Chapter 2 FUEL SYSTEM

(Completely Revised)

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DESCRIPTION

General

1. Nine permanent tanks and two under-wing drop tanks contain approximately 330 and 200 gallons of fuel respectively. All the fuel from these tanks is fed into a collector box at the base of the fuselage tank. A booster pump, which is immersed in the collector box, supplies the engine through a fuel cock and filter. A diagrammatic outline of the system is given in Fig.3. The portion of the system between the engine-driven fuel pumps and the burner ring is described in detail in A.P.4121B and C, Vol.1, but is included in the diagram in order to maintain the continuity of the system. The general layout of the system showing the relative positions of the various airframe components is given in Fig.2.

Fuel tanks

2. The nine permanent fuel tanks comprise a single rigid fuselage tank of light alloy construction (Fig. 4) and four flexible bag type tanks in each wing (Fig.5). The disposition of the tanks is shown in Fig.2. The combined contents of all the permanent tanks is recorded by the Pacitor

system on a single gauge in the cockpit.

Fuel collector box (Fig. 1)

3. A collector box, which is housed in the base of the fuselage fuel tank, is fed by gravity from all the permanent tanks. An electrically-driven booster pump, which is immersed in the fuel collector box, supplies the fuel to the engine at a pressure of about 2 p.s.i. An additional function of the collector box is to safeguard the fuel supply when the aircraft is subjected to negative 'G' or inverted flight. Under these conditions, the inlet clack valves to the pump and the vapour vent valve are automatically closed thus forming the collector box into a small reservoir of about $2\frac{1}{2}$ gallons capacity. This is sufficient to feed the engine for about 15 seconds inverted flight.

Drop tanks

4. A drop tank which may be jettisoned when necessary (Sect. 1, Chap. 3), is suspended from the underside of each wing at No. 6 rib. The fuel in the drop tanks is transferred to the fuselage tank by compressed air, which is supplied from the impeller casing of the engine. The air is admitted, after being reduced to $2\frac{3}{4}$ p.s.i., through the drop tank pressure venting pipe. The fuel transfer is controlled by a float valve at the top of the fuselage tank. When the level of fuel in the fuselage tank has dropped approximately 15 gallons from full, the float valve opens to permit the transfer of fuel from the drop tanks

