

## Chapter 2 FUEL SYSTEM

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## 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 two 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.4117A, Vol. 1 and 6.

### Fuselage tanks

2. The four fuselage tanks are flexible rubber bag-type tanks reinforced with mada-pollan vulcanized 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 S.P.E. 1,007 Mk. 1 electrically-driven booster pump with inverted float valve, each pump being fitted in a negative g fuel trap (*para. 8*). All four tanks are each provided with a Mk. 12 refuelling valve, these being in connection with a standard  $1\frac{1}{2}$  in. 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 mentioned above, operate

in an opposite or inward direction to that of a normal relief valve, thus allowing air to enter the tanks should the pressure fail, and consequently avoiding the setting-up of a negative pressure and possible collapse of the tanks. Non-return valves are fitted in the pipe lines between the front tanks and centre tanks to prevent back-flow during 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 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. 3A*) set to blow-off at  $7\frac{1}{2}$  to  $8\frac{1}{2}$  lb. per sq. in. 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, while the inboard tanks house a low-level float switch to operate a warning light in the cabin.

### Drop tanks

6. Universal pylons are fitted outboard of the wing tanks and located between ribs H and J; these can be used to accommodate various external stores, including drop tanks, which when carried are mounted one under each wing. Consideration is being given to the provision of a second pylon on each wing, in which case additional tanks or other stores may be carried. The tanks are of streamlined construction and are connected to the wing tanks by means of transfer pipes which incorporate a suction relief valve set to open at a pressure below  $\frac{1}{2}$  lb. per sq. in. 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. 16*) which connect the air and fuel pipes when the drop tanks are jettisoned. A by-pass valve, consisting of a ducted plate which intercon-

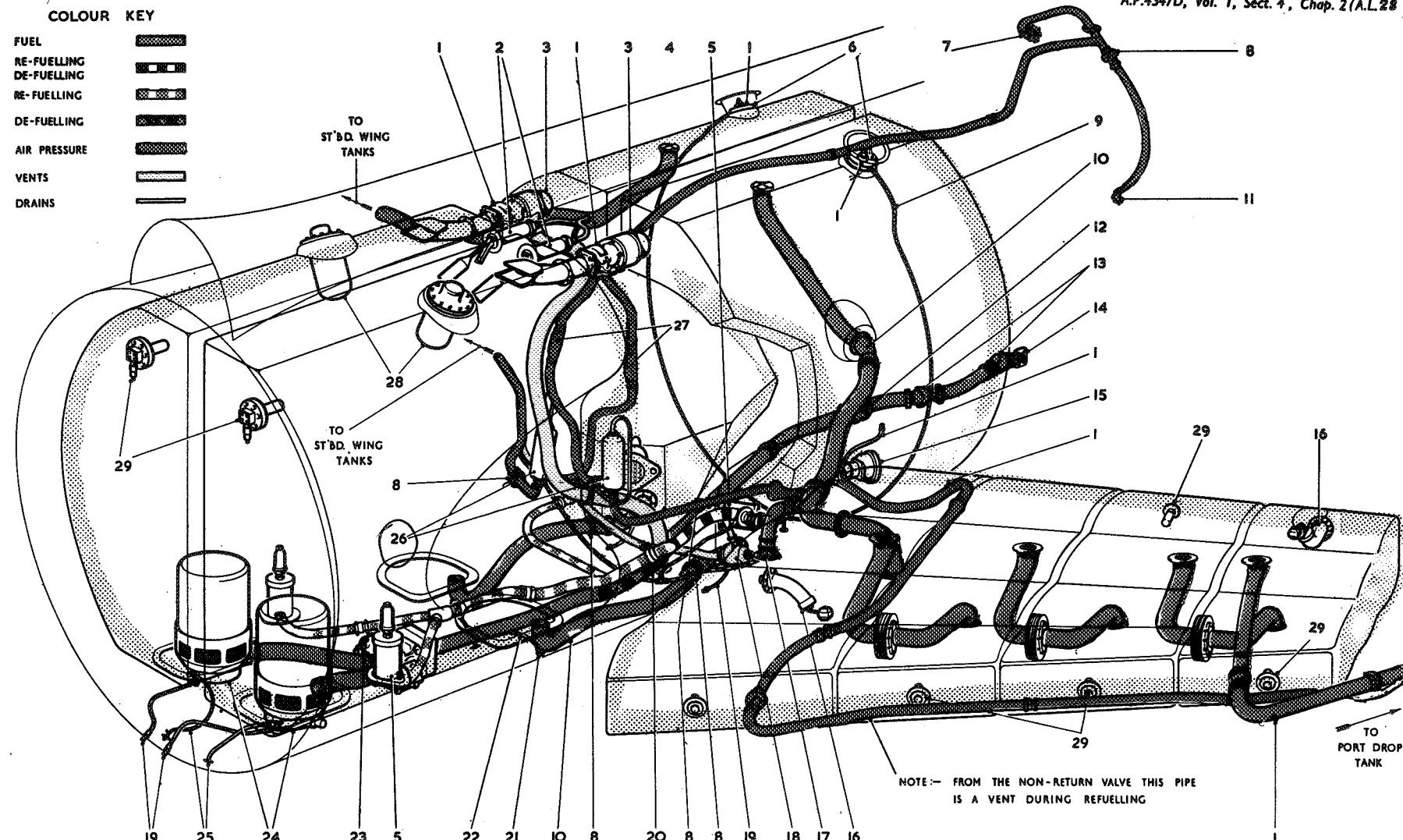
ncts the air and fuel pipes, is assembled to the wing when the pylon is not fitted. Each drop tank has its own float switch which comes into action automatically during refuelling of the tanks. The construction of the universal pylon to which the drop tanks may be attached is described in Sect. 3, Chap. 2 of this volume, and the drop tank release mechanism in Sect. 5, Chap. 1.

### 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 6 lb. per sq. in. is required. The air supply for fuel tank pressurization is taken from a restricted tapping on the engine compressor and then through a non-return valve and filters to pipes which feed the port and starboard tank installation. Each of these pipes contains a filter and a reducing valve which has an outlet pressure of approximately 6 lb. per sq. in. 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 remaining tanks. Should the transfer system fail, however, no fuel will be transferred from the wing and drop tanks, and only part of the fuel will be transferred from the centre tanks. Under these circumstances the fuel transfer pressure switches (*Sect. 5, Chap. 1*) will operate, causing the fuel transfer doll's eye to indicate. The warning switches are also in connection with the contents gauges, giving an "empty" indication for the centre tanks (there is, at present, no contents gauge for wing tanks). Thus, when the warning doll's eye shows, the contents of the front tanks only are indicated, this being the only amount of fuel available to the engine.

### ► Fuel flow proportioner

7A. A Rotol F.F.P.2/2 fuel flow proportioner is fitted in the main delivery line from the booster pumps. It consists of a ganged pair of vane type pumps with a non-return



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

F.S./2

FIG. I FUEL SYSTEM INSTALLATION

(A.L.28, Feb. 56)

