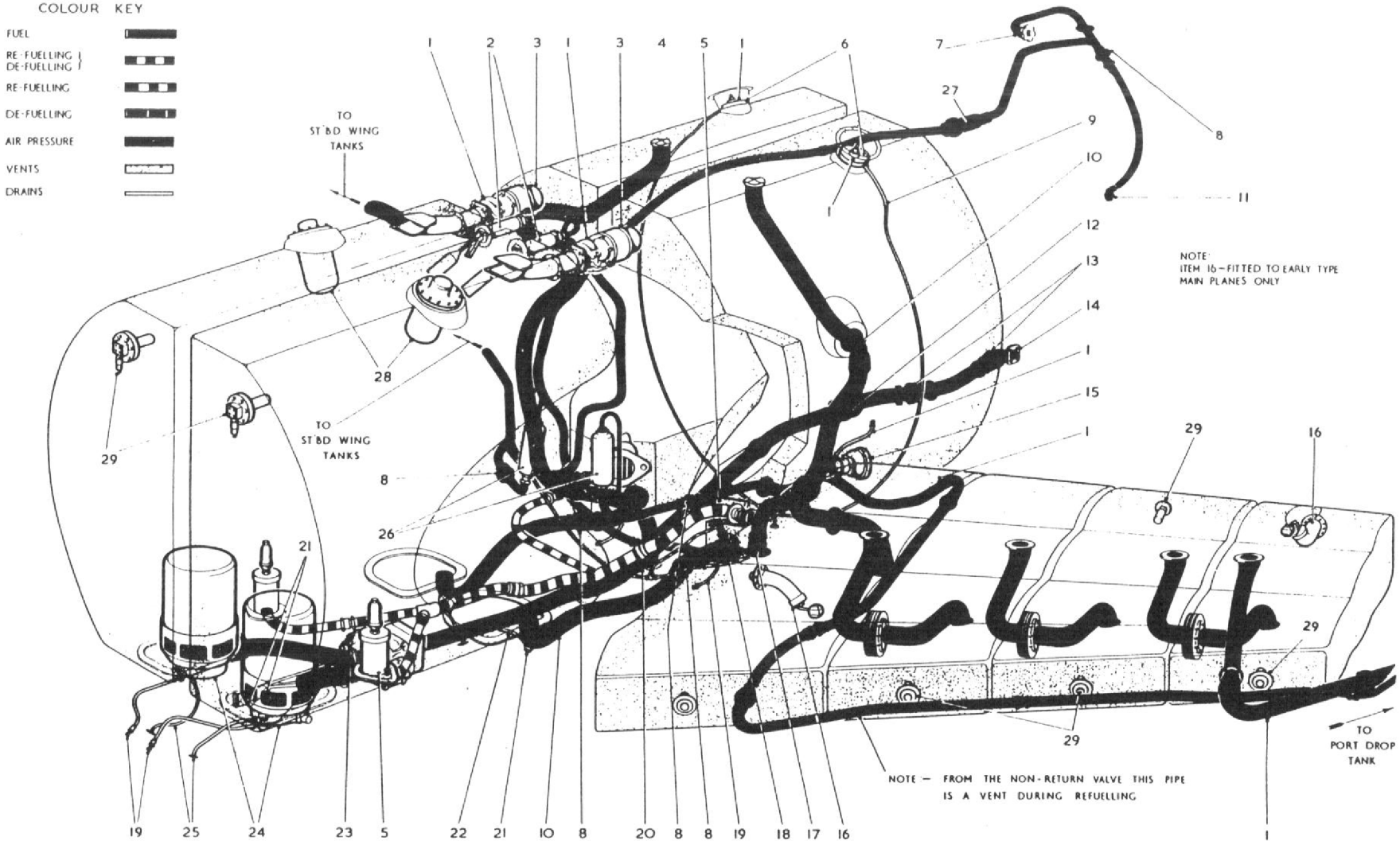
Chapter 2 FUEL SYSTEM

CONTENTS

ILLUSTRATIONS

TABLE



1 PRESSURE TAPPING
2 VAPOUR RELEASE VALVE
3 SUCTION AND PRESSURE RELEASE VALVE
4
5 RE-FUELLING VALVE
6 SUCTION RELIEF VALVE
7 DE-FUELLING TANK PRESSURIZING CONNECTION
8 NON-RETURN VALVE
9 DRAIN
10 TRANSFER PIPE
11 TANK PRESSURIZING CONNECTION ON ENGINE
12 LOW PRESSURE COCK
13 FLEXIBLE COUPLING
14 INLET TO ENGINE
15 RE-FUELLING AND DE-FUELLING COUPLING
16 FUEL LEVEL SWITCH
17 RE-FUELLING PRESSURE RELIEF VALVE
18 PRESSURE RELIEF VALVE
19 WATER SEDIMENT DRAIN
20 DE-FUELLING COCK
21 PRESSURE SWITCH
22 BALANCE PIPE TO ATMOSPHERE
23 FUEL FLOW PROPORTIONER
24 INVERTED FLIGHT VALVE AND BOOSTER PUMP
25 GLAND DRAIN
26 PRESSURE REDUCING VALVE
27 AIR FILTER
28 FUEL LEVEL SWITCH
29 FUEL CONTENTS GAUGE TERMINAL BOX

Fig.1 Fuel system installation
(Pressure switches added)

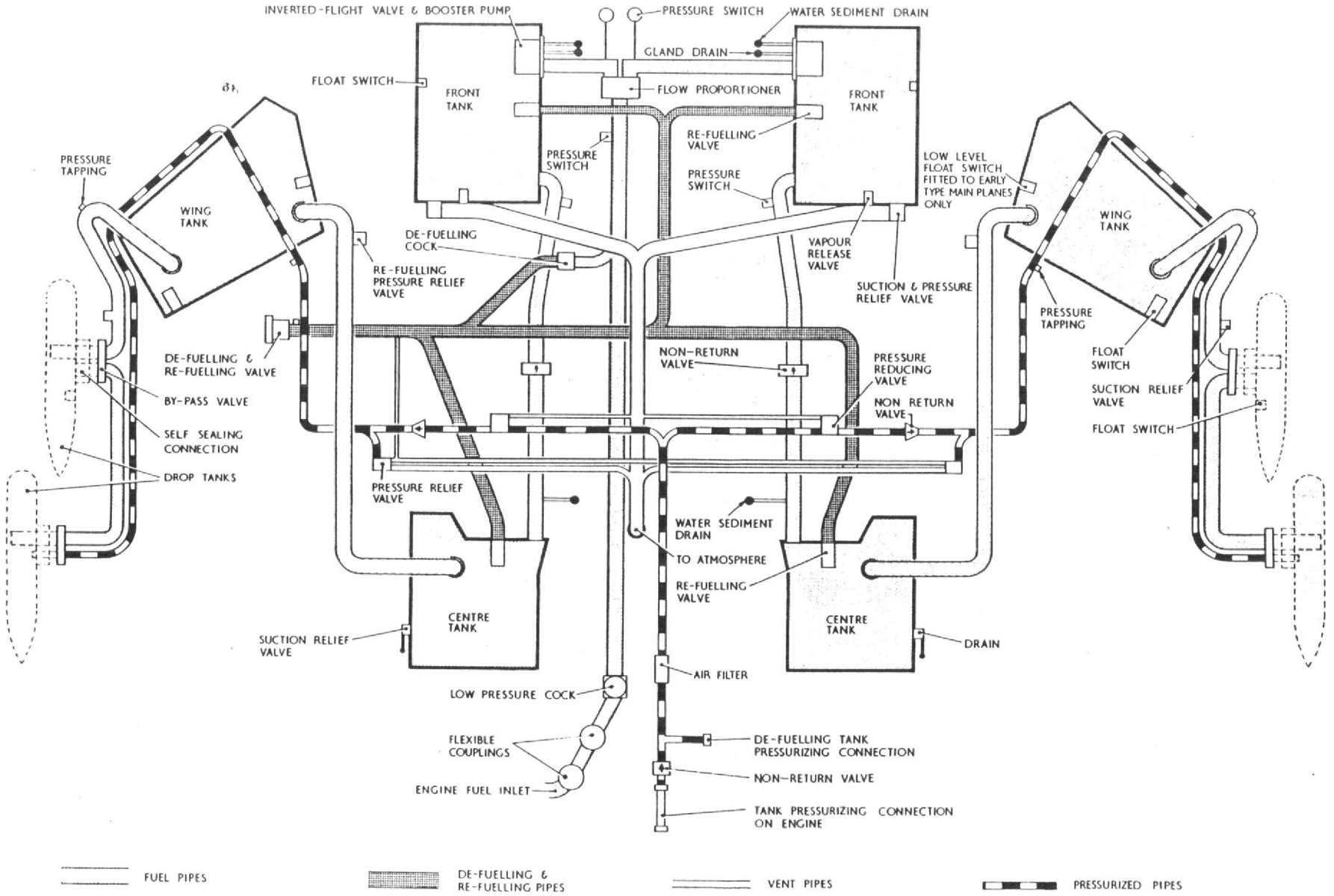


Fig.2 Fuel system diagram

◄ (Pressure switch added) ►

DESCRIPTION AND OPERATION

Introduction

1. The fuel system installation consists of four flexible bag-type tanks installed within the centre fuselage, four in each wing, and provision for drop tanks. Delivery to the engine is from the front pair of fuselage tanks, the supply being supplemented by means of electrically-driven booster pumps, one of which is submerged in each of the two fuselage front tanks. Transfer of fuel from the remaining tanks to the fuselage front tanks is accomplished by means of air pressure obtained from a restricted tapping on the engine compressor. Provision is made to ensure an adequate supply of fuel under negative 'g' conditions. The system is designed for pressure refuelling. The capacity of the tanks is given in the Leading Particulars. The construction of the tanks is described in A.P.106 series.

Fuselage tanks

2. The four fuselage tanks are flexible rubber bag-type tanks reinforced with madapollan vulcanised on the outside. Over this reinforcement are three layers of glass cloth, the tanks afterwards being finished with fire-proof lacquer. The tanks are mounted in front of the engine in the centre fuselage, two on each side between and around the engine air-intake ducts.

3. Each front tank is provided with an electrically-driven booster pump with inverted flight valve, each pump being fitted in a negative 'g' fuel trap *(para.9).* All four tanks are each provided with a refuelling valve, these being in connection with a pressure refuelling coupling situated in the port wheel bay.

4. The two front tanks are each provided with a combined pressure and suction relief valve. Vapour release valves, one to each front tank are also incorporated. The two rear tanks of the four in the centre fuselage *(referred to as the centre tanks for convenience)* are each provided with a lightly-loaded suction relief valve. These valves, like their counterparts in the combined valves of the front tanks, operate in an inward direction, opposite to that of a normal relief valve, thus permitting air to enter the tanks should the pressurisation fail and, consequently, prevent the setting up of a negative pressure and the possible collapse of the tanks. Non-return valves are fitted in the pipe-lines between the front and centre tanks to prevent back-flow during the refuelling of the tanks.

Wing tanks

5. Each wing accommodates four tanks, these being installed in the wing roots in bays formed between the front and leading edge spars and between ribs A and 1, 1 and 2, 2 and 3 and between ribs 3 and G. The four tanks are interconnected and, for practical purposes, may be considered as one tank. The fuel from these tanks is transferred to the centre fuselage tanks by air pressure *(para. 7)*, interconnection being by means of transfer pipes, one of which runs from each inboard wing tank to its respective centre tank in the fuselage. These pipes each incorporate a refuelling pressure relief valve *(fig.8)* set to blow off at 11–13lbf/in^2 to safeguard the tanks in the event of a refuelling valve failure. The outboard tank in each wing contains a float switch fitted for refuelling purposes.

Drop tanks

6. The aircraft can be fitted with four under-wing pylons *(Sect.3, Chap.2)* on which drop tanks or alternative stores may be carried. The drop tanks are of streamlined construction and are mounted outboard of the wing tanks, to which they are connected by means of transfer pipes. The transfer pipes incorporate a suction relief valve set to open at a depression below ½lbf/in^2. These pipes, and the air-pressure pipes which feed engine air into the drop tanks for fuel transfer purposes, are joined to the drop tanks by means of self-sealing fuel and air valves *(fig.9)* which connect the fuel and air pipes when the drop tanks are jettisoned. A by-pass valve, consisting of a ducted plate which interconnects the air and fuel pipes, is assembled to the wing when a pylon is not fitted. Each drop tank has its own float switch which comes into action automatically during the refuelling of the tanks. The construction of the pylons to which the drop tanks may be attached is described in Sect.3, Chap.2, the drop tank release mechanism in Sect.5, Chap.1, and the method of attachment in Sect.2, Chap.2.

Fuel tank pressurization

7. For effective transfer of fuel to the fuselage front tanks at all altitudes and rates of flow, a pressure of about 6lbf/in^2 is required. The air supply for tank pressurization is taken from a restricted tapping on the engine compressor and then through a non-return valve and a filter to pipes which feed the port and starboard tank installations. Each of these pipes contains a reducing valve which has an outlet pressure of approximately 6lbf/in^2 at the necessary rate of flow. From these valves, pipes convey the air to the drop tanks through non-return valves. The air pressure causes the necessary displacement of fuel from the drop tanks to the wing tanks and thence to the centre tanks in the fuselage and finally to the front tanks. Except in the case of transfer failure the front tanks remain full as long as there is fuel in the other tanks. Should the transfer system fail, however, no fuel will be transferred from the wing and drop tanks, and only part of the fuel from the centre tanks. Under these circumstances the fuel transfer pressure switches *(Sect.5, Chap.1)* will operate causing the fuel transfer magnetic indicators to show. The warning switches are also in connection with the fuel contents gauges giving an 'empty' indication for the centre tanks. Thus, when the warning indicators show, the contents of the front tanks only are indicated, this being the only amount of fuel available to the engine.

Fuel flow proportioner

8. A fuel flow proportioner is fitted in the main delivery line from the booster pumps. It consists of two cells of equal capacity, each equipped with a vane type rotor, a non-return valve and a by-pass valve. The non-return valves are open under normal conditions but if the rotors become stiff or inoperative the by-pass valves open to allow the fuel to flow unmetered. The inlet of each cell is connected to its associated tank system and the outlet from each delivers into a common manifold. Providing that the inlet pressures to the unit do not differ by more than 2 lb/in², the flow proportioner ensures that equal amounts of fuel are taken from both sides of the tank system. For more detailed information refer to A.P.4737A Vol. 1.

