

Chapter 2 FUEL SYSTEM

(Completely revised)

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DESCRIPTION

Introduction

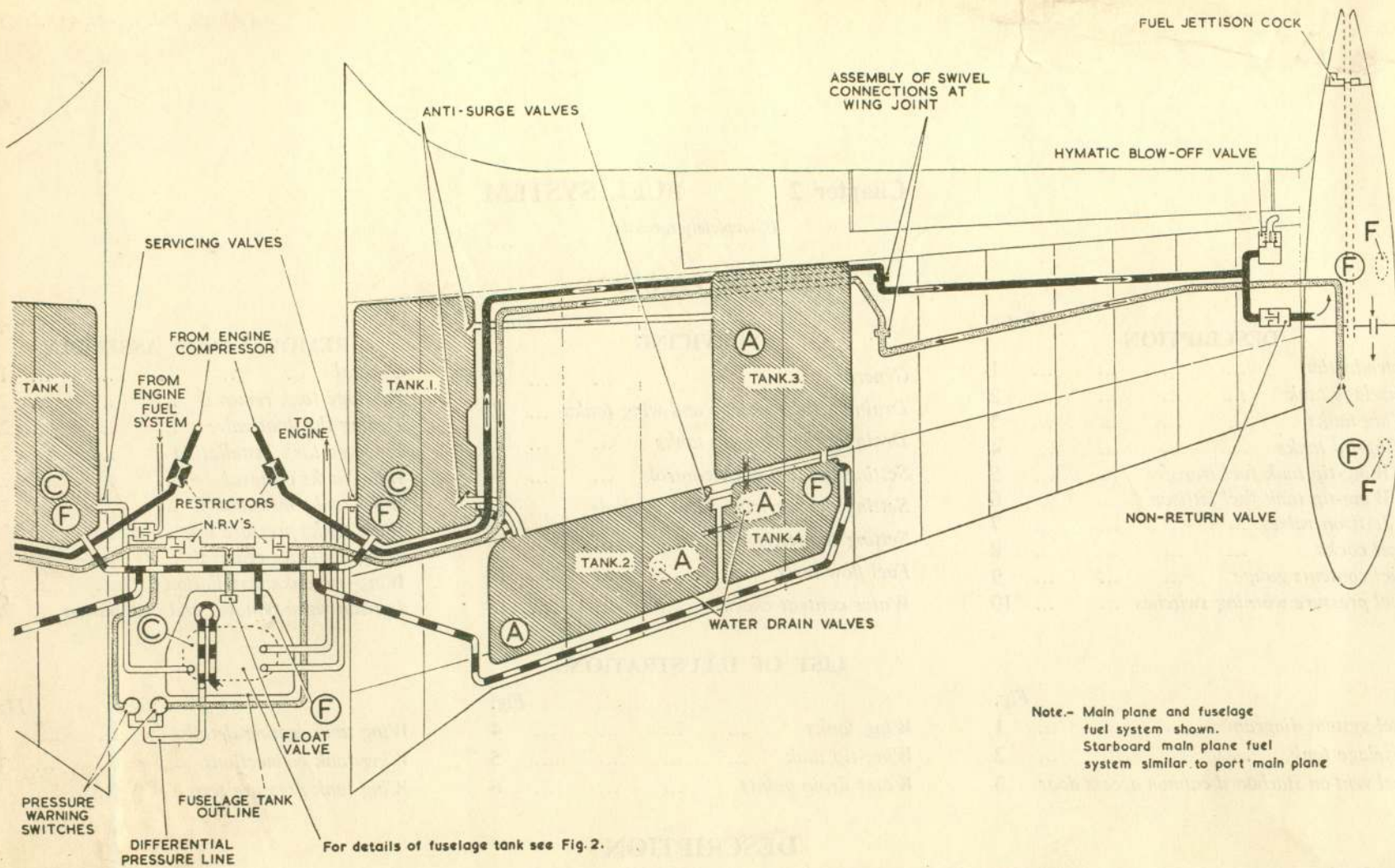
1. The fuel is contained in eleven tanks, the capacities of which are given in the Leading Particulars; the fuel system is illustrated diagrammatically in fig. 1. Four interconnected flexible bag tanks in each main plane supply fuel direct to a rigid fuselage tank. To each wing-tip is secured a streamlined rigid tank from which fuel is transferred to the fuselage tank by compressed air supplied from the engine diffuser casing. The fuel supply from all internal wing tanks is fed directly into a collector box or negative

g reservoir at the base of the fuselage tank, whilst the wing-tip tanks first feed into the top of the fuselage tank and then to the collector box. An electrically-operated booster pump, immersed in the collector box, supplies fuel to an engine low-pressure filter through a low-pressure fuel cock controlled from the cockpit. The combined contents of the fuselage tank and the eight flexible bag tanks are indicated by a Pacitor system on a single gauge in the cockpit. Fuel in the wing tip tanks can be jettisoned. For a detailed

description of the engine fuel system, reference should be made to A.P.4320B, Vol. 1.

Fuselage tank

2. The rigid fuselage tank (fig. 2) is installed between bulkhead No. 3 and the fireproof bulkhead. The collector box, which is housed in the base of the tank, is fed from the port and starboard main plane and fuselage tanks through non-return valves in the base of the collector box. Fuel from the collector







KEY			
CONTENTS GAUGE, TANK UNIT.	(C)	FUEL FEED	
FUEL FILLER	(F)	FUEL AIR TRANSFER	
ACCESS PANELS AND DOORS.	(A)	AIR PRESSURE	
		VENTING SYSTEM	

Fig. 1. Fuel system diagram

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box enters a pump chamber through two inlets, positioned near the base, which are fitted with gravity-operated clack valves, and also through an aperture at the top of the pump chamber; the immersed booster pump is housed in the pump chamber, and delivers fuel to the engine at a pressure of 8 p.s.i. A vapour vent pipe from the top of the collector box extends upwards into the tank; this is fitted with a gravity-operated vapour escape valve. The collector box also ensures the supply of fuel to the engine when the aircraft is subjected to negative g or inverted flight; under these conditions, the inlet gravity-operated clack valves to the pump chamber and the vapour escape valve close automatically, leaving available for use the contents of the collector box (a little less than four gallons), which is sufficient to feed the engine for approximately 15 seconds of inverted flight. A fuel drain and vent pipe within the tank leads to a vent to atmosphere below the starboard cannon access door; the upper end of the pipe is arranged to prevent fuel syphoning during catapult launching, and at the lower end, outside the tank, a differential pressure pipe from pressure warning switches (para. 10) in the wing-tip tank fuel transfer system is connected to the pipe at a special banjo union (fig. 3). The rear face of the tank has connections for vent pipes from the wing tanks and for fuel transfer pipes from the wing-tip tanks; the fuel transfer connection is coupled to a float valve (para. 5) in the tank. Pipes are provided to drain the fuel filler cap assembly and the booster pump gland.

Wing tanks

3. The arrangement of the flexible bag tanks in the main planes and the disposition of the pipe runs are illustrated in fig. 4, and the assembly and inter-tank connection details are shown in fig. 7 and 8. For general information and further details of flexible fuel tanks, reference should be made to A.P.4117A, Vol. 1 and Vol. 6, Sect. 3.

Wing-tip tanks

4. A streamlined rigid tank (fig. 5) is fitted to each wing-tip. Each tank is divided into two completely separate compartments by a