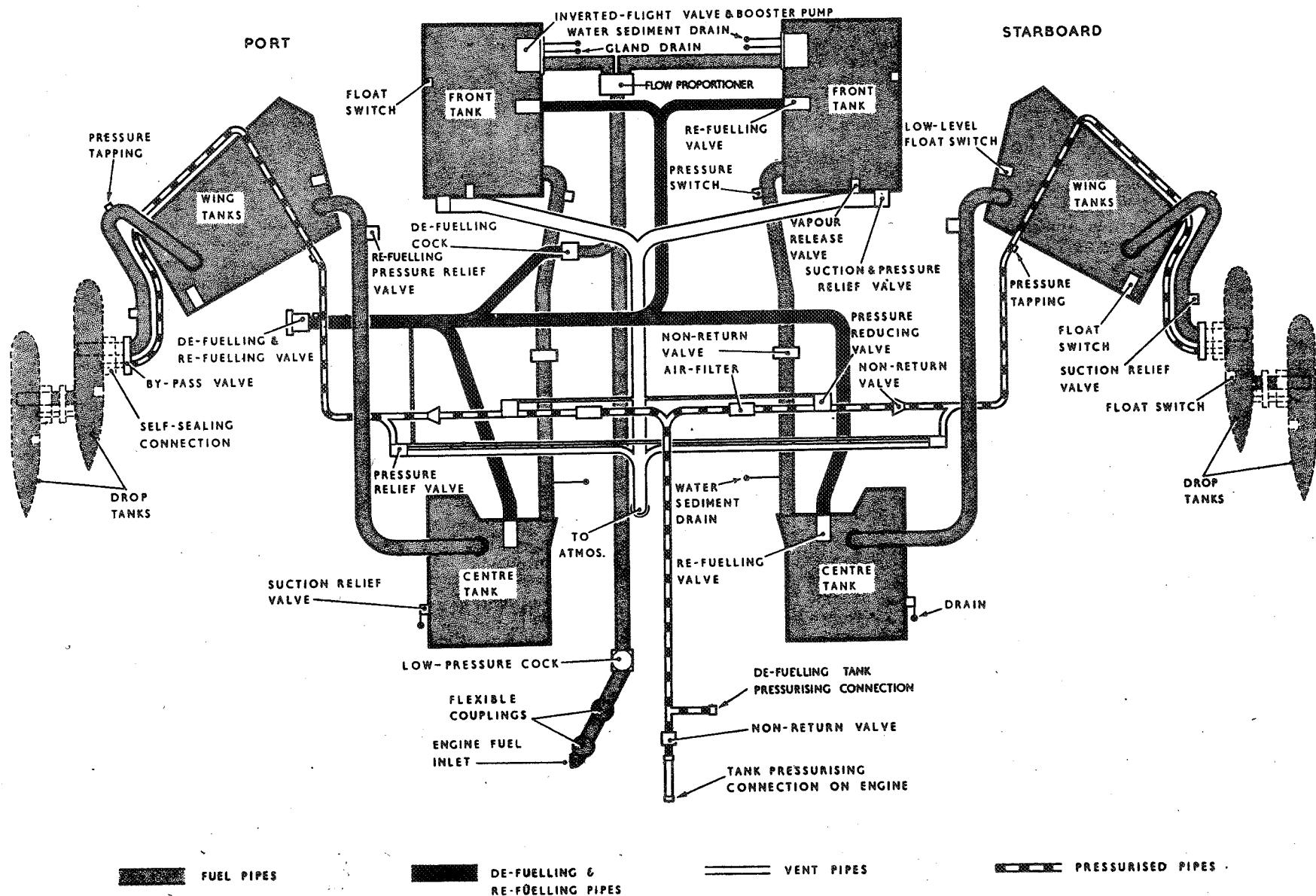


Fig. 2. Fuel system diagram

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valve in each side and a by-pass valve to permit flow if the pump rotor jams. Providing that the inlet pressures to the unit do not differ by more than 2 lb. per sq. in., the flow proportioner ensures that equal amounts of fuel are taken from both sides of the tank system.

#### Delivery

8. The fuel is pumped to the engine-driven pumps from the front tanks by means of S.P.E. B.P.1007 tank booster pumps, with inverted flight valves, one of which is immersed in a negative g fuel trap in each front tank. The fuel traps each contain 6 gallons of fuel, together allowing for just over 15 seconds 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. per sq. in. for no flow, dropping to about 21 lb. per sq. in. for a flow of 500 gallons per hour each and 17 lb. per sq. in. for 1,000 gallons per hour for one pump when the other tank is empty. 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. 7A), 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

9. The dual engine-driven pump is of the positive-displacement multi-plunger type, the delivery being controlled by variation of the stroke 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

10. The low-pressure fuel cock control is mounted in the cabin on the 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. It should never be turned off before the H.P. cock. The high-pressure fuel cock control is mounted in a quadrant also on the 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.

#### Throttle control

11. The throttle control is mounted in the cabin on the port shelf and moves forward from OFF to ON. The throttle consists of a profiled plunger, movement of which varies the flow of fuel to the burners.

#### Fuel contents gauges

12. The fuel contents gauges are grouped together on the forward portion of the starboard shelf. 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.

#### Engine fuel pumps isolating switch

12A. A switch mounted in the cabin on the forward portion of the port shelf is provided to energize 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 26 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 on the starboard side instrument panel.

#### Note . . .

*When locking the switch with the 26 s.w.g. locking wire only one strand of the wire is to go round the switch dolly.*

#### Fuel pump test switches

13. A selector switch and an ammeter socket, both of which are mounted on the starboard shelf, are provided for testing the

fuel pumps. The fuel pump circuit breakers, which are mounted on the same shelf, should be tripped before the pumps are tested.

#### Suction and pressure relief valve—front tanks

(fig. 3)

14. 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 11 lb. per sq. in. 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 pressurization system fail, thus preventing the formation of a vacuum and possible collapse of the tanks. The valve is lightly loaded, being set to open at a pressure below  $\frac{1}{2}$  lb. per sq. in.

#### Suction relief valves—centre tanks (fig. 5)

15. These are simple spring-loaded valves designed to open at a pressure below  $\frac{1}{2}$  lb. per sq. in. One is fitted to each centre fuselage tank and one in the drop tank by-pass pipe. 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.

#### Vapour release valves (fig. 6)

16. Under some 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 or vapour to escape to atmosphere and the fuel to transfer. A weighted arm overrides the valve while it is under negative g conditions, thus rendering

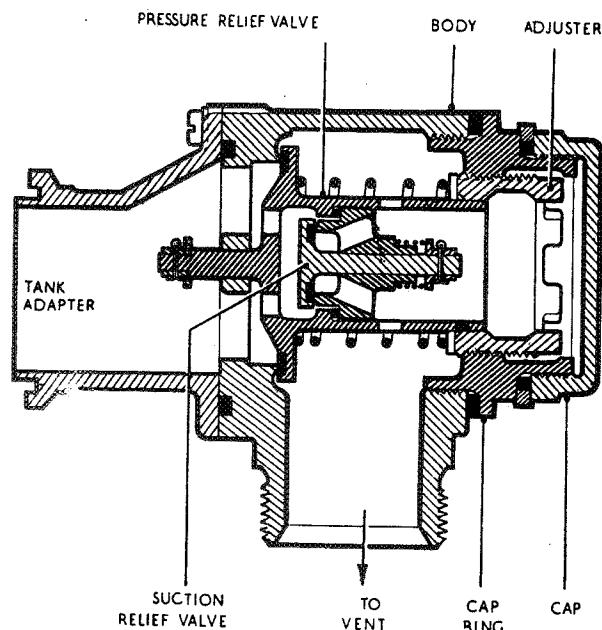


Fig. 3. Suction and pressure relief valve

it incapable of opening and passing fuel to the vent pipe.

#### Fuel filter de-icing (if fitted)

16A. 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 fuel and forms ice crystals if the fuel 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.

16B. The fuel filter de-icing tank is of stainless steel, partly for its non-corrodible properties, but mainly to increase the fire resistance of the system as it is mounted in the engine bay. The tank is provided with a suction and pressure relief valve (fig. 8). The valve opens at less than  $\frac{1}{2}$  lb. per sq. in. suction and at 6 lb. per sq. in. pressure, the

pressure setting being to prevent excessive alcohol loss due to boiling. A Plessey priming pump Type F.P.3 Mk. 3 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. per sq. in. The system is controlled by a F.A.W/A/325 Teddington control valve.

16C. 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 the pressure drop returns to normal, the pressure switch opens. This stops the pump and closes the valve. A filter is inserted in the pipe line from tank to pump and a non-return valve in the line from the pump to the fuel system. The metering jet, where alcohol enters the fuel, is  $\frac{1}{16}$  in. dia. orifice protected by a small filter. Filling of the system is given in Sect. 2, Chap. 2.

#### Refuelling

17. The aircraft is refuelled by pressure through a standard  $1\frac{1}{2}$  in. coupling in the port wheel bay. The  $\blacktriangleright$   $\blacktriangleleft$  de-fuelling cock, which is accessible through the engine starter access door aft of the main spar in the bottom of the fuselage, must be turned off when refuelling, otherwise the engine pump seals will be damaged. A time switch adjacent to the refuelling coupling must be turned on. This switch energizes the refuelling circuit (Sect. 5, Chap. 1). Smith float switches in the front and Flight Refuelling switches in the 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

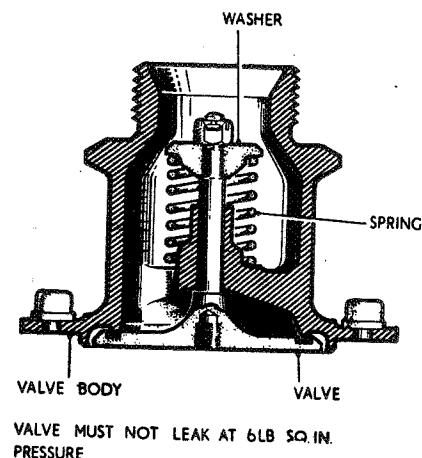


Fig. 4. Refuelling pressure relief valve

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 tank vents are set at 11 lb. per sq. in. The wing tanks are vented through a relief valve which