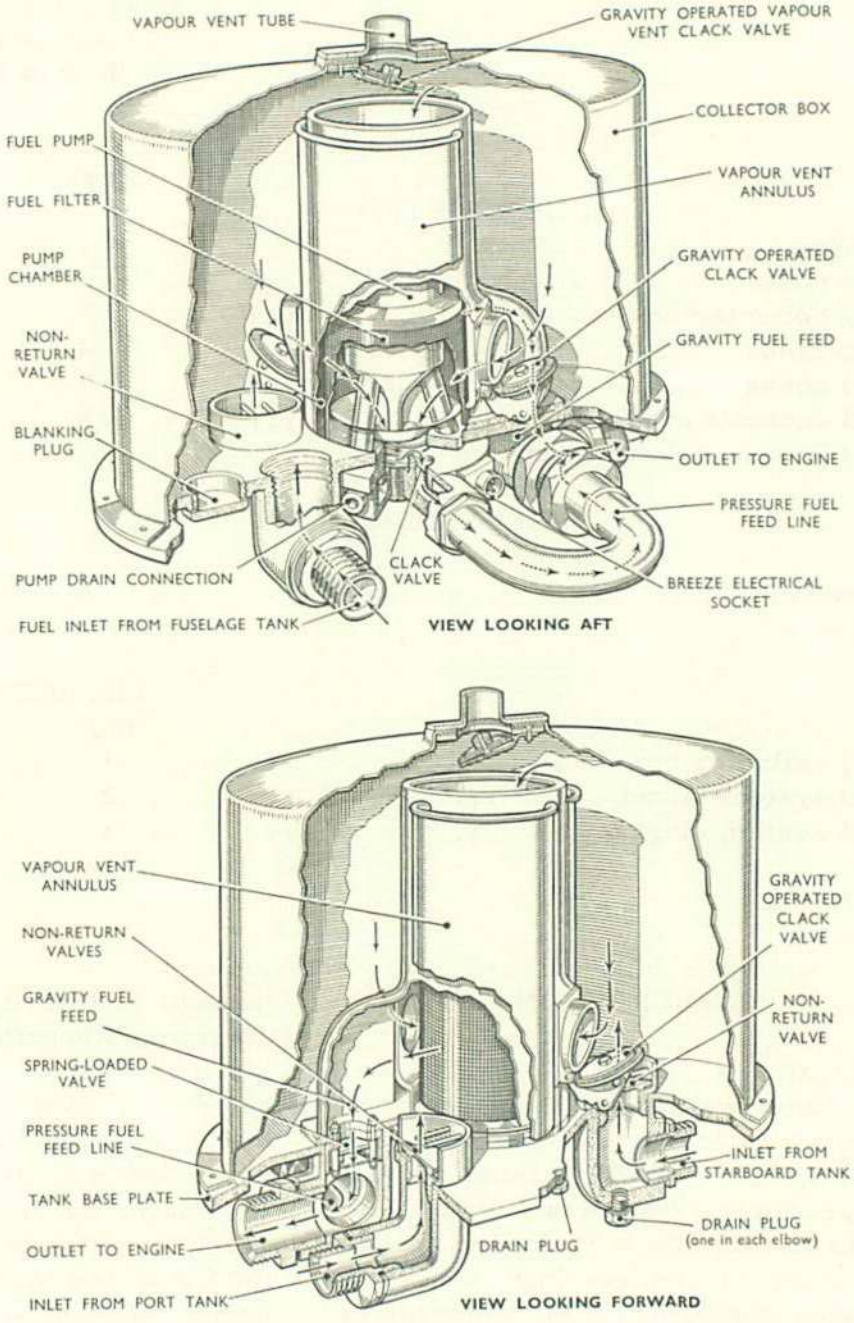

Fig. 1. Fuel collector box

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until the latter are empty. The float valve remains open when the tanks are empty, to vent the air pressure admitted to the drop tanks back through the fuel transfer pipe to the fuselage tank and thence to atmosphere. This method ensures that the drop tanks are the first tanks to be emptied.

Fuel cocks

5. Two cocks control the fuel supply to the engine. One, a low pressure cock, is situated on the firewall between the booster pump and the fuel filter, and is operated by Teleflex cable from the cockpit. The other, a fuel shut-off valve, is incorporated in the throttle box and is used for shutting off the engine fuel pump delivery. This cock is termed the high pressure fuel cock since it controls the fuel flow after it has passed through the engine-driven pumps; it is a component of the engine fuel system. Details of the control runs for both of these fuel cocks are illustrated in Chapter 1 of this Section.

Fuel contents gauge

6. A Pacitor fuel contents gauge, positioned on the left-hand side of the pilots' instrument panel indicates the total capacity of the fuel tanks irrespective of the attitude of the aircraft. The tank units which operate the gauge are installed in the fuselage tank and also in No.1 and 3 tanks in each wing. The location and theoretical diagrams of the installation are given in Sect. 5 and full details of the equipment in A.P.1275A, Vol.1, Sect.18.

Fuel pressure warning switch

7. A fuel pressure warning switch, which is fitted to the outlet connection of the fuel filter, operates a warning light in the cockpit, if the fuel pressure drops below $1\frac{1}{2}$ p.s.i.

SERVICING

General

8. The procedure for refuelling and defuelling the system is given in Sect. 2, Chap.2, together with the precautions to be taken against water condensation.

Fuel flow tests

9. These tests must be carried out with the aircraft in the level flight position. The flow may either be checked by using a measuring container in conjunction with a stop watch or by a fuel flow rig. The fuel hoses should be disconnected from the inlet to the engine-driven pumps for the gravity flow check, and from the outlet of the low pressure fuel cock for the booster pump flow check. The accumulator voltage should not be less than 24 volts at the booster pump for the following tests :-

(1) Fuselage tank : With 30 gallons of fuel in the fuselage tank and with the wing tanks empty, check that the minimum flow is 200 gallons per hour on gravity (i.e., with the immersed booster pump switched OFF), and 650 gallons per hour with the booster pump switched ON.

(2) No.1 wing tanks : With 25 gallons of fuel in No.1 starboard wing tank only (i.e., no fuel in port wing or fuselage tanks), check that the minimum flow is 160 gallons per hour with the booster pump switched OFF, and 650 gallons per hour with the booster pump switch ON. These flow requirements must be maintained for a minimum of 20 seconds. Repeat the test on the port wing with the starboard wing and fuselage tanks empty.

(3) No.2,3 and 4 wing tanks : With 25 gallons of fuel in No.2, 3 and 4 port wing tanks (remaining tanks empty), filled through No. 4 tank orifice, check that the minimum flow is 150 gallons per hour with the booster pump switched OFF. Repeat the test on the starboard tanks, with the remaining tanks empty.

