining is as follows:-

WARNING . . .

During refuelling, defuelling and drainage operation, the fire precautions detailed in A.P.4117A, Vol.1, Sec.1, Chap.2 are to be strictly observed.

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- (1) Remove the dust cap from the valve and unscrew the locking ring.
- (2) Press on the spring-loaded base of the valve.
- (3) Examine the drainage, and, if water is found, report in accordance with current instructions.
- (4) Tighten the locking ring and fit the dust cap.

TANK PRESSURE TEST

53. After the installation of a tank, when the functioning test of the fuel tank pressurisation system (Sect.4, Chap.6) is carried out, hold the pressure in the tank by careful operation of the servo exhaust valve. Check all joints for leaks at approximately 2.8 p.s.i.

ENGINE FEED AND BOOSTER PUMP CHECK

54. To check the engine feed and operation of the booster pump after a fuel tank has been installed.

- (1) Close the L.P. cock in the engine feed from the group to which the installed tank belongs.
- (2) Select MANUAL on the AUTO - MANUAL switch.
- (3) Run the booster pump of the installed tank and check:-

That the L.P. dolls-eye indicator operates.

That the fuel pipes do not leak. That the current passing through the pump test coil in the bomb bay, when checked with a clip-on type ammeter, is between 2.3 and 3.2 amps.

- (4) Open the L.P. cock and check

that the L.P. dolls-eye indicator is functioning correctly.

- (5) Check that the booster pump operates correctly at full and half speed. To check this:-

Ensure by reference to the navigator's voltmeter that the bus bar voltage is not below 110 volts. Select AUTO on the AUTO - MANUAL switch.

Switch on the inverter and the battery isolation switch.

Check aurally that the pump is changing from full to half speed in correct sequence.

NON-RETURN VALVE SEATING CHECK

55. To ensure that the non-return valves in the tank feed lines are seating correctly:-

- (1) Close all cross-feed cocks.
- (2) Close all engine L.P. cocks.
- (3) Open all tank service cocks.
- (4) Set AUTO - MANUAL switch to MANUAL.
- (5) Take gauge readings of all tanks.
- (6) Switch on No.4 booster pump in Groups 1 and 4 and No.3 booster pump in Groups 2 and 3.
- (7) Leave the pump running for three minutes and check whether No.3 or 4 tank contents are decreasing. If they are decreasing check which tank has its contents increasing. Any tank which increases its fuel contents is suspect to a faulty non-return valve in its feed line.
- (8) Repeat this test running booster

pumps 1 and 2 in each side of the aircraft then 5 and 6 in each side.

FUEL TRANSFER AND C.G. INDICATOR CHECK

56. The transfer of fuel from No.1 and No.7 tanks and the subsequent change of reading on the C.G. indicator may be checked as follows:-

- (1) Ensure that there is approximately 50 per cent fuel in No.1 and No.7 tanks and record contents.
- (2) Switch on No.7 fuel tank transfer pump and check by the contents gauges that fuel is passing from No.7 to No.1 tank. Run the pump for 15 minutes and from the contents gauges ensure that 700 lb. of fuel is transferred in this period.
- (3) Repeat this test with No.1 tank transfer pump delivering fuel to No.7 tank. Run the pump for 15 minutes during which time 1,500 lb. of fuel should be transferred.
- (4) Transfer fuel from No.7 to No.1 tank or vice-versa to trim the C.G. indicator to read zero, record the contents of No.1 and 7 tanks.
- (5) Transfer fuel from No.1 tank to No.7 tank stopping the transfer when the C.G. indicator touches the red sector indicating C.G. aft.
- (6) Check by the contents gauges that 750 ± 75 lb. has been transferred from No.1 to No.7 tank.
- (7) Transfer fuel from No.7 to No.1 tank until the C.G. indicator reads zero. Record the contents of No.1 and 7 tanks.

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- (8) Transfer fuel from No.7 tank to No.1 tank stopping the transfer when the C.G. indicator touches the red sector indicating C.G. forward.
- (9) Check by the contents gauges that 375 ± 38 lb. has been transferred from No.7 to No.1 tank.
- (10) Transfer fuel from No.1 to No.7 tank until the C.G. indicator reads zero.
- (11) Repeat the check on the other side of the aircraft.

PUMP CALIBRATION AND FEED LINE CHECK

57. The equipment required to carry out pump calibration and feed line checks, consists of a 2 in. flexible hose, two 40-gallon drums, one carefully calibrated in 10-gallon stages and a stop watch. Incorporated in the 2 in. flexible hose, an on-off cock at the outlet end, a cock, to be used as a metering cock, fitted in the hose at a sufficient distance from the inlet end to enable 0-25 p.s.i. pressure gauge to be tapped into the hose between the inlet end and the metering cock. This equipment is fitted to the aircraft is illustrated in fig.11.

58. To carry out a pump calibration and feed line check proceed as follows:-

- (1) Close all the tank servicing cocks.
- (2) Ensure that all L.P. and cross-feed cocks are closed.
- (3) Disconnect the fuel delivery line to No.1 engine at the front bulkhead in the engine bay and connect the flexible hose to the pipe.

- (4) Select the No.1 group AUTO - MANUAL switch to AUTO and switch No.3 inverter ON to start the sequence timer.
- (5) Switch all the No.1 group fuel pumps ON and using the sequence timer test box (Ref.No.26DC/95290) determine which pump is running at full speed.
- (6) Switch the AUTO - MANUAL switch to MANUAL and switch the fuel pumps and No.3 inverter OFF.

- (7) Open the No.1 group tank service cock for the tank with the fuel pump running at full speed.
- (8) Open No.1 engine L.P. fuel cock.
- (9) Prime the fuel lines by switching on the fuel pump running at full speed and opening the cocks in the flexible hose. When the fuel flow from the flexible hose is free of air switch the fuel pump OFF and close the flexible hose on-off cock.