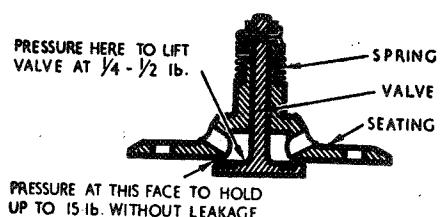


Fig. 5. Suction relief valves (centre tanks)

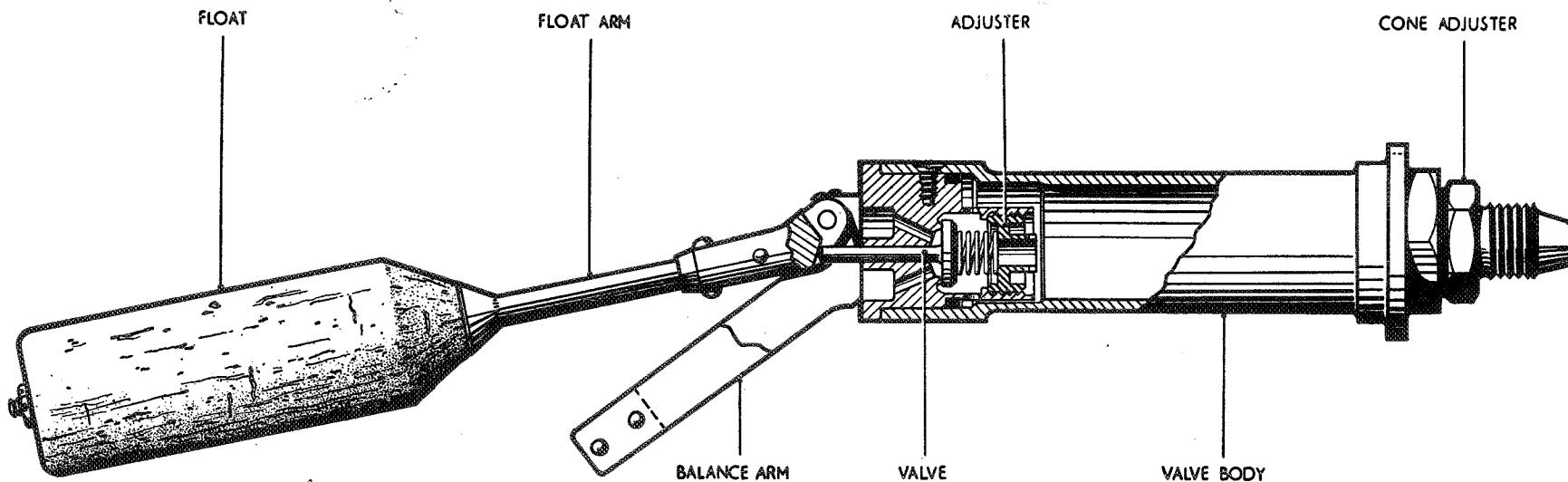


Fig. 6. Vapour release valve

normally opens at 7 lb. per sq. in. During refuelling, fuel pressure is applied to a bellows which off-loads the valve and reduces the opening pressure to 2 lb. per sq. in. This is to keep the refuelling pressure in the system to an acceptable value. The 7 lb. per sq. in. valve is a safety valve which operates only when the refuelling valves fail. 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 at a pressure below  $\frac{1}{2}$  lb. per sq. in. These valves operate in an opposite or inward direction and allow air to enter the tanks should the pressure fail, thus avoiding a negative pressure and consequently collapse of the tanks. Suction relief valves set to open at a pressure below  $\frac{1}{2}$  lb. per sq. in. are also fitted to the centre and wing tank assemblies. These are fitted between the tanks and the tank body to prevent back

The procedure for refuelling the system is described in Section 2, Chapter 2 of this volume.

#### Defuelling

18. Defuelling is effected from the refuelling coupling in the port wheel bay. *The defuelling cock, accessible via the engine starter access door, aft of the main spar in the bottom of the fuselage, must be turned on during defuelling.* An air pressure of 10 lb. per sq. in. 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 pressurizing 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 normal pressurization. The procedure for defuelling the fuel system is described in Section 2, Chapter 2.

#### SERVICING

##### General

19. Scrupulous cleanliness is essential dur-

ing 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 allowed 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 Section 2, Chapter 2 of this volume.

##### Water sediment drains

20. 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 given in Section 2, Chapter 2 of this volume.

March, 1958

Air Publication 4347D

Air Ministry

Volume 1

HUNTER F Mk.4 AIRCRAFT

ADVANCE INFORMATION LEAFLET NO. 1/58

Insert this leaflet to face Vol. 1, Sect. 4, Chap. 2, para. 19

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After para. 19, add the following NOTE:-

NOTE . . .

When replacing the 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 which do not have the painted red line, the pipe should be turned until a clearance of 0.3 in. is obtained with the temperature control actuator fully extended. This method of assembly is most important in order to ensure the correct operating clearance between the pipe and the control rod of the top temperature control actuator.

NOTE.-(1) The information contained in this leaflet will be incorporated by normal amendment list action in due course.

(2) If, after receipt of this leaflet, an amendment list with a prior date and conflicting information is received, the information in the leaflet is to take precedence.

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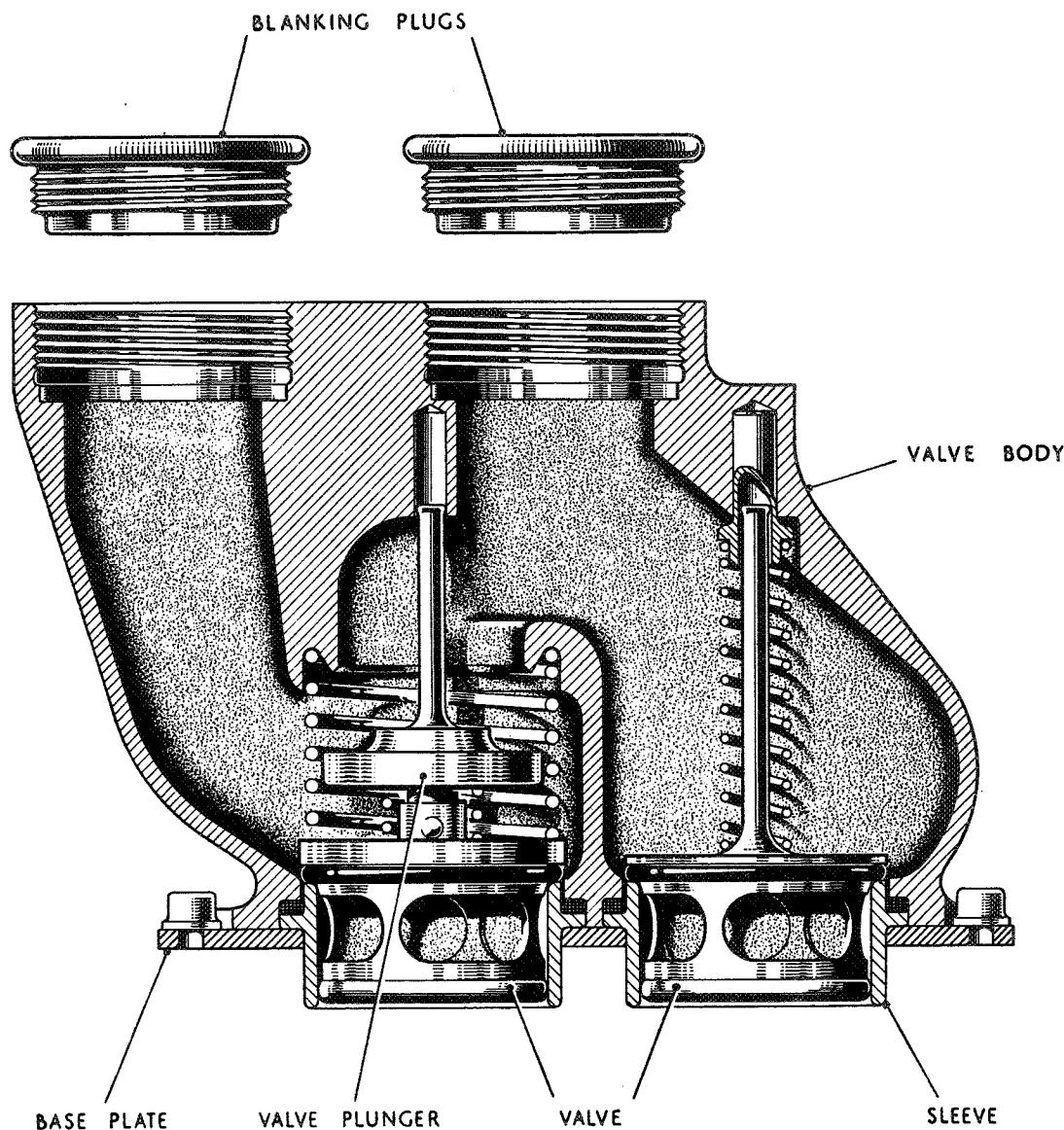


Fig. 6a. Fuel and air valve for inboard pylon

**Refuelling pressure relief valves**

21. The refuelling pressure relief valves in the underside of the stub wings should be checked to ensure that they are free to operate

by screwing a  $\frac{1}{4}$  in. B.S.F. bolt into the valve and pulling the valve down. This is particularly important if the aircraft has not been flown for an appreciable length of time.