(4) Drop tanks : The fuel transfer from each drop tank to the fuselage tank must be checked separately. Remove the filler caps from both the drop tanks, fill each tank with approximately 25 gallons of fuel, then substitute a pressure gauge and adapter in place of the filler cap on the tank which is to be tested first. Do not refit the filler cap on the other tank. Check that the fuselage tank is empty. Apply air pressure of 50 to 75 p.s.i. to the supply line from the engine impeller casing, at a point before the reducing valve, then check that the

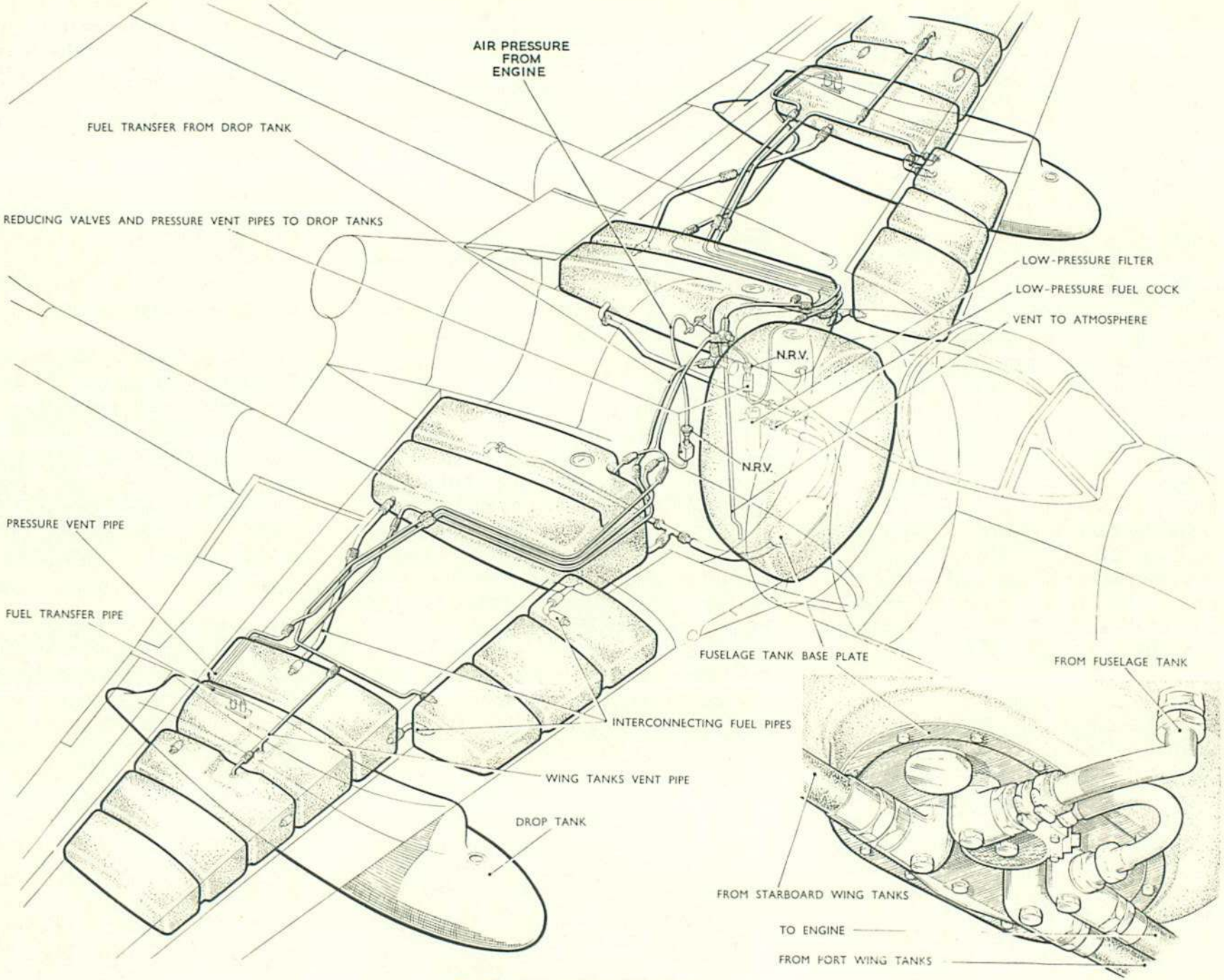


Fig. 2 Fuel system layout

gauge on the tank reads $2\frac{1}{2}$ to $2\frac{3}{4}$ p.s.i. The fuel flow which is measured at the outlet of the low pressure fuel cock, should not be less than 150 gallons per hour and this flow requirement must be maintained for a period of not less than 30 seconds. Repeat this test on the other drop tank ensuring that the filler cap is removed from the tank which is not under test. Both tanks must empty to within one gallon.

(5) Float valve : Fill the fuselage tank to capacity, put about 5 gallons in each drop tank and securely refit all the filler caps. Pressurize the drop tanks in the manner described in sub-para. (4) and check whether the float valve is leaking. A leaking float valve would be indicated by fuel flowing from the fuel tank vent pipe beneath the fuselage. The fuel transfer pipes from the drop tanks to the fuselage tank should also be checked for leaks during this test.

Setting the fuel cock controls

10. The procedure for setting both the high pressure and the low pressure fuel cocks with their respective levers in the cabin is described in Chapter 1 of this Section.