Delivery

9. The fuel is pumped to the engine-driven pumps from the front tanks by means of tank booster pumps with inverted flight valves, which are immersed in a negative 'g' fuel trap in each front tank. The fuel traps each contain 3½ gallons of fuel, together allowing for short periods of inverted flight. The two booster pumps are matched units which should empty the front tanks simultaneously, but provision is made to enable the pilot to balance the fuel levels manually should such action become necessary. The manual balancing controls consist of two switches mounted on the cabin starboard shelf. The pumps, which under normal conditions are running continuously throughout the flight, give, together with tank pressure, a pressure of about 25 lb/in² for no flow, dropping to about 21 lb/in² for a flow of 500 gallons per hour each, and 17 lb/in² for 1,000 gallons per hour for one pump when the other tank is empty. Indicators, situated adjacent to the pump switches, provide warning in the event of pump failure. From the pumps, the fuel passes to a fuel flow proportioner, which ensures a balanced flow from the two sides of the system under normal conditions *(para. 8)*, and thence to the low-pressure cock. From the low-pressure cock the fuel passes to the engine-driven pumps, connection being made by means of flexible couplings which allow for engine expansion.

Engine-driven pump

10. The dual engine-driven pump is of the positive-displacement multi-plunger type, the delivery being controlled by variation of the pump plungers. For further information on the engine-driven pump and the engine fuel system generally, reference should be made to A.P.4281A and A.P.4321G and J.

Low-pressure and high-pressure fuel cock controls

11. The low-pressure fuel cock control is mounted on the cabin port shelf and moves forward from OFF to ON. The cock is fitted in the pipe lines from the tank booster pumps to the engine inlet. The high-pressure fuel cock control is also mounted, in a quadrant, on the cabin port shelf and moves forward from OFF to ON. It is used to stop the engine by shutting off the fuel supply to the burners as described in the Engine Handbook.

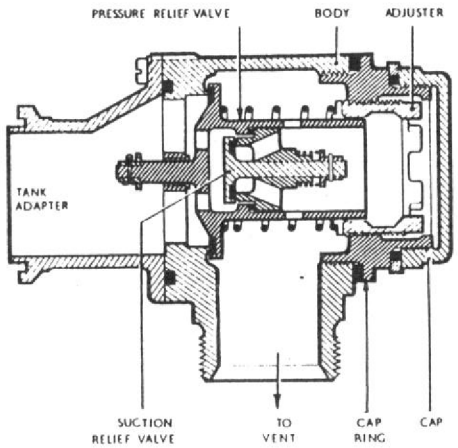


Fig. 3 Suction and pressure relief valve

Throttle controls

12. The throttle controls are mounted one on the cabin port shelf (*for the pupil's use*), and the other on the centre console (*for the use of the instructor*). The throttle consists of a profiled plunger, movement of which varies the flow of fuel to the burners.

Fuel contents gauge

13. The fuel contents gauges are grouped together at the top of the centre instrument panel. The tank units, which are assembled by the tank manufacturers, consist of small condensers on flexible straps. They are fitted into pockets in the tanks and are secured by press fasteners. The condensers operate the gauges through amplifier units. The system is described in A.P.1275A, Vol. 1. The 100 gallon drop tanks are not gauged.

Engine fuel pumps isolating switch

14. A switch mounted on the cabin port shelf is provided to energise a solenoid-operated valve in the engine fuel pump circuit to isolate one pump from the other in the event of a defect in the engine fuel pump system. The switch is normally locked with 28 s.w.g. copper locking wire, which, if broken, serves as an indication to the ground crew that the emergency has been operated in flight. A warning light (*adjacent to the switch*) indicates that the emergency is in operation. A fuel pressure warning indicator is situated beneath the fuel contents gauges.

Note . . .

When locking the switch with the 28 s.w.g. locking wire, only one strand of the wire is to go round the switch dolly.

Fuel pump test switches

15. A selector switch and an ammeter socket (*both of which are mounted above the cabin starboard shelf*), are provided for testing the fuel pumps. The fuel pump circuit breakers, which are mounted on the forward face of the centre instrument panel, must be tripped before the pumps are tested.

Suction and pressure relief valves—front tanks (*fig. 3*)

16. The suction and pressure relief valves (*one of which is fitted to each front tank*), consists of a body which contains a spring-loaded relief valve. The valve is adjusted to open at a pressure of 1 lb/in² by means of an adjuster which screws into a cap ring. After adjustment, the cap ring is sealed by a screwed cap. The valve allows excess tank pressure to escape via the orifice which is in connection with the vent pipe. This pressure relief valve incorporates a small spring-loaded suction relief valve, the action of which is opposite to that of the pressure relief valve in that it admits air into the tanks should the fuel tank pressurisation system fail, thus preventing the formation of a vacuum and possible collapse of the tanks. The valve is lightly loaded, being set to open when subjected to a depression of ¼ to ½ lb/in².

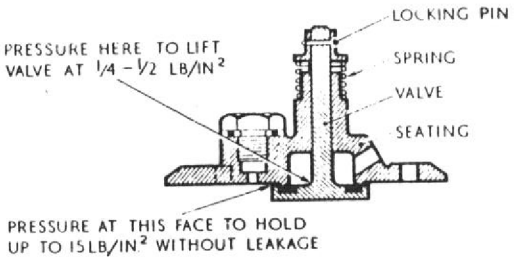


Fig. 4 Suction relief valves (centre tanks)

Suction relief valves (*figs. 4 and 5*)

17. These are simple spring-loaded valves designed to open when subjected to a depression below ½ lb/in². They serve as inward vents to relieve the tanks in the event of them being subjected to negative pressure, thus preventing possible collapse of the tanks. One (*fig. 4*) is fitted in each of the fuselage centre tanks and one (*fig. 5*) in each port and starboard pipes to the drop tank by-pass valves.

Vapour release valves (*fig. 6*)

18. Under certain conditions of flight, particularly during inverted flying, air may pass into the front tanks. Air also comes out of solution from the fuel at altitude, or the fuel may boil. The expansion of this air or vapour while climbing may prevent fuel transfer and allow the front tanks to empty while fuel remains in the other tanks. To prevent this, a vapour release valve is fitted to each front tank. These consist of a rubber-faced poppet valve controlled by a cork float. When the fuel level falls, the valve opens and allows the air to escape to atmosphere and the fuel to transfer. A weighted arm overrides the valve while it is under negative 'g' conditions, thus rendering it incapable of opening and passing fuel to the vent pipe.

Fuel filter de-icing system (*fig. 6A*)

18A. Aircraft fuel normally contains a small quantity of water dissolved from the atmosphere. As the fuel temperature falls, some of this water comes out of solution with the

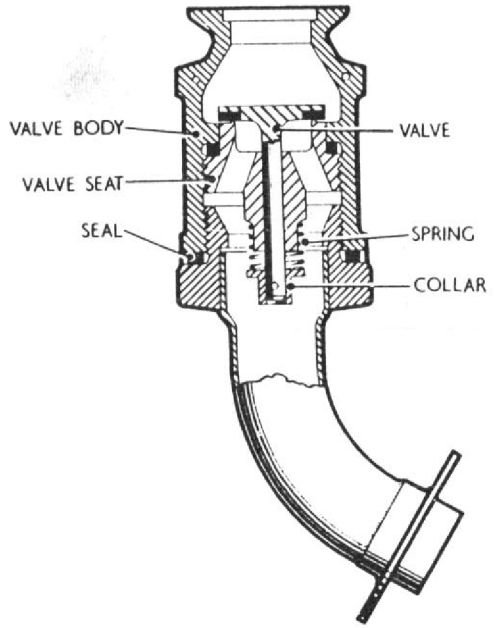


Fig. 5 Suction relief valves (wings)

fuel and forms ice crystals if the temperature is below about −10 deg. C. To eliminate a blockage of the system due to an accumulation of ice crystals on the engine fuel filter element, a fuel filter de-icing system is provided. The fuel filter de-icing tank, which is mounted in the rear fuselage, is provided

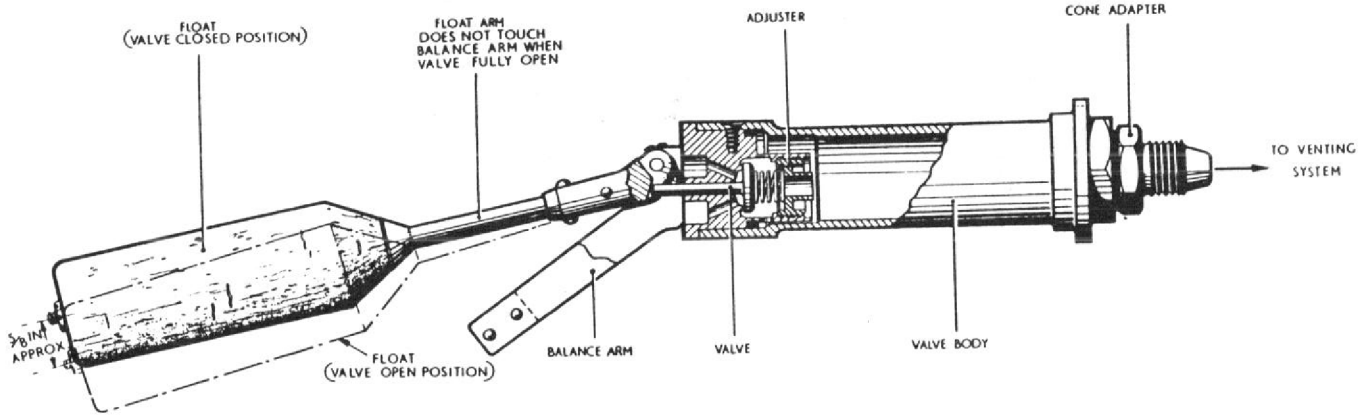


Fig. 6 Vapour release valve

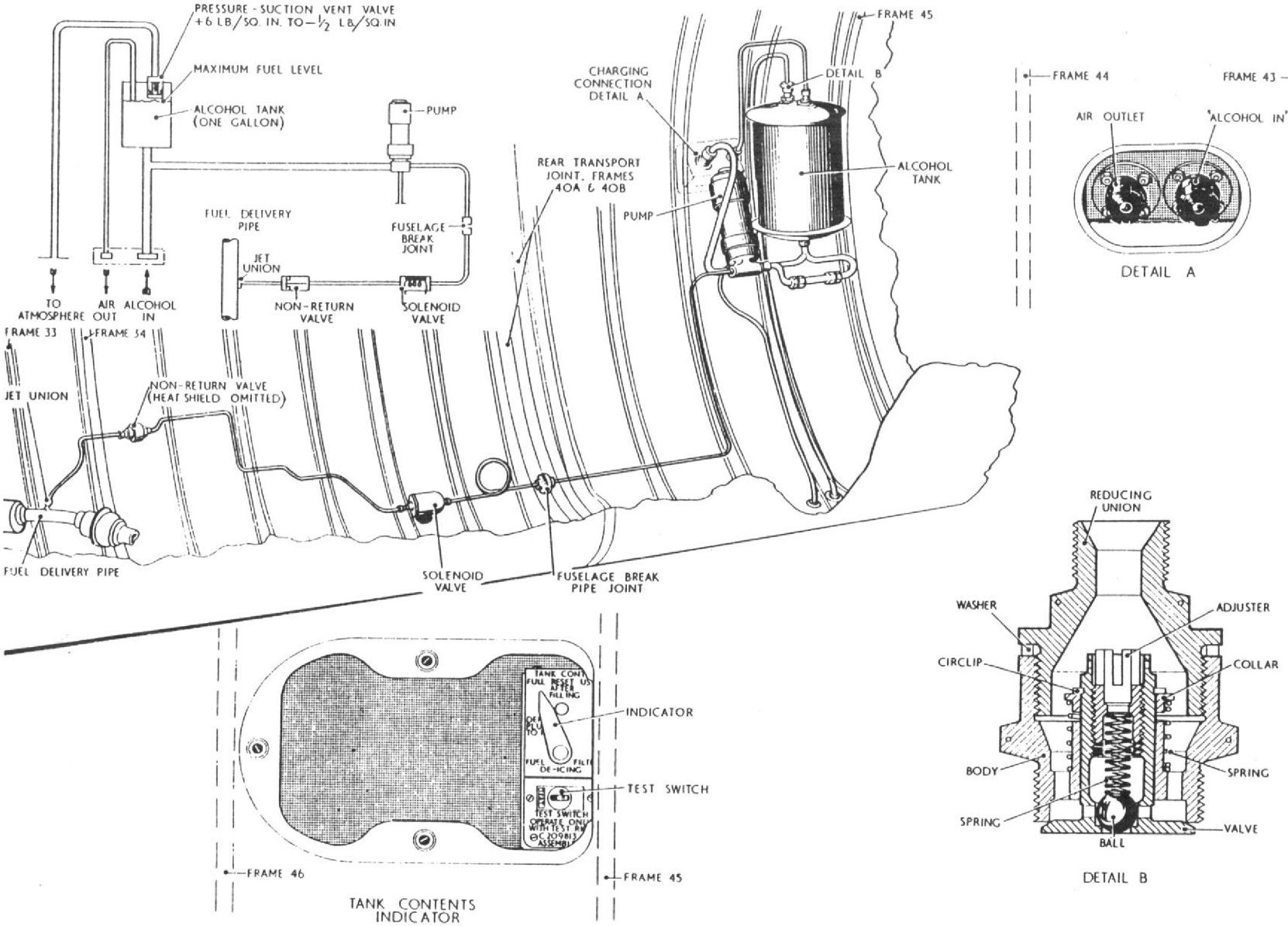


Fig. 6A Fuel filter de-icing system

with a suction and pressure relief valve (*fig. 6A*). The valve is set to maintain a pressure of 6 to 6½ lb/in² in the tank and a suction of ½ lb/in², with an airflow through the valve of approximately 1 cu. ft/min. (*Refer to para. 23A for testing*), the pressure setting being to prevent excessive alcohol loss due to boiling. A priming pump is used in the installation and to ensure an adequate flow of de-icing fluid against the fuel delivery pressure, its relief valve is set to 60 lb/in². The system is controlled by a control valve. Icing is detected by an increase in the pressure drop through the filter, which operates a differential pressure switch. This switch, through a relay, starts the pump and opens the solenoid valve. When the ice is cleared and pressure returns to normal, the pressure switch opens. This stops the pump and closes the valve. A non-return valve is fitted in the pipe line from the pump to the fuel system. The metering jet, where alcohol enters the fuel pipe line, is a 1/16 in. dia. orifice protected by a small filter. Filling of the fuel filter de-icing tank is described in Sect. 2, Chap. 2.