**Low-pressure fuel cock control**

22. 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.*

**Replacement of fuel pipe-lines**

23. Before attempting to replace fuel pipe-lines that have been removed during servicing, or when fitting new pipe-lines, ensure that they are clean and unobstructed. Ensure also that the pipes are smooth internally, as sharp edges at joints, nipples, etc., can cause aeration of the fuel. When fitted, ensure that all connections are secure and effectively locked. The piping of the pressure system affected by the replacement should be pressure tested as follows:—

- (1) Engine feed lines 28 lb. per sq. in. *This can be satisfactorily approximated by pressurizing the tanks to operating pressure and switching on the tank booster pumps.*
- (2) Refuelling lines (with L.P. cock OFF) 50 lb. per sq. in. *This can be done with the aid of the refuelling bowser.*

**WARNING**

*The test pressure of 50 lb. per sq. in. 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. per sq. in. (including head of pressure). *The tank pressure test described in para. 24 will cover this requirement.*
- (4) Air supply line—engine to tanks. Apply an air pressure of 120 lb. per sq. in. to the spine air connection, using Mk. 1 or Mk. 2 Pneumatic Servicing Trolley and adapter A.208035, and check for leaks. The tank pressure gauges should be observed and should not register more than 7 lb. per sq. in.

**Note . . .**

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

#### ◀ Fuel and air valve for inboard pylon

**23A.** The fuel and air valve unit should be checked for leaks as follows:—

- (1) Blank off the outlet port to the wing tanks, apply air pressure of 6 lb. per sq. in. to the inlet port and immerse the unit in water for 2 minutes. Increase the pressure to 20 lb. per sq. in. and immerse for a further 2 minutes. The unit must be leak proof.
- (2) Remove the blanking plug from the outlet port to the wing tanks, raise the inlet valve from the drop tank by 0.65 in. and apply a pressure of 3 lb. per sq. in. to the inlet port. There should be no leaks at the outlet port to wing tanks when the unit is immersed in water.

**Note . . .**

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

#### Ground pressure testing of fuel system

**24.** The fuel system installation, including tanks, should be pressure tested as follows:—

- (1) Fit bung (Part No. A.207899) into 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 through 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 front tanks relief valves. (Access panels, top centre fuse-

lage, 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. 207700) and thence to external air supply trolley.
- (5) Apply an air pressure of 13½ lb. per sq. in. *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. per sq. in.*

- (6) When the test has been satisfactorily completed, all bungs and other test equipment must be removed immediately. *This is especially important before refuelling or before flight.*

**WARNING**

*The air brake is on no account to be operated while the bung is assembled to the rear tanks vent pipe.*

#### ◀ Ground pressure testing the fuel filter de-icing system (when fitted)

**24A.** 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, a relief valve and associated piping. The procedure for ground pressure testing is as follows:—

- (1) The alcohol tank must be full, the fuel system primed, the L.P. cock OFF and the throttle closed (i.e., H.P. cock OFF).
- (2) Remove the blanking cap from the King drain valve on the fuel delivery pipe in the engine bay and fit the pipe of the test equipment (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. per sq. in. Inspect for leakage in the low pressure system from tank to pump.

- (5) If no leakage occurs in the low pressure system, remove the external air equipment from the tank vent and operate the test switch to start the pump and inspect for leakage from pump to fuel delivery line. With pump running, the pressure on the gauge should rise to 45 lb. per sq. in. *To avoid unnecessary spillage from the test equipment relief valve, do NOT run the pump any longer than is necessary to conduct the test.*

**WARNING**

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

#### Checking the fuel filter de-icing system (when fitted)

**24B.** To check the fuel filter de-icing system, use the same equipment described in para. 24A as follows:—

- (1) Prepare the aircraft as described in para. 24A, 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 rise to 45 lb. per sq. in. Switch off, without delay, once this pressure has been attained, in order to avoid unnecessary spillage from the test equipment relief valve.

**WARNING**

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

#### REMOVAL AND ASSEMBLY

**General**

**25.** When handling the tanks, extreme care must be taken to ensure that they are not damaged. Under no circumstances are they to be dragged across the floor as such treatment will cause damage to the outer surface of the tanks. When taken out of the aircraft, they should be laid on a layer of felt. The fact that the tanks are flexible does not

mean that they may be folded indiscriminately. During removal or installation they should not be folded any more than is absolutely necessary. It is particularly important to remember that the capacitors for the fuel gauges are built into the structure of the tanks and, consequently, may be damaged if the tanks are subjected to rough handling. Under no circumstances may implements of any nature, or material of any kind, be inserted into the tanks to push them into the shape of the tank bays during installation, as to do so will cause serious damage to the tanks and capacitors.

**26.** To prevent leakage at the tank unit connections after assembly, it is important that the two countersunk screws at each tank opening are flush with the structure. The following method of assembly must be adopted:—

- (1) Check that the inner sealing washer is in place on the tank studs. To retain the washers on the studs while fitting the tank, the face of the washer in contact with the tank may be lightly smeared with graphite grease.
- (2) Fit the studs into the holes provided in the tank bay skin and screw down the nuts on the studs adjacent to the countersunk screw holes (four nuts for the Marston tank and two nuts for the Fireproof tank).
- (3) Fit and screw down flush the countersunk screws (2 B.A. for Marston tank and 4 B.A. for Fireproof tank). Remove the nuts, fit the outer sealing washers, fit the unit and bolt down.

#### **Removal of front fuel tanks (fig. 7)**

##### **General**

**27.** 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 of the following paragraphs 28–36. Paragraphs 37 to 39 give notes on assembly.

##### **Preliminaries**

**28.** 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 gun package (*Sect. 7, Chap. 3*).
- (4) Remove the wireless access door from under the fuselage between frames 16 and 18.
- (5) Remove the wireless sets and structure (*Sect. 6, Chap. 1 and 2*).
- (6) Remove the fuel pump access door (12) and the fuel system access door (20).
- (7) Remove the fuel level switch access door (4) and the fuel vent connection access door (7).
- (8) Remove the tank door on frame 19.

##### **Removal of fuel contents gauge terminal box (fig. 7)**

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

- (1) Remove the eight nuts attaching the fuel contents gauge terminal box (10) to fuselage (frame 19).
- (2) Withdraw the terminal box sufficiently to disconnect the electrical cables (on early aircraft, the cables are soldered), then remove terminal box with sealing ring, making sure that the detached cables do not fall back into the tank. (While working at this location, remove the two countersunk screws attaching the fuel tank to the rear of frame 19.)

##### **Removal of fuel level switch (fig. 7)**

**30.** 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. (While on this location, remove the two countersunk screws attaching the fuel tank to the fuselage inner skin).

##### **Removal of tank retaining cords (fig. 7)**

**31.** 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. Alternatively, it may be found more convenient to insert a drill of suitable size into the tank retaining nuts and "chew" the cord knots until they are severed, taking care not to penetrate the tank skins or to damage the threads of the tank retaining nuts.
- (4) Pull out the severed cords and put back the screws.

##### **Disconnection of suction and pressure relief valve (fig. 7)**

**32.** At the connection of the suction and pressure relief valve, disconnection should be 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. 7)**

**33.** 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. 7)*

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

- (1) Remove the terminal box cover on 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, remove the four nuts, distance pieces and washers and the two countersunk screws attaching the support plate to the tank skin and remove the support plate. Remove the gun heating pipe from under the front port tank. Unclip and spread apart, where necessary, electrical cables running along the fuselage under the tank).

*Removal of booster pump and inverted flight valve (fig. 7)*

35. 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 (11).
- (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 at 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 by 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). (While on the same location, remove the four countersunk screws attaching the tank and sealing washer to the support plate).