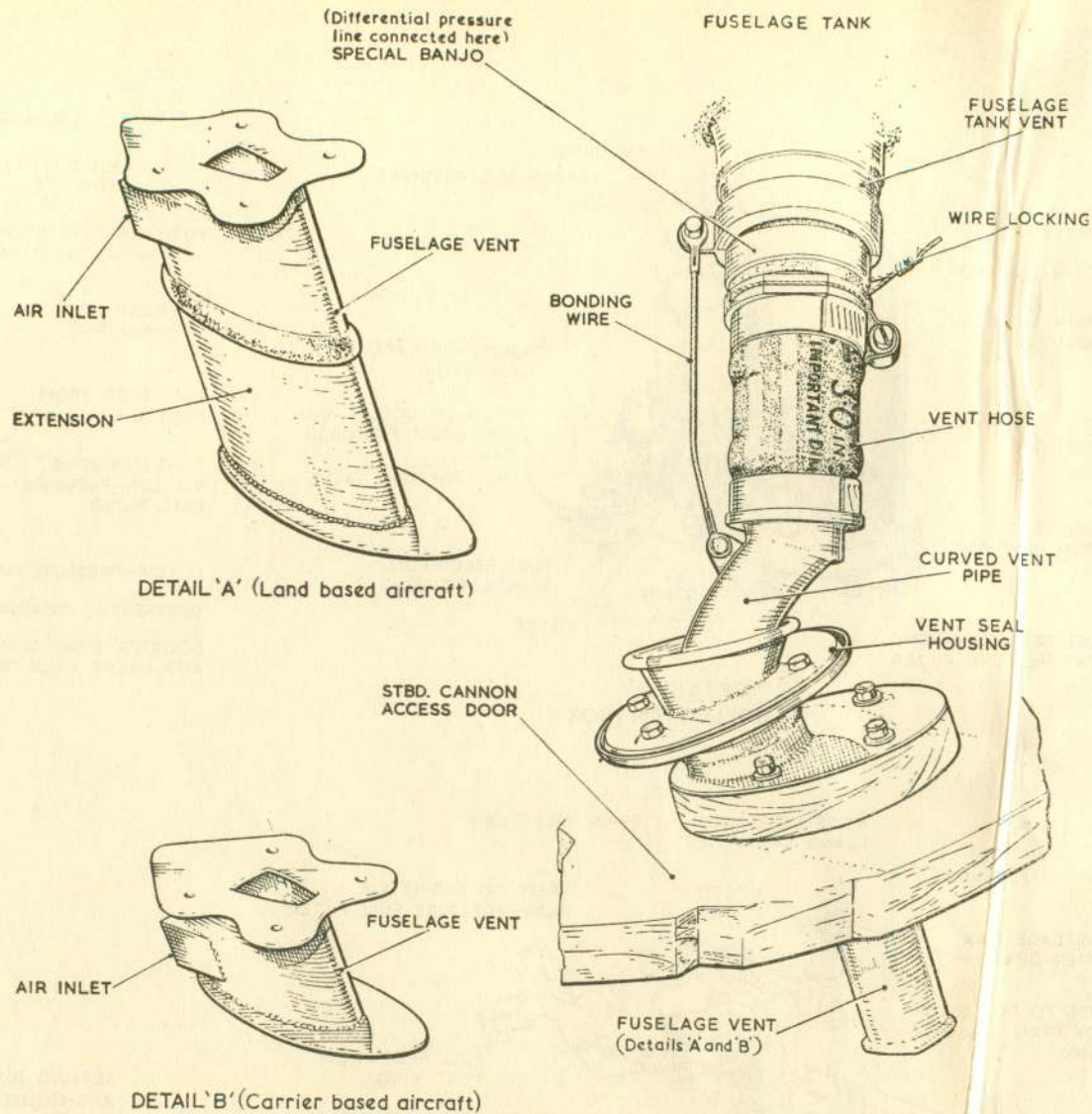
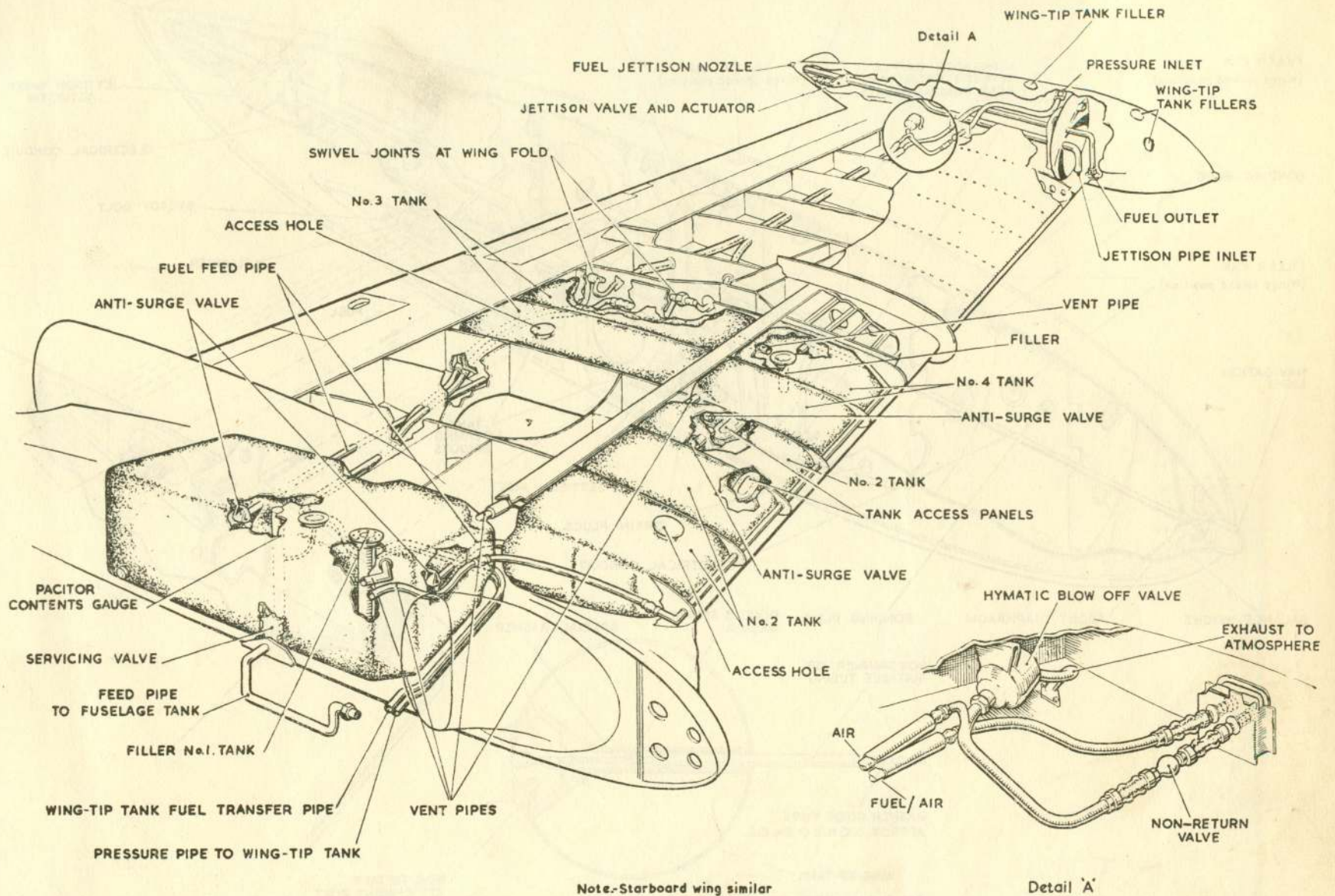


Fig. 3. Fuel vent on starboard cannon access door

tank separator baffle, and incorporates fuel transfer, jettison and electrical systems. The fuel and air pressure transfer connections engage with corresponding spring-loaded connections on the wing. Four small spring-loaded plungers, situated on the tank abutting

face aft of the fuel and air connections, register with contacts inset into the wing tip rib and connect the electrical supply leads for a navigation lamp and a jettison valve actuator; the leads are run in conduits through the fuel compartments.

RESTRICTED



Note.-Starboard wing similar

Fig. 4. Wing tanks

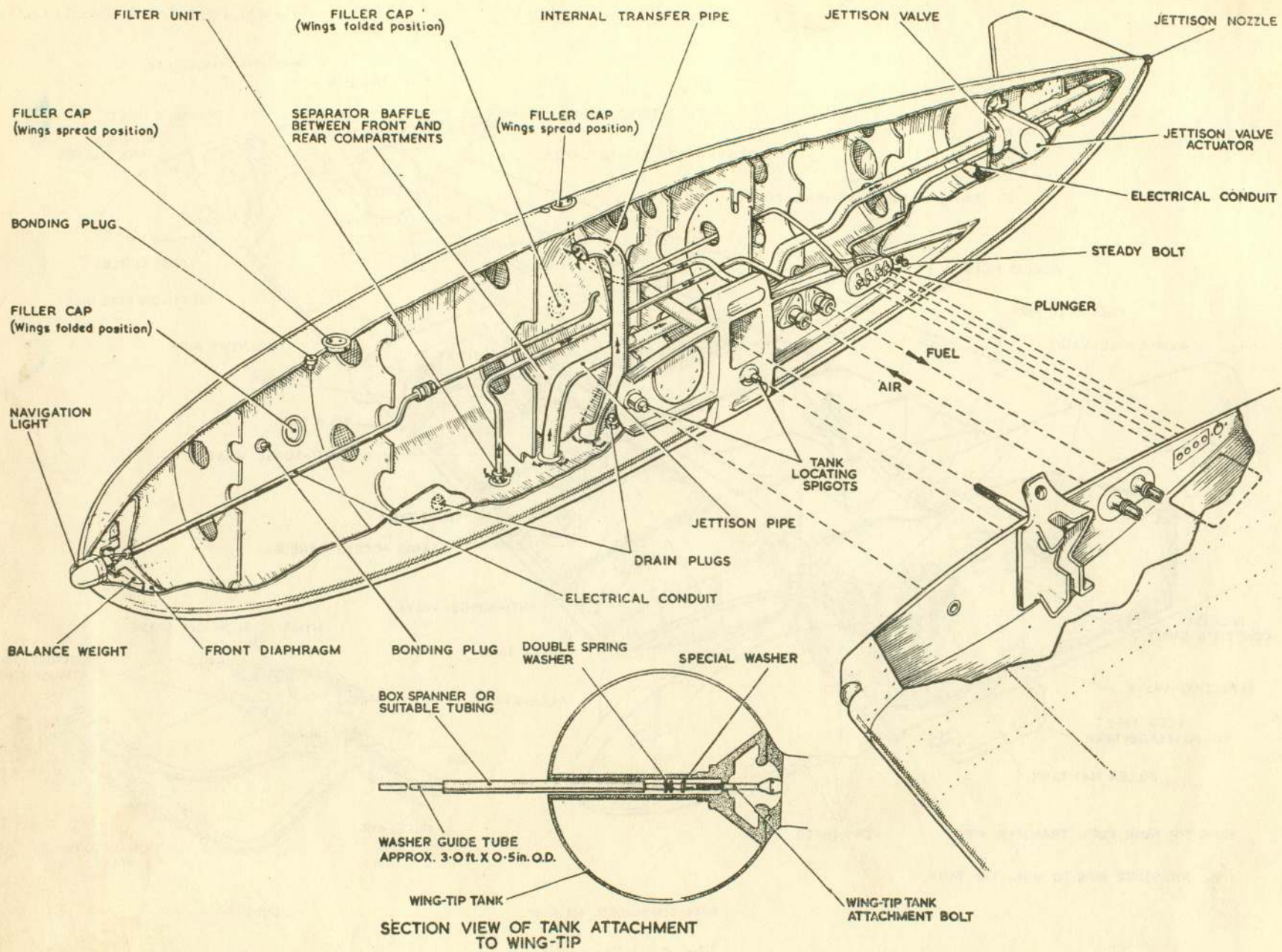


Fig. 5. Wing-tip tank

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Wing-tip tank fuel transfer

5. Compressed air from the engine diffuser casing is led to the rear compartment of each wing-tip tank through a supply line which incorporates a Hymatic blow-off valve (*fig. 4*) and a non-return valve. Fuel from the rear compartment of the tank is transferred to the front compartment through an internal transfer pipe (*fig. 5*), and then passes inboard through the fuel transfer pipe and a non-return valve to supply the fuselage tank (*fig. 1 and 2*). Fuel transfer is controlled by the float valve at the top of the fuselage tank; details of the valve are given in A.P.4117A, Vol. 1 and Vol. 6, Sect. 8, Chap. 4. When the fuel level falls below the level of the float valve, the valve opens to allow fuel to flow from the wing-tip tanks; the valve will remain open after the wing-tip tanks have emptied, and the transfer air pressure will be vented to the fuselage tank and thence to atmosphere. Back pressure is built up in the air supply line from the diffuser casing to each wing-tip tank when the engine is running, and pressure in excess of 6.25 p.s.i. is spilled to atmosphere through the Hymatic blow-off valve; a description of the Hymatic blow-off valve is given in A.P.4303C, Vol. 1, Sect. 4, Chap. 26.