Refuelling

19. The aircraft is refuelled by pressure through a coupling in the port wheel bay. The defuelling cock, which is accessible through the engine starter access door aft of the main spar in the bottom of the fuselage, and which is normally locked in the OFF position, must be OFF when refuelling, as otherwise the engine pump seals will be damaged. The L.P. fuel cock must also be OFF during refuelling. A time switch adjacent to the refuelling coupling in the port wheel bay must be turned ON. This switch energizes the refuelling circuit *(Sect. 5, Chap. 1)*. Float switches in the front and wing tanks are on until the switches are immersed. Refuelling valves *(fitted in the front and centre tanks)* are essentially servo-controlled poppet valves, the servos being operated by the refuelling pressure. A solenoid, when energized, opens the servo by-pass and allows the valve to open. Incorporated in the poppet valve is a spring relief which eliminates hammering due to excessive pressure. When operations are commenced, fuel flows through the refuelling valves to the front and centre tanks. When the centre tanks are full, fuel flows down the transfer pipes to the wing tanks and thence to the drop tanks. When these tanks are full, the float switches operate and close the refuelling valves in the centre tanks. The operations are as follows:—

When the tanks are full, the float is immersed and switches off, thus releasing the solenoid in the refuelling valve and closing the servo by-pass. The servo then fills with fuel and closes the valve.

During refuelling, the front tanks are vented to atmosphere through the vapour release valves and, when these are immersed, through the tank relief valves which are opened by the refuelling pressure. The relief valves in the front tanks are set at 11lb/in². The wing tanks are vented through a relief valve *(fig. 7)* which normally opens at 7½ lb/in². During refuelling, however, fuel pressure is applied to a bellows which off-loads the valve and reduces the opening pressure to 2 lb/in². This is to keep the refuelling pressure in the system at an acceptable value. A refuelling relief valve set at 11–13 lb/in² is fitted to the underside of each wing to safeguard the tanks in the event of a refuelling valve failure. This condition is catered for in the fuselage tanks by large vent pipes. The higher pressure setting for the front tank relief valves is to prevent transfer pressure, plus head of fuel, from forcing fuel out of the vents when the aircraft is in a steep dive. The pressure relief valves in the front tanks incorporate suction relief valves which are set to open when subjected to a depression of ¼ to ½ lb/in². These valves operate in an opposite or inward direction and allow air to enter the tanks should pressure fail, thus avoiding a negative pressure and, consequently, collapse of the tanks. Suction relief valves, also set to open at a negative pressure of ¼ to ½ lb/in², are fitted to the centre tank and in the pipes to the drop tank by-pass valves. Non-return valves are fitted between the front and centre tanks to prevent back flow during refuelling. The procedure for refuelling the system is described in Sect. 2, Chap. 2.

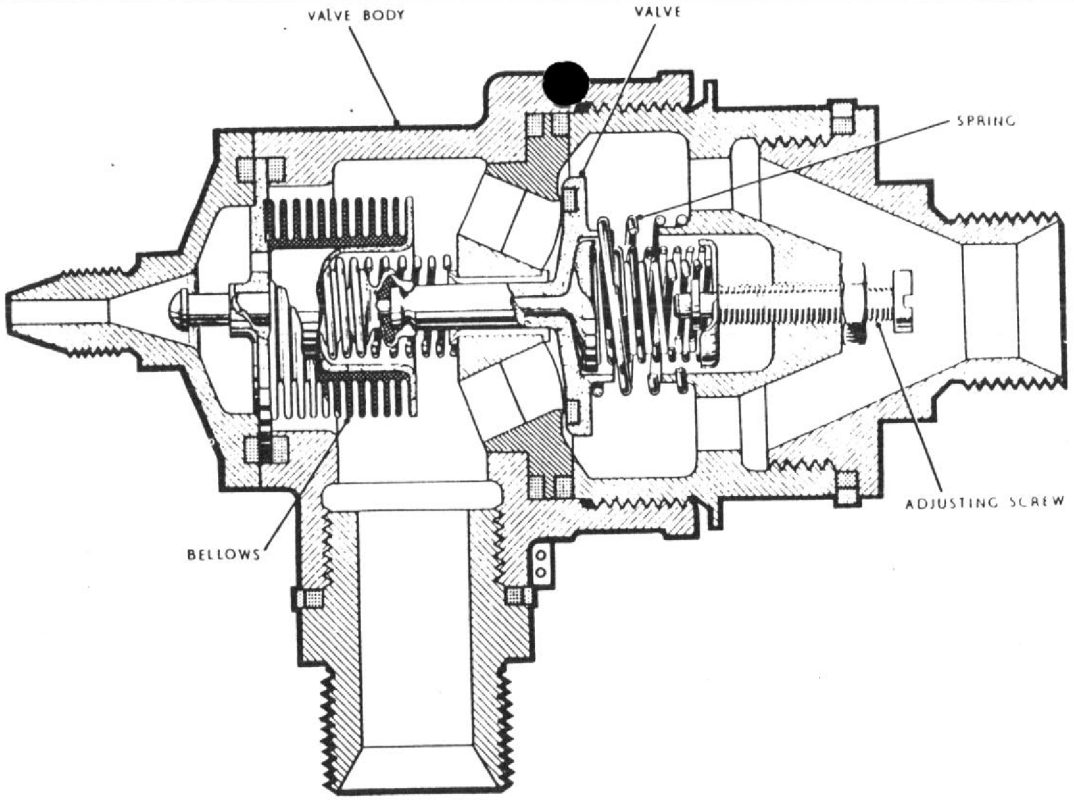


Fig. 7 Wing tank pressure relief valve

Defuelling

20. Defuelling is effected from the refuelling coupling in the port wheel bay. The defuelling cock, accessible through the engine starter access door, and which is normally locked in the OFF *(flight)* position, must be turned to ON before defuelling is commenced. The L.P. fuel cock must be OFF. An air pressure supply of 10 lb/in² is necessary to transfer the fuel from the centre, wing and drop tanks to the front tanks, from where it is sucked overboard by bowser pump or pumped out by the aircraft booster pumps. The air is fed through the tank defuelling pressurising connection mounted in the spine of the centre fuselage, the air passing through the reducing valves into the drop tanks and wing tanks in the same manner as for pressurization. The procedure for defuelling the fuel system is described in Sect. 2, Chap. 2.

SERVICING

General

21. Scrupulous cleanliness is essential during all servicing of the fuel system. The fuel pumps and their accessories are manufactured to a high degree of accuracy and, in order to ensure maximum pumping efficiency, tolerances are reduced to a minimum. Consequently, the efficiency of these components will be seriously impaired if foreign matter, however small, is permitted to enter the system. When components are removed for servicing, the pipe lines should be blanked off immediately to prevent the ingress of dirt or moisture. The servicing of certain components of the fuel system is described in the Air Publications appropriate to the components concerned, to which reference should be made when it is found that the servicing of a particular component is not included in this chapter. The procedure for filling, priming and draining the system is described in Sect. 2, Chap. 2.

◀ **Note . . .**

On Aircraft Pre-mod. 1325, wherever it is necessary to pressurize the fuel system using an external air supply connected to the ground pressurization connection, the integrity of the non-return valve fitted in the pipe line between the air filter and the engine must first be established as follows:—

Disconnect the flexible air pressurizing hose at the engine end, connect and start the external air supply and blow air through the disconnected hose; if the non-return valve has failed, detached parts of the valve will be discharged from the open end of the hose. Where no defects are found, shut off external air supply, reconnect flexible hose and proceed with normal pressurization. Change non-return valve if found defective. ▶

Water sediment drains

22. Drain valves are provided in the lowest points of the fuel system, from which water or sediment can be drawn off during servicing. The procedure for doing so is described in Sect. 2, Chap. 2.

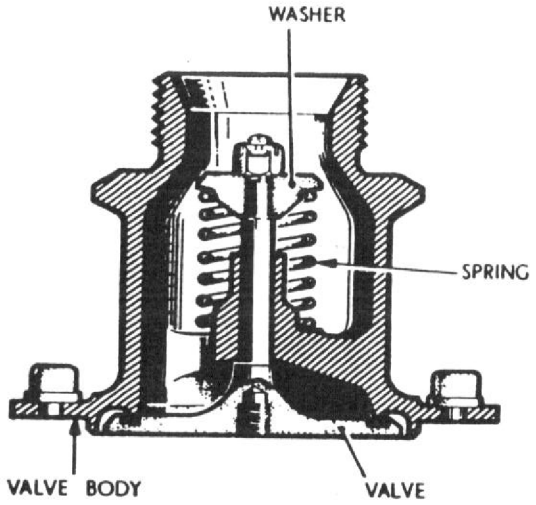


Fig. 8 Refuelling pressure relief valve

Refuelling pressure relief valves *(fig. 8)*

23. The refuelling relief valves in the underside of the stub wings should be checked to ensure that they are free to operate *(screw a ¼ in. B.S.F. bolt into the valve and pull the valve down)*. This is particularly important if the aircraft has not been flown for an appreciable length of time or when icy

Testing of pressure and suction relief valve—fuel filter de-icing tank (fig. 6A)

23A. The ball (pressure) valve of the combined pressure and suction relief valve must be adjusted so that a pressure of 6 to 6½ lb/in² is maintained at the valve end, with an airflow of approximately 1 cu. ft/min. passing through the valve at the opposite (reducing union) end. In addition, with the body of the valve connected to a tank of approximately 13 gallon capacity, pressure in the tank must not fall from 3 to 2¾ lb/in² in less than one minute. With the valve end open to atmosphere and an airflow of approximately 1 cu. ft/min. applied at the reducing union end and passing through the valve, the suction valve should ensure that the air pressure does not rise above ½ lb/in². With a suitable blank screwed on to the body, enclosing the valves, there should be no external leakage when an air pressure of 15 lb/in² is applied at the reducing union end.

Low pressure fuel cock control

24. Adjustment of the low-pressure cock control must be so arranged that with the control lever set to OFF in the quadrant, the cock is fully closed. *This is important.*

Fuel and air valve for inboard pylon *(fig. 9)*

25. The fuel and air valve unit should be checked for leaks as follows:—

(1) Blank off port 'B', apply an air pressure of 5 lb/in² to port 'A' and immerse the unit in paraffin for 2 minutes. Increase the pressure to 20 lb/in² and immerse for a further 2 minutes. The unit must be leak proof.

(2) Remove the blanking plug from port 'B', raise the valve *(Part No. A.219054)* by 0·55 in. *(using tank adapter Part No. A.206906 with suitable blanking cap)* and apply a pressure of 3 lb/in² to the port 'A'. There should be no leakage at port 'B' when the unit is immersed in paraffin.

Note . . .

It is essential to ensure that the inside of the valve body and the working parts of the valve are entirely free of any foreign matter

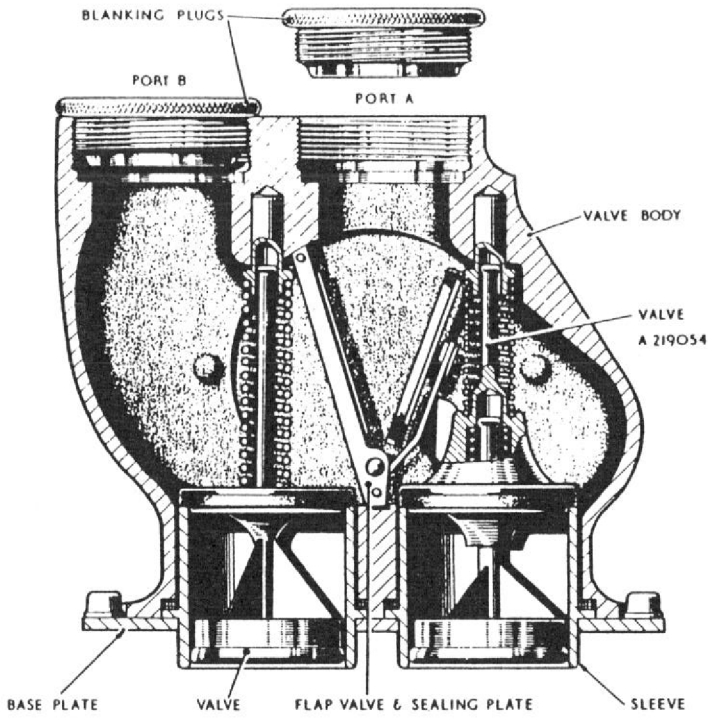


Fig. 9 Fuel and air valve for inboard pylon

Fuel and air valve for outboard pylon (*fig. 9A*)

25A. The fuel and air valve unit should be checked for leaks as follows:—

(1) Blank off port 'B', apply an air pressure of 5lb/in² to port 'A' and immerse the unit in paraffin for 2 minutes. Increase the pressure to 20lb/in² and immerse for a further 2 minutes. The unit must be leak proof.

(2) Remove the blanking plug from port 'B', raise the valve *(Part No. F.220353)* by 0·65 in. *(using tank adapter Part No. A.206906 with suitable blanking cap)* and apply a pressure of 3lb/in² to the port 'A'. There should be no leakage at port 'B' when the unit is immersed in paraffin.

Note . . .

It is essential to ensure that the inside of the valve body and the working parts of the valve are entirely free of any foreign matter and that the valve assembly functions smoothly.

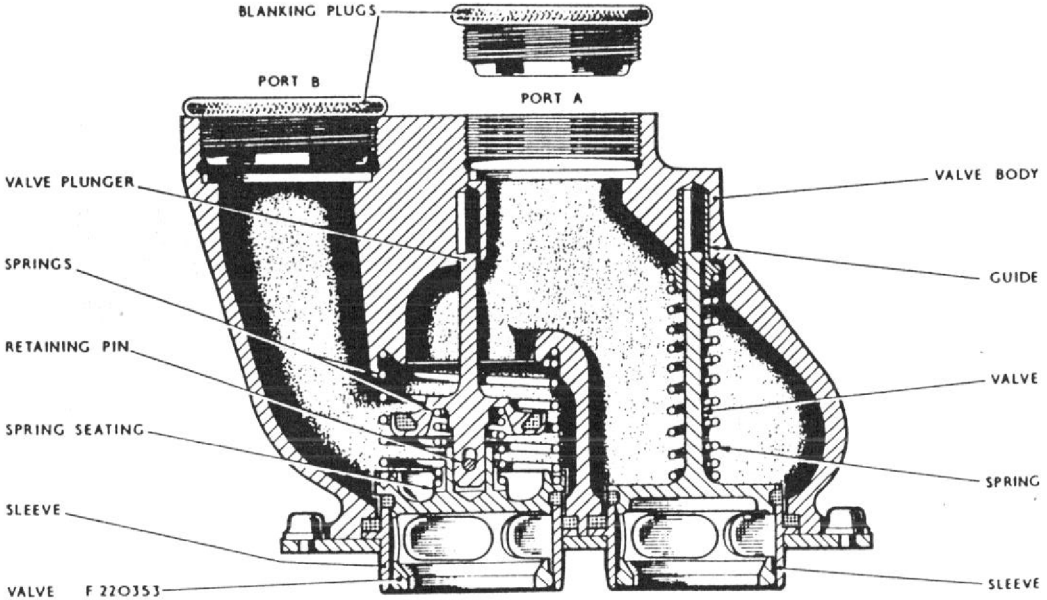


Fig. 9A Fuel and air valve for outboard pylon

Pressure reducing valves—air pressurization

25B. The pressure reducing valves in the air pressurization system should be checked, at those periods stated in the Aircraft Servicing Schedule, as follows:–

(1) Fit a pressure gauge to the test connection on the air pressurizing pipe located in each wheel bay.