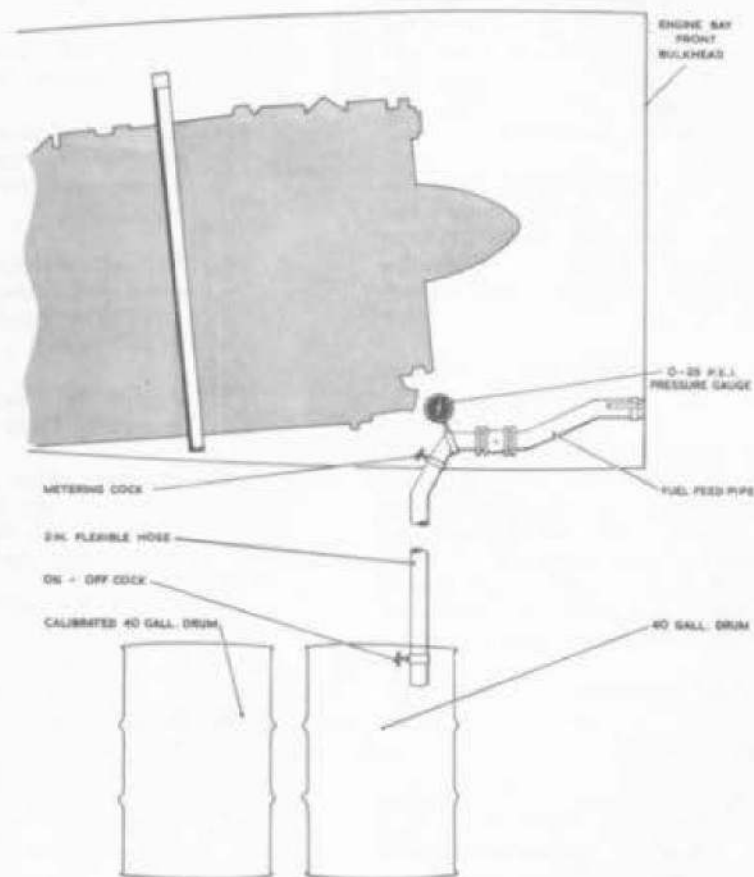


Fig.11. Fuel system test equipment

- (10) Note and record the static pressure registered on the gauge fitted to the flexible hose.
- (11) Switch the fuel pump ON, note and record the stall pressure. Subtract the static pressure, obtained in sub-para.(10), from the stall pressure and the value obtained should be not less than 14.5 p.s.i.
- (12) With the fuel pump still running open the flexible hose on-off cock and set the metering cock until a pressure of 10 p.s.i. + static pressure is indicated on the pressure gauge. Close the flexible hose on-off cock and switch the fuel pump OFF.
- (13) Switch the fuel pump ON, open the flexible hose on-off cock and measure into the calibrated drum 20 gallons of fuel. Time the flow which should not exceed 1 min. 36 sec.
- (14) Switch the fuel pump OFF and close the tank servicing cock.
- (15) Open the tank servicing cock of one of the tanks with the fuel pump running at half speed, open the flexible hose on-off cock and switch the fuel pump ON. When the fuel flow is clear of air switch the fuel pump OFF and close the flexible hose on-off cock.
- (16) Note and record the static pressure registered on the flexible hose pressure gauge.
- (17) Switch the fuel pump ON, note and record the stall pressure. Subtract the static pressure obtained in sub-para.(16) from the stall pressure, the value obtained should not exceed 9.0 p.s.i.
- (18) Repeat sub-para.(15), (16) and (17) on the remaining pumps in No.1 group running at half speed.
- (19) Switch No.3 inverter ON, select the AUTO - MANUAL switch to AUTO and using the sequence timer test box (Ref.No.26DC/95290) determine when the first pump tested at high speed changes to half speed and which pump is operating at high speed. Switch the AUTO - MANUAL switch to MANUAL, No.3 inverter OFF and the fuel pumps OFF.
- (20) Repeat sub-para.(7) to (14) on the fuel pump now running at full speed.
- (21) Repeat sub-para.(15), (16) and (17) on the first pump tested at high speed and now running at half speed.
- (22) Repeat sub-para.(7), to (14) on the remaining pumps in No.1 group after changing them from half speed to full speed.
- (23) Repeat the complete check on tank groups 2, 3 and 4.
- (24) On completion of check reconnect and lock all disconnected pipes and lock the tank servicing cocks in the open position.
- CROSS-FEED CHECK**
59. On completion of pump calibration and fuel flow checks, with the flexible hose connected to No.4 engine main fuel feed line carry out a cross-feed flow check as follows:-
- (1) Close all tank servicing cocks except that for No.1 tank, No.1 group.
- (2) Open No.4 engine L.P. cock, both engine and the aircraft cross-feed cocks.
- (3) Ensure that Nos.1, 2 and 3 L.P. cocks are closed.
- (4) Switch No.1 group AUTO MANUAL switch to MANUAL.
- (5) Open the flexible hose on-off cock, switch No.1 group, No.1 tank fuel pump ON, when the fuel flow from the flexible hose is free from air switch the fuel pump OFF and close the on-off cock.
- (6) Note and record the static pressure registered on the flexible hose gauge.
- (7) Switch No.1 group, No.1 tank fuel pump ON, open the flexible hose on-off cock and set the flexible hose metering cock to give a pressure of 9.2 p.s.i. + static pressure. Switch the fuel pump OFF and close the hose on-off cock.
- (8) Switch No.1 group, No.1 tank fuel pump ON, open the flexible hose on-off cock and time the flow of 20 gallons of fuel into a calibrated drum; the time should not exceed 1 min. 36 sec.
- (9) If the time exceeds 1 min. 36 sec. a restriction must exist, either in the engine or the aircraft cross-feed lines. To determine which line, a check must be carried out at No.2 and 3 engines. With a pressure of 9.7 p.s.i. + static pressure at No.2 engine and 9.5 p.s.i. + static pressure at No.3 engine a flow of 20 gallons in 1 min. 36 sec. should be achieved.
- (10) On completion of check connect and lock all disconnected pipes.

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**FUEL TANK RESERVOIR FLAP VALVE
CHECK**

60. To check the correct operation of the wing fuel tank reservoir flap valves proceed as follows:-

- (1) Ensure that the wing tanks fuel contents is less than 40 per cent of total capacity.
- (2) Isolate all the S.P.E.106 auxiliary pumps by disconnecting the electrical supply plugs at the pumps.
- (3) Close all the tank servicing cocks with the exception of No.7 fuel tank, No.1 group.
- (4) Disconnect the fuel feed line to No.1 engine, at the "King" coupling on the E.C.U., and connect the flexible hose (para.57) to the feed line.
- (5) Ensure that the engine and aircraft cross-feed cocks are closed.
- (6) Select the AUTO - MANUAL switch to MANUAL, No.1 engine L.P. cock open and No.7 fuel pump ON.
- (7) Open the hose on-off cock; when the fuel flow from the hose is free of air switch No.7 fuel tank pump OFF and close the hose on-off cock.
- (8) Note and record the static fuel pressure registered on the hose pressure gauge.
- (9) Select No.7 fuel tank pump ON, open the hose on-off cock and set the hose metering cock to give a pressure of 8 p.s.i. + static pressure on the hose pressure gauge. Select No.7 fuel tank pump OFF and close the hose on-off cock.

- (10) Select No.7 tank fuel pump ON, open the hose on-off cock and using the calibrated drum check the flow rate which should be 20 g.p.m. Select No.7 tank fuel pump OFF, close the hose on-off cock and close No.7 tank ground servicing cock.

NOTE...

The fuel flow must be checked over a full minute.

- (11) Repeat the check on the remaining wing tanks in No.1 group ensuring that the tank servicing cocks are opened prior to and closed after the check.
- (12) Repeat the check on all wing tanks in No.2, 3 and 4 groups.
- (13) On completion of check connect and lock all engine main fuel feed pipes, connect the electrical supply to the S.P.E.106 auxiliary fuel pumps and lock all the tank ground servicing cocks in the open position.

AUXILIARY PUMP CHECK

61. To check the operation of the fuel tank S.P.E.106 auxiliary fuel pumps proceed as follows:-

- (1) Ensure that the individual wing tank fuel capacity does not exceed 10 per cent.
- (2) Ensure that the aircraft and engine cross-feed cocks are closed and that the L.P. cock in the group being checked is closed.
- (3) Unlock and depress the drain cock on the sump of one of the tanks in the group selected for checking, drain off fuel to ensure that the reservoir fuel level is not

higher than the fuel tank fuel level. ▶

- (4) Attach one end of a flexible hose to the drain cock and the other end to a glass tube mounted rigidly in a vertical position forward of the wing leading edge or aft of the trailing edge, whichever is the more convenient for the tank under test.
- (5) Depress the drain cock until fuel rises in the glass tube to the same level as that in the fuel tank reservoir.
- (6) Mark the glass tube fuel level on the glass tube support.
- (7) Switch ON the fuel pump on the tank being tested, depress the drain cock and note that, a rising level in the glass tube indicates that the S.P.E.106 auxiliary pump is raising the fuel level in the fuel tank reservoir.
- (8) On completion of check disconnect the test equipment and lock the drain cock.
- (9) Repeat the check on the remainder of the wing tanks.