Wing-tip tank fuel jettison

6. Fuel in the wing-tip tanks may be jettisoned by operating a switch just aft of the engine control box. With the switch in the JETTISON position, the actuators (*fig. 5*) will open jettison valves so that fuel is jettisoned through discharge nozzles in the tails of the tanks. The forward end of each jettison pipe passes through the separator baffle, where it is bent down to reach almost to the bottom of the front compartment of the tank; thus,

General

11. The procedure, for refuelling and defuelling, and the precautions to be observed during these operations, are given in Sect. 2, Chap. 2.

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with the jettison valve open, the transfer air pressure will force fuel from the rear and front compartments into the jettison pipe and thence to atmosphere. With the jettison switch moved to the CLOSE position, which is the normal position for the switch, the actuators will close the jettison valves.

Jettison valves

7. A 2 in. jettison valve, which is incorporated in the jettison pipe and is electrically-operated by a rotary actuator, is secured to the aft face of the rear diaphragm of the rear compartment of each wing-tip tank. Refer to Sect. 5, Chap. 1 for a description of the valve and actuator circuit.

Fuel cocks

8. Two fuel cock levers in the cockpit control the supply of fuel to the engine. The cock which controls the low-pressure supply is situated on the port side of the aft face of the fireproof bulkhead in the feed line from the booster pump to the low-pressure filter. The high-pressure fuel cock is incorporated with the throttle valve in the control box on the engine; this cock controls fuel delivery from the engine fuel pumps to the burners. The control system for each of these cocks is described in Chap. 1 of this Section. A servicing valve (*fig. 4*) is installed on the No. 1 rib of each main plane in the fuel line between the No. 1 tank and the fuselage tank; the valve, which can be operated only on the ground, isolates the fuel in the wing tanks from that in the fuselage tank when required; each valve gate lever is connected to an adjustable push-pull rod secured at its lower end to a small cover plate inset into the No. 1 tank panel.

SERVICING**Note . . .**

The flexible metallic hose couplings which are fitted to the air pipe to engine assembly (port and starboard) on the forward face of the diffuser casing, must be proof pressure tested (at one and a half times maximum working pressure) at the specified engine overhaul periods.

RESTRICTED**Fuel contents gauge**

9. The quantity of fuel in the combined fuselage and main plane tanks is indicated on the Pacitor fuel contents gauge on the top right-hand side of the pilot's instrument panel (*Sect. 1, Chap. 1*). Pacitor tank units are installed in the fuselage tank and in the No. 1 tank in each main plane; these units are not interchangeable. Refer to Sect. 5, Chap. 2 for the location of the components; a full description of the Pacitor system for fuel indication is given in A.P.1275A, Vol. 1, Sect. 18, Chap. 14.

Fuel pressure warning switches

10. Pressure warning switches are installed in the fuel system; each switch, which is set at a predetermined figure, completes a circuit and energises an indicator in the cockpit when the pressure is no longer maintained. One switch is mounted on the engine low-pressure filter outlet, and causes a magnetic indicator on the pilot's instrument panel (*Sect. 1, Chap. 1*) to show WHITE if the fuel supply pressure falls below 1.5 p.s.i. A pressure warning switch in the fuel transfer line from each wing-tip tank to the fuselage tank is situated on the starboard diagonal bracing strut in the fuselage tank bay; each switch is set to operate at 0.9 p.s.i. \pm 0.1 p.s.i., and causes a magnetic indicator, situated on the pilot's instrument panel, to change from BLACK to WHITE when fuel transfer is completed. Access to the switches can be gained by removing the starboard gun bay door. A full description of the pressure switches and of the method of adjusting them is given in A.P.1275A, Vol. 1, Sect. 11, Chap. 31.

Draining the fuselage and wing tanks

12. The contents of the fuselage tank and the main plane bag tanks are drained through a standard S.B.A.C. drain valve in the base plate of the fuselage tank; access to this valve is gained by removing the gun bay doors.

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The filler caps and the fuselage tank drain valve cap should be removed, a suitable container placed under the valve, the standard draining adapter (Detail A, fig. 6) fitted and the system drained; full details of this adapter appear in A.P.4117A, Vol. 1 and Vol. 6, Sect. 8, Chap. 3. Any small residual quantity of fuel may be drained through the water drains in the collector box (fig. 2) and through the water drains in the No. 4 tanks. Both servicing valves (para. 8) should be closed and the locking plates (Sect. 2, Chap. 4) inserted if the fuselage tank only is being drained. If it is necessary to drain the wing tanks on one side only, the servicing valve on the other wing should be closed and locked and draining through the fuselage tank drain carried out as described above. When the tanks have been drained, the filler caps and the drain cap and plugs must be replaced and, as appropriate, the servicing valves unlocked and opened.

Draining the wing-tip tanks

13. Air supply lines should be attached to the air transfer pressure connections just forward of the diffuser casing, containers positioned at the jettison nozzles with suitable hoses extending from the nozzles, and the fuel jettison switch set to JETTISON; air at a maximum of 40 p.s.i. should then be supplied to the transfer system and the tanks drained. When the flow stops, the air supply should be shut off and the residue of fuel removed through the water drains in the bases of the tanks. Alternatively, if no air supply is available or the jettison valves are in-operative, the fuel may be drained through the water drains.

Setting the fuel cock controls

14. The procedure for rigging the low-pressure and high-pressure fuel cock controls with the low-pressure cock and the engine high-pressure cock levers, respectively, is described in Chap. 1 of this Section.

Setting the servicing valve controls

15. The setting of the servicing valve controls should be carried out before the

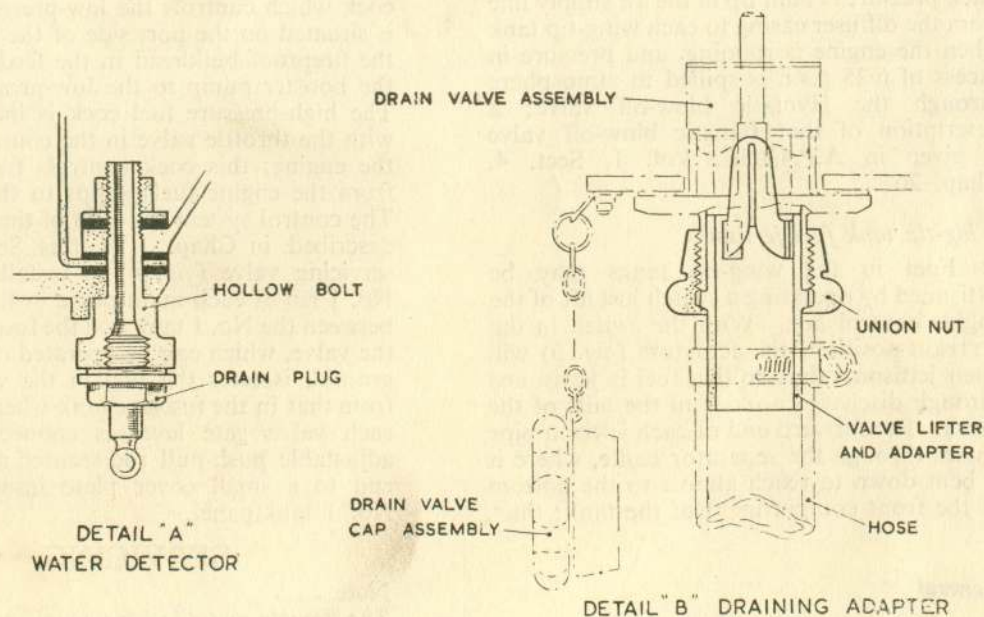
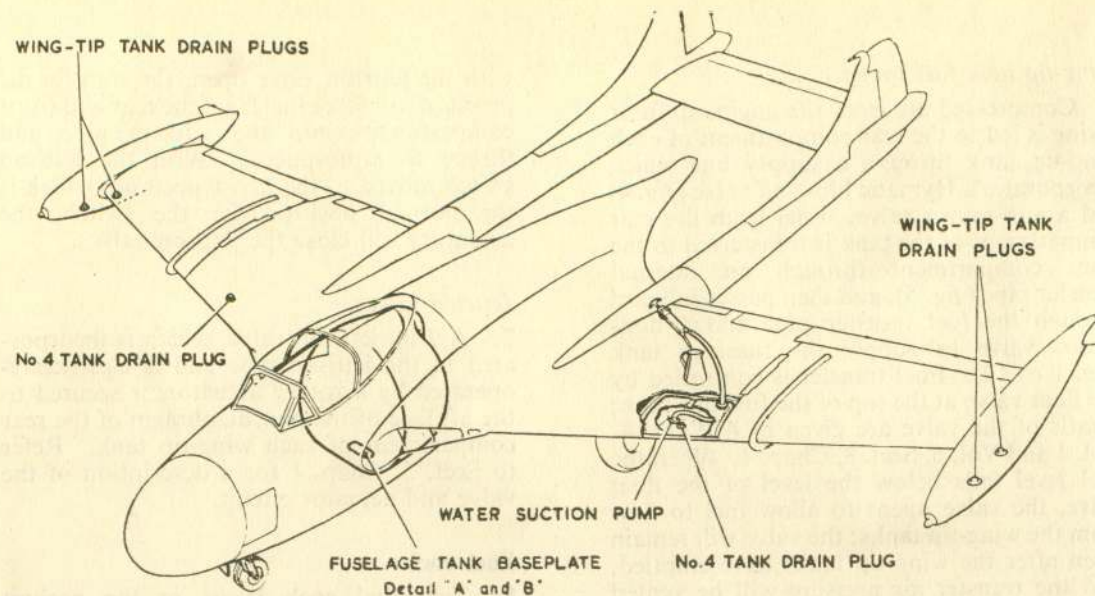