Fuel filter

11. The Tecalemit fuel filter is located between the low pressure fuel cock and the engine-driven pumps, and is accessible through the lower port inspection door. Before removing the filter, ensure that the low pressure fuel cock is OFF. The filter base together with the element may be removed by following the instructions on the plate which is attached to the unit. The element should be washed in kerosene and then subjected to an air blast. The filter base must also be rinsed out with kerosene. After installation the safety pin must be refitted in lock plunger.

Fuel pressure warning switch

12. A full description of the switch together with the procedure for adjustment is given in A.P.1275A, Vol. 1, Sect. 1, Chap. 11.

Drop tank release gear (Fig. 6)

13. The following checks should be made to the release gear mechanism before fitting the drop tanks (para. 17) :-

(1) Ensure that the operating lever in the cabin has a full and free movement.

(2) Attach a suitable weight to the end of the tank suspension bolt and press the bolt up into the release unit. This should cock the release unit and secure the bolt.

(3) Check that the release unit is properly cocked by pressing the finger on the test plunger. The pin point of the indicator should be felt projecting through the plunger when the unit is cocked.

(4) Check that the position of the spring balanced lever is in the same position relative to the main spar on each wing. The cable adjusters are provided for this purpose and all slack in the cables must be taken up after this adjustment.

(5) Pull up the operating lever in the cabin and check that both weights are released simultaneously. The moment of release should occur when the quadrant lever is approximately $\frac{1}{4}$ in. from its full travel.

REMOVAL AND INSTALLATION

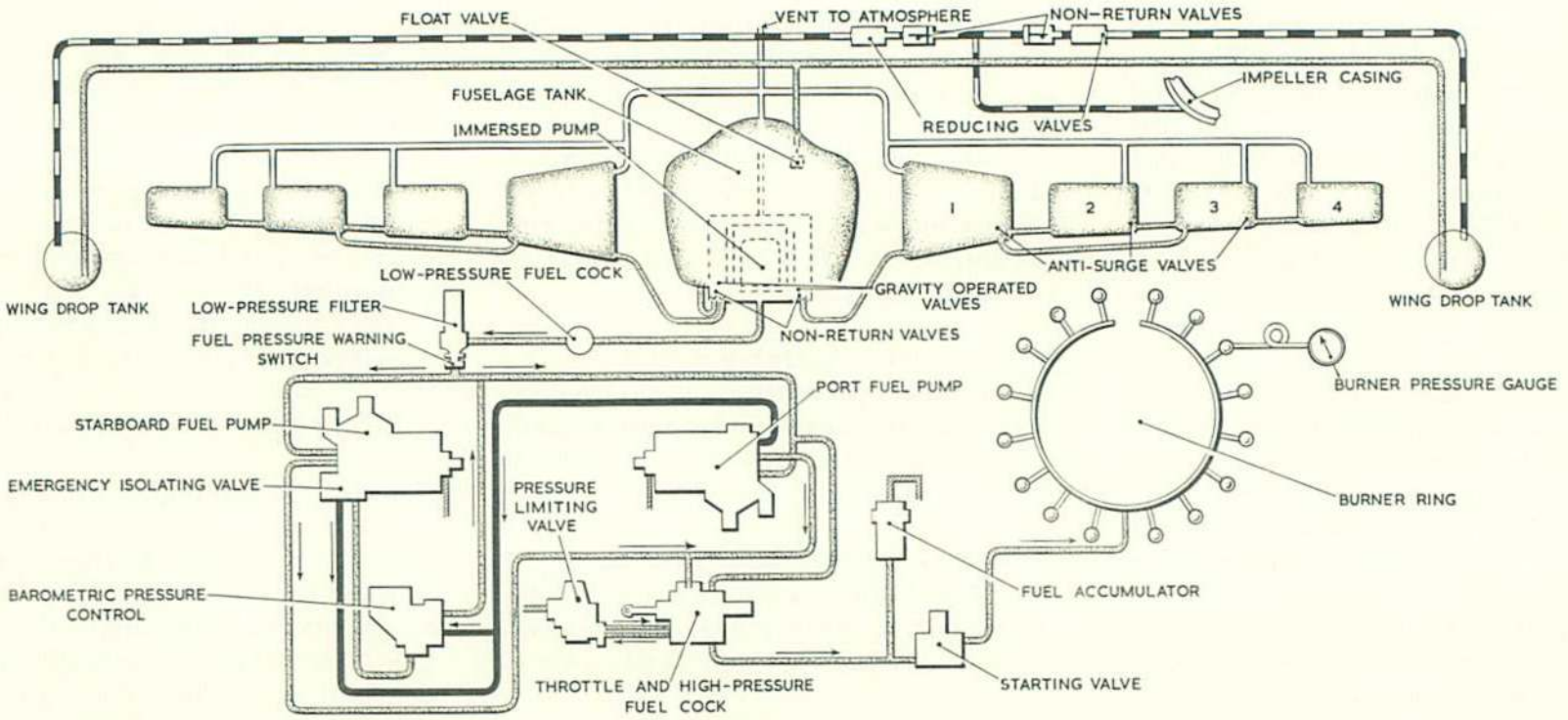
Removal of fuselage tank (Fig. 4)