RECUPERATOR FLOW TEST

62. To carry out a fuel flow test from a recuperator proceed as follows:-

- (1) Disconnect and blank off the engine air feed line to the fuel tank pressurisation system at the tank side of the non-return valve immediately after the T-piece in the common feed line.
- (2) Connect the flexible hose (para.57) to the No.1 engine main fuel feed pipe.

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- (3) Close all tank servicing cocks except that for No.1 tank port.
- (4) Ensure that the aircraft and engine cross-feed cocks are closed.
- (5) Disconnect the tank pressurisation and recuperator air supply line from No.1 engine. Connect an air supply to the pipe and apply a pressure of 60-200 p.s.i.
- (6) Open No.1 engine L.P. cock and select the AUTO - MANUAL switch to MANUAL.
- (7) Open fully the two cocks set in the flexible hose connected in subpara.(2) and switch No.1 tank fuel pump ON.
- (8) When air free fuel flows from the flexible hose, close the flexible hose on-off cock and after one minute switch No.1 tank fuel pump OFF and close No.1 tank servicing cock.
- (9) Open the flexible hose on-off cock, time the flow of fuel into a calibrated drum until the flow breaks down. The amount of fuel must be not less than 2.5 gallons and the time must not exceed 9 seconds.
- (10) Repeat the test on the three remaining groups, in the case of Nos.2 and 3 groups the recuperators can be charged using the No.2 tanks.
- (11) On completion of tests connect and lock all pipes.

FLIGHT REFUELLING DISTRIBUTION TEST

63. To check the correct distribution of fuel during in-flight refuelling a simulated flight refuelling test must be carried out. Prior to checking the distribution, refuel the aircraft to 50 per cent capacity using

the normal ground refuelling connections and disconnect the refuelling hoses. Ensure that a full refuelling tanker is available and proceed as follows:-

- (1) Note and record the individual tank contents.
- (2) Isolate, electrically, one side of the aircraft refuelling system. This is carried out by removing the refuelling group fuses 318 and 353 from distribution box 16P for the port side and fuses 317 and 352 from distribution box 16P for the starboard side. Alternatively disconnect the electrical supply plug from each Mk.40 refuelling valve.
- (3) Connect the refuelling tanker hose to the flight refuelling probe using the adapter (Ref.No.27F/4819).
- (4) Select, in turn, each half of the flight refuelling master switch to ON. Check that the flight refuelling indicator shows all the refuelling valves open, on the side of the aircraft not isolated electrically.

NOTE...

Only one half of the master switch gives C.G. indication. For the other half it is necessary to depress the C.G. check switch in addition to selecting the master switch to ON.

- (5) Record the C.G. indicator reading, this must be approximately zero.
- (6) Set the tanker bulkmeter to zero. The total number of gallons of fuel pumped into the aircraft must be noted. The time taken to pump this total must be taken, using a stop watch.
- (7) Commence refuelling, adjust tanker r.p.m. to give an initial flow rate of approximately 250 to 270 gallons per minute with all tanks filling.

- (8) When the flow rate and probe pressure have stabilised, which must occur within one minute, time the fuel flow in the following 2 to 3 minutes. Calculate the flow rate and check that the probe pressure is within the permissible band as shown on fig.12.
- (9) Check and record, every minute, the C.G. indicator and probe pressure readings. At the end of five minutes the C.G. indicator reading must not exceed 15 deg. (or 22,500 lb.ft.) tail heavy.

NOTE...

At no time during the test must the C.G. indicator pointer leave the green sector (or above 15,000 lb.ft. nose heavy or 30,000 lb.ft. tail heavy).

- (10) Record the time as each tank reaches float switch level, indicated by the extinguishing of the flight refuelling indicator lights.

NOTE...

On aircraft without Mod.1143 embodied, the flow rate must be reduced to 90 gallons per minute when three tanks reach float switch level.

WARNING...

If fuel issues from the fuel tank vents as the tanks reach float switch level, refuelling must cease immediately. This must be done by stopping the tanker. The supply must not be stopped by selecting the flight refuelling master switch to OFF. The simultaneous closing of the refuelling valves causes excessive surge pressures.

- (11) On completion of refuelling, stop the tanker pump and select the flight refuelling master switch to OFF.

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(12) Record the final readings of the aircraft fuel contents gauges and the C.G. indicator. The final C.G. indicator reading must be zero ± 5 deg. (or $\pm 7,500$ lb.ft.).

(13) From the recorded readings of gallons refuelled and time taken (item (7)) calculate the average flow rate. If the flow rate averaged 250 gallons per minute the C.G. indicator will remain within the green sector (or $- 15,000$ lb.ft. or $+ 30,000$ lb.ft.), throughout the test.

NOTE...

On aircraft pre Mod.1143 the flow rate must be calculated from the recorded gallons refuelled, and time taken, for the first three tanks to reach float switch level.

- (14) Defuel the aircraft side, just tested, to 50 per cent capacity and isolate, electrically, the refuelling valves.
- (15) Connect, electrically, the refuelling valves isolated in item (2) and repeat the test.
- (16) On completion of test connect the isolated refuelling valves and disconnect the tanker from the probe.

MAIN FEED PIPING PRESSURE TEST

64. The main feed piping will be satisfactory when subjected to a maximum pressure of 35 p.s.i. and tested as follows:-

- (1) Disconnect and blank off the main-feed fuel pipes at the engines.
- (2) Close the aircraft cross-feed cock, open the engine cross-feed and L.P. cocks.