Fig. 6. Water drain points

No. 1 tanks have been installed. If, however, a tank is already installed, the lower front engine cowling should be removed, the servicing valve inset cover plate disengages from the tank panel, and the tank panel removed, passing the valve inset cover plate through its housing as the panel is lowered; the fuel feed moulded stub pipe should then be disconnected from the valve on the outboard side of No. 1 rib, and from the feed pipe to the fireproof bulkhead on the inboard side of No. 1 rib. The procedure is then as follows:—

- (1) Remove the guard over the valve from the outboard side of No. 1 rib. Check visually that the valve gate moves from the *open* to the *closed* position without interference, and that the bore is full diameter in the *open* position.
- (2) Loosen the two lock-nuts on the push-pull rod and offer up the tank panel and temporarily secure it in position; pull the push-pull rod and the attached cover plate through the housing in the tank panel.
- (3) Secure the cover plate in its housing in the tank panel, and check visually that the bore through the servicing valve is full diameter; if the bore is obstructed, release the cover plate, and pull down and adjust the length of the push-pull rod until a clear bore is obtained with the cover plate secured.
- (4) Remove the tank panel, and tighten the lock-nuts of the push-pull rod without disturbing the adjustment.
- (5) Reconnect all disconnected joints and replace the guard.

Setting the jettison valves

16. To check the setting of the jettison valves, the tail fairings must be removed from the wing-tip tanks and the connections between the outlets of the valves and the jettison nozzle pipes disconnected; the jettison switch in the cockpit should then be operated

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and a check made to ensure that, with the switch in the forward or JETTISON position, the valve gates have moved to show completely unobstructed bores into the jettison pipes. Finally, the switch should be moved to the aft or CLOSE position, and a check made to ensure that the valve gates now close the bores completely.

Fuel flow tests

17. The aircraft must be at rest in the open on level ground; these tests should not be carried out inside a hangar. The engine fuel feed pipe line should be disconnected at the inlet to the low-pressure fuel filter and the tests conducted as follows:—

- (1) *Fuselage tank.* With 30 gallons of fuel in the fuselage tank only, check, when a steady flow is obtained, that the time taken to fill a one gallon measure does not exceed seven seconds with the booster pump switched OFF and three seconds when it is switched ON.
- (2) *Wing tanks.* With 30 gallons of fuel in the No. 1 tank of the appropriate main plane, check, when a steady flow is obtained, that the time taken to fill a one gallon measure does not exceed seven seconds with the booster pump switched OFF and three seconds when it is switched ON. With the fuselage tank drained, put 30 gallons of fuel into No. 4 tank and check that it all flows into the No. 1 tank. *All wing tanks not under test should be empty.* Repeat the test for the tanks in the other main plane.
- (3) *Wing-tip tank fuel jettison test.* With the fuselage and the appropriate wing-tip tank completely filled with fuel, break the air supply line to the wing-tip tank at the diffuser casing end of the flexible hose and apply an air pressure of 21 p.s.i. at this point; *this air pressure must be maintained during the jettison test.* With the electrical supply at 26-28 volts, open the jettison valve by the switch in the cockpit and catch the jettisoned fuel

in an 80 gallon container. Close the jettison valve after 90 seconds, release the air pressure in the tank and check that the fuel remaining is not more than five gallons; reconnect the air supply line to the engine. Repeat the test on the other wing-tip tank.

- (4) *Wing-tip tank flow test.* Drain the fuselage tank, rig the aircraft until it has 1 deg. incidence and is level laterally, and fit a 0-10 p.s.i. pressure gauge on each wing-tip filler cap. Fill both wing-tip tanks full with equal quantities of fuel and break the air supply lines to the tanks at the diffuser casing ends of the flexible hoses, and apply an air pressure of 40-50 p.s.i. The transfer rate from both tanks must not be less than 550 gallons per hour, and the difference in time for the tanks to empty must not vary by more than 60 seconds; after transfer, fuel contents in each tank must not exceed half a gallon. Connect the engine fuel feed pipe to the inlet of the low-pressure fuel filter and the air supply lines to the engine.

Water content check

18. A water content check should be carried out periodically at points illustrated in fig. 6. With the electrical power switched ON, the water detector switch at the relay adjuster box (Sect. 5, Chap. 2) situated in the gun bay should be depressed, and the reading of the fuel contents gauge in the cockpit checked; if water is present in the main fuselage tank, the indicator pointer will read hard down in the "red" section below the "empty" position on the gauge. If a water indication is obtained, the electrical power should be switched OFF, the water detector situated in the base plate of the fuselage tank removed, the tank contents drawn off until only uncontaminated fuel emerges and the water detector refitted; the remaining fuselage tank drain plugs (fig. 2) should then be removed, the fuel checked and the drain plugs

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refitted. When the electrical power is switched ON and the water detector switch depressed, the pointer on the fuel contents gauge should just flicker, indicating that there is no water

General

19. The following paragraphs outline the recommended sequences for the removal of the main components of the fuel system, but it may be found necessary to alter the order in certain cases to suit particular requirements. Unless otherwise indicated, the assembly or replacement procedure will be in the reverse order to that for removal. The method of jacking and trestling the aircraft and the location of access panels and inspection doors are given in Sect. 2, Chap. 4.

Warning

(1) *Whenever the fuel system has been disconnected for servicing, a fuel flow test (para. 17) must be made on the relevant part of the system.*

(2) *Before electrical connections are disconnected, the aircraft must be rendered electrically safe in accordance with the instructions given in Sect. 5, Chap. 1.*

(3) *Strict cleanliness must be observed when new components, pipe lines or tanks are being fitted.*

Fuselage tank removal

20. Before the fuselage tank is removed the servicing valves on the No. 1 ribs of the main planes must be closed and locked, the tank drained and the aircraft jacked up to give the necessary working clearance between the bottom of the fuselage and the ground.

The procedure is then as follows:—

- (1) Remove the gun bay doors and the guns (Sect. 7, Chap. 3), swing the outer gun mounting brackets forward and secure them. Disconnect the gun heating duct and the B.P.C. total head filter on the starboard side of the gun bay, then remove the gun duct and its mounting bracket complete with the total head filter.

present in the fuselage tank. A pump and suction pipe (Sect. 2, Chap. 4) may be used to remove water which collects in the rear inboard corner of a No. 4 wing tank and

REMOVAL AND ASSEMBLY

- (2) Remove the batteries and their support trays, and fold the centre supporting bracket back against the firewall.
- (3) Disconnect the electrical lead from the fuel contents tank unit at the base of the tank on the starboard side, the lead from the immersed booster pump, and the bonding connections.
- (4) At the forward face of the firewall, disconnect the fuel feed hose to the engine at the low-pressure fuel cock (fig. 2) and the feed hoses from the wing tanks.
- (5) Disconnect the differential pressure line from the special banjo union, and remove the fuel drain and vent pipe from the starboard side of the tank (fig. 3).
- (6) Disconnect and remove the common drain pipe for the tank filler and immersed fuel booster pump.
- (7) Disconnect the electrical loom from the fuselage wall on the starboard side at the forward attachment joints, and position it clear of the tank. Remove the three 2 B.A. nuts securing the pulley for the cable runs on the starboard side of the fuselage wall, and swing the pulley clear of the tank. Disconnect the two wing tank vent pipes and the two wing-tip fuel transfer pipes from their connectors at the top of the rear face of the firewall. Unscrew the pillar adapters from the tank and draw them aft through their clearance holes in the firewall as far as they will go, then temporarily secure them so that their forward ends are clear of the tank.
- (8) Remove the twelve 2 B.A. stiffnuts securing the Pacitor unit flange to the tank, and screw three 2 B.A. bolts into the tapped holes provided in the flange (this provides easy separation of the tank and Pacitor unit flanges), then remove the tank unit. There is sufficient

which cannot be drained by the plug; it is essential that this equipment is assembled correctly in the tank relative to the true lateral line of the aircraft (fig. 6).

clearance for this to be done with the aircraft standing normally on the ground.

- (9) Remove the gun electrical relay panel from the starboard diagonal bracing strut.
- (10) Remove the two diagonal bracing struts at the bottom of the tank bay.

Note . . .

The struts must be temporarily replaced if the aircraft is to be manhandled with the tank removed.

- (11) Release the four clips which secure the tank rear support to the lower cross tube on the forward face of the firewall. Detach the support block and turn the mounting bracket close to the firewall. Release all pressure from the hydraulic system, and remove the hydraulic engine-driven pump pressure supply pipe (routed from bulkhead No. 4 to the automatic cut-out valve) where it passes round the port centre hinge mounting for the gun bay door; blank off all open pipe ends.
- (12) Release the trunnions on the tank straps from the adjuster, and lower the tank vertically from the bay.