*Removal of transfer pipe cover plate and tank (fig. 7)*

36. 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.

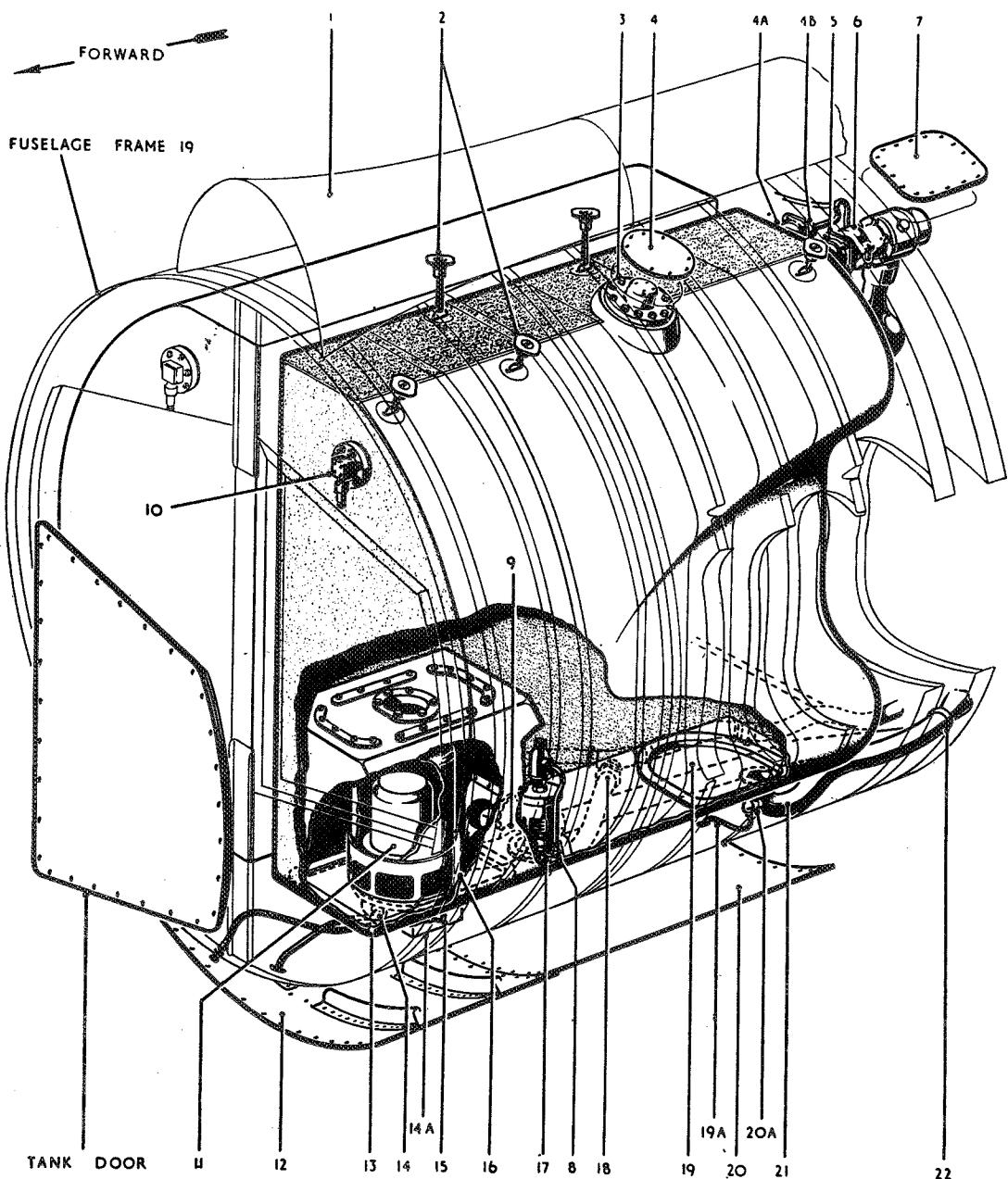


Fig. 7. Removal of front fuel tanks

- (3) Unscrew the thirty-two nuts and remove the cover plate and sealing ring.
- (4) Remove the four countersunk screws attaching the tank to the support plate.

The tank, which is now ready for removal, should be folded and withdrawn through the tank door in frame 19, ensuring that the sealing washers are left on the studs attached to the tank at the fuel contents gauge terminal box (10), the fuel level switch (3), the refuelling valve (8), the booster pump and inverted flight valve (11), and the transfer pipe cover plate (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.

#### Assembly of front fuel tanks (fig. 8, 9 and 10)

##### General

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

- (1) For ease of installation, the outer surface of the tank should be dusted with french chalk.
- (2) Ensure that the tank bay is clean, free from all foreign matter, nuts, washers, etc.
- (3) The suction and pressure relief valve connection and vapour release valve connection must each be fitted with a guide (Part No. A.194464, fig. 8).
- (4) All sealing rings and sealing washers must be examined for serviceability prior to use.

##### Assembly

38. Proceed with the assembly of the tank as follows:—

- (1) Remove the screws from the five tank retaining nuts.
- (2) Procure about 40 yards of 8 oz. kite cord (Stores Ref. 32A/107), cutting the cord into five lengths of about 8 yards.
- (3) Thread the kite cord through the nuts into the tank bay and out through the tank door in frame 19.

- (4) Pass the cords through the buttons on top of the tank (fig. 7, item 2, and fig. 10), form each cord into a loop about 12 in. long and securely whip end.
- (5) Carefully fold the tank and push it into the tank bay. Pull all cords until the tank is held against the tank bay 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. 10) and pull 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.

##### Miscellaneous precautions

39. During assembly, the following precautions should be taken:—

- (1) 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.
- (2) All internal fittings, pumps, contents gauge units, etc., should be examined for damage and corrosion.
- (3) Before tightening up the slip knots, ensure that the tank skin studded plates are positioned correctly and that the holes for the countersunk screws are set squarely against the holes drilled in the fuselage structure. Also ascertain 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, that the grooves are engaged correctly with the locking plates on the aft face of the main spar and that the locating lug on the vapour release valve connection is at the top.

Unless these precautions are taken it is possible for the connections to be fractured.

#### Removal of centre fuel tanks (fig. 11, 12 and 13)

##### General

40. 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 41 to 50. Paragraphs 51 and 52 give notes on assembly.

##### Preliminaries

41. 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. 3, Chap. 4).
- (4) Remove the rear fuselage (Sect. 3, Chap. 1).
- (5) Remove the engine starter access door (Sect. 2, Chap. 4, fig. 2), the suction relief valve access door and the fuel vent connection access door.
- (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. 11)