(2) Run the engine at 5 500 rev/min and note the pressure recorded on the gauges.

(3) Increase and decrease the engine revolutions between 7 000 rev/min and idling speed several times and check that the gauges record a pressure between 5½ and 6½ lb/in² at 5 500 rev/min and over.

Where pressures are outside the limits given in sub-para. (3) the affected valve(s) must be renewed.

Replacement of fuel pipe lines

26. Before replacing fuel pipe lines that have been removed during servicing, or fitting new pipe lines, ensure that they are clean and smooth internally, as sharp edges at joints, nipples, etc., can cause aeration of the fuel. Ensure also that, when replaced, the arrows on the pipes and non-return valves point in the direction of flow. When refitting the pipes, ensure that the Flight Refuelling pipe connectors *(fig. 9B)* are assembled correctly. The procedure for the assembly of these connectors, which must be strictly adhered to, is as follows:—

(1) Ensure that the two pipes *(fig. 9B, item 4)*, to be connected, are in alignment.

(2) Fit the inner sleeve *(1)* over the one pipe end, and the outer sleeve *(2)* over the opposing pipe end.

(3) Fit the split collars *(3)* over the pipes, beyond the beading as shown, by removing the circlip *(5)* and replacing when the collars are in position.

(4) After first ensuring that there is a gap of ◀ 0.135 in. max. to 0.060in. min. between ▶ the pipe ends, fit the rubber sleeve *(6)* over the ends of each pipe, at the same time ensuring that the gap between the pipes is maintained: this is very important.

(5) Screw the outer sleeve on to the inner sleeve after first smearing the threads with anti-seize compound ZX-28.

(6) Tighten the coupling by hand, then finally tighten with spanners a ¼ to ½ turn beyond hand-tightening.

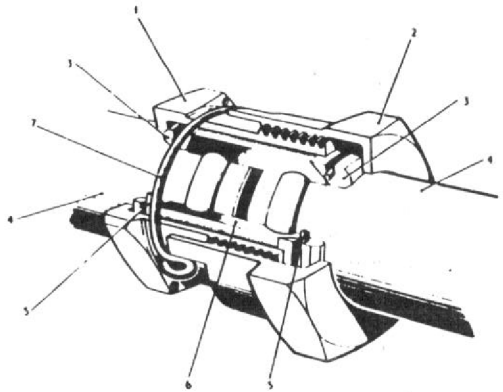


Fig. 9B Pipe connector (Flight Refuelling)

(7) Fit locking circlip *(7)* by inserting the plain end into one of the three $\frac{1}{16}$ in. holes in the hexagon of the inner sleeve so that the formed end of the circlip is between two of the castellations.

Note . . .

When replacing fuel pipe (Part No. C.188051/10) between the two flexible couplings at the engine connection, ensure that the pipe is assembled with the painted red line on the underside, thus representing the lower centre line. On aircraft in which the pipe does not have the painted red line, the pipe must be turned until a clearance of 0·30 in. is obtained with the temperature control actuator fully extended. This method of assembly is important in order to ensure the correct operating clearance between the pipe and control rod of the top temperature control actuator.

26A. When replacing the refuelling pipe to the port front tank refuelling valve ensure that there is a clearance of 0.05 in. minimum between the pipe and the nut on the flow proportioner.

26B. After ensuring that all pipe connections are tight and effectively locked, the piping of the circuit affected by such replacement should be pressure tested as follows:–

(1) *Engine feed lines*—28 lb/in² This can be satisfactorily approximated by pressurising the tanks to operating pressure and switching on the tank booster pumps.

(2) *Refuelling lines (with L.P. cock off)* 50 lb/in². This can be done with the aid of the refuelling bowser.

WARNING

The refuelling lines test pressure of 50 lb/in² must not be exceeded, as otherwise fuel will flow through the refuelling valve reliefs and out through the vent pipe.

(3) *Transfer pipes—14 lb/in² (including head of pressure).* The tank pressure test described in para. 27 will cover this requirement.

(4) *Air supply line—engine to tanks.* Apply an air pressure of 120 lb/in² to the spine air connection, using a Pneumatic Servicing Trolley and an adapter *(Ref. 26 FX/95527)* and check for leaks. The tank pressure gauges should be observed and should not register more than 7 lb/in²

For a general test of the system refer to para. 27.

Note . . .

During the foregoing test, ensure that all tank vent lines are clear to guard against damage to the tanks in the event of a leaking reducing valve.

Ground pressure testing of fuel system

27. The fuel system, including tanks, should be pressure tested as follows:—

(1) Remove vent pipe extension and fit bung *(Part No. A.207899)* into the front tanks vent pipe *(bottom skin of centre fuselage).*

Note . . .

These bungs have a plate attached, warning of the necessity of removing the bungs before refuelling and before flight. These plates must not be removed from the bungs.

(2) Fit blanking covers *(Part No. A.207818)* over the refuelling pressure relief valve in the underside of each stub wing *(to fit, remove two screws from access door; replace after test).*

Note . . .

To safeguard against the aircraft being flown with the blanking covers in position, each is fitted with a red warning pennant. These pennants must not be removed from the blanking covers.

(3) Connect pressure gauges *(service supply)* to tapping points on the front tank relief valves. *(Access panels, top centre fuselage, either side of spine in region of main spar frame.)*

(4) Fit pressure test connector to centre fuselage spine connection, and connect other end to the Fuel System Ground Pressure Test Control Box *(Part No. B.207700)* and thence to the external supply trolley.

(5) Apply an air pressure of 13½ lb/in² with tanks full. This pressure should be maintained for 10 minutes without any signs of leakage at any point in the system.

Note . . .

The test must be carried out with all tanks full. Under no circumstances is the test pressure to be allowed to exceed 14 lb/in².

(6) When the test has been satisfactorily completed, all bungs and other test equipment must be removed immediately, and the vent pipe extension refitted with the angled aperture facing forward.

Note . . .

The setting of the Control Box (Part No. B.207700) may change after periods without use and as it is essential that the outlet pressure is within the limits of 13½ ± ½ lb/in², it is recommended that the following checks be carried out to the Control Box at regular nine monthly intervals:—

(1) Connect a pressure gauge registering 0–30 lb/in² to the outlet cock and apply an air pressure of approx. 100 lb/in² to the inlet connection. Check that the pressure indicated on the gauge is 13½ ± ½ lb/in². If the pressure is outside these limits proceed with operations as detailed in sub-para. (2) to (4).

(2) Remove the cover of the Control Box and with an air pressure of approx. 100 lb/in² applied to the inlet connection, screw in the adjusting screw of the centre reducing valve until the pressure relief valve (the valve nearest the outlet cock) opens and can be adjusted to 'blow off' at 15 ± ¼ lb/in².

(3) With the pressure relief valve adjusted to release pressure at 15 ± ¼ lb/in² screw out the adjusting screw of the centre reducing valve until the gauge registers 13½ ± ½ lb/in².

(4) Re-lock the adjusting screws, replace the cover of the Control Box and seal the screw heads with a suitable material.

Between these periodic checks the Control Box may be considered serviceable, provided that, when in use, the pressure measured at the tapping in the wheel bay is between 11–13½ lb/in².

Ground pressure testing the fuel filter de-icing system

27A. A test switch to operate the system on the ground is located adjacent to the solenoid valve in the engine bay. This switch is used in conjunction with special ancillary test equipment which consists of a pressure gauge, relief valve and associated piping. The procedure for ground pressure testing the system is as follows:—

(1) The alcohol tank must be full, the fuel system primed, the L.P. and the H.P. fuel cocks OFF.

(2) Remove the blanking cap from the drain valve on the fuel delivery pipe in the engine bay, and fit the pipe of the test equipment *(Part No. C.209813)* in its place. *(The fitting of the pipe opens the valve).*

(3) Place the relief valve of the test equipment into a suitable container.

(4) Connect an external air supply to the alcohol tank vent pipe and apply an air pressure of 10 lb/in². Inspect for leakage in low pressure system from tank to pump.

(5) If no leakage occurs in the low pressure system remove external air equipment from tank vent and carry out functioning test described in para. 27B, sub-para. (2) and (3).

Functioning check, fuel filter de-icing system

27B. The functioning check of the fuel filter de-icing system, using the same equipment as described in para.27A is as follows:–

(1) Prepare the aircraft as described in para. 27A, sub-para.(1), (2) and (3).

(2) Operate the test switch to start the pump and note the pressure on the test equipment pressure gauge, which should be 30 to 35 lb/in ^{2}. Disconnect and remove the test equipment and replace the drain valve.

(3) Finally, the de-icing tank must be topped up and an engine run carried out immediately to clear the fuel pipe line of alcohol.

CAUTION...

The test switch must NOT be operated unless the test equipment with its relief valve is connected to the drain valve.

Vapour release valve–inspection

27C. At periods determined by the Aircraft Servicing Schedule the vapour release valves must be removed from the fuel system (*para.36*) and examined for:–

(1) Sticky deposit, scoring or other marks, on the poppet valve stem. If found, the valve assembly is to be rejected.

(2) Any burr on the float arm fork which bears on the poppet valve stem. If found, carefully remove the burr and check for subsequent free movement of the valve.

(3) Complete freedom of the float arm and negative 'g' arm pivots. Relieve any stiction by cleaning the affected parts.

Before refitment to the aircraft, depress the poppet valve by finger pressure and check that the valve returns without restriction. Where the valve is sluggish to return the assembly must be rejected.

Note...

On no account should the vapour release valve be dismantled and the spring setting disturbed.

Wing tank pressure relief valve–air pressurization

27D. With the fuel contents of the aircraft approximately 100 gallons below full capacity, irrespective of the fitment of drop tanks, the wing tank pressure relief valves in the air pressurization system should be checked at those periods stated in the Aircraft Servicing Schedule, as follows:–

(1) Locate the ¼ in. plug (*fig.1, item 1*) in the air pressurization pipe in each wheel bay. Remove the plug and fit:

Banjo bolt (*Part No. A.G.S. 1135B*).
Banjo body (*Part No. A.G.S. 1130B*).
Bonded seals (*Part No. Dowty G.D. 1307B*).

(2) Make up suitable adapter pipes to attach a 0–10 lb/in^2 pressure gauge (*Ref.6A/3343*) and a pneumatic servicing trolley (*Ref.4F/1805*) to the double-ended banjo.

(3) Pressurize the wing tanks separately.

Note...

The inlet into the fuel system should not exceed 10 lb/in^2

(4) Check that the pressure at which the wing tank pressure relief valves vent to atmosphere is between 6¾ and 8 lb/in^2. When the pressure relief valves vent to atmosphere, air will flow out of the vent on the bottom of the fuselage just forward of frame 28.

(5) Disconnect the pneumatic servicing trolley and fit a blank in lieu to the banjo body.

(6) Refuel the aircraft at full pressure and during refuelling check that the port and starboard gauges read between 1 and 3 lb/in^2

(7) If the pressures recorded do not comply with sub-para. (4) and (6) the wing tank pressure relief valve (*fig.1, item 18*) is unserviceable and must be replaced by a new or serviced valve.

REMOVAL AND ASSEMBLY

General

28. When handling the tanks, extreme care must be taken to ensure that they are not damaged. They should not be dragged across the floor. When taken out of the aircraft, they should be laid on felt, and during removal or installation they should not be folded any more than is absolutely necessary. The capacitors for the fuel gauges are built into the structure of the tanks and may be damaged if the tanks are subjected to rough handling. Implements or materials of any kind should not be inserted into the tanks to push them into the shape of the tank bays, to do so will damage the tanks and the capacitors. When assembly is complete, ensure that all pipes and non-return valves have been assembled correctly *(i.e. arrows on the components pointing in the direction of flow).* Where pipe connection sleeves incorporate an inspection hole, the sleeves must be screwed on to the threaded fitting until the thread covers or partially covers the inspection hole. When the fuel filter de-icing pump is removed, it must be inhibited with oil OX–275.

Fuselage flexible fuel tanks – post Mod.836

28A. Fuselage fuel tanks with Mod.836 incorporated were manufactured by Fireproof Tanks Ltd. and their part numbers include the suffix FT/H. A fuel resistant adhesive was used during manufacture and these tanks, when subjected to folding, are liable to incur lifting and wrinkling of the glass-cloth covering. This in no way affects the efficiency of the tanks as fuel containers nor the ability of the glass-cloth covering to protect the tank against heat soakage. Therefore in these respects the tanks are satisfactory for installation.

29. When pipe-lines are removed, the ends of the pipes and the unions that connect to them should be immediately blanked off and the pipes placed where they will be safe from damage. Every care must be taken to ensure that the pipe-lines are clean and unobstructed prior to their being reassembled to the system.

Manacle clamp connectors

29A. Manacle clamps are used at several locations on fuel pipe or component connections, examples are shown in Sect.3, Chap.2, fig.6 (item 6) and in fig.18 (items 15 and 20) in this chapter.

29B. Whenever any manacle clamp is removed, the internal faces of the machined groove are to be closely examined for signs of fretting and corrosion attack. The clamp halves are to be subjected to a dye penetrant test for cracks along the centre line as shown in fig.9C Where corrosion or cracks are found, the clamps are to be renewed.

29C. Before assembling manacle clamps, check that the pipe or component flanges are correctly aligned and parallel to each other. The sealing ring (fig.9D) should hold the flanges slightly apart, so that the clamping pressure compresses the ring, but the gap between the flanges is not to exceed 0.040in. If these conditions are not satisfactory, suspect incorrect assembly (such as rotational positioning of pipe or component) or distortion.