14. Before the fuselage tank is removed, the fuel system must be drained (Sect. 2, Chap. 2) and the aircraft jacked up approximately 7 in. to give the necessary clearance between the bottom of the fuselage and the ground, then proceed as follows :-

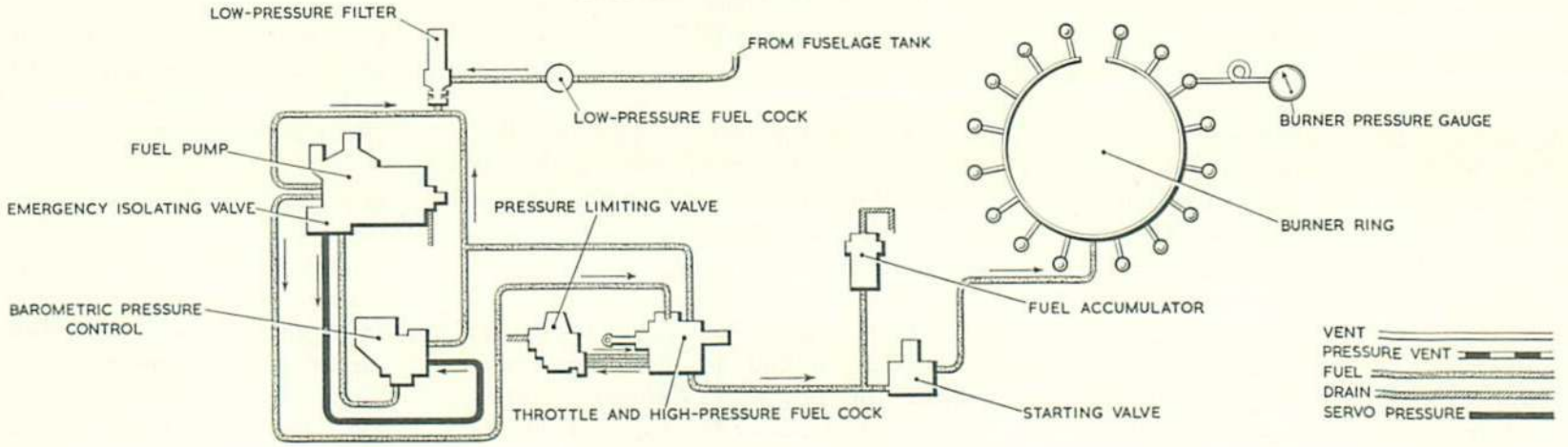
(1) Remove the gun bay doors, the gun heating pipe from the starboard side of the gun bay and the guns (Sect. 7, Chap. 3).

(2) Disconnect the banjo connections for the drop tank fuel transfer pipes and the vent pipes from their pillar adapters, which project through the top of the firewall, then unscrew the adapters from the tank.

(3) Disconnect the electric leads from the fuel gauge tank unit on the bottom starboard side of the tank,



DUAL PUMP GOBLIN 3 AND 35



SINGLE PUMP GOBLIN 3 AND 35

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Fig. 3 Fuel system diagram

also the leads from the booster pump motor. Disconnect the bonding connections.

(4) Disconnect the fuel feed pipe to the engine from the fuel cock adapter on the firewall and the feed pipes from the wing tanks at the firewall. Remove the filler neck drain pipe from the bottom of the tank.

(5) Release the four Jubilee clips which secure the rear support bracket to the lower cross tube on the forward face of the firewall.

(6) Remove the diagonal bracing struts below the tank and dismantle the flying control cable pulley assembly from the starboard side of the tank bay.

NOTE...

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

(7) Release the trunnions from the turnbuckles on the tank straps the lower the tank vertically from the bay.

NOTE ...

The procedure for the installation of the fuselage tank is a reversal of the above, ensuring that, before the tank is offered up to the fuselage, the sealing ring on the mounting plate surrounding the filler cap is in good condition. All traces of the original Bostik must be cleaned off with solvent and a fresh coat of Bostik 1410 applied. After the tank has been installed, it is important to check that the sealing ring is compressed at all points against the locating block, to ensure