42. The refuelling valve must be removed as follows:—

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

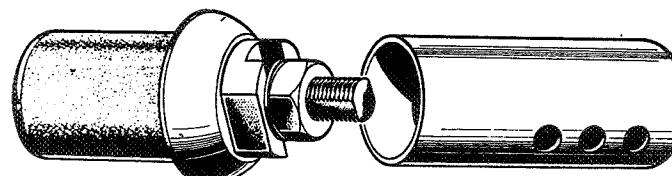


Fig. 8. Guide for suction and pressure relief valve connection

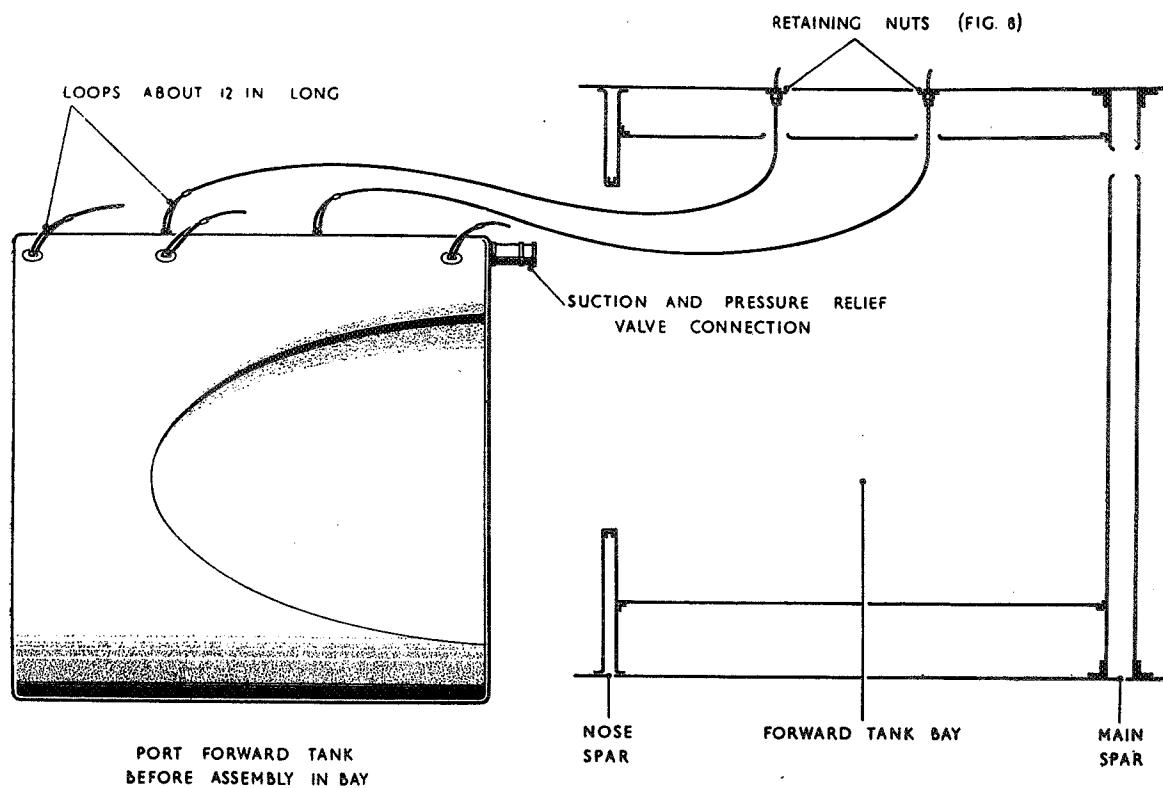


Fig. 9. Method of installing front tanks

- (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 twelve nuts and remove the valve and sealing washer. (While on the same location, remove the two countersunk screws attaching the sealing ring to the lower tank skin).

*Removal of fuel transfer pipe connecting the front and centre tank (fig. 11)*

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

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

- (2) Remove the split pin and clamp (6) from the non-return valve (7) and remove the non-return valve.
- (3) Unscrew the eight nuts (3) attaching the pipe to the forward face of the tank lower 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). (While at this location, remove the two countersunk screws attaching the sealing ring to the tank lower skin and free the tank studs).

*Removal of fuel contents gauge terminal box (fig. 11)*

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

- (1) Unscrew the eight 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 (these are soldered connections on early aircraft).
- (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. (While at this location, remove the two countersunk screws attaching the fuel tank to the rear face of frame 27).

*Removal of suction relief valve (fig. 13)*

**45.** The suction relief valve is removed as follows:—

- (1) Unscrew the eight screws attaching the gauze door to the outer skin and remove the door.
- (2) Unscrew the six nuts attaching the suction relief valve (11) to the valve mounting bracket and remove the valve together with the sealing washers. (While at this location, remove the two countersunk screws attaching the sealing ring and tank to the valve mounting bracket).

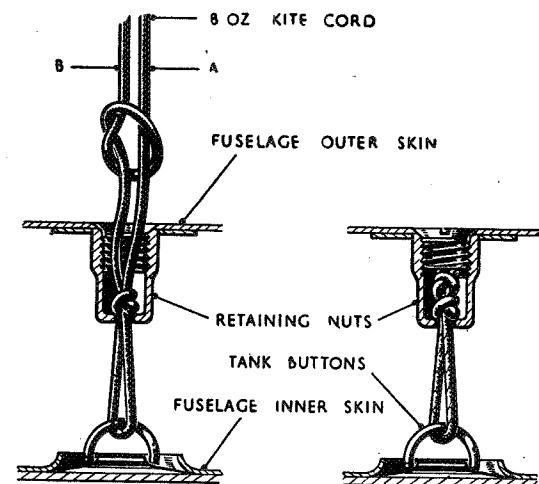


Fig. 10. Securing the tank cords

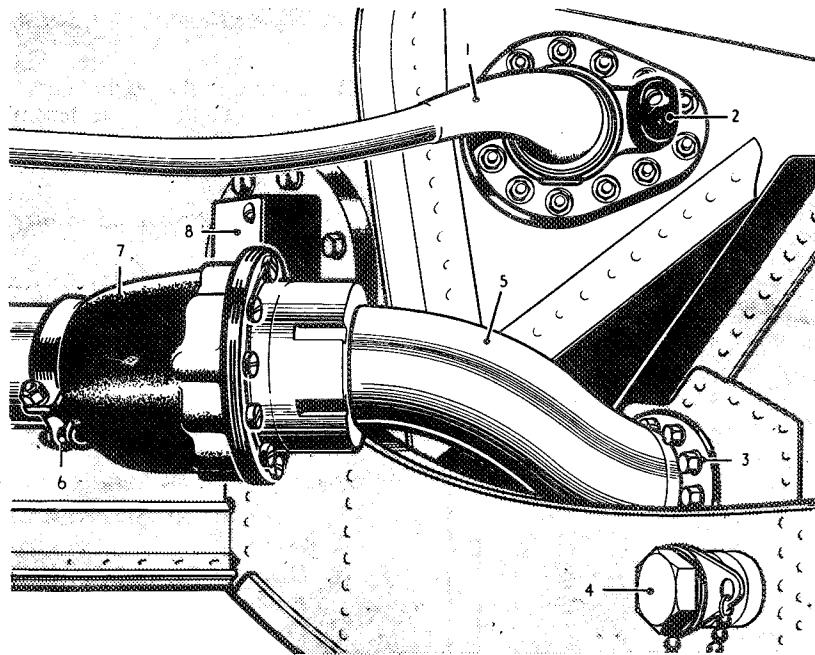


Fig. 11. Removal of centre fuel tanks (1)

*Dismantling pressurization duct (fig. 13)*

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

*Removal of transfer pipes connecting centre to wing tanks*

47. 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 releasing the bolts at the flanges (port and starboard).
- (4) Carefully withdraw the pipes from the tanks.

*Removal of blanking plate (fig. 12)*

48. The blanking plate is removed as follows:—

- (1) Remove the eight nuts (9) from the studs securing the blanking plate and remove the plate and sealing washer.
- (2) Remove the two screws securing the tank to the panel and ease the eight studs carefully through the holes in the tank support panel, taking with them the sealing ring and at the same time avoiding damage to the tank skin.

*Removal of centre tank support panels (fig. 13)*

49. 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 two access doors (20), the top access door (14), the rubber sealing (16) and the bottom access door (18).

- (3) Unscrew the bolt which passes through the pressurizing 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 main tank bay support panels. If desired, these may be removed in four pieces by removing the bolts along the panel joint situated below the pressurising duct.

*Removal of tank retaining cords and tank (fig. 13)*

50. 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.

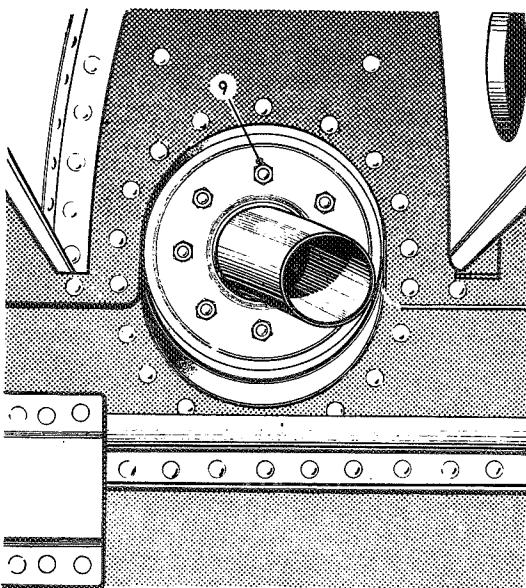


Fig. 12. Removal of blanking plate

(3) Replace the screws and withdraw the tank, ensuring that all sealing washers are retained on the tank studs at the refuelling valve, fuel transfer pipe, fuel contents gauge terminal box and suction relief valve.

Pipe lines must be blanked off immediately after removal to prevent the ingress of dirt or moisture. Any fuel 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.

**Assembly of centre fuel tanks (fig. 14)**

*General*

51. 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 all foreign matter, nuts, bolts, etc.
- (2) Ensure that all sealing rings and sealing washers are serviceable before re-use.
- (3) For ease of installation, the outer surface of the tank, inside of the bay, and tank support panels should be dusted with french chalk.