Removal of front tanks *(fig. 10)*

30. Either the port or starboard front tanks may be removed first. The removal of the port tank is described, the removal of the starboard tank being similar, except that in this instance it is not necessary to remove the wireless equipment. During removal it is essential that the sequence followed is in the order given by the following paragraphs 31–39. Paragraphs 40 and 41 give notes on assembly.

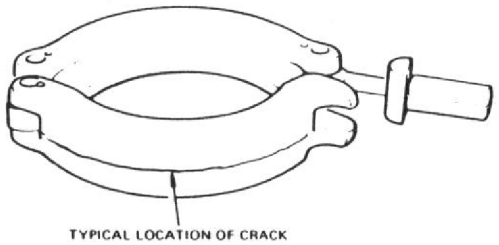


Fig.9C Manacle clamp failure

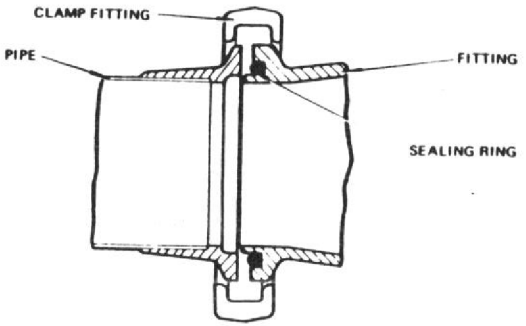


Fig.9D Clamped connection details

Preliminaries

31. Preparatory to removal, the following operations should be carried out:—

(1) *Render the aircraft electrically safe (Sect. 5, Chap. 1).*

(2) Drain the fuel system *(Sect. 2, Chap. 2).*

(3) Remove the wireless access panel from under the fuselage between frames 16 and 18.

(4) Remove the wireless sets and structure *(Sect. 6, Chap. 1 and 2).*

(5) Remove the fuel pump access panel *(12)* and the fuel system access panel *(20).*

(6) Remove the fuel level switch access panel *(4)* and the fuel vent connection access panel *(7).*

(7) Remove the tank panel on frame 19.

Removal of fuel contents gauge terminal box *(fig. 10)*

32. The fuel contents gauge terminal box is removed as follows:—

(1) Remove the nuts attaching the fuel contents gauge terminal box *(10)* to fuselage *(frame 19).*

(2) Withdraw the terminal box sufficiently to disconnect the electrical cables, then remove the terminal box with sealing ring, making sure that the detached cables do not fall back into the tank.

Removal of fuel level switch *(fig. 10)*

33. To remove the fuel level switch, proceed as follows:—

(1) Remove the terminal box cover from the fuel level switch *(3)*, disconnect the cables and replace the cover.

(2) Take off the twelve nuts and remove the fuel level switch and sealing ring.

Removal of tank retaining cords (*fig. 10*)

34. Remove the tank retaining cords as follows:—

(1) Remove the section of the fuselage spine *(1)* from frame 18 to frame 23.

(2) Remove the screws from the tank retaining nuts *(2)*.

(3) Working from front to rear, insert one hand between the fuel tank and the inner skin of the fuselage and, while compressing the tank with this hand, use the other to cut the retaining cords with a suitable blade.

(4) Pull out the severed cord knots and put back the screws.

Disconnection of suction and pressure relief valve (*fig. 10*)

35. At the connection of the suction and pressure relief valve, disconnection is effected as follows:—

(1) Unscrew the nut on the clamp eyebolt *(6)*, swing the clamp open and remove the clamp.

(2) Remove the circlip and the two halves of the collar.

(3) Unscrew the four bolts and remove the two halves of the locking plate *(5)* on the rear face of the main spar.

Removal of vapour release valve (*fig. 10*)

36. Remove the vapour release valve as follows:—

(1) Disconnect pipe at *(4B)*.

(2) Unscrew vapour release valve retaining nut.

(3) Withdraw vapour release valve *(4A)*.

(4) Unscrew four bolts and remove the two halves of the locking plate on the rear face of the main spar.

Removal of refuelling valve (*fig. 10*)

37. The procedure for removing the refuelling valve is as follows:—

(1) Remove the terminal box cover from the refuelling valve *(8)* and disconnect the electrical cables.

(2) Disconnect the fuel pipe at *(17)* and *(18)* and remove the pipe.

(3) Take off the twelve nuts and locking lug.

(4) Remove the valve and sealing ring. *(While on the same location, unclip and spread apart, where necessary, electrical cables running along the fuselage under the tank.)*

Removal of booster pump and inverted flight valve (*fig. 10*)

38. To remove the booster pump and inverted flight valve, proceed as follows:—

(1) Disconnect the electrical lead (*15*) on the booster pump and inverted flight valve installation.

(2) Disconnect the water sediment drain at (*13*) and the fuel gland drain at (*14*).

(3) Disconnect the fuel outlet pipe at (*16*) on the pump and the non-return valve (*9*) and remove the pipe.

(4) On the port side, disconnect the leads from the suppressor box (*14A*). Remove the suppressor box after removing the four nuts and bolts. Remove the forward support bracket for the suppressor box by unscrewing the two bolts.

(5) Take off the thirty-four nuts attaching the booster pump and inverted flight valve installation to the support plate and tank, and remove the pump and valve unit (*11*).

Removal of transfer pipe cover plate and tank (*fig. 10*)

39. The transfer pipe cover plate is removed as follows:—

(1) Disconnect the static pipe (*19A*) on the fuel pressure differential switch (*20A*) and disconnect the switch by removing the banjo bolt.

(2) Remove the six screws attaching the transfer pipe (*21*) to the cover plate (*19*) and disconnect pipe at (*22*) and remove with sealing ring.

(3) Unscrew the thirty-two nuts and remove the cover plate and sealing ring.

The tank, which is now ready for removal, should be folded and withdrawn through the tank panel in frame 19. Pipe lines must be blanked off immediately after removal to prevent the ingress of dirt or moisture. Any fuel there may be on the outside of the tank must be dried off. If the tank is to be stored, blanking plates and caps should be fitted over all apertures.

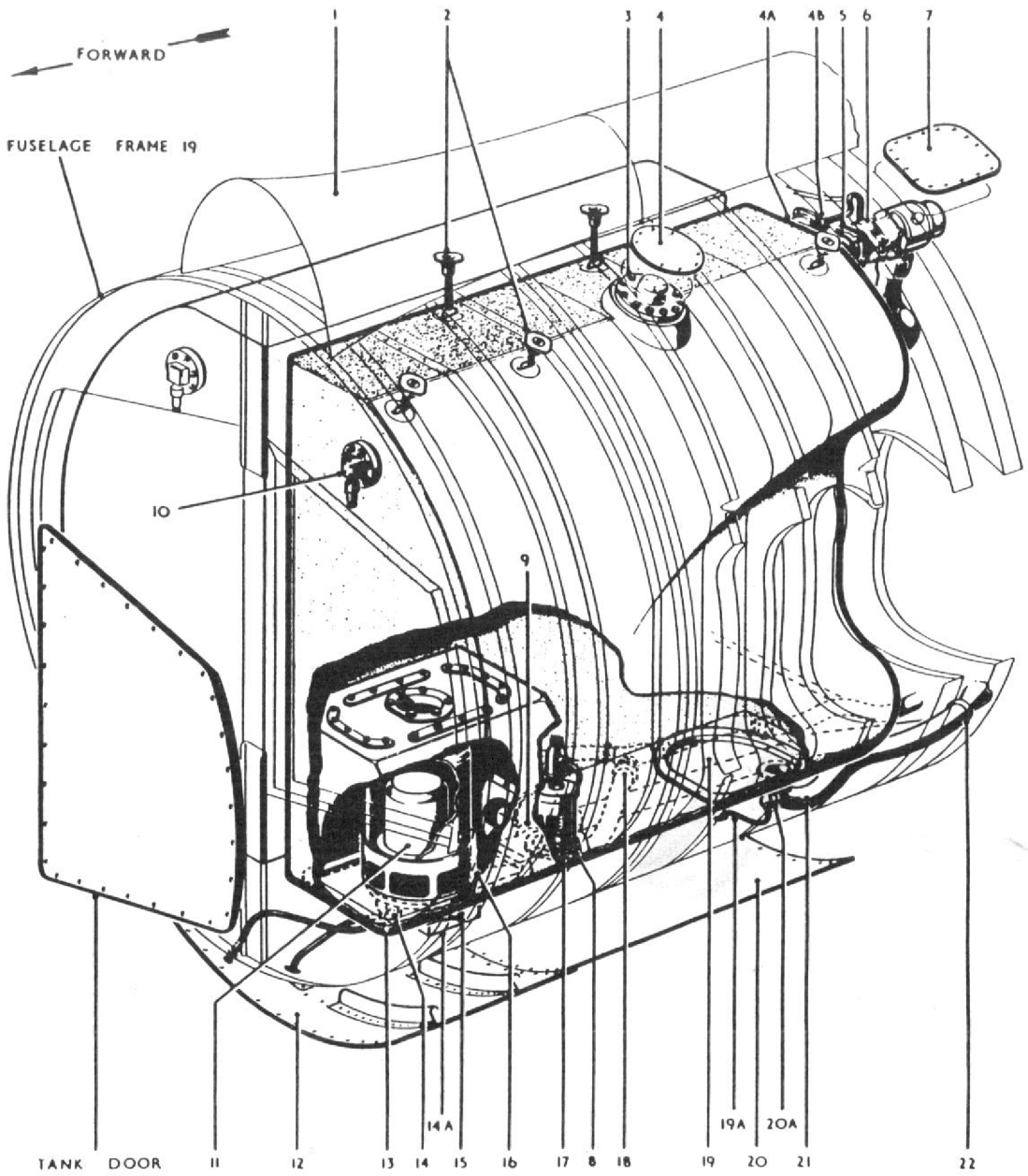


Fig. 10. Removal of front fuel tanks

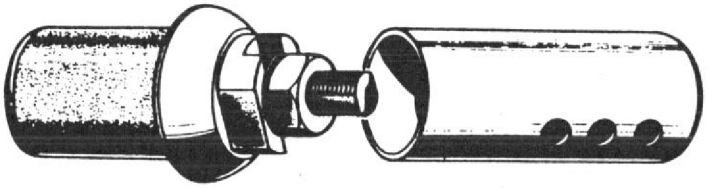


Fig. 11. Guide for suction and pressure relief valve connection

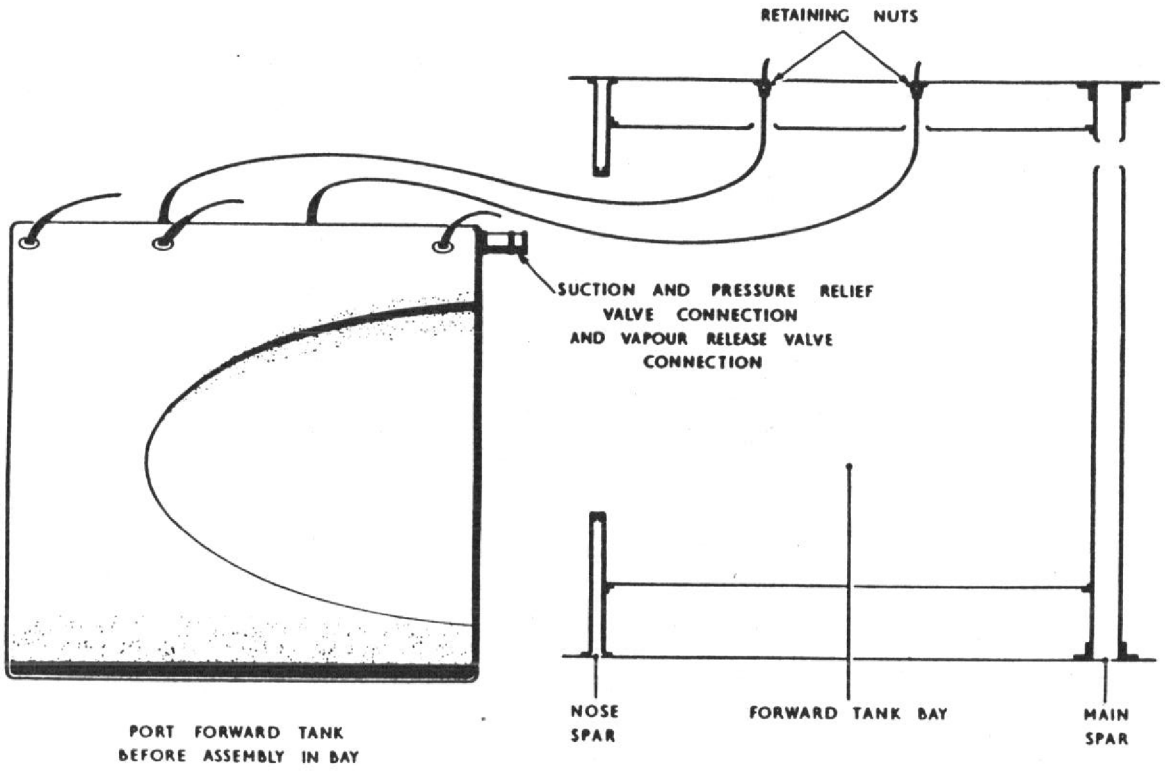


Fig. 12. Method of installing front tanks

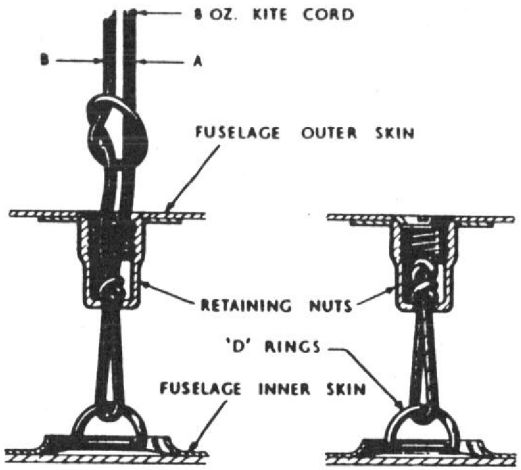


Fig. 13. Securing the tank cords

Assembly of front tanks ***(fig. 11, 12 and 13)***

General

40. The procedure for the assembly of the front fuel tanks is a reversal of the removal procedure, but the following points should be observed:—

(1) Ensure that the tank bay is clean and free from all foreign matter, nuts, washers etc.

(2) For ease of installation the inside of the tank bay and the outer surface of the tank should be dusted with french chalk.