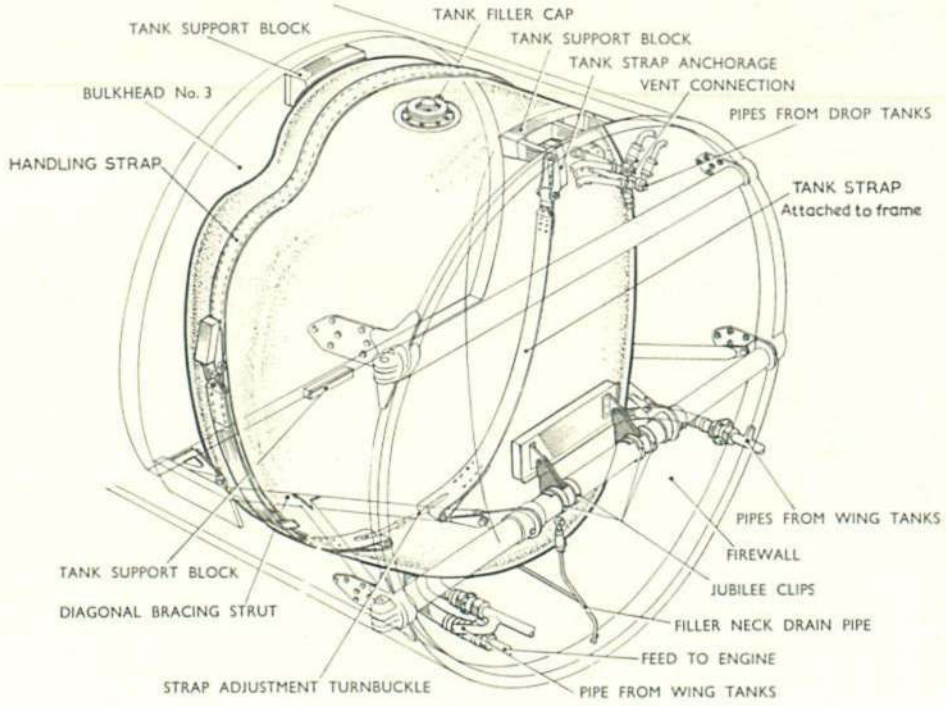

Fig. 4 Fuselage tank

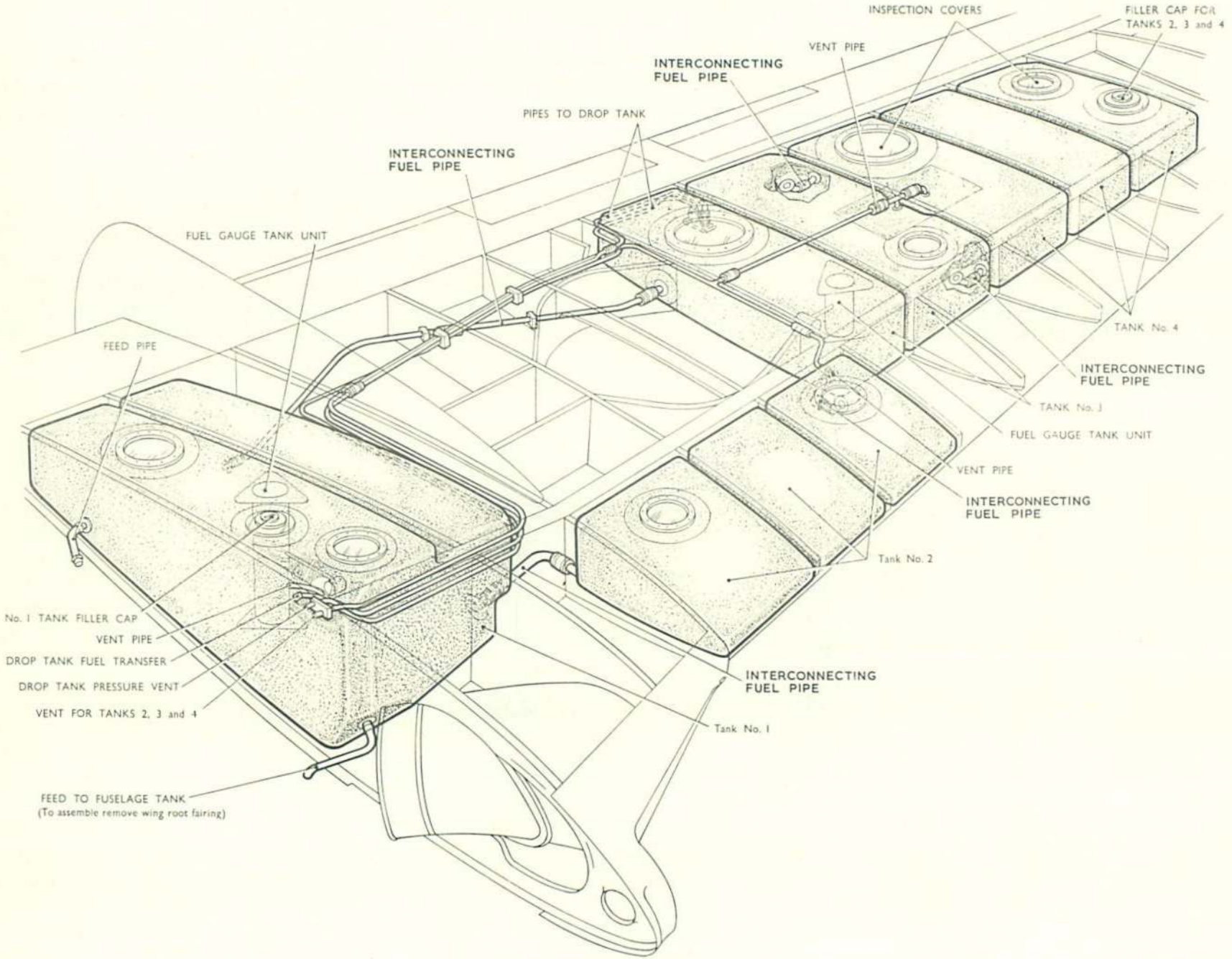

Fig. 5 Wing tanks

a completely sealed joint. Since the tank is a close fit in the bay it is important to check that there are no sharp edges or projections likely to cause damage to the tank covering.

Removal of wing tanks (Fig. 5)

15. Before attempting to remove any of the wing tanks, the complete fuel system must be drained. The tank panels afford the only support for the tanks and, when the panels are removed, improvised support slats must be inserted until the tank is ready for lowering. This will prevent damage to the hose connections which would otherwise have to support the weight of the tank. The detailed procedure for the removal of each of the wing tanks is given in the following sub-paragraphs.

NOTE...

It is important that all wing tank doors are refitted if the aircraft is to be manhandled.

(1) No. 1 tank

(a) Open the upper and lower engine inspection doors, remove the small wing root fairing, disconnect the fuel feed connections and the vent hose.

(b) Remove the tank panel securing screws and lower the panel, then insert wooden slats to support the tank.

(c) Disconnect the hoses from the fuel balance pipe and the vent pipe at the outboard end of the tank.

(d) Disconnect the electric leads from the fuel gauge tank unit.

(e) Remove the four countersunk screws securing the filler neck flange to the skin.

(f) Remove the wooden slats and lower the tank.

(2) No. 2 tank

(a) Remove the oval panel from the forward wall of the undercarriage wheel well diaphragm and disconnect the hoses from the outboard fuel balance pipe and the vent pipe.