Testing the float valve

21. If a fuselage tank has to be changed, the following check must be carried out on the replacement tank to test the float valve before it is fitted to the aircraft:—

- (1) Using suitable blanks, blank off the port and starboard wing tank fuel connections, the booster pump outlet and the wing tank vent connection at the top rear of the tank. Remove the tank filler cap, and replace it by a solid cap (no inward relief valve). Fit an air supply adapter to the float valve inlet connection, and invert the tank.

- (2) Remove the water drain plug from the hollow bolt at the rear edge of the collector box base plate to allow air to vent to atmosphere whilst the test fuel is being poured in the tank.
- (3) Pour 25 gallons of fuel into the tank through the engine fuel feed, and refit the water drain plug.
- (4) Couple an air line and shut-off cock to the air supply adapter.
- (5) Apply an air pressure of 6.5 ± 0.25 p.s.i., and check that no fuel emerges from the outlet of the combined drain and vent pipe over a period of five minutes.
- (6) If the requirements of sub-para. (5) are not met, suspend the test operation and inspect the valve, then repeat the test.
- (7) On completion of the tests, drain the tank by removing the blank from the wing tank vent connection, then remove the other blanks.

Fuselage tank installation

22. The procedure for installing the fuselage tank is mainly the reverse of that given for its removal, but the following precautions must be observed:—

- (1) Before the tank is installed the internal structure of the tank bay, aft of the tank base plate and filler cap assembly must have received one full coat of anti-sulphuric paint to Spec. 9/N.M.648 (Ref. No. 33A/-).
- (2) Before the tank is offered up, the sealing ring on the filler cap mounting plate assembly must be examined to ensure that it is in good condition, and traces of old sealing compound cleaned off with Bostik solvent 6428 (Ref. No. 33C/1438). A trial installation must be made to ensure that the sealing ring is compressed against the fuselage; if the joint is not satisfactory, a tapered plywood reinforcing assembly may be fitted to the fuselage shell. Bostik sealing compound 1790 (Ref. No. 33C/1138) should be used to make the joint. A maximum gap of $\frac{1}{16}$ in. at one point only is permissible

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between the fuselage shell, the reinforcing assembly and the sealing ring on the tank. Any such gap must be filled with sealing compound applied liberally all round the joints (building up thickness where required) and allowed to become semi-plastic before the installation of the tank; there must be no gap when the tank is fitted finally.

Note . . .

The sealing compound must be kept clear of the drain hole in the filler cap assembly.

(3) After the tank has been installed, checks must be made to ensure that the tank is centrally positioned, and that there is adequate clearance between the tank and the intermediate air-intake ducts, that the tank bears against the support at the rear of the gun bay decking at bulkhead No. 3, and that the tank rear support is located to give maximum support. When the tank and guns have been installed, it is most important to check that there is a minimum clearance of 0.10 in. between the air-intake and the tank, and of 1.40 in. between the rearmost point on any gun and any part of the fuel tank or its connecting pipes.

(4) Refitting the main tank Pacitor unit is the reverse of removal, and during this operation, the upper end of the tank unit should be guided by the hand to its position with the spigot; this is best achieved by using the tank filling aperture as an access hole. There is sufficient clearance for refitting the Pacitor unit with the aircraft standing normally on the ground.

(5) Before the curved vent pipe is assembled through the vent seal housing in the starboard cannon access door (fig. 3), entry must be facilitated by adjusting the pipe and lubricating the end with a solution of ten per cent glycerine and water. Also check that the Bostik primer No. 1751 (Ref. No. 33C/1139) is serviceable on the inside of the extended fuel vent and the inside of the tapered hole of the access door.

Note . . .

After the first flight following a tank replacement, the security of the fuselage tank retaining strap must be checked and tightened where necessary.

Wing tanks removal

23. Before any of the wing tanks can be removed, the relevant part of the fuel system must be drained. The special tool for removing the ferrules from the tank tie-rods and the socket and keyhead (Sect. 2, Chap. 4) for adjusting the Cheney clips securing the tank moulded connections to the rigid feed and vent pipes must be used so that damage to component parts is avoided. The recommended sequence of operations for the removal of the individual tanks from a main plane is given below:—

- (1) No. 1 tank
 - (a) Remove the lower front and rear engine cowling panels.
 - (b) Remove the screws securing the filler neck casting and the cover plate over the Pacitor tank unit (Detail A and B, fig. 7).

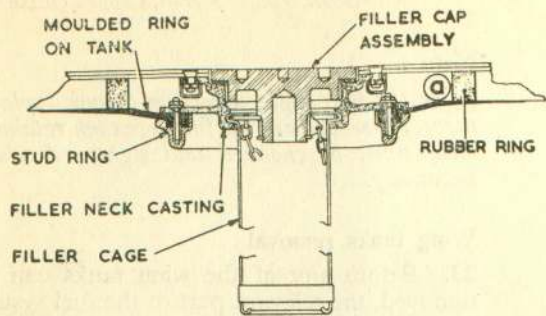
Note . . .

The filler neck casting is located in its position on the main plane skin by two locating spigots.

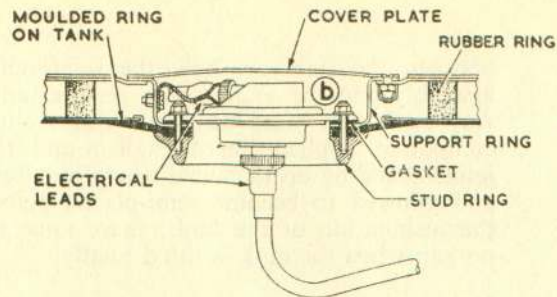
- (c) Render the aircraft electrically safe (Sect. 5, Chap. 1), remove the twelve nuts and washers from the studs which secure the tank unit connector to its stud ring (Detail B, Fig. 7), disconnect the external and internal electrical connections, and remove the Pacitor tank unit from the tank together with the gasket and stud ring.
- (d) Using the special tool, unscrew the countersunk head ferrule and withdraw the tie-rod from either the top or the bottom surface of the wing.

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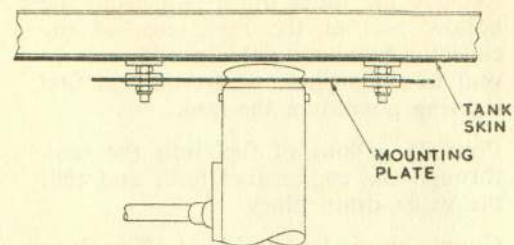
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DETAIL 'A'
FILLER (Tank No.1)

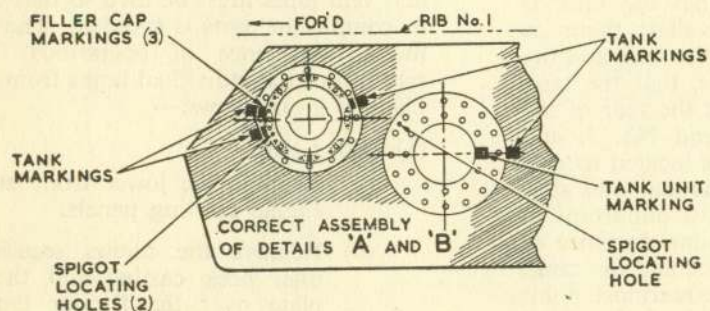


TANK UNIT CONNECTOR

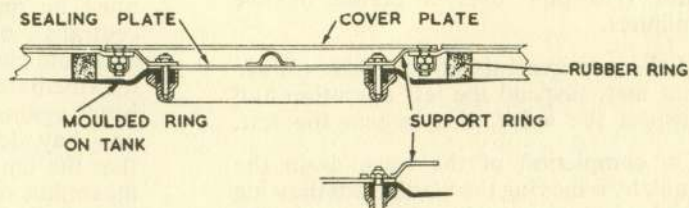


TANK UNIT

DETAIL 'B'
FUEL CONTENTS GAUGE UNIT (Tank No.1)

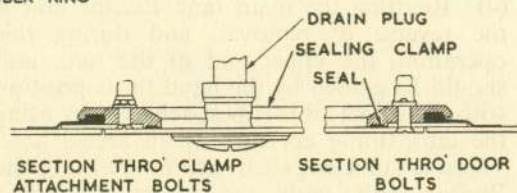
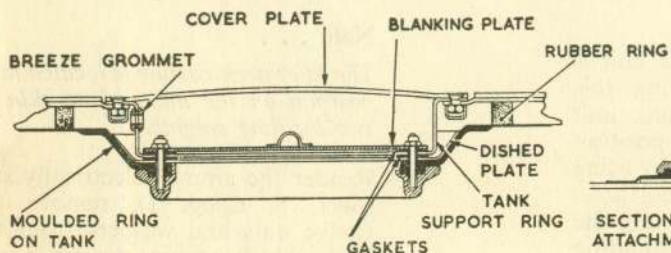


DETAIL 'D'
COVER PLATE (Tank No.3)

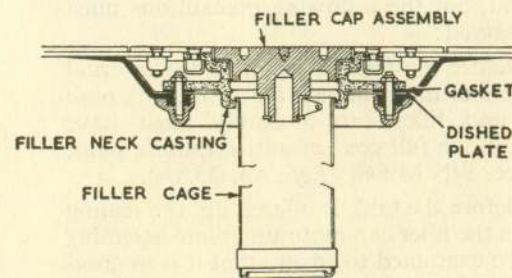


ATTACHMENT OF
SEALING PLATE
TO TANK

DETAIL 'C'
ACCESS HOLE (Tank No.2)



DETAIL 'E'
SEALING OF TANK ACCESS DOORS
(Tank No. 2 and 4)



DETAIL 'F'
FILLER (Tank No.4)

Fig. 7. Wing tank sealing details

- (c) Within No. 4 tank, remove the nut and washer from the stud which connects the clamping spider (*fig. 8*) in No. 4 tank to the anti-surge valve in No. 2 tank, and withdraw the spider, nut and washer through No. 4 tank access hole. Disengage the anti-surge valve from its moulded ring seating in No. 2 tank, whence it is removed through the access hole.
- (d) Within No. 2 tank, slacken off the clip securing the inward protruding moulded vent connection to the vent pipe to No. 4 tank.
- (e) Remove the circular cover plate from the upper surface of the wing between rib No. 2 and 3. Remove the six nuts which secure the dished support ring (*Detail C, Fig. 7*) to the tank sealing plate, detach the support ring and remove the sealing plate and stud ring from the tank moulded ring.
- (f) Unscrew the five countersunk head ferrules and withdraw the tie-rods from either the upper or lower surface of the wing.
- (g) Disengage the tank support buttons and release the Carr fasteners. Ease the tank moulded connections from the vent pipes to No. 1 and 4 tanks and from the feed pipe to No. 1 tank. Fold the tank lengthwise and remove it through the oval access hole in the underside of the wing inboard of rib No. 5.