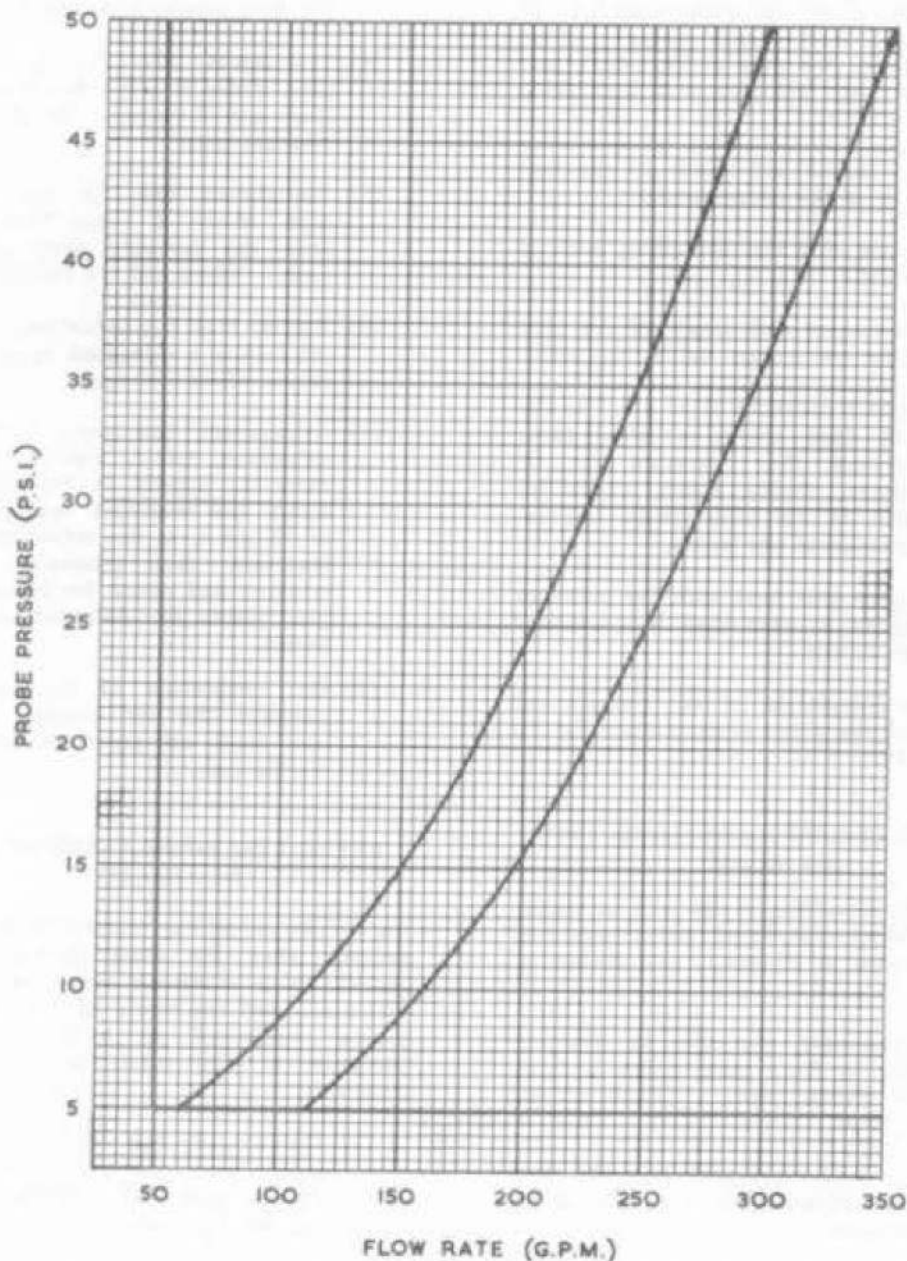


Fig.12.Probe pressure/flow rate curve

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- (3) Disconnect and blank off the main-feed pipes at each tank except No.1, at the fuel pumps. Disconnect the pipe at No.1 tank fuel pump and connect to it a suitable air supply.
- (4) Disconnect and blank off the fuel pipes at the recuperators.
- (5) Ensure that the defuelling cock is closed.
- (6) Disconnect and blank off the pipe at the emergency defuelling point.
- (7) Apply a pressure of 35 p.s.i. to the main feed piping at No.1 tank. Maintain this pressure for 30 minutes, during which, check for leaks at all pipe joints and deformation at the bends.
- (8) Repeat this test with the pressure applied at each tank feed connection in turn.
- (9) On completion of test connect and lock the pipes disconnected for the test.

REFUELLING PIPING PRESSURE TEST
(pre Mod.38)

65. The refuelling pipes will be satisfactory when subjected to a maximum test pressure of 75 p.s.i. and tested as follows:-

- (1) Disconnect the 1½ in. flexible pipe to No.1 tank where it joins the ¾ in. pipe. Blank off the T-piece.
- (2) Disconnect the pipe from the No.3 tank refuelling valve. Blank off the pipe.
- (3) Disconnect the 1½ in. flexible pipe to No.4 and 6 tanks where it joins

the four-way connection. Blank off the four-way connection.

- (4) Disconnect the 1½ in. flexible pipe where it joins the T-piece at No.5 and 7 tanks. Blank off the flexible pipe.
- (5) Disconnect the 1¼ in. flexible pipe where it joins the N.R.V. from the transfer pump of No.7 tank. Blank off the flexible pipe.
- (6) Ensure that the defuelling cock is off, this is a safeguard against non-return valve leakage.
- (7) Disconnect the pipe from No.2 refuelling valve, connect a suitable air supply to the pipe and apply the maximum test pressure of 75 p.s.i. to the refuelling pipe. Maintain this pressure for 30 minutes and check for leaks at all pipe joints and deformation at the bends.
- (8) On completion of the test disconnect the air supply, connect and lock all pipes disconnected for the test.

REFUELLING PIPING PRESSURE TEST
(post Mod.39)

66. The refuelling pipes will be satisfactory when the wing piping is subjected to a maximum test pressure of 150 p.s.i. and the whole of the refuelling piping subjected to a maximum test pressure of 120 p.s.i. and tested as follows:-

- (1) Disconnect the 1½ in. flexible pipe from the T-piece in the ¾ in. pipe at No.1 tank. Blank off the T-piece.
- (2) Disconnect the refuelling pipes from No.2 and 3 tanks refuelling

valves. Blank off the pipes.

- (3) Disconnect the 1½ in. flexible pipe to No.4 and 6 tanks where it joins the four-way connection. Blank off the four-way connection.
- (4) Disconnect the 1½ in. pipe where it joins the T-piece to No.5 and 7 tanks. Fit a 0-200 p.s.i. pressure gauge and a bleed cock to the pipe.
- (5) Disconnect the fuel transfer pipe from No.7 tank at the sump side of the non-return valve. Blank off the non-return valve.
- (6) Ensure that the defuelling cock is closed. This is a safeguard against non-return valve leakage.
- (7) Disconnect the ¾ in. refuelling pipe at the forward end of the main undercarriage bay. Fit a blank, incorporating an adapter for the attachment of a pump capable of delivering fuel at 150 p.s.i., to the pipe leading to the wing.
- (8) Connect a refuelling bowser to the ground refuelling point and prime the wing refuelling lines with fuel. During this operation open the bleed cock fitted in sub-para.(4) until all air is expelled from the system, close the bleed cock and disconnect the refuelling bowser.
- (9) Connect a pump to the adapter on the blank fitted in sub-para.(7) and pump in fuel to build up a pressure of 150 p.s.i. in easy stages checking all the time for leaks at the joints and deformation at the bends. Maintain the 150 p.s.i. pressure for 30 minutes.
- (10) Release the pressure and drain the refuelling pipes.

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- (11) Remove the blank fitted to the refuelling pipe in the undercarriage bay and connect the refuelling pipes.
- (12) Connect the refuelling bowser to the flight refuelling probe using the adapter (Ref.No.27F/4819).
- (13) Connect the pump used in sub-para.(9) to the drain in the branch pipe immediately to the rear of the flight refuelling probe.
- (14) Using the refuelling bowser fill the refuelling system pipe. During this operation bleed the refuelling pipe by loosening the blank on the No.2 tank refuelling pipe and the bleed cock in the pipe to No.5 and 7 tanks. When the air is fully expelled from the system tighten the blank and close the bleed cock.
- (15) Disconnect the refuelling bowser from the probe. Using the pump connected in sub-para.(13) pump fuel into the system and build up a pressure of 120 p.s.i. in easy stages. Maintain the 120 p.s.i. pressure for 30 minutes and examine the pipes for leaks at the joints and deformation at the bends.
- (16) To check the 4 in. non-return valves (pre Mod.823) for reverse flow leaks, release the pressure forward of the non-return valves through the drain point in the branch pipe aft of the probe. Check, by means of the pressure gauge fitted in sub-para.(4), that the pressure aft of the non-return valves is maintained. With no other leaks being present a loss of pressure will indicate a reverse flow leak through a 4 in. non-return valve.
- (17) Lower the pressure aft of the non-

return valves to 10 p.s.i. by the bleed cock in the hose to No.5 and No.7 tanks. Check for a drop in pressure which will indicate a reverse flow leak at low pressure.