(3) When assembling the booster pump into the inverted flight valve attachment, the latter must be in the normal flight position *(i.e. not inverted)*, as otherwise damage to the link mechanism will occur. All internal fittings, pumps, contents gauges etc., should be examined for damage and corrosion.

(4) The Flight Refuelling connectors *(fig. 9B)* must be assembled to the pipes as described in para. 26.

(5) All sealing rings and sealing washers should be renewed.

(6) The suction and pressure relief valve connection and the vapour release valve connection must each be fitted with the guide *(Part No. A.194464)*.

(7) When fitting the vapour release valve connection to the tank, ensure that the locating lug on the connection is at the top. This will obviate the possibility of the vapour release valve being fitted incorrectly. If this valve is fitted upside down, expansion of air or fuel vapour inside the tanks may prevent fuel transfer allowing the front tanks to drain while fuel remains in the other tanks. It is possible to fit the vapour release valve connection in any one of six positions, but the correct position is with the locating lug at the top when the tank is in position.

◀(7A) After fitting check, through the float switch aperture, that the vapour release valve float is free of obstruction, i.e. is not fouling the tank wall or the fuel gauging unit captive nut. ▶

(8) Ensure that the suction and pressure relief valve connection and the vapour release valve connection are correctly inserted in the retaining holes in the main spar and that the grooves are engaged correctly with the locking plates on the aft face of the main spar. Unless these precautions are taken it is possible for the connections to be fractured.

◀(9) Before tightening the slip knots, ensure that the tank is correctly positioned by filling with fuel and pressurizing to 6 lbf/in^2.

(10) On installing the booster pump gland drain pipe ensure that the pipe projects below the fuselage skin between 0.35 in. and 0.5 in. The open end of the pipe, cut to a 45 degree angle, must face aft.▶

Assembly

41. Proceed with the assembly of the tank as follows:–

(1) Remove the screws from the five tank retaining nuts.

(2) Obtain about 40 yards of 8 oz. kite cord *(Ref. 32A/107)*, cutting the cord into five lengths of about 8 yards each.

(3) Thread the cut lengths of kite cord through the nuts into the tank bay and out through the tank door in frame 19.

(4) Pass the cords through the 'D' rings on top of the tank *(fig.12 and fig.13)*, form each cord into a loop about 12 in. long and securely whip the end.

(5) Carefully fold the tank and push it into the tank bay. Pull all cords until the tank is held against the tank skin by the cords and the loops appear through the tank retaining nuts.

(6) Cut the cords below the whipping and tie one cord A round the other B in a slip knot *(fig.13)* and pull the knot down into the retaining nut. Tie another slip knot, cord B round cord A this time, and work down into the retaining nut as far as possible. Cut both ends of the cord at outer skin level.

(7) Replace the screws in the retaining nuts and lock by peening the skin into the slot.

42. Paragraph not applicable.

Removal of centre fuel tanks *(fig.14, 15 and 16)*

General

43. Either the port or starboard centre tanks may be removed first. The removal of the port tank is described and, except where stated otherwise, the removal of the starboard tank is similar. When removing a tank, the sequence to be followed is given in the following paragraphs 44 to 53 inclusive. Paragraphs 54 and 55 give notes on assembly.

Preliminaries

44. Before attempting to remove either fuel tank, proceed as follows:–

(1) Render the aircraft electrically safe *(Sect. 5, Chap.1)*.

(2) Drain the fuel system *(Sect.2, Chap.2)*.

(3) Trestle the aircraft *(Sect.2, Chap.4)*.

(4) Remove the rear fuselage *(Sect.3, Chap.1)*.

(5) Remove the engine starter access door *(Sect.2, Chap.4)*, the suction relief valve access panel and the fuel vent connection access panel.

(6) Remove the section of the aircraft spine positioned above the centre tanks.

(7) Remove the engine *(Sect.4, Chap.1)*.

(8) Remove the engine starter exhaust pipe.

Removal of refuelling valve *(fig.14)*

45. The refuelling valve must be removed as follows:–

(1) Remove the terminal block cover *(2)* from the refuelling valve and disconnect the electrical cables.

(2) Disconnect the fuel pipe *(1)* by removing the locking wire from the locking lug and removing the ring nut at the rear end and the union at the forward end.

(3) Unscrew the nuts and remove the valve sealing washer.

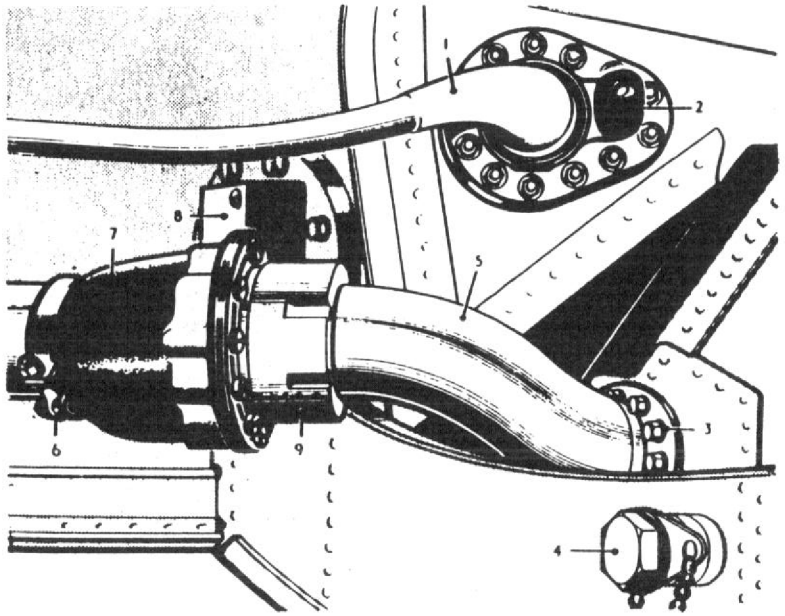


Fig. 14 Removal of centre fuel tanks (1)

Removal of transfer pipe connecting front and centre tank (*fig. 14*)

46. The fuel transfer pipe must be removed as follows:—

(1) Remove the sediment drain pipe (*4*).

(2) Unscrew the outer sleeve (*9*) then remove the split pin and clamp (*6*) from the non-return valve (*7*) and remove the non-return valve.

(3) Unscrew the nuts (*3*) attaching the pipe to the forward face of the lower tank skins and remove the pipe and sealing washer. (*Care must be taken to ensure that the end of this pipe is not damaged during removal.*)

Removal of fuel contents gauge terminal box (*fig. 14*)

47. The fuel contents gauge terminal box is removed as follows:—

(1) Unscrew the nuts attaching the fuel contents gauge terminal box (*8*) to the fuselage at frame 27 and withdraw the terminal box sufficiently to permit disconnection of the electrical cables.

(2) Having disconnected the cables and ensured that they will not fall back into the tank, remove the terminal box together with the sealing ring.

Removal of suction relief valve (*fig. 16*)

48. The suction relief valve is removed as follows:—

(1) Unscrew the screws attaching the gauze panel to the outer skin and remove the panel.

(2) Unscrew the nuts attaching the suction relief valve (*11*) to the valve mounting bracket and remove the valve together with the sealing washers.

Dismantling pressurisation duct (*fig. 16*)

49. Disconnect the pressurisation duct (*15*) between frames 33 and 34 or, in the case of the starboard pressurisation duct (*13*), between frames 32 and 34, removing ten nuts and bolts in either case.

Removal of transfer pipes connecting centre to wing tanks

50. The transfer pipes are removed as follows:—

(1) Disconnect the transfer pipes at the wing tanks as described in wing removal (*Sect. 3, Chap. 2*).

(2) Uncouple the other end of the pipes in the wheel bay (*port and starboard*) and remove these portions of the transfer pipes.

(3) Uncouple the portions of the pipes that run into the centre tanks by removing the nuts (*1*) from the studs at the flanges (*port and starboard*).

(4) Carefully withdraw the pipes from the tanks.

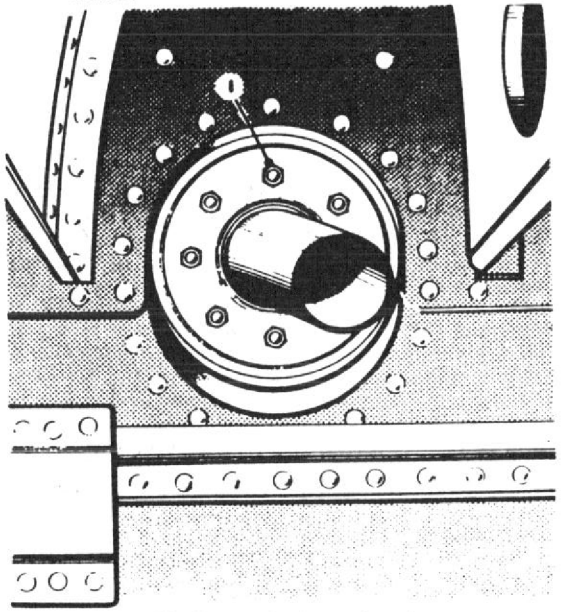


Fig. 15 Removal of transfer pipe

Removal of blanking plate (*fig. 16*)

51. The blanking plate is removed as follows:—

(1) Remove the nuts from the studs and remove the blanking plate and washer.

(2) Ease the eight studs carefully through the holes in the tank support panel (*12*) and at the same time avoiding damage to the tank skin.

Removal of centre tank support panels (*fig. 16*)

52. Remove the centre tank support panels as follows:—

(1) Remove the sealing strips (*19*) at the forward end of the tank support panels by releasing the 21 Dzus fasteners.

(2) Remove the air intake rubber sealing ring (*16*), two access panels (*20*), the top access panel (*14*), and the bottom access panel (*18*).

(3) Unscrew the bolt which passes through the pressurising duct (*17*).

(4) Unscrew the four bolts at the front joint plate (*21*) and remove the plate. Unscrew the ten bolts at the rear joint plate (*22*) and remove the plate. Unscrew the two nuts at the top joint plate and remove the plate.

(5) Remove the tank support panels. If desired, these may be removed in four pieces by removing the bolts (*23*) along the panel joint situated below the pressurising duct.

Removal of tank retaining cords and tank

53. Remove the tank retaining cords as follows:—

(1) Working from rear to front, insert one hand between the fuel tank and the inner skin of the fuselage and, while compressing the tank with this hand, use the other to cut the retaining cords with a suitable blade.

(2) Remove the screws from the tank retaining nuts and pull out the cord knots.

(3) Replace the screws and withdraw the tank.

Note . . .

Pipelines must be blanked off immediately after removal to prevent the ingress of dirt or moisture. If a tank is to be stored, blanking plates should be fitted over all apertures.

Assembly of centre fuel tanks

General

54. The assembly of the tanks is a reversal of the removal procedure, but the following points should be noted:—

(1) Ensure that the tank bay is free from foreign matter, nuts, bolts, etc.

(2) Ensure that all sealing rings and sealing washers are renewed.

(3) All internal fittings, pipes, contents gauges, etc., should be examined for damage and corrosion.

(4) For ease of installation, the outer surface of the tank, the inside of the tank bay and tank support panels should be dusted with french chalk.

(5) Before tightening up the slip knots ensure that the tank skin studded plates are positioned correctly.

Note . . .

Before installing the tanks observe the precautions in paras. 28 and 29.

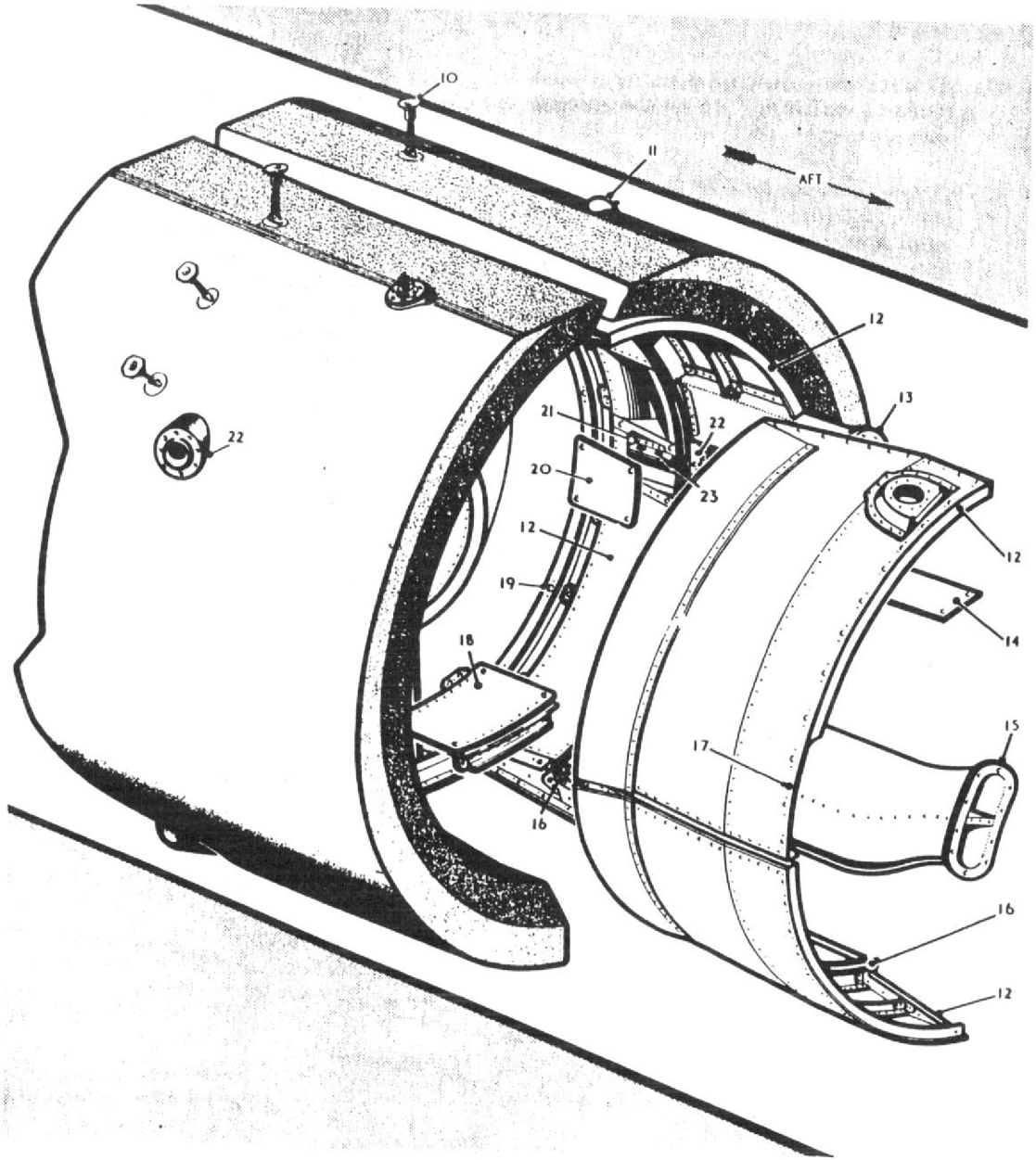


Fig. 14 Removing [illegible]

Assembly (*fig. 17*)

55. The installation of the port tank is described, that for the starboard tank is similar.

(1) Remove the screws from the three tank retaining nuts (*fig. 16*) on the fuselage skin.