**Assembly (fig. 14)**

52. Proceed with the assembly of the tanks as follows:—

- (1) Remove the screws from the six tank retaining nuts (10, fig. 13).
- (2) Obtain about 40 yards of 8oz. kite cord (Stores Ref. 32A/107) and thread the cord through the six nuts into the tank bay and back through the top tank assembly hole in the structure at the rear spar and pass the cord through the buttons on the tank.
- (3) Thread three lengths of kite cord through both port and starboard fuel vent connection access doors (Sect. 2, Chap. 4, fig. 2), pass the cord through the holes in frame 26 into the tank bay and back through the top tank assembly hole in the structure at the rear spar and pass the cords through the buttons at the top of the front face of the tank.

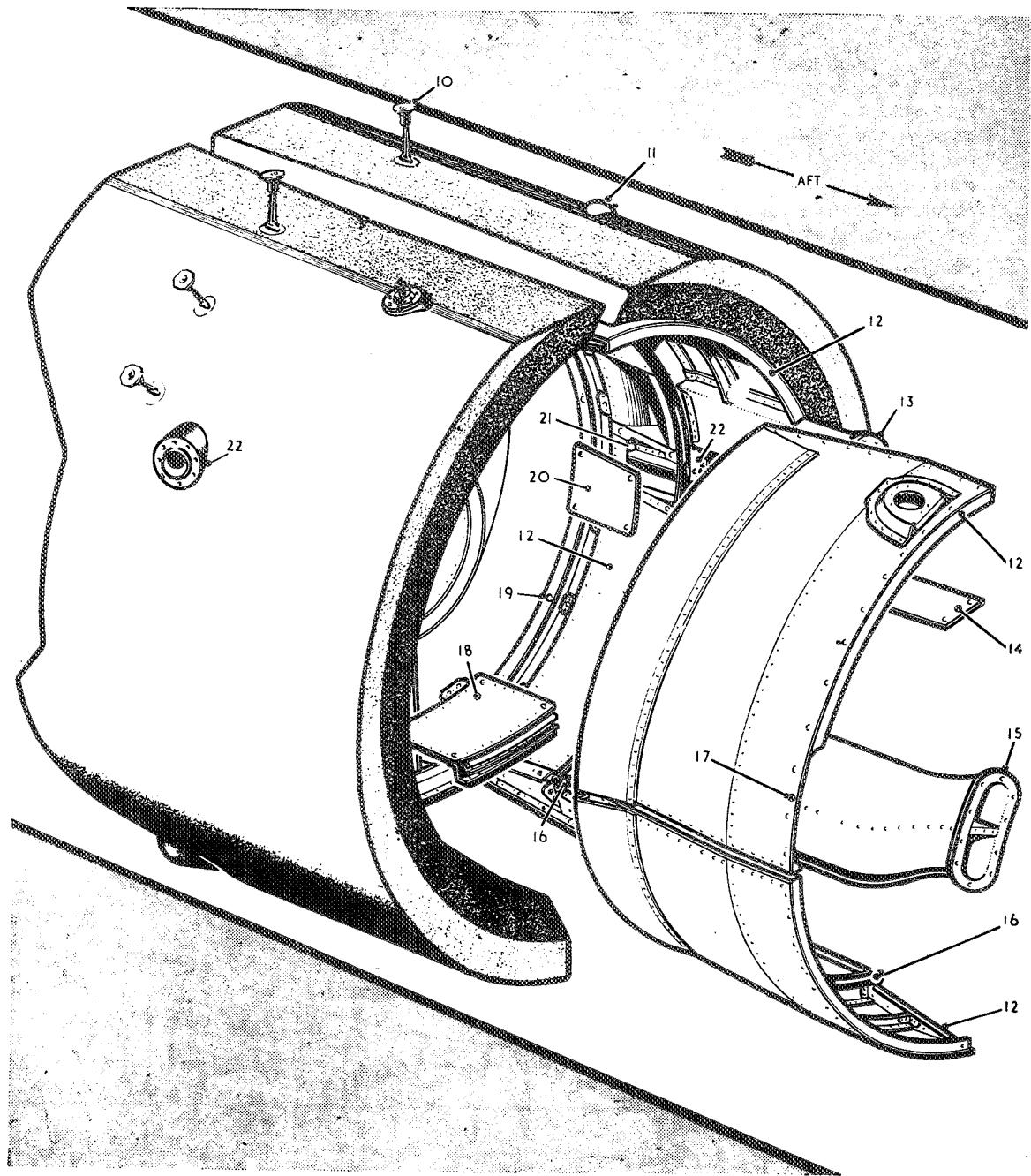


Fig. 13. Removal of centre fuel tanks (2)

(4) Pass two lengths of cord up through the engine starter access door (Sect. 2, Chap. 4, fig. 2) and pass the cords through holes in frame 27 into the tank bay and up through the bottom tank assembly hole in the structure at the rear spar, and then pass the cords through the buttons at the bottom of the front face of the tank.

**Note . . .**

*Before assembling the tank, observe the precautions given in para. 25 and 26.*

(5) Position the tank adjacent to the assembly hole in the structure and insert the tank.

(6) Pull all cords until the tank is held against the skin and the kite cord appears through the tank retaining nuts.

(7) Cut the cords and tie one end of the cord round the other in a slip knot (fig. 10) and pull down into the retaining nut. Tie another slip knot (around the other end of the cord this time) and work down into the retaining nut as far as possible.

(8) Cut both ends of the cord at outer skin level, put back the screw and lock by peening the skin into the slot.

All external fittings, contents gauges, refuelling valves, etc., should be examined for corrosion and damage before assembly.

#### Removal of wing fuel tanks (fig. 15)

##### *General*

53. The removal of the port wing tanks is described, the starboard wing tanks being similar. The removal should be carried out in the order described below.

#### Preliminaries

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

#### Removal of fuel contents gauge terminal boxes

53A. The four fuel contents gauge terminal boxes, one in front of each wing tank, are each removed in-situ with the tanks. The interconnecting cables between them must be disconnected and removed prior to the removal of the tanks. The instructions for the removal of an unserviceable terminal box are

similar to those given below for the terminal box housed in the rear of the tank. The fuel contents gauge terminal box at the rear of the tanks is removed as follows:—

- (1) Remove the nuts attaching the terminal box to the wing 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)

54. Remove the twelve tank-stud nuts and washers securing the outlet pipe mounting plate to nose rib A, then withdraw the pipe assembly. Remove the two set screws locating the tank to nose rib A (these being omitted when Fireproof tanks are fitted) and push the tank studs inwards to free the