(3) No. 3 tank

- (a) Remove the circular cover plate (*Detail D, fig. 7*) from the top surface of the wing between rib No. 5 and 6. Disengage and remove the blanking plate, support ring, gaskets, dished plate and stud ring.
- (b) Unscrew the two countersunk head ferrules and withdraw the tie-rods from either the upper or lower surface of the wing.

- (c) Within the tank, slacken off the clip securing the moulded vent connection to the vent pipe to No. 4 tank.
- (d) If No. 3 tank only is to be removed, remove the access door from No. 4 tank in the lower surface of the wing between rib No. 5 and 6, and, through this hole, dismantle the fuel feed spider connection (*fig. 8*) between No. 3 and 4 tanks. Withdraw the nut, washer and spider from No. 4 tank access hole; the other spider complete with the stud is removed from No. 3 tank.
- (e) Remove the outboard access panel in the rear diaphragm of the wheel well, and slacken off the clip securing the feed connection from No. 3 tank to No. 1 tank.
- (f) Disengage the tank support buttons, release the Carr fasteners beneath the tank, and ease the tank moulded connections from the vent pipe and from the feed pipe to No. 1 tank.
- (g) Remove the shroud cover from the dive brake access. Disconnect the inboard R.P. electrical lead from the terminal block, and release the clip which secures the lead to the underside of the top skin inboard of rib No. 6. Withdraw the lead through the hole in the underside of the top flange of rib No. 6, first into the tank recess above the collapsed tank and then through the tube in the tank into the bottom of the tank bay.

Note . . .

It is advisable to attach a length of waxed cord to the disconnected end of the lead during withdrawal, so that on replacement of the tank, the lead may be drawn through the hole in the flange of No. 6 rib and thence through the conduit into the dive brake recess.

- (h) Fold the tank lengthwise and withdraw it through the hole in the top surface, ensuring that the dished plate is moved clear of the aperture.

(4) No. 4 tank.

- (a) Remove the annular plate around the filler neck by unscrewing the inner ring of eight screws and the outer ring of twelve screws.
- (b) Remove the twelve nuts from the securing studs and withdraw the filler neck casting (*Detail F, fig. 7*), gasket, dished plate and stud ring from the tank.
- (c) If No. 4 tank only is to be removed, remove the access door and sealing clamp for No. 4 tank from the lower surface of the wing, and without disturbing the engagement of the complementary clamping parts within No. 2 and 3 tanks, disconnect the inter-tank fuel connections to these tanks, then withdraw the nuts, the washers and the two clamping spiders through the access hole.

Note . . .

If either the clamping spider within No. 3 tank, or the anti-surge valve assembly within No. 2 tank, is disturbed during this or subsequent tank removal operations, it is essential to gain access to the tank concerned to ensure that re-engagement of the disturbed clamping device is satisfactory.

- (d) Unscrew the countersunk head ferrule and withdraw the tie-rod from either the upper or lower surface of the wing.
- (e) Within the tank, slacken off the clips securing the moulded vent connections to the vent pipes which lead to No. 2 and 3 tanks.
- (f) At the forward end of the indented portion of rib No. 7A on the upper surface of the wing remove the small access cover and, immediately below, slacken off the clip securing the external moulded tank connection to the vent pipe to the fuselage tank.

- (e) Remove the screws retaining the servicing valve cover plate inset into the tank panel just outboard of No. 1 rib, and pull the cover plate down clear of the panel. Withdraw the screws in the underside of the wing and lower the tank panel, guiding the servicing valve cover plate through its housing as the panel descends.
- (f) On the outboard side of No. 1 rib, slacken off the clips securing the tank front moulded feed connection to the servicing valve and to the rear fuel connection blank.
- (g) Remove the circular access panels in front of and behind the main undercarriage leg, and slacken off the clips securing the tank moulded connections to the feed pipes from No. 2 and No. 3 tanks. Slacken off the clip securing the moulded front vent connection between No. 1 and 2 tanks.
- (h) Disconnect the tank vent connecting pipe from the 3-way adapter pipe on the inboard side of No. 1 rib, and remove the two bolts securing the split support plate to No. 1 rib.
- (i) Disengage the tank support buttons and release the Carr fasteners at the rear of the tank bay. Withdraw the tank moulded connections from engagement with the feed pipes to No. 2 and 3 tanks and from the servicing valve, then draw the externally disconnected vent pipe into the tank bay.
- (j) Lower the tank, remove the two anti-surge valve assemblies from the internal feed connections from No. 2 and 3 tanks, the vent pipes from the moulded connections and the filler casting assembly from the moulded ring.

(2) No. 2 tank

- (a) Remove the access cover and sealing clamp in the lower surface of the wing, just aft of the main spar between rib No. 2 and 3, and slacken off the clip securing the moulded tank connector to the fuel feed pipe to No. 1 tank. Slacken off the clip securing the vent moulded tank connector to No. 1 tank.

- (b) Gain access to the feed and anti-surge valve assembly between No. 2 and No. 4 tanks (fig. 8) and to the vent connection, by removing the two access doors from the lower surface of the wing forward of the main spar between rib No. 4 and 5 and rib No. 5 and 6 (Detail E, fig. 7). Disengage the sealing clamps from the tanks and withdraw them through the access holes.