- (18) To check the 4 in. non-return valves for reverse flow leaks (post Mod.823), release the pressure and drain the fuel, forward of the valves, through the drain point in the branch pipe aft of the probe. Leave the drain point open for 10 minutes, a steady fuel drip from the drain point will indicate a reverse flow leak through a 4 in. non-return valve.
- (19) Lower the pressure aft of the non-return valves to 10 p.s.i. by the bleed cock in the hose to No.5 and 7 tanks. Check the non-return valves for reverse flow leaks at low pressure indicated by a steady fuel drip from the branch pipe drain point.
- (20) On completion of test remove the pressure gauges, bleed cock and blanks fitted to the system for the purpose of the test. Provision must be made to catch the fuel from the pipes when the blanks are removed.
- (21) Connect all pipes and lock the unions.
- (22) Carry out an operation of the nitrogen purge system to clear the pipes of fuel.

RECUPERATOR FUEL BLEED FLOW TEST

67. To check the recuperator bleed flow:-

- (1) Switch the L.P. cocks off.
- (2) Disconnect the recuperator bleed pipe from the non-return valve in

the sump plate of No.4 tank.

NOTE...

The non-return valve should be removed from the sump and included in the test when specified by the Servicing Schedule.

- (3) Blank off the air line to the tank pressurisation system on the tank side of the non-return valve immediately after the T-piece in the common feed line.
- (4) Disconnect the air supply pipe at the appropriate engine and connect a low pressure air supply to the pipe.
- (5) Apply a pressure of 20-30 p.s.i. to the system.
- (6) Switch on a fuel booster pump in the relevant tank group and check the fuel flow from the bleed pipe. The restrictor in the recuperator end of the piping should permit a flow of approximately 2 gallons per hour.
- (7) Switch off the booster pump, remove the blanks, connect the recuperator bleed pipe, the engine air supply pipe and the tank pressurisation pipe. Lock all the pipe unions.

RECUPERATOR AND RECUPERATOR AIR LINE RELIEF VALVE TEST

68. To check the operation of these relief valves:-

- (1) Connect a pressure gauge to the recuperator water drain connection in the main-wheel undercarriage bay.
- (2) Disconnect the air supply pipe from the appropriate engine and connect a low pressure air supply to the pipe.

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- (3) Apply a slowly increasing air pressure to the system until the gauge fitted in op.(1) registers 5 p.s.i.
- (4) Increase the pressure slowly and check that the recuperator air line relief opens fully at 6.5 ± 0.5 p.s.i.
- (5) On completion of test remove the pressure gauge and fit the drain blank.
- (6) Remove the test air supply pipe from the engine air supply pipe and connect the pipe to the engine.

REMOVABLE FITTINGS

70. To remove the flight refuelling removable fittings:-

- (1) Remove the radome (Sect.3, Chap.1).
- (2) Remove the clips securing the probe fairing to the probe seal. Slide the seal off the probe.
- (3) Remove the screws securing the probe fairing and slide the fairing off the probe. Replace the screws.
- (4) Disconnect the probe mounting at former 470F by undoing the tension bolt securing the two halves of the strap together.
- (5) Break the joint between the probe and the branch pipe. Retain the sealing washers and clamp, (Ref.No.26DC/3594).
- (6) Disconnect the nitrogen purge pipe from the rear end of the probe.

Lock all pipe unions.

RECUPERATOR AIR SUPPLY PIPING PRESSURE TEST

69. The air supply pipes from the engine to the fuel recuperator are pressure tested as follows:-

- (1) Disconnect the feed pipe to the fuel tank pressurisation system at the tank side of the non-return valve immediately after the T-piece in the common feed line.
- (2) Disconnect and blank off the pipe

REMOVAL AND ASSEMBLY

- (7) Remove the probe by holding down the spring plunger in the base of former 510F and turning the probe tube fillet from the slot in the probe mounting.
- (8) Fit the blanking assembly, normally stowed on the forward face of former 470F, to the branch pipe, by securing the links to the aft face of former 470F with the pip pins supplied, and coupling the blanking cap to the branch pipe utilising the sealing washers and the clamp retained in op.(5).
- (9) Remove the probe nitrogen purge system (Sect.4, Chap.6).
- (10) Fit the blanking panel over the probe aperture in the nose metal fairing.
- (11) Fit the radome.

Assembly of the probe is a reversal of the removal procedure. On assembling

at the engine side of the recuperator air line relief valve.

- (3) Disconnect the air supply pipe from the engine and connect an air supply to the pipe.
- (4) Apply an air pressure of 200 p.s.i. to the system. Maintain this pressure for 30 min. and examine the pipes for leaks at the unions and deformation at the bends.
- (5) On completion of the test, disconnect the air supply, remove the blanks and connect and lock all disconnected pipes.

the probe to the branch pipe, the clamp and its securing bolts must be well coated with grease XG-295 and the securing bolts torque loaded to 6 lb.ft. Attention must also be made to the instruction given in para.72 when making the joint.

70A. During assembly of the Mk.8 probe nozzle to the fuel pipe, care must be taken to ensure that a correct joint is made with the seal, fitted on the beading of the fuel pipe, positioned with the thick edge forward. The sealing ring between the nozzle shell and the outer sleeve must also be fitted correctly. Both seals are shown in their correct position on fig.13.

70B. If, after assembly, the nozzle outer sleeve has to be depressed, Flight Refuelling loading tool (Part No.6805463) only must be used. Prior to depressing the outer sleeve, clean the nozzle thoroughly using a clean cloth soaked in Kerosine, this removes dust and grit which could damage the seal between the outer

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◀ sleeve and the nozzle nose portion and will also lubricate the seal. ▶

REMOVAL OF FUEL PUMPS

71. Detailed instructions for the removal of fuel pumps are not considered necessary but, it must be noted that it is necessary to remove the sump plates of No.3, 5 and 7 fuel tanks to remove the fuel pumps. Reference must be made to para.73 for the removal of the sumps.

FLIGHT REFUELLING LTD., FUEL PIPE COUPLINGS

72. Care must be exercised when releasing or tightening fuel pipe couplings. When tightening a coupling:-

- (1) It is recommended that, prior to final assembly, the threads of the coupling be lightly smeared with grease ZX-25. This obviates thread pick-up.
- ◀ (2) As the seals in Flight Refuelling couplings are prone to damage due to rotation of the components caused by alternating pressure, it is recommended that, prior to assembly, all seals and the backing rings and outer sleeves which contact the seals be lubricated with Kerosine. ▶
- (3) It is important that the outer sleeve be screwed on to the inner, since the split collars are fitted to prevent any rotation and consequent distortion of the inner sleeve.
- (4) Do not overtighten the connector as this will tend to distort the rubber sleeve and cause leakage.
- (5) Lugs are provided on the inner sleeve of the couplings for tightening the connectors with the following C spanners:-

Pipes up to
3½ in.dia. - See Table 2, Sect.2,
Chap.4

Pipes of
3½ in.dia. - C spanner
(Ref.No.26DC/95352)

Pipes of
4 in.dia. - C spanner
(Ref.No.26DC/95353)

- (6) To ensure correct assembly, when red lines are painted on each side of a coupling, the distance between the coupling and the adjacent edges of the lines must be measured after it has been tightened. The distance must be 0.5 ± 0.0625 in.