(2) Obtain seven lengths of 8 oz. kite cord (*Ref. 32A/107*), each approximately 6 yards long.

(3) Thread three of the lengths of cord through the tank retaining nuts (*one cord to each nut*), then rearward through the tank bay in the fuselage and through the respective 'D' rings on the upper surface of the tank. Form each cord into a 12 in. loop around the 'D' ring and securely whip the end.

4) Thread three of the remaining lengths of cord through the port fuel vent connection access panel opening, through the hole in frame 26, then rearward through the tank bay and securely fasten the cords to the 'D' rings on the top front face of the tank (*one cord to each 'D' ring*).

(5) Pass one end of the last cord through the engine starter access door opening, through the hole in frame 27, then rearward through the tank bay and securely fasten the cord to the 'D' ring on the bottom front face of the tank.

(6) Ease the tank through the fuselage into the tank bay at the same time pulling on all cords until the tank is held firmly against its supporting skins, with the loops on the three pieces of kite cord (*sub-para. 3*), through their respective retaining tank nuts.

(7) Taking each of these three supporting cords in turn, cut the cord below the whipping, tie one cord A around the other B in a slip knot (*fig. 13*) and pull the knot down into the retaining nut. Tie another slip knot, this time B round A and work it down into the retaining nut as far as possible (*fig. 13*). Cut both ends of the cord at outer skin level.

(8) Replace the screws in the tank retaining nuts and lock the screws by peening the skin plating into the slot.

(9) Remove the remaining four pieces of kite cord. (*These are only required for installation purposes.*)

All external fittings, contents gauges, refuelling valves, etc., should be examined for corrosion and external damage prior to reassembly.

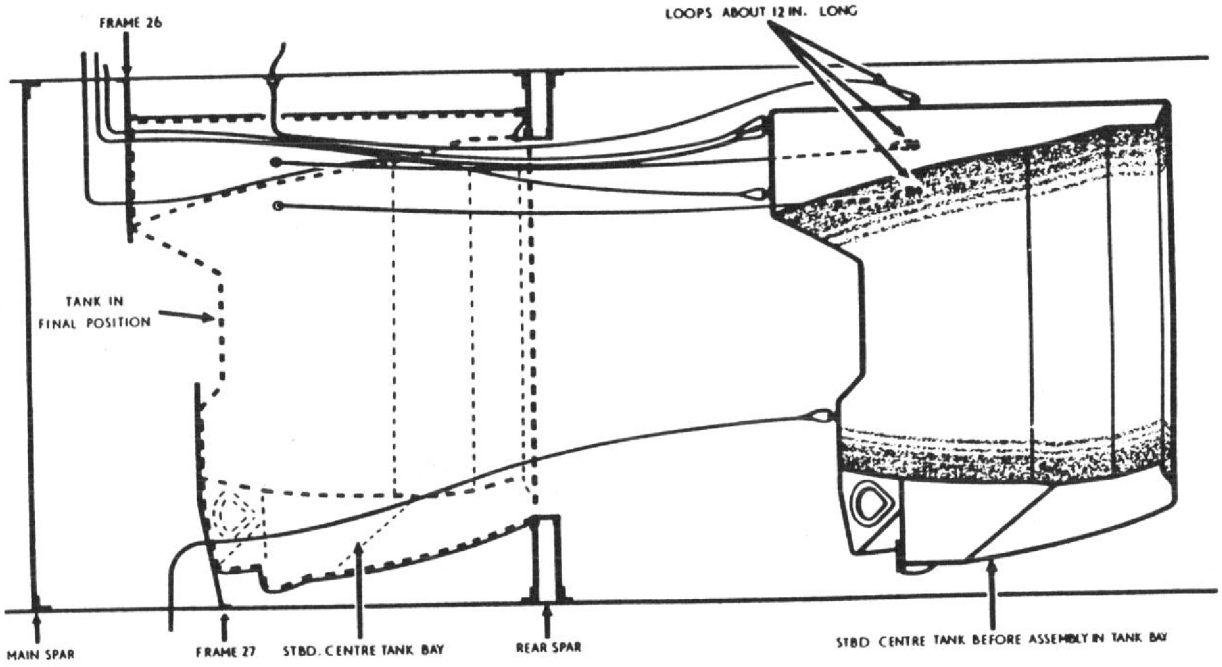
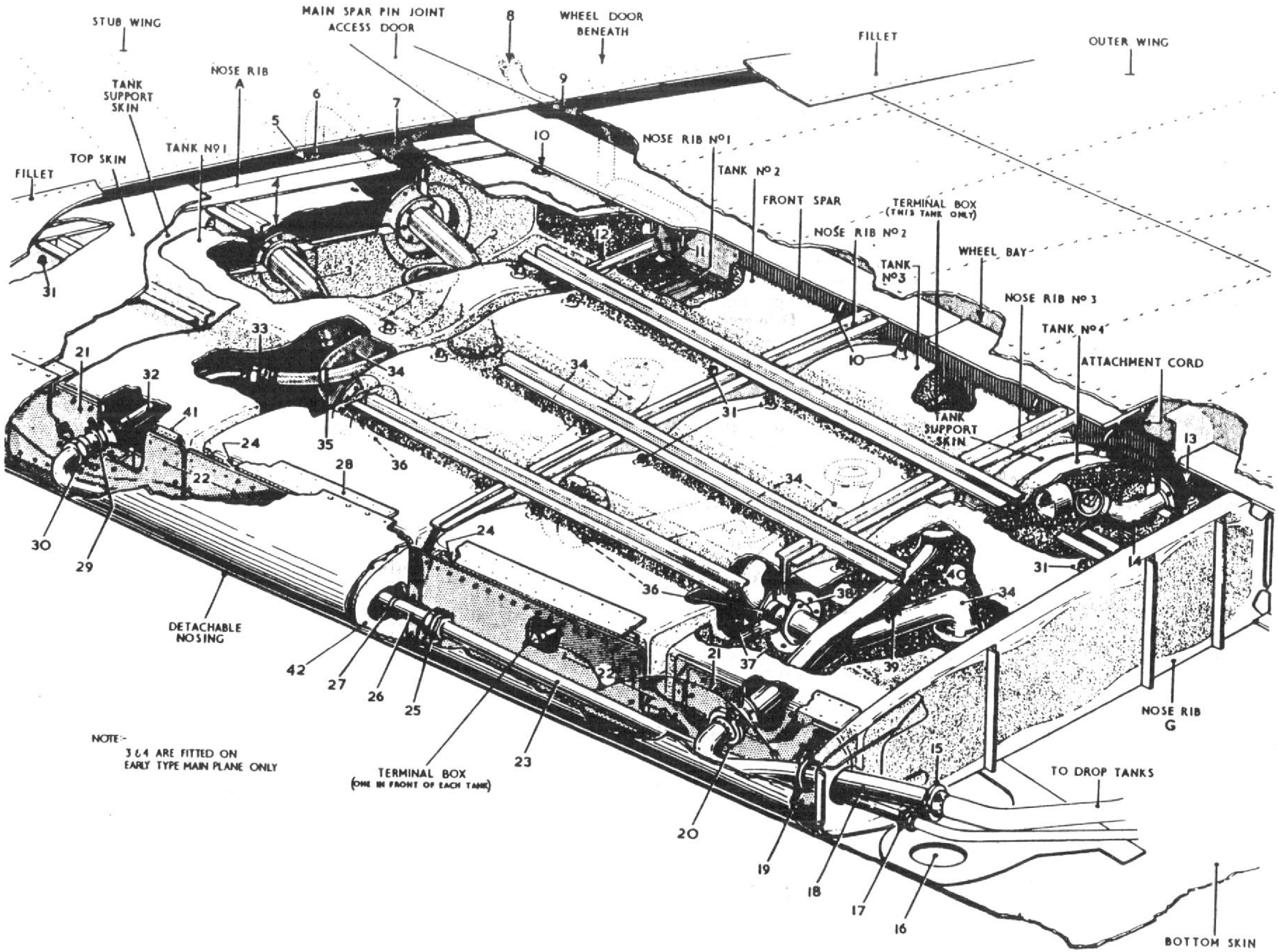


Fig. 17. Method of installing centre tanks



TP16525

Fig. 18 Removal of wing fuel tanks

Removal of wing fuel tanks (*fig. 18*)

General

56. The removal of the port wing tanks is described, the removal of the starboard tanks being similar. The removal must be carried out in the order described below:—

Preliminaries

Preparatory to the removal, the following operations should be effected:—

(1) *Render the aircraft electrically safe* (*Sect. 5, Chap. 1*)

(2) Drain the fuel system (*Sect. 2, Chap. 2*).

(3) Disconnect the refuelling pressure relief valve (*5*), the pipe (*6*) and the branch pipe (*7*) in the stub wing as described in wing removal (*Sect. 3, Chap. 2*).

Removal of fuel contents gauge terminal box

57. The fuel contents gauge terminal box at the rear of No. 3 tank is removed as follows:—

(1) Remove the nuts attaching the terminal box to the front spar structure.

(2) Withdraw the terminal box sufficiently to disconnect the electrical cables, then remove the terminal box complete with sealing ring, ensuring that the detached cables do not fall back into the tank.

Removal of the outlet pipe assembly (*2*)

58. Remove the twelve tank-stud nuts and washers securing the outlet pipe mounting plate to nose rib A, then withdraw the pipe assembly Push the tank studs inwards to free the tank from the structure.

Removal of the low-level switch assembly (*3*)

59. Remove the electrical cable plug (*4*) from its socket. Remove the seven 2 B.A. and one ¼ in. B.S.F. tank-stud nuts and washers securing the assembly flange to nose rib A, then withdraw the switch assembly. Push the tank studs inwards to free the tank from the structure.

◀ **Note . . .**

This switch has been removed on later production main planes and replaced by a blanking plate, which must be removed before removing the wing inboard fuel tank. ▶

Removal of the nosing

60. Remove the screws in the leading edge spar (*28*), six at nose rib A, four at nose rib G, and fifteen in the upper surface at nose ribs 1, 2 and 3.

Removal from the leading edge of transfer pipe (*18*) **and air pressure pipes** (*23*) *and* (*26*)

61. Through the general access hole (*16*) remove the split pin, slacken off the nut and open the clamp coupling (*15*). Likewise open the clamp coupling (*20*), also remove the clip (*19*). Remove the locking wires from the unions (*17*) and (*25*) and disconnect. Remove the air-pressure pipe (*23*), then the transfer pipe. Dismantle clip (*27*), remove the locking wire from the union (*30*) and disconnect. Remove the air-pressure pipe (*26*).

Removal of the four leading edge spar webs (*22*)

62. Detach the four wing nosing ribs (*42*) by removing the bolts and washers securing them to the leading edge spar webs. Remove the sixteen bolts and washers fixing the four mounting plates (*21*) and (*24*) to the four leading edge spar webs and the necessary bolts and washers round the web perimeters, then remove the webs from the structure.

Removal of electrical leads to terminal boxes

63. Disconnect the electrical leads interconnecting the four terminal boxes, one in each tank. To remove a faulty terminal box, withdraw it sufficiently to disconnect the electrical leads inside the tank, then remove the terminal box complete with sealing ring, ensuring that the detached leads do not fall back into the tank.

Removal of the four mounting plates (*21*) *and* (*24*)

64. Remove the locking wire from the adapter (*29*) and unscrew the adapter. Remove from beneath No. 1 tank, the six bolts and washers and one locking lug with seal, securing the flexible air-pressure pipe (*32*) flange, also the twenty-four nuts and washers securing the tank and remove the mounting plate (*21*).

Remove from tanks No. 2 and 3 the twenty-four nuts and washers securing each tank, then remove the mounting plates (*24*).

Remove from tank No. 4 the eight nuts securing the inlet transfer pipe (*40*) flange, also the twenty-four nuts and washers securing the tank and remove the mounting plate (*21*).

Removal of inlet pipe (*40*)

65. Through the access hole in tank No. 4 free the lug (*39*) and withdraw the inlet pipe.

Removal of flexible air-pressure pipe (*32*)

66. Through the access hole in tank No. 1 remove the locking wire from the union nut (*33*) and unscrew (*using two spanners to avoid wrenching the joint*), then remove the flexible pipe.

Removal of rigid air-pressure pipe (*12*)

67. Through the access hole in tank No. 1 remove the stiff-nut, bolt and clip (*35*) to free the air pipe from the interconnection pipe (*34*). Through the stub wing general access doors immediately aft of the main spar pin joint, remove the locking wire and loosen the nipple (*8*), then remove the coupling (*11*). With the outboard end of the pipe (*9*) twisted upwards, remove the eight nuts and washers securing the pipe flange to the front spar web and withdraw the pipe. Push the tank studs inwards to free the tank from the structure.

Removal of refuelling level switch (*14*)

68 Remove the electrical cable plug (*13*) from its socket in the wheel bay. Remove the seven 2 B.A. and one ¼ in. B.S.F. nuts and washers securing the flange to the front spar web and remove the switch. Push the tank studs inwards to free the tank from the structure.

Removal of tank interconnection pipes (*34*)

69. The six tank interconnection pipes are similar but not interchangeable, and care should be taken to ensure their return to the appropriate tank on re-assembly. Reaching through any two adjoining tanks, remove the two ¼ in. bolts and nuts and four sealing washers (*38*), then withdraw the pair of interconnection pipes and seals, one from each tank. Similarly, withdraw the two remaining

pairs. To free the tanks from one another, remove at each interconnection (*36*) the six remaining 2 B.A. nuts and twelve sealing washers and extract from each tank the clamp ring (*37*). In readiness for removal, ease the tank walls inwards from the nose rib webs.