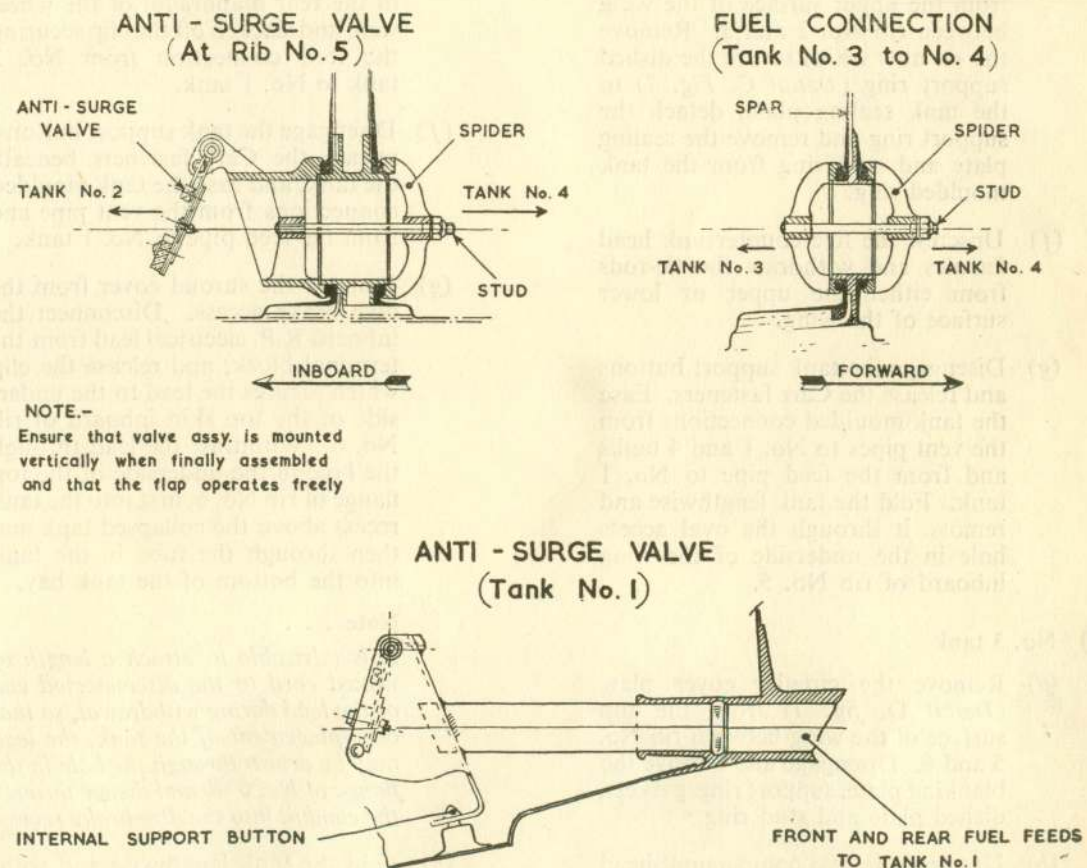


Fig. 8. Wing tank connections

- (c) Within No. 4 tank, remove the nut and washer from the stud which connects the clamping spider (*fig. 8*) in No. 4 tank to the anti-surge valve in No. 2 tank, and withdraw the spider, nut and washer through No. 4 tank access hole. Disengage the anti-surge valve from its moulded ring seating in No. 2 tank, whence it is removed through the access hole.
- (d) Within No. 2 tank, slacken off the clip securing the inward protruding moulded vent connection to the vent pipe to No. 4 tank.
- (e) Remove the circular cover plate from the upper surface of the wing between rib No. 2 and 3. Remove the six nuts which secure the dished support ring (*Detail C, Fig. 7*) to the tank sealing plate, detach the support ring and remove the sealing plate and stud ring from the tank moulded ring.
- (f) Unscrew the five countersunk head ferrules and withdraw the tie-rods from either the upper or lower surface of the wing.
- (g) Disengage the tank support buttons and release the Carr fasteners. Ease the tank moulded connections from the vent pipes to No. 1 and 4 tanks and from the feed pipe to No. 1 tank. Fold the tank lengthwise and remove it through the oval access hole in the underside of the wing inboard of rib No. 5.
- (3) No. 3 tank
- (a) Remove the circular cover plate (*Detail D, fig. 7*) from the top surface of the wing between rib No. 5 and 6. Disengage and remove the blanking plate, support ring, gaskets, dished plate and stud ring.
- (b) Unscrew the two countersunk head ferrules and withdraw the tie-rods from either the upper or lower surface of the wing.
- (c) Within the tank, slacken off the clip securing the moulded vent connection to the vent pipe to No. 4 tank.
- (d) If No. 3 tank only is to be removed, remove the access door from No. 4 tank in the lower surface of the wing between rib No. 5 and 6, and, through this hole, dismantle the fuel feed spider connection (*fig. 8*) between No. 3 and 4 tanks. Withdraw the nut, washer and spider from No. 4 tank access hole; the other spider complete with the stud is removed from No. 3 tank.
- (e) Remove the outboard access panel in the rear diaphragm of the wheel well, and slacken off the clip securing the feed connection from No. 3 tank to No. 1 tank.
- (f) Disengage the tank support buttons, release the Carr fasteners beneath the tank, and ease the tank moulded connections from the vent pipe and from the feed pipe to No. 1 tank.
- (g) Remove the shroud cover from the dive brake access. Disconnect the inboard R.P. electrical lead from the terminal block, and release the clip which secures the lead to the underside of the top skin inboard of rib No. 6. Withdraw the lead through the hole in the underside of the top flange of rib No. 6, first into the tank recess above the collapsed tank and then through the tube in the tank into the bottom of the tank bay.
- Note . . .**
It is advisable to attach a length of waxed cord to the disconnected end of the lead during withdrawal, so that on replacement of the tank, the lead may be drawn through the hole in the flange of No. 6 rib and thence through the conduit into the dive brake recess.
- (h) Fold the tank lengthwise and withdraw it through the hole in the top surface, ensuring that the dished plate is moved clear of the aperture.
- (4) No. 4 tank.
- (a) Remove the annular plate around the filler neck by unscrewing the inner ring of eight screws and the outer ring of twelve screws.
- (b) Remove the twelve nuts from the securing studs and withdraw the filler neck casting (*Detail F, fig. 7*), gasket, dished plate and stud ring from the tank.
- (c) If No. 4 tank only is to be removed, remove the access door and sealing clamp for No. 4 tank from the lower surface of the wing, and without disturbing the engagement of the complementary clamping parts within No. 2 and 3 tanks, disconnect the inter-tank fuel connections to these tanks, then withdraw the nuts, the washers and the two clamping spiders through the access hole.
- Note . . .**
If either the clamping spider within No. 3 tank, or the anti-surge valve assembly within No. 2 tank, is disturbed during this or subsequent tank removal operations, it is essential to gain access to the tank concerned to ensure that re-engagement of the disturbed clamping device is satisfactory.
- (d) Unscrew the countersunk head ferrule and withdraw the tie-rod from either the upper or lower surface of the wing.
- (e) Within the tank, slacken off the clips securing the moulded vent connections to the vent pipes which lead to No. 2 and 3 tanks.
- (f) At the forward end of the indented portion of rib No. 7A on the upper surface of the wing remove the small access cover and, immediately below, slacken off the clip securing the external moulded tank connection to the vent pipe to the fuselage tank.

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- (g) Disengage the tank support buttons and release the Carr fasteners beneath the tank. Slide the tank vent connections from the vent pipes, fold the tank lengthwise and remove through the access hole.

Wing tanks installation

24. Before, during, and after the installation of wing tanks, the following points should be noted:—

(1) Before a No. 1 tank is installed, the internal support buttons of the anti-surge valve assemblies must be inspected for security; a damaged or insecure button necessitates the replacement of the tank. Defective tanks should be repaired in accordance with A.P.4117B, Vol. 1 and Vol. 6, Part 2, Sect. 2, Chap. 2; no load must be placed on a repaired button until 72 hours have elapsed.

(2) At No. 1 tank tie-rod assemblies, it is permissible to increase the depth of the ferrule slots to 0.10 in. where the slots have become badly worn.

Note . . .

The slots in the No. 1 tank ferrules should run longitudinally, but all the remaining tie-rod slots should run laterally.

(3) If a new tank access door has to be fitted, there must be a 45 deg. chamfer of 0.08 in. on the leading edge.

(4) There must be no swarf or foreign matter in a tank bay; swarf will cause leakage after the tank has been installed for some time. All burrs must be removed from the tie-rod holes in tank bays.

(5) Felt padding overlaid with black self-adhesive waterproof tape must be used to cover all internal projections and also sharp edges which cannot be protected by tape alone. The area should be degreased thoroughly with carbon tetrachloride (Ref. No. 33C/1030) and the felt secured by Bostik adhesive No. 772 (Ref. No. 33C/1321); the tape should then be applied and given two coats of Bostik S.23.95 (Ref. No. 33C/1335). If the Bostik on the tape has flaked, the tape

has lost its adhesion, or where waterproof tape is found covered with three coats of D.T.D.399A lacquer, the tape should be removed, the area cleaned, and new tape fitted and coated with Bostik S.23.95. Holes should be cut through the felt and tape where they pass over the drain holes. For more detailed information, refer to Vol. 6.

(6) The inside of the tank bay must be completely dry from fuel. If there is any sign of fuel penetrating behind the black waterproof tape, the tape and felt must be renewed as described in sub-para. (4) above. A warm air blower may be used to dry the tank bay thoroughly.

(7) The tank bay screens must be checked for security and all sharp edges must be removed completely. The kerosine-resistant rubber rings (Detail C, fig. 7), which are attached with Bostik adhesive 1410 (Ref. No. 33C/1327), should be in contact with the screens and the top skin; any gaps which might admit foreign matter to the tank bays must be sealed with black waterproof tape.

(8) The outer surface of the tank must be completely dry from fuel and clean from swarf and other foreign matter before it is assembled in the wing.

(9) All paint must be removed from the tank studs, and a solution of ten per cent glycerine and water applied to the studs to assist the assembly.

(10) All jointing faces and stub pipes must be dry and free from kerosine, and moulded connections must be fitted to all stub pipes. Where the fuel feed pipe from a No. 1 tank to the fuselage tank and the vent pipe from a No. 1 tank pass through rib No. 1, the red line on each fuel tank pipe moulding must correspond with that on the fuel feed pipe or vent pipe. Where a No. 1 tank vent pipe runs through the rib No. 1 into the engine bay, care must be taken that no torsional load is imposed on this pipe with resultant distortion of the tank moulding; the pipe must not be pulled in any way from its normal

position. The socket and keyhead should be used to secure Cheney pipe attachment clips in restricted places.

Warning

(1) Moulded connections are NOT interchangeable between Marston and Fire-proof tanks.

(2) Plastic Hermetite must NOT be used to assemble moulded connections and rings or gaskets in tank apertures.

(11) When fuel pipes which have belled ends are being connected, other than feeds into the No. 1 tanks, it must be ensured that the bellings just protrude into the tanks, vent pipes, however, must be fitted so that the plain ends do not protrude beyond the beginnings of the radii inside the moulded tank vent connections. The heads of the clips on internal connections must be kept clear of the tank walls. As a general rule, the moulded tank connections should be located before the support buttons and Carr fasteners are secured. The vent pipe from a No. 1 tank (which passes through No. 1 rib) must be connected to the moulded tank connection and the securing clip tightened correctly before installation, as, once the tank is in position in the recess, this connection is inaccessible. Where a hose joint is wrapped on the outside with copper gauze, it must overlap each end of the hose by approximately 0.50 in. and curl over and under the end of the hose, the clips being secured over the gauze.

(12) When the filler neck casting and the tank unit connector support ring are being secured to the moulded rings on a No. 1 tank, incorrect assembly will result in twisting and damage to the tank material; care should be taken, therefore, to align the markings on the components with those on the tank. Thus, when the tank is being attached to the wing skin, the spigot locating holes (fig. 7) should be in the correct position and should register with the spigots without necessitating any twisting of the tank.

Warning

(1) Care must be taken not to over-tighten the stud ring nuts; a special spanner (Sect. 2, Chap. 4) should be used to tighten nuts on all these fittings to a torque of 25 lb. in. for Marston type tanks (Black), and to a torque of 18 lb. in. for Fireproof type tanks (Green).

(2) Stud rings are NOT interchangeable between Marston and Fireproof tanks; this instruction applies to ALL reinforced apertures.

(13) Protective rubber slippers must be fitted to the anti-surge valves for the No. 1 and 2 tanks before they are assembled in the tanks; after they have been assembled in the tanks, the valves must be checked for freedom of movement throughout their normal travel. The valves must not be pushed or held through the tank material.

(14) The tie-rods must be inserted before the access holes are closed. One ferrule should be assembled to each of the tie-rods, and the tie-rod ends filed flush with the ferrules and centre-punched into the slots. The rods should be assembled to the wing, using the special bullet (Sect. 2, Chap. 4), and care taken to prevent damage when the rods are being passed through the internal rubber tubes; the bullets should then be removed. The other ferrules should be fitted using the special tool (Sect. 2, Chap. 4), and a straight-edge held across the skin, adjacent to the ferrules being tightened, to ensure that the skin is not distorted; the tie rods should then be filed flush, and centre-punched lightly into the ferrule slots. The tie-rods should not become distorted if the tank support buttons and Carr fasteners are disengaged.