(b) Remove the circular inspection plate located on the lower surface of the wing at No. 2 rib and to the rear of the front spar. This will give access for the removal of the inboard fuel balance pipe hose.

(c) Remove the tank panel and lower the tank forward side first.

(3) No. 3 tank

(a) Remove the panel from the rear of the wheel well diaphragm No. 5 rear rib, and the cover plate from the wing upper surface at No. 7 rib.

(b) Disconnect the rear fuel balance pipe from the adapter projecting through No. 5 rib. Access is gained through the diaphragm panel.

(c) Disconnect the hose from the vent pipe adapter on the top of the tank and loosen the clip securing the hose to the vent pipe extension to No. 4 tank. Access for this operation is gained through the cover plate at No. 7 rib.

(d) Remove the outboard tank panel. As this panel supports both No. 3 and No. 4 tanks, both these tanks must be temporarily supported with slats.

(e) Disconnect the leads from the fuel gauge tank unit.

(f) Release the hoses from the two fuel balance connections to No. 4 tank and the single hose from No. 2 tank.

(g) Lower the tank and manipulate the tank adapters from the hose connections.

(4) No. 4 tank. After removal of No. 3 tank which is outlined above, it is only necessary to remove the four countersunk screws securing the filler neck flange to the skin to permit removal of No. 4 tank. If only No. 4 tank is to be removed, the two fuel balance pipes and the vent pipe to No. 3 tank must be disconnected. The tank panel, as previously mentioned, supports both No. 3 and No. 4 tanks.