REMOVAL OF FUEL TANKS

WARNING...

Before the installation or removal of a fuel tank on aircraft fitted with Mod.171 i.e., explosion protection equipment, ensure that the power supply is switched

off and then remove the fuses from the explosion protection electrical circuits in panel 22P. To avoid a serious or fatal accident, the suppressor columns must not be removed or any work carried out in a tank until the suppressor columns have been disconnected and the connection points covered with earthing caps.

General

73. Removal and installation procedures for No.1 and 2, port and starboard, fuselage tanks are provided in para.79 - 82. Except for items peculiar to individual tanks which are noted, the procedures in para.83 and 84 are applicable to all wing tanks. Before applying these procedures, the tradesman responsible must make himself familiar with the relevant contents of:-

- (1) A.P.957, Part 1 - R.A.F. Fire Manual.
- (2) A.P.4117B, Vol.1 and Vol.6 - Aircraft Flexible Tanks - particularly Part 1 and Part 3.

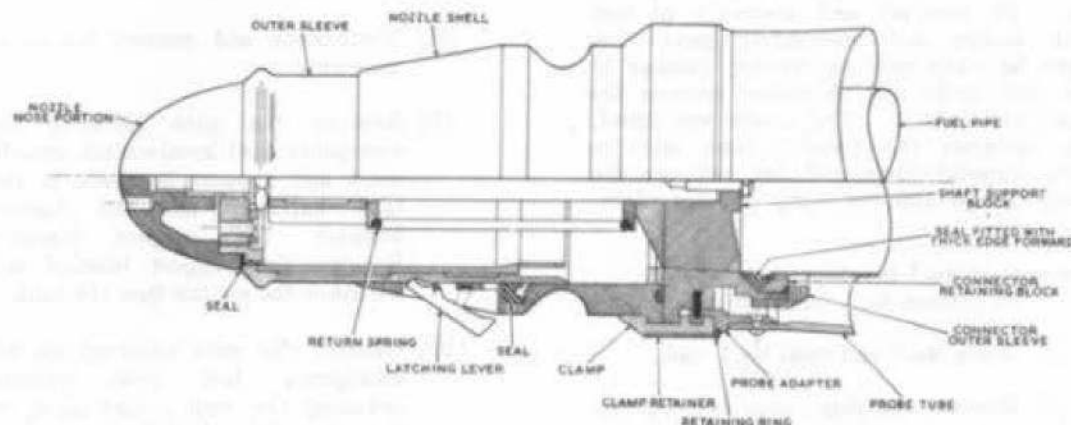


Fig.13. Mk.8 probe nozzle

(3) The defuelling and refuelling warnings in para.35 of this chapter and para.5 of Sect.2, Chap.2 of this book.

74. If a tank is to remain empty for fourteen days or more, it should be completely blanked off after introducing approximately five gallons of the fuel in use, or an equivalent non-aromatic fuel, to prevent deterioration. Evaporation losses should be replaced at least once a month.

75. When inserting or releasing the tank colleted studs into or from the tank bay skin, control the pressure applied, as excessive pressure can crack the skin.

76. A bolt of greater diameter than the others is fitted into the securing rings of the emergency fuel level switch mountings to ensure that they are positioned correctly when installed.

77. Before fuel pipes are connected or fitted, they must be examined to ensure that all blanking plates have been removed and that the bore of the pipe is clear.

78. On removal and assembly of fuel tank sumps and reservoirs, great care must be exercised to prevent damage to the fuel tanks and to ensure correct fitment of seals. The seals are fitted, one between the flexible tank and the sump support plate and one between the sump flange and the sump support plate.

Removal of No.1 fuselage tank

79. To remove No.1 fuselage tank:-

- (1) Drain No.7 and then No.1 tank.
- (2) Remove the drip trays beneath the sump assembly.
- (3) Ensure that the power supply is switched off and then remove the

fuses from the explosion protection electrical circuits in panel 22P if Mod.177 is fitted.

(4) Disconnect electrical connections from:-

The sump assembly.

The tank terminal box adjacent to the sump assembly.

The fuel level switch.

Access to the fuel level switch on the inboard side of the rear bulkhead of the tank is through the bomb bay and over the front spar.

(5) Place a receptacle beneath the sump assembly to receive residual fuel.

(6) Disconnect the fuel pipe at the sump assembly.

(7) Disconnect and remove the fuel pump from the sump assembly to facilitate its removal.

(8) Disconnect and remove the sump assembly.

(9) Remove the nuts securing the emergency fuel level switch attachment and support brackets to the tank bulkhead and the channel beneath the support bracket. Remove the support bracket and withdraw the switch from the tank.

(10) Remove the nuts adjacent to the emergency fuel level switch, securing the vent outlet pipe, to the rear bulkhead of the tank.

(11) Insert an air pipe through the sump aperture and vent the tank

with a slow and steady flow of air.

(12) When entering the tank, the safety precautions outlined in A.P.4117A, Vol.1 and Vol.6, Sect.1, Chap.4 must be strictly adhered to.

(13) Enter the tank and remove:-

Explosion protection equipment if Mod.177 is fitted.

The fuel gauge system.

(Installation and removal procedures for this equipment are provided in A.P.4505A & C, Vol.1, Book 2).

Disconnect and remove the vent anti-splash fitting from the roof of the tank.

Disconnect and remove the clip securing the vent outlet pipe to the roof of the tank.

Remove the vent outlet pipe from the tank.

(14) Disconnect and remove the tank terminal box from the outside of the tank.

(15) Release the colleted studs from the tank bay skin, collapse the tank, and withdraw it through the sump aperture.

Installation of No.1 fuselage tank

80. To install No.1 fuselage tank:-

- (1) Fold the tank in accordance with instructions in A.P.4117A, Vol.1 and Vol.6.
- (2) Check the tank bay for sharp

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projections and ensure that the bay is absolutely clean.

- (3) Commence inserting the tank colleted studs into the forward bulkhead of the tank bay.
- (4) Working back from the forward bulkhead, insert the colleted studs by rows round the tank bay until the sump is reached.
- (5) At the sump enter the tank and proceed as before to the rear bulkhead of the tank bay.
- (6) Installation is now a reversal of the removal procedure in para.79.

NOTE...

The nuts securing the vent anti-splash fitting, the vent outlet pipe, the emergency fuel level switch and the sump plate should be tightened to a controlled torque loading of 18 lb.in.

- (1) Check all locking devices and then carry out the following tests:-

Refuelling test and fuel contents gauge calibration (A.P. 4505A & C, Vol.1, Book 2).

Fuel tank pressurisation functioning test (Sect.4, Chap.6).

If No.1 or No.7 tanks have been installed a fuel transfer test (A.P.4505A & C, Vol.1, Book 2 and para.56 of this chapter).

Engine feed and booster pump checks (para.54).

Check on non-return valve seating (para.55).

Removal of No.2 fuselage tank

81. To remove No.2 fuselage tank:-

- (1) Drain No.7 and then No.2 fuel tanks.
- (2) Ensure that the power supply is switched off and then remove the fuses from the explosion protection electrical circuits in panel 22P.
- (3) Disconnect the electrical connections from:-

The sump assembly.

The tank terminal box and the emergency fuel level switch. Entrance to the access panels for these components in the top of the tank bay skinning is through the bomb bay and over the front spar.