(15) After the sealing clamps have been inserted in the bottom access holes in the No. 2 and No. 4 tank bays, all nuts and rivets securing the sealing clamp attachments should be brushed over with Bostik primer No. 1752 (Blue) (Ref. No. 33C/1339); care must be taken that the tank mould rings are positioned fully in the outer grooves of the sealing clamps (Detail E, fig. 7) before the nuts are

tightened. New sealing rings must be used when the access doors beneath the No. 2 and 4 tanks are being re-fitted. Bostik primer No. 1752 (Blue) should be used only on the faces of the rings remote from the doors; the bottom faces of the rings must be completely free from the Bostik primer.

(16) If difficulty should be experienced in pressing a metal pipe into a tank moulded

connection, a small application of a solution of ten per cent glycerine and water may be used to facilitate the operation.

◀ (17) The non-return valve in the fuel 'return to tank' line from the starboard side of the engine must be fitted correctly, i.e., with the arrow on the valve pointing upwards. ▶

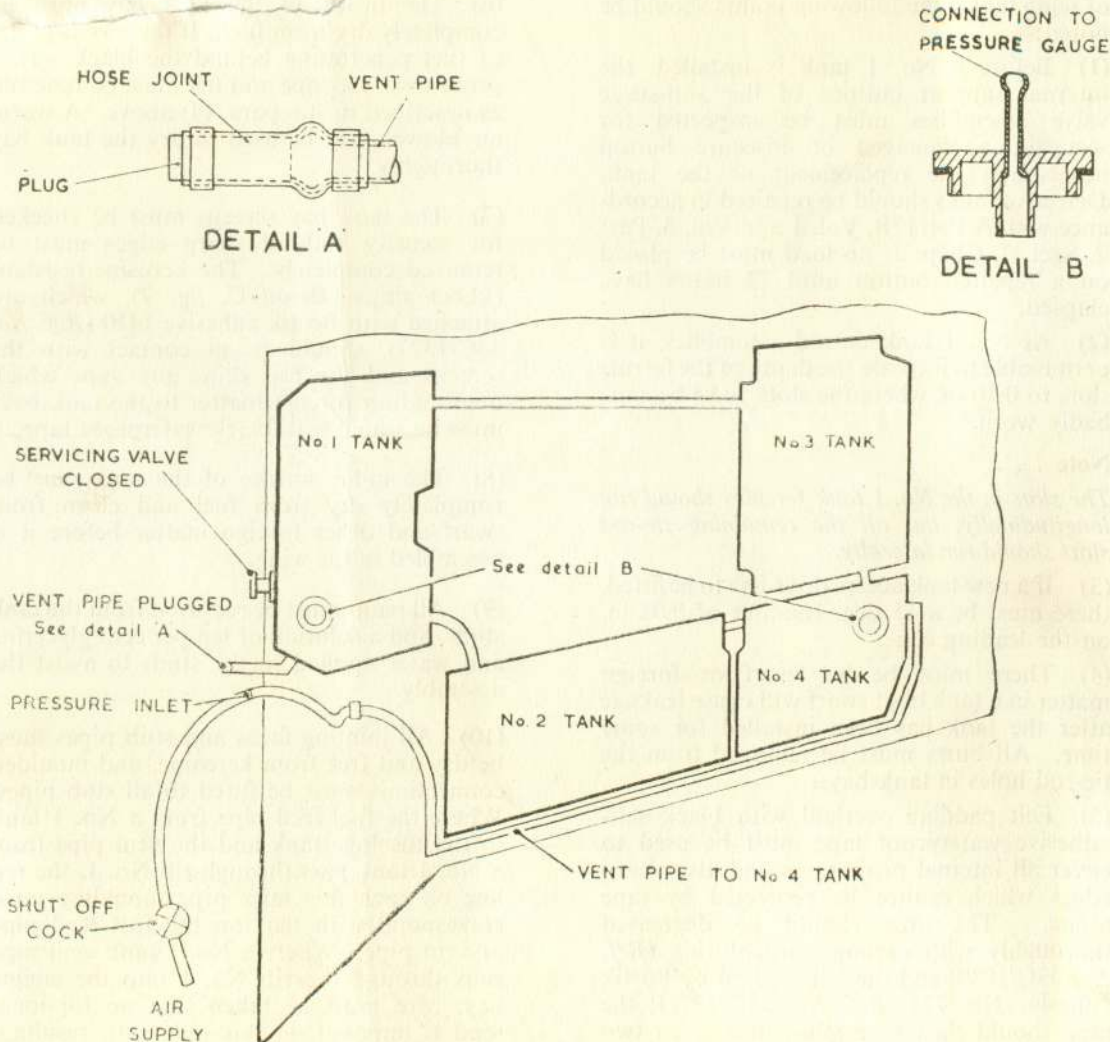


Fig. 9. Wing tank pressure test

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Wing tanks pressure test

25. The assembly of flexible fuel tanks within a wing must be pressure tested if any wing fuel tank is removed and replaced.

The procedure is as follows:—

- (1) Remove the upper front engine cowling. Disconnect the vent pipes from No. 1 tank and No. 4 tank from the 3-way adapter pipe on the inboard side of No. 1 rib. Secure a plug to the vent pipe connection from No. 1 tank, and assemble an air pressure pipe line, which must include a shut-off cock, to the vent pipe from No. 4 tank. Close and lock the servicing valve.
- (2) Fill the tanks with fuel as specified in the Leading Particulars, and fit the adapter filler caps (*Detail B, fig. 9*), complete with accurate 0 to 5 p.s.i. pressure gauges, to No. 1 and No. 4 tank filler necks (mercury U tubes may be used in lieu of gauges if desired).
- (3) Apply a suitable air supply to the inlet hose and pressurize the installation to 3 p.s.i.; when this pressure is reached, close the shut-off cock.
- (4) The test pressure must be held without any drop for 30 minutes; any drop in pressure indicates a leak which must be rectified and the test repeated.

Wing-tip tanks removal (fig. 5)

26. Before a wing-tip tank is removed, the fuel must be drained (*para. 13*), the procedure is then as follows:—

- (1) Remove the upper and lower inspection covers at the steady casting and at the steady bolt position, unlock the lock-nut and screw in the steady bolt clear of the tank.

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- (2) Support the tank by personnel at each end, and remove the $\frac{1}{2}$ in. stiffnut, double spring washer, and special washer using an extended socket spanner.
- (3) Withdraw the tank outboard and clear of the wing.

Wing-tip tanks installation

27. Before a wing-tip tank is installed, it must be ensured that the locating spigots and the fuel and air connections are in a serviceable condition, and that the spring-loaded electrical connections are free and positive in their movements. The installation procedure is then as follows:—

- (1) Grease the sockets for the tank locating spigots, and ensure that the mating surfaces of steady castings, spigots and bushes are free from paint.
- (2) Remove the access panels from the tip tank fairings and screw the rear steady bolt right in, and apply engineer's 'blue' to the mating surfaces of the steady casting.
- (3) Offer up the tank to the steady casting passing the attachment bolt through the hole in the tank and engaging the tank spigots in their respective sockets.
- (4) With a guide tube, approximately 3 ft. long by 0.50 in. outside diameter, locate the end of the tip tank attachment bolt as shown in the detail in *fig. 5*. Slide the special washer and then the double spring washer over the end of the guide tube, and, with the aid of a sliding tube over the guide tube, push the washers fully home on the tip tank attachment bolt. Remove the guide tube, and visually check with a torch that the washers are correctly assembled on the tip tank attachment bolt. Thickly

grease the inside of the socket (*Sect. 2 Chap. 4*), push the $\frac{1}{2}$ in. B.S.F. self-locking nut home in the socket, and, using the extension bar and the torque wrench (*Sect. 2, Chap. 4*), offer up and secure the nut to the attachment bolt; check that there are twenty-four to twenty-five complete turns to tighten, ensure that the nut is tightened to a torque loading of 300 lb. in. and that the figure stencilled on the tip tank agrees with this. Re-check with a torch to ensure correct assembly.

Note . . .

The personnel holding the tank in position during this operation must keep the tank perfectly still, otherwise there is a danger of the washers being pushed off the end of the tip tank attachment bolt before the self-locking nut has been fitted.

- (5) Remove the tank, and check that a minimum bearing surface of 50 per cent is obtained on the mating surfaces of the tank steady and the tank casting. If less than a 50 per cent bearing is obtained, file the casting face lightly until the correct mating is obtained. The maximum allowable gap over the remaining area must not exceed 0.005 in.
- (6) Repeat the operations given in sub-para. (2), (3) and (4); screw out the rear steady bolt by hand until it is touching the wing-tip stop, screw out a further half turn with a spanner, and lock in this position.
- (7) Check that the clearances between the tip tank and the main plane are as shown in *Sect. 3, Chap. 2*. If necessary, the wing-tip slats may be trimmed to provide clearance for the strakes of the wing-tip tanks (*Sect. 3, Chap. 2*).
- (8) Check that there is a compression of 0.125 in. minimum of the hose joint connection inside the wing-tip.

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- (9) Replace the access panels on the tip tank fairings and ensure that these panels clear the steady casting by 0.05 in. all round.
- (10) If a tip tank is removed, and then refitted on the same wing-tip, the rear steady bolt must be re-adjusted as described in sub-para. (6).

Jettison valve removal and installation

28. The screws securing the appropriate wing-tip tank tail fairing should be removed and the fairing slid aft over the jettison nozzle, the jettison nozzle pipe disconnected at its junction with the outlet from the jettison valve, and the electrical leads detached from the actuator. The inspection cover and seal forward of the rear diaphragm

on the outboard side of the tank should then be removed, and, through this access hole, the nuts and washers removed from the six bolts which secure the valve to the rear diaphragm; the valve, complete with the actuator, may now be withdrawn aft. On the completion of the assembly of the valve, which is in the reverse order to that for its dismantling, a satisfactory check of the setting of the valve must be made.

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