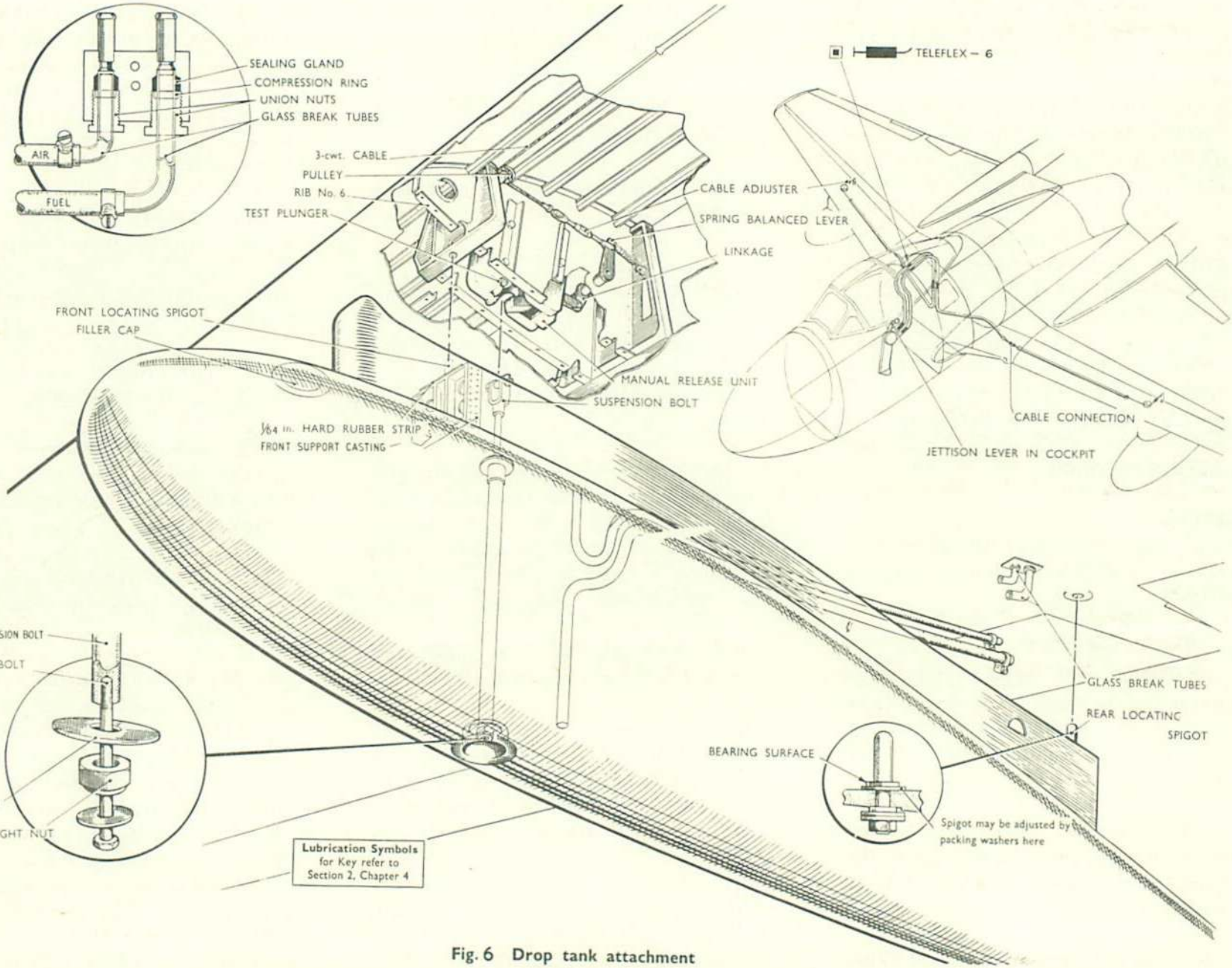

Fig. 6 Drop tank attachment

Installation of wing tanks

16. Special care must be taken to examine the interior of the wing tank bays for sharp edges or other projections which are likely to cause damage to the flexible tanks. The procedure for installing the tanks is mainly the reversal of that given for removal and it is recommended that, when all the wing tanks are to be installed, No. 1 tank is installed first and the remainder in numbered sequence. Special attention must be paid to the securing of the tank panels as various sizes of bolts are used. Full instructions giving the position of the bolts, which are identified by a number stamped on the head of each bolt, are contained in Sect. 3, Chap. 2. On No. 1 and 3 tanks ensure that the fuel contents gauge tank unit is supported on its lugs, so that the base of the unit will not rest on the tank panels.

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NOTE...

On installation of Port No. 1 fuel tank, ensure that a clearance exists between the pipe to the fuselage tank, and the body of the inboard hydraulic ground test non-return valve, situated on the rear face of No. 4 bulkhead.

Installation of drop tanks (Fig. 6)

17. The drop tank is attached to the underside of each wing at No. 6 rib in the following manner :-

(1) Check the operation of release gear (para. 13), and grease the release hook before pressing the tank suspension bolt into the hook. This will lock the unit and secure the bolt.

(2) Ensure that the 1/64 in. hard rubber strip is in position on the tank front support casting and then offer up the tank to the wing, passing the suspension bolt through the hole in the tank.

(3) Screw a 2 B.A. bolt about 7 in. long into the end of the suspension bolt as shown in Fig. 6. This will support the tank while connections are made in the air pressure and fuel transfer lines. The hose connections are secured to the glass break tubes with Jubilee clips.

(4) Place the washer and Aerotight nut on the tank suspension bolt and tighten the nut to a torque loading of approximately 450 $\pm$ 50 lb. in., ensuring that the front and rear locating spigots enter their appropriate holes.

(5) Check that the tank is rigidly secured to the wing with an overall clearance between the tank fairing and the undersurface of the wing. The maximum clearance at any point should be approximately 0.25 in. but this may be exceeded where necessary to prevent the fairing from fouling the undersurface of the wing.

(6) The clearance may be adjusted by removing the tank from the wing and adjusting the rear bearing spigot as shown. The edge of the tank fairing may also be filed away locally if it is proud of the L-sectioned stiffener.

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