- (4) Place a receptacle beneath the sump assembly to receive residual fuel.
- (5) Disconnect fuel pipes from the sump assembly.
- (6) Disconnect and remove the nuts and bolts securing the tank servicing cock bracket to the sump plate.
- (7) Disconnect and remove the fuel pump from the sump plate, to facilitate the removal of the sump assembly.
- (8) Disconnect and remove the sump assembly.
- (9) Remove the nuts securing the emergency fuel level switch support bracket to the tank bay

skin and withdraw the switch and support bracket from the tank.

- (10) Insert an air pipe through the sump aperture and vent the tank with a slow and steady flow of air.
- (11) When entering the tank, the safety precautions outlined in A.P.4117A, Vol.1 and Vol.6, Sect.1, Chap.4 must be strictly adhered to.
- (12) Enter the tank and remove:-

Explosion protection equipment if Mod.171 is fitted.

The fuel gauge system.

Installation and removal procedure for this equipment are provided in A.P.4505A & C, Vol.1, Book 2.

Disconnect and remove the vent outlet anti-splash fitting.

- (13) Disconnect and remove the tank terminal box from the outside of the tank.
- (14) Release the colleted studs from the tank bay skin, collapse the tank, and withdraw it through the sump aperture.

Installation of No.2 fuselage tank

82. The installation procedure outlined in para.80 for No.1 tank is applicable to No.2 tank when the reverse of the removal procedure in para.81 is substituted in item 6.

Removal of the wing fuel tanks

83. To remove a wing fuel tank:-

- (1) Drain the fuel tank observing the warning in para.35.

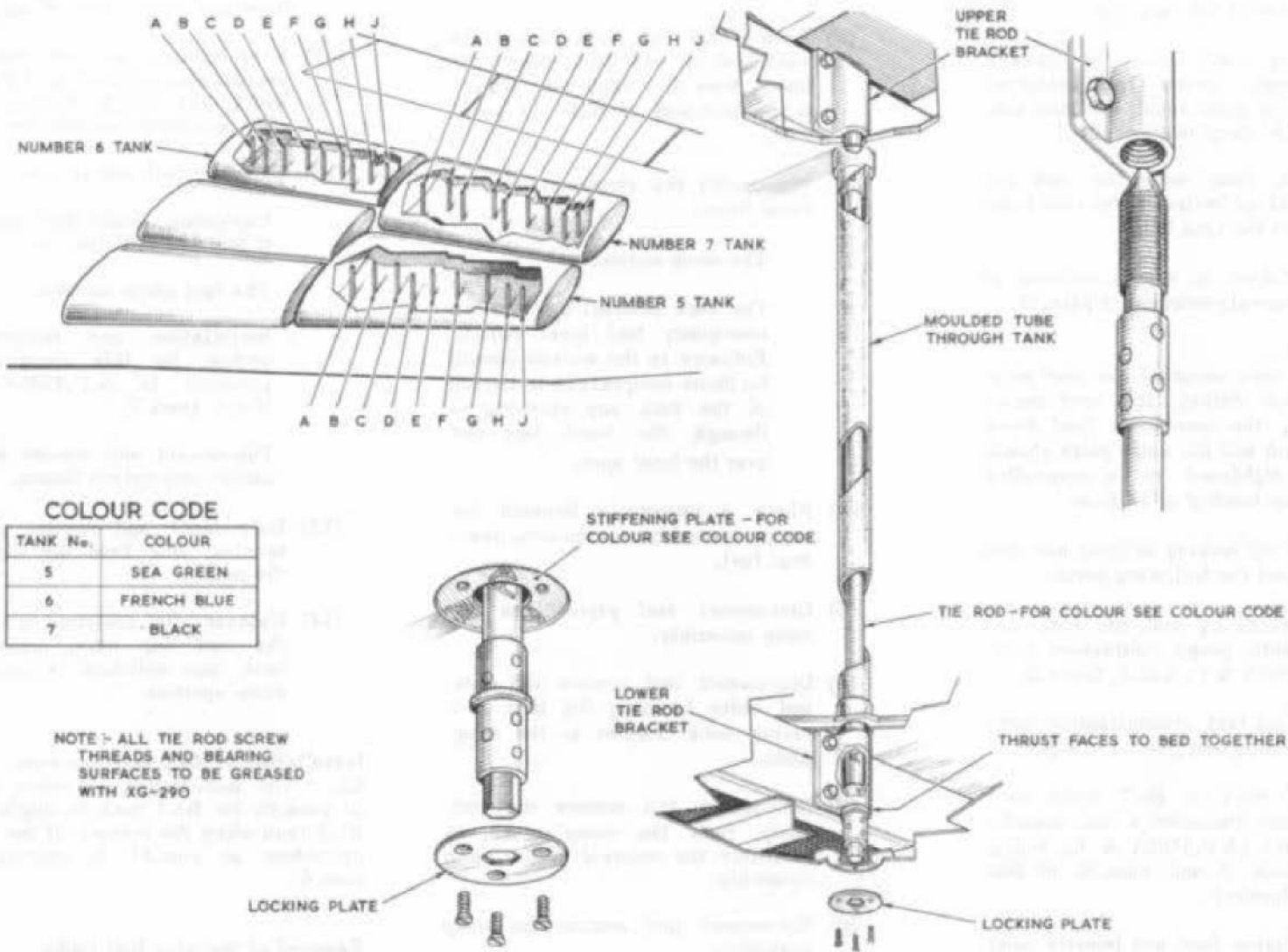


Fig.14. Arrangement of wing fuel tank tie rods.

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- (2) Ensure that the power supply is switched off and then remove the explosion protection electrical circuit fuses from panel 22P if Mod.171 is fitted.
- (3) Disconnect the electrical connections from:-
 - The sump assembly.
 - The emergency fuel level switch and the internal transfer pump.
 - The tank terminal box.
- (4) Disconnect and remove the electrical junction box beneath the sump assembly (No.3 and 4 tanks only).
- (5) Place a receptacle beneath the sump assembly to receive residual fuel.
- (6) Disconnect the recuperator bleed pipe and remove the light alloy fuel pipe beneath the sump assembly (No.4 tank only).
- (7) Disconnect the fuel pipes at the sump assembly.
- (8) Remove the refuelling valve from the sump plate (No.3 and No.5 tanks only).
- (9) Remove the fuel transfer pump from the sump plate (No.7 tank only).
- (10) Disconnect and remove the sump assembly. Care must be exercised when removing No.4 tank sump assembly not to damage the adjacent fuel pipes.
- (11) Disconnect and remove the internal transfer pipe support from the top of the fuel reservoir.

(12) To remove the reservoir:-

- (a) Disconnect the bottom tier from the sump moulding.
- (b) Disconnect the bottom tier from the centre tier, or in the case of No.5 and No.7 tanks, the top tier.
- (c) Raise the tier, or tiers, above the bottom tier, sufficient to permit it to be tilted and removed, with the gasket, through the sump aperture.
- (d) Remove the top tier in No.5 and No.7 tanks through the sump aperture.
- (e) In No.3, 4 and 6 tanks, disconnect the centre from the upper tier, and raise the latter sufficiently to permit the centre tier to be tilted and removed, with its gasket, through the sump aperture.
- (f) In No.3, 4 and 6 tanks remove the upper tier through the sump aperture.

(13) To remove the emergency fuel level switch, its support and the internal transfer pump, complete:-

- (a) Disconnect the short length of pipe between the internal transfer pump and the base of the internal transfer pipe.
- (b) Disconnect and remove the two bolts securing the base of the switch support.
- (c) Disconnect the base of the emergency fuel level switch support from the tank and withdraw the switch, the

support and pump complete, from the tank.