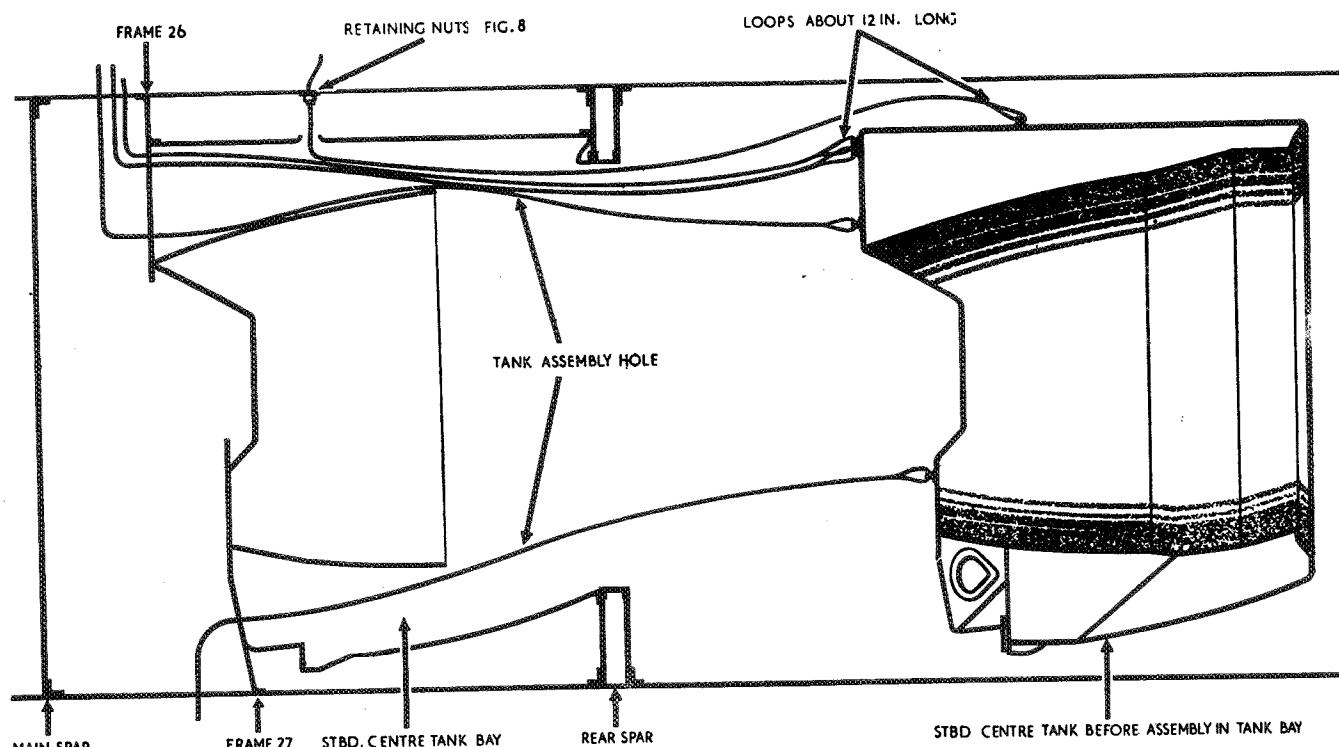


Fig. 14. Method of installing centre tanks

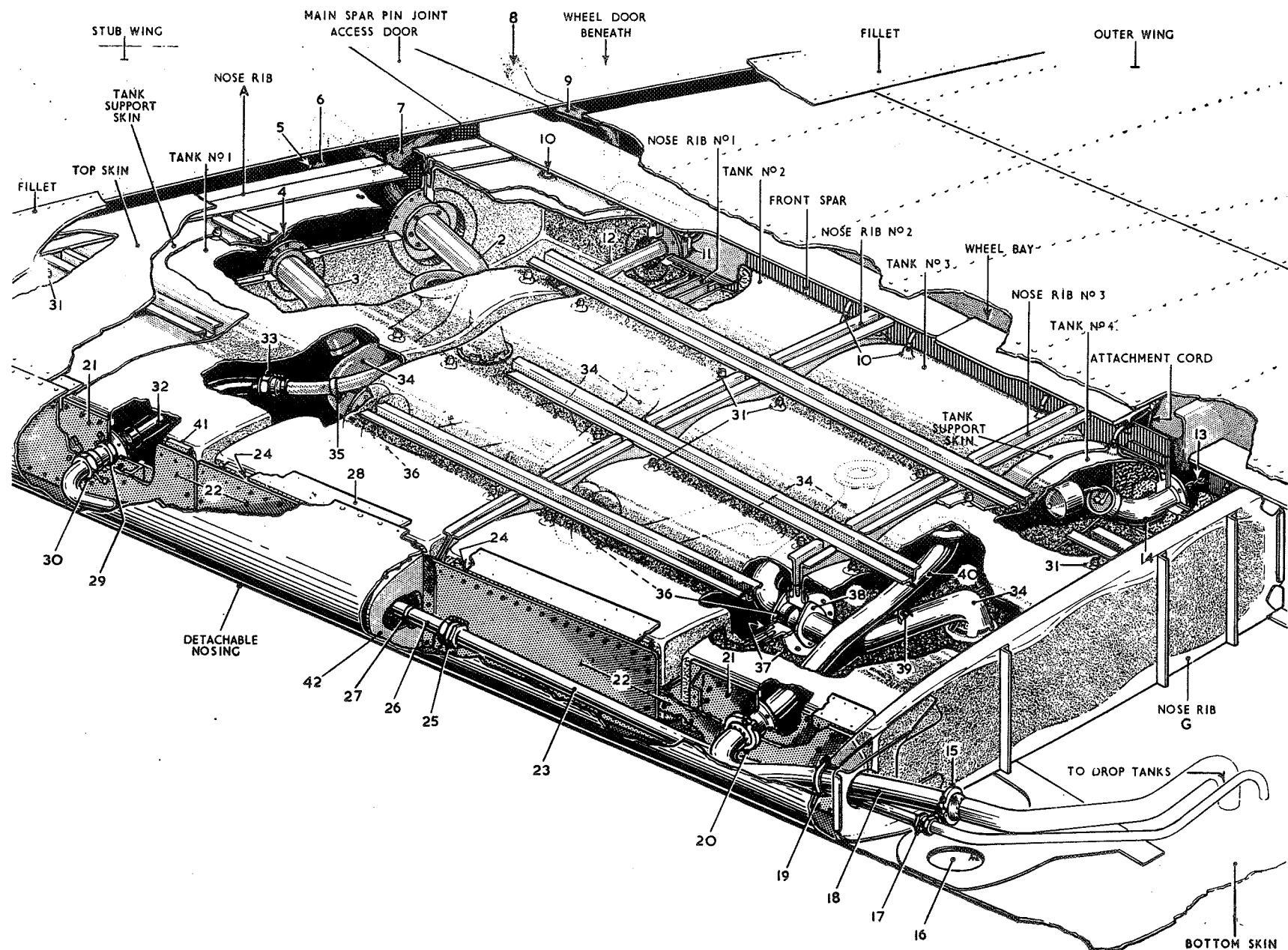


Fig. 15. Removal of wing tanks

tank from the structure. Retain the seals for re-assembly.

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

55. Remove the electric cable plug (4) from its socket. Remove the seven 2 B.A. and one  $\frac{1}{4}$  in. B.S.F. tank-stud nuts and washers securing the assembly flange to nose rib A, then withdraw the switch assembly. Remove the two screws locating the tank to nose rib A (these being omitted when Fireproof tanks are fitted) and push the tank studs inwards to free the tank from the structure. Retain the seals for re-assembly.

#### *Removal of the nosing*

56. Remove the fifty 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)*

57. 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 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)*

58. 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 the four mounting plates (21) and (24)*

59. Remove the locking wire from the adaptor (29) and unscrew and retain the bonded washer for re-assembly. 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). Retain the seals for re-assembly.

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

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

#### *Removal of the inlet pipe (40)*

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

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

61. 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)*

62. 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 and retain the seal for re-assembly.

#### *Removal of refuelling level switch (14)*

63. Remove the electric cable plug (13) from its socket in the wheel bay. Remove the seven 2 B.A. and one  $\frac{1}{4}$  in. B.S.F. nuts and washers securing the flange to the front spar web and withdraw the switch. Remove the two set screws from behind the "U" seal flange locating the tank to the front spar and push the tank studs inwards to free the tank from the structure. Retain the seal on the spar web for re-assembly.

#### *Removal of tank interconnection pipes (34)*

64. The six tank interconnection pipes are similar but not interchangeable, and care must be taken to ensure their return to the appropriate tank upon re-assembly. Reaching through any two adjoining tanks, remove the two  $\frac{1}{4}$  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)*

65. Adjacent to the stringers, withdraw from the support skins the thirty-four integral rubber tank attachment buttons, lubricate with Hellerine fluid D.T.D.900/4388 (Stores Ref. N.I.V.) if necessary. The buttons are located as follows:—

Seven on the top and seven 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.

#### *Note . . .*

*Hellerine is the proprietary name for a mixture of castor oil and alcohol.*

#### *Tank eyelet cord attachment (10)*

66. 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. 15)*

##### *Preliminaries*

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

(1) Ensure that the aircraft is electrically safe (Sect. 5, Chap. 1).

- (2) Reference should be made to the precautions given in para. 25 and 26.
- (3) Ensure that the tank bays are free from foreign matter.

**Assembly**

**68.** Select sixteen 5-yard lengths of kite cord (Stores Ref. 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. Sprinkle a little french chalk in each bay and distribute evenly with a blast of air. Coat the thirty four tank buttons (31) with Helleine fluid (Stores Ref. N.I.V.) to assist insertion.

Concertina the tanks slightly and 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.

Proceed in the reverse order as described for removal (para. 64 and 65). When assembling the clamp rings (37) and the interconnection 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.

Proceed in the reverse order as described for removal (para. 63), 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. The set screws must be tightened as much as possible, as the flange bolts, when tightened, may force the set screws back and proud on the outer seal, thus causing possible leakage.

Proceed in the reverse order as described for removal (para. 62), ensuring that the "O" seal is seating evenly while tightening up.

Proceed in the reverse order as described for removal (para. 60 and 61).

Proceed in the reverse order as described for removal (para. 59), ensuring that the bonded washer is replaced beneath and not above the wiring lug.

Proceed in the reverse order as described for removal (para. 56, 57 and 58).

Proceed in the reverse order as described for removal (para. 54 and 55), and in each case the tightening of the set screws should be aided by pulling up on the adjacent studs, otherwise the flange, when tightened fully, may force the set screws back and proud on the outer seal.

Complete in the reverse order, using new locking wire and taking care that all seals are replaced in serviceable condition.



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