Tank attachment buttons (*31*)

70. Adjacent to the stringers, withdraw from the support skins the integral rubber tank buttons, lubricate with ZX-36 *(Ref. 34B/1459)* if necessary. The buttons are located as follows :—

Seven on top and eight on the bottom surface of tank No. 1.

Six on the top and six on the bottom surface of tanks No. 2 and 3.

Four on the top and four on the bottom surface of tank No. 4.

Tank eyelet cord attachment (*10*)

71. Cut the sixteen attachment cords spaced along the rear face of the front spar, these being located adjacent to the four rear corners of each tank The tanks may now be withdrawn forwards (*with care*) from the structure. In order to clear the packing pieces (*41*) at the two front corners it is necessary to concertina tank No. 1.

Assembly of wing fuel tanks (*fig. 18*)
Preliminaries

72. Before commencing assembly, the following precautions should be taken:—

(1) *Ensure that the aircraft has been rendered electrically safe (Sect. 5, Chap. 1).*

(2) Ensure that the precautions given in para. 28 and 29 have been observed.

(3) Ensure that the tank bays are clean and free from foreign matter.

Assembly

73. Select sixteen 5 yard lengths of kite cord *(Ref. No. 32A/107)* and wax about 18 in. of one end and knot the other end of each cord. The wax assists threading and durability. Thread each of the sixteen attachment tubes *(10)* from the rear side of the front spar, with a waxed end of cord and from the front pull the cords through the tank bays and secure the waxed ends to the appropriate tank eyelet. Dust the outside of each tank and the inside of tank bays with french chalk. Coat all tank buttons *(31)* with ZX-36 *(Ref. 34B/1459)* to assist insertion Proceed as follows :—

(1) Concertina the tanks sufficiently to pass them through the apertures in the leading edge spar *(28)*, taking up in the wheel bay the slack on the cords and from the inside push the tank walls into position against the adjacent structure. Pull each cord tightly through its bracket, to be found on the top or bottom skin and secure with a knot as shown. Cut off and remove the surplus kite cord.

(2) Proceed in the reverse order as described in the removal (*para. 68 and 69*). When assembling the clamp rings *(37)* and the inter-connection pipes *(34)* pass the bonded washers along the bolts by hand as far as possible and then tighten up by turning the bolt heads to ensure even seating of the washers, otherwise the threads may drag the seals from their bonds, giving rise to leakage.

(3) Proceed in the reverse order as described in the removal (*para. 67*) ensuring that the "U" seal has its large flange forward when fitted to the front spar web and that the tank bolts when engaged pass through both flanges of the "U" seal.

Note . . .

When refitting the tank interconnection pipes refer to A.P.4117B, Vol. 1 and 6, Book 2, Part. 3.

(4) Proceed in the reverse order as described in the removal (*para. 66*),ensuring that the "O" seal is seating evenly while tightening up.

(5) Proceed in the reverse order as described for removal (*para. 64 and 65*).

(6) Proceed in the reverse order as described for removal (*para. 63*), ensuring that the bonded washer is replaced beneath and not above the wiring lug. When replacing the terminal box in the rear of No. 3 tank ensure that the sealing washer is undamaged and that the Pye socket is situated on the inboard side approximately 30 deg. from top dead centre.

(7) Proceed in the reverse order as described for removal (*para. 60, 61 and 62*). The Flight Refuelling connectors *(fig. 9B)*must be assembled to the pipes as described in para. 26,

(8) Proceed in the reverse order as described for removal (*para. 58 and 59*).

(9) Complete in the reverse order using new locking wire. All seals should be renewed on re-assembly of components.

Assembly of defuelling cock locking latch

74. Aircraft embodying Mod. 1031 are provided with a nylon locking latch on the defuelling cock to secure it in the closed (flight) position. The latch consists of a slotted plate which pivots on a special bolt incorporated in the cock assembly. When turned up, the slot in the latch engages with the cock lever and the lever is then secured by the insertion of a locking pin into a hole in the lever. The locking pin is secured to the latch assembly by means of balloon cord. The special bolt engages with the threaded hole in the foot of the latch. The lock nut is screwed up finger tight, after the latch is centralized by adjustment of the bolt, and secured with a split pin. Assemble the latch as follows :—

(1) Screw in the special bolt, allowing the latch to assume a mid-position clear of the cock end flanges.

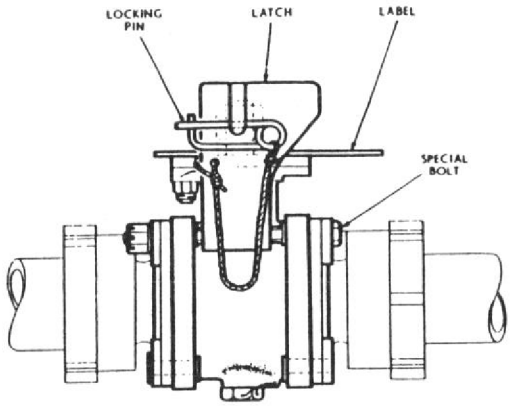


Fig. 19 Defuelling cock locking latch

(2) Assemble the nut and washer, and secure with a split pin. *The bolt must be free to rotate to facilitate the movement of the latch from the engaged position.*

(3) Adjust the latch by turning the bolt so that the slot engages the lever. *There should be no movement of the lever, with the cock in the fully closed (flight) position.*

(4) With the cock in the OFF (flight) position and latch engaged with the cock lever insert and secure the locking pin.

100 gallon drop tank

75. The assembling, dismantling and testing of the 100 gallon drop tank is described in A.P.4117A, Vol. 1 and 6, Sect. 3, Chap. 1.

TABLE 1 Component and Air Publication reference

Component	Manufacturer	Part No. or Ref.	Air Publication
Defuelling cock	Saunders Valve Co.	42/A/10	A.P.4737A, Vol. 1 & 6, Sect. 1
Low pressure cock	Saunders Valve Co.	51/B/12	A.P.4737A, Vol. 1 & 6, Sect. 1
Pipe connectors	Flight Refuelling	F.R.S.110/J F.R.S.110/K F.R.S.132/F	A.P.4511, Vol. 1 & 6, Sect. 5
Refuelling coupling	Avery Hardoll or Flight Refuelling	F.C.110 or F.C.110 Mk. 11 C.724000/1	A.P.4511, Vol. 1 & 6, Sect. 3
Flexible coupling	King Aircraft Corp.	C.3829/S, or C.6397 C.4460/S, or C.6395	
Flow proportioner	Rotol Ltd.	F.F.P.2/2	A.P.4737A, Vol. 1 & 6, Sect. 9
Fuel booster pump	Self Priming Pump Co.	S.P.E.1007, Mk. 3	A.P.4343D, Vol. 1, Book 2
Inverted flight valve	Self Priming Pump Co.	S.P.E. B.26, Mk. 2	
Float switches			A.P.1275A, Vol. 1, Sect. 24
Refuelling valves	Flight Refuelling	C.1112000/3	A.P.4511, Vol. 1 & 6, Sect. 2

Testing wing tanks for leakage in situ *(fig. 20)*

76. The wing tanks can be tested for leakage in situ with the test equipment shown in the illustration. The procedure for testing the tanks, when leakage is suspected, in order to locate the leaking tank, is as follows :—

(1) Render the aircraft electrically safe (*Sect. 5, Chap. 1*).

(2) Drain the fuel system (*Sect. 2, Chap. 2*).

(3) Remove the nosing (*para. 60*).

(4) Remove the transfer pipe and the air pressure pipes (*para. 61, fig. 18, items 18, 23 and 26*). Blank off the transfer pipe orifice with the blank (*fig. 20, item 3*).

(5) Disconnect and remove the co-axial cables from the terminal boxes.

(6) Remove the leading edge spar webs from No. 2 and 3 tanks (*para. 62*).

(7) Remove the mounting plates from No. 2 and 3 tanks (*para. 64*) and before finally removing disconnect the electrical leads from the terminal boxes behind the mounting plates.

(8) Remove the tank interconnection pipe tank No. 2 to 3 from either No. 2 or No. 3 tank and fit a blank (*fig. 20, item 2*).

(9) Fit the wing tank test panels (*fig. 20, item 1*) complete with a 0-10 lb/in² pressure gauge to No. 2 and 3 tanks and secure to the tanks with the nuts and washers removed at operation (7) and to the spar booms with the straps (*fig. 20, item 5*).

(10) Remove the branch pipe (*fig. 18, item 7*) from No. 1 tank [*para. 56(3)*] and fit the blank (*fig. 20, item 4*).

(11) With a foot pump pressurize the tanks to 5 lb/in² pressure, and allow them to remain pressurized for at least 15 minutes. Note any pressure drop which occurs. If the tanks are serviceable no drop should occur.

(12) Having established which pair of tanks is leaking, depressurize the tanks.

The following sub-paragraphs assume that No. 1 and 2 tanks are leaking, and No. 3 and 4 are serviceable.

(13) Remove the test panels from No. 2 and 3 tanks.

(14) Remove the leading edge spar web and the mounting plate at No. 1 tank.

(15) Remove the interconnection pipe—tank No. 2 to No. 1 tank from No. 2 tank and fit a blank (*fig. 20, item 2*).

(16) To eliminate any possibility of a leak from the air pipe in No. 1 tank, fit a blank (*fig. 20, item 6*) at the pipe coupling (*fig. 18, item 33*).

(17) Fit the wing tank test panels to No. 1 and 2 tanks and test as described in operation (11).

(18) On completion of the tests, remove the test equipment and blanks.

Tanks 3 and 4 can be tested in similar manner. Change the faulty tank(s) and on completion carry out a pressure test in accordance with para. 27.

Note . . .

When the tank is found to be leaking at the tank interconnection it should be examined and repaired in accordance with A.P.4117B, Vol. 1 and 6, Part 3, Sect. 3, Chap. 2.

◀ **Refuelling coupling (STI/Hunter/389)**

77. The chain attached to the refuelling coupling sealing cap is to be secured to the aircraft structure by one of the upper line of four bolts (*above* the refuelling coupling)[1] which secure the refuelling-coupling mounting to the stub-wing diaphragm.

78. With the sealing cap in place on the coupling and the chain secured in this manner, the length of the chain is to be insufficient to allow the chain to become trapped between the periphery of the sealing cap and the undercarriage door when the door closes (the critical arc of the periphery is between clock-face reference 5 o'clock and 8 o'clock when viewed on the face of the cap).

79. Before dismantling this assembly, check that trapping cannot have previously occurred. If it can, remove any covering from the chain, examine it for signs of deformation and renew it if damaged.

80. On assembly, adjust the length of the chain to remove any possibility of trapping and cover the chain with a suitable length of P.V.C. tubing Ref. 5F/9708463. This covering must always be present and intact. ▶

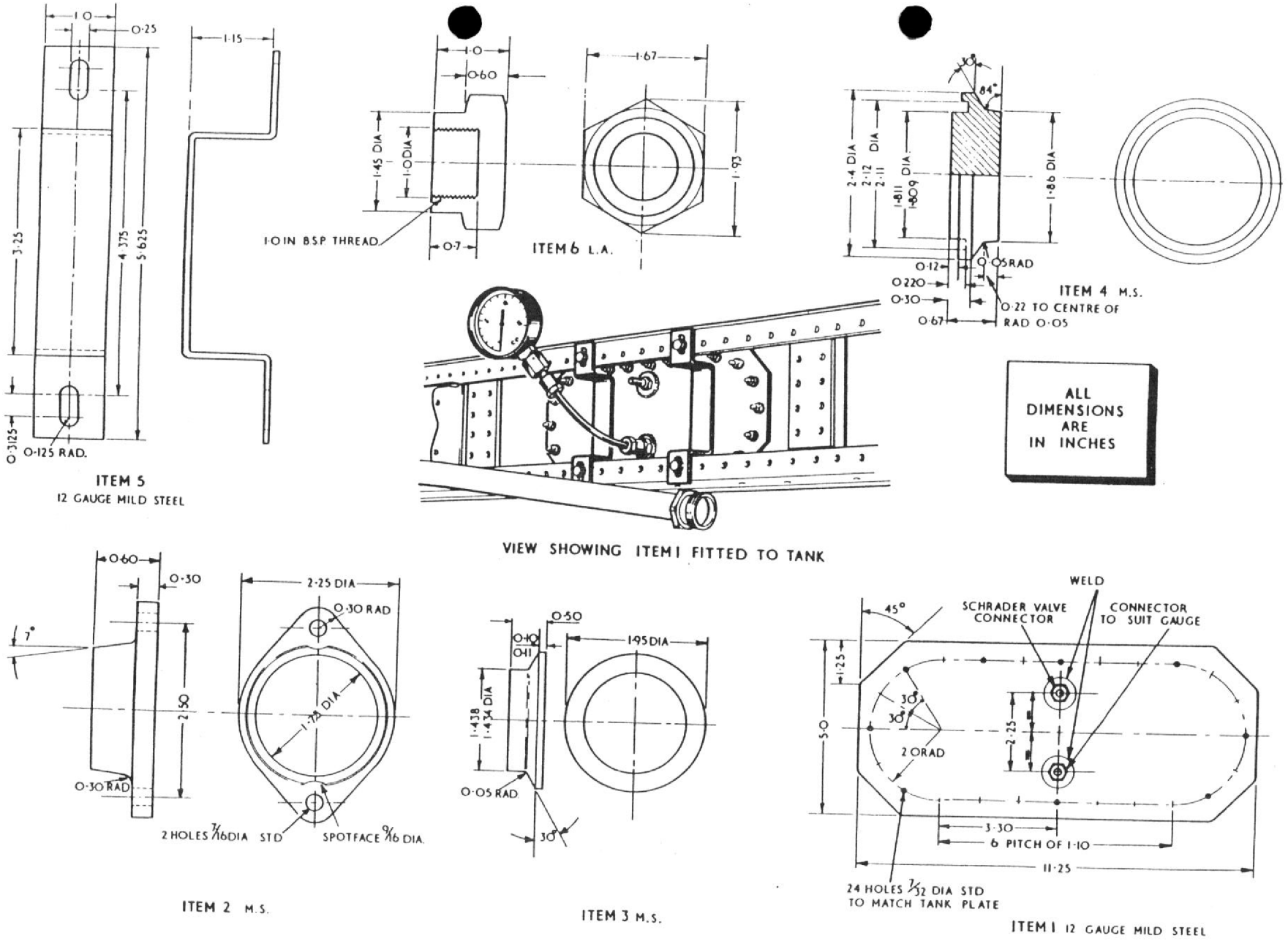


Fig. 20 Test equipment for wing tanks

T.P. 1764C

RESTRICTED