- (14) Disconnect and remove the tank tie rods, the heads of which are located about the lateral centre line of the tank in the bottom skin of the wing. The tie rods unscrew after removal of the screwed locking plates, (fig.14) (No.5, 6 and 7 tanks only).

- (15) Insert an air pipe through the emergency fuel level switch aperture and vent the tank with a slow and steady flow of air.

- (16) When entering the tank, the safety precautions outlined in A.P. 4117A, Vol.1 and Vol.6, Sect.1, Chap.4 must be strictly adhered to.

(17) Enter the tank and:-

- (a) Remove the explosion protection equipment if Mod.171 is fitted.
- (b) Remove the fuel gauge system. Installation and removal procedures for this equipment are provided in A.P.4505A & C, Vol.1, Book 2.
- (c) Disconnect and remove the vent valve from the roof of the tank. To obtain access to the securing nuts, disconnect the outward vent valve and the inward relief valve from the vent valve body (fig.4).
- (d) Disconnect the clips securing the inner transfer pipe to the fuel level switch steady and the switch support tank moulding clamp ring.
- (e) Remove the inner transfer pipe by releasing the clips

that secure the pipe support plates to the tank roof.

- (f) Disconnect and remove the fuel level switch steady.
 - (g) Disconnect and remove the blanking plates from the outboard vent valve apertures.
- (18) Disconnect and remove the tank terminal box from the outside of the tank.
- (19) Release the tank colleted studs from the tank bay skin, collapse the tank and remove it through the sump aperture.

Installation of wing fuel tanks

84. To install a wing tank:-

- (1) Fold the tank in accordance with instructions in A.P.4117A, Vol.1 and Vol.6.
- (2) Check the tank bay for sharp projections and ensure that it is absolutely clean.
- (3) Commence inserting the tank colleted studs into the inboard bulkhead of the tank.
- (4) Working outboard from the inboard bulkhead of the tank, insert the

rows of colleted studs round the tank bay until the sump is reached.

- (5) At the sump, enter the tank and proceed as before to the outboard bulkhead of the tank.
- (6) Installation is now a reversal of the removal procedure. The following points must be noted:-
 - (a) The controlled torque loading on the nuts securing components to the tank is 25 lb.in.
 - (b) To bench test the internal transfer pipe for leaks, before installation, blank off one end and apply a pressure of 8 p.s.i.
 - (c) When securing the internal transfer pipe to the top tier of the reservoir ensure that the flow from the pipe will not impinge on the flap valves. A flow of fuel on to the valves impairs their opening as the volume of fuel in the tank decreases.
 - (d) Stiffening plates beneath the tie rod locking plates, and the tie rods, are coloured and lettered to ensure that the rods are assembled in their correct positions. Colours which are as follows:-

No.5 TANK	SEA GREEN
No.6 TANK	FRENCH BLUE
No.7 TANK	BLACK

identify the tank to which the rod belongs. The letter on the rod matches that on the stiffening plate and indicates the position of a rod in its tank. Before the tie rods are assembled and tightened to a torque loading of 20 lb.in. the screw threads and bearing surfaces should be lightly smeared with grease XG-290.

- (7) Check all locking devices and then carry out the following tests:-

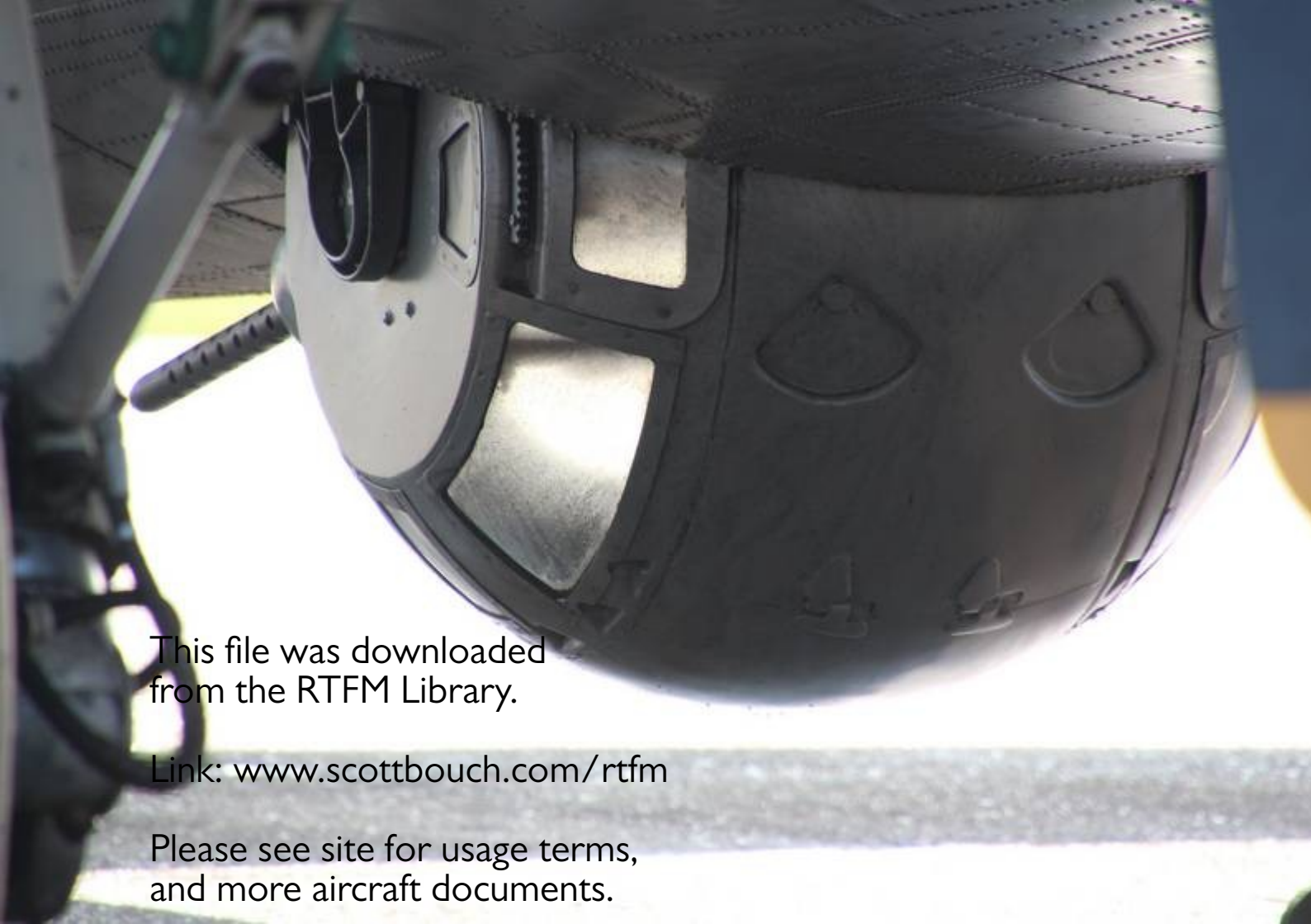
Refuelling test and fuel contents gauge calibration (A.P. 4505A & C, Vol.1, Book 2).

Fuel tank pressurisation functioning test, and a tank pressure test (Sect.4, Chap.6).

If No.1 or 7 tanks have been installed a fuel transfer test (para.56).

Engine feed and booster pump checks (para.54).

Check on non-return valve seating (para.55).



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