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GROUP/106:AIRCRAFT FUEL, OIL, AND WATER SYSTEM EQUIPMENT
SUB-GROUP D : PRESSURE FUELLING EQUIPMENT

REFUELLING/DEFUELLING VALVE Mk. 27 FLIGHT REFUELLING PART No. 1127050, 1127145

GENERAL AND TECHNICAL INFORMATION.

FITS, CLEARANCES AND REPAIR TOLERANCES.

BY COMMAND OF THE DEFENCE COUNCIL

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(Ministry of Defence)

FOR USE IN THE
NAVAL SERVICE

(Prepared by the Ministry of Aviation)

AMENDMENT RECORD SHEET

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REFUELLING/DEFUELLING VALVE, Mk. 27, FLIGHT REFUELLING

Part No. 1127050
1127145

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Introduction

1. The Mk.27 valve, Part No.1127050, is an electrically operated selective fuelling/defuelling valve designed for fuel line installation. The valve provides automatic shut-off of fuel at a predetermined level when operated by a float switch mounted inside the tank. Alternatively the valve circuit may be controlled by a master switch in the aircraft cabin.

General

2. The valve (fig. 1) consists of a cylindrical shell and a valve body joined by six 6-32 UNC bolts equally spaced around mating flanges. Together the two components form a housing for the cylinder and piston assembly. The solenoid assemblies whose circuits can be switched either manually, or by the float mechanism in the relevant fuel tank, control the refuelling and defuelling operations and are installed on the valve body. A spring-loaded valve mounted externally on the valve body enables the defuelling operation to be initiated under conditions where an electrical power supply for the solenoid circuit is unavailable.

Outer shell

3. The outer shell is reduced and machined with a standard conoseal flange to fit a $1\frac{1}{4}$ in. dia. pipe by which the valve is connected to the inlet fuel supply and has a flange at the other end for attachment to the valve body. A step in the bore of the shell at the refuelling inlet end forms a seating for the spring-loaded valve head assembly. The shell wall is drilled longitudinally so that when the shell and body are joined a continuous fuel passage is formed to connect the refuelling inlet with the defuelling solenoid chamber. This passage is referred to as the defuelling exhaust duct.

Valve body

4. The valve body forms an extension to the outer shell and has an external flange to mate with that on the shell. A conical housing supported by two integral webs is formed concentrically inside the body. The open end of the cone projects into the outer shell as a

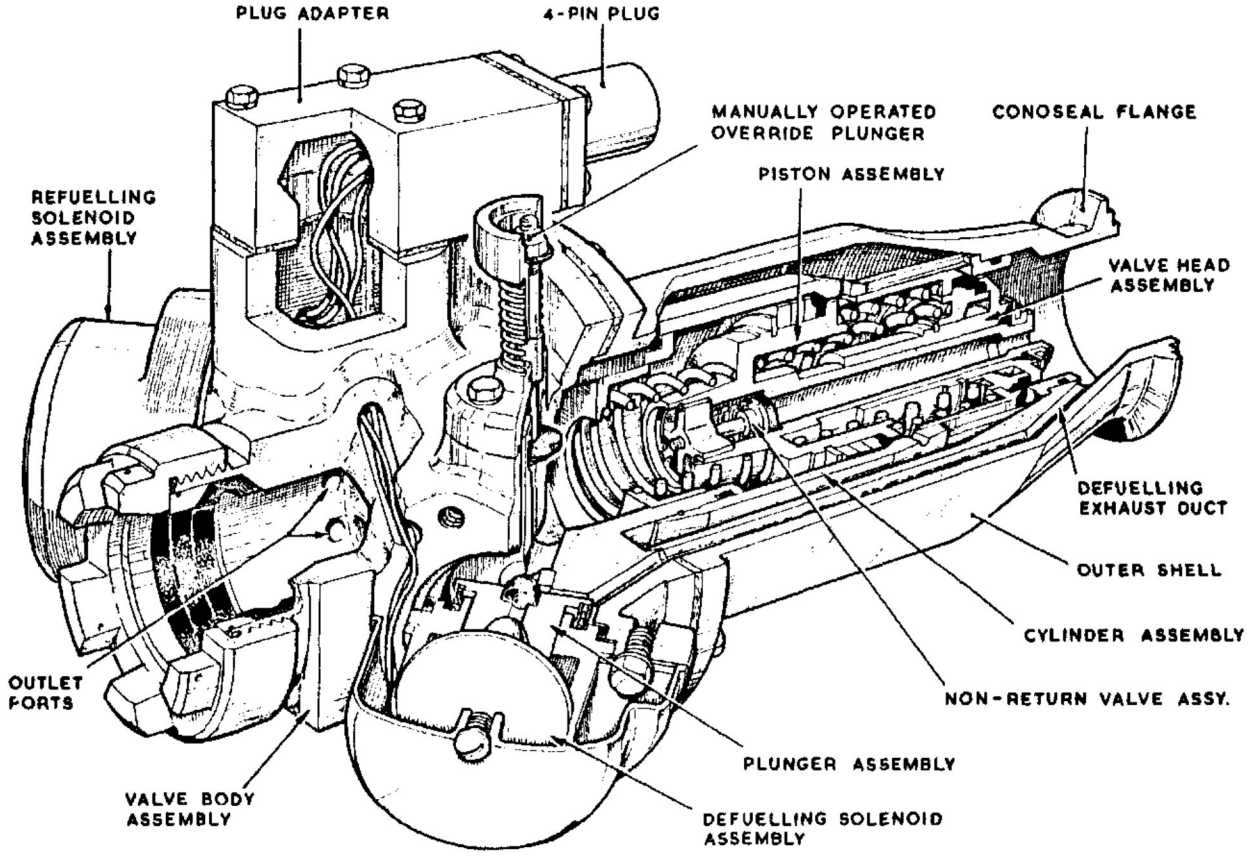

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Fig. 1 Cut-away view of valve, Part No. 1127050

spigot over which the cylinder (para. 6) fits. A protruding port at the other end of the body (refuelling outlet) is threaded $1\frac{1}{2}$ in. BSP externally and provided with a rubber seal, split collar and outer sleeve to form a $1\frac{1}{4}$ in. termination-type special connector. The port communicates with the interior of the outer shell via two fuel passages in the supporting webs and forms a connection between the aircraft fuel system and the valve defuelling inlet.

5. Two bosses, positioned one on either side of the outlet port, provide housings for the refuelling and defuelling solenoids. The bosses are bored centrally to connect with the interior of the valve body thereby providing, in each case, a fuel passage which can be sealed by the closing of the solenoid plunger valve (para. 11).

Cylinder

6. The cylinder housing the valve piston assembly is positioned inside the valve outer shell. One end of the cylinder is a close fit over the spigot in the valve body to which it is locked by a trapwire; the other end locates on a step in the reduced end of the outer shell. Fuel leakage between mating surfaces of the cylinder and valve body is prevented by an O-ring located in a groove on the valve body surface. Similarly, an O-ring in a groove on the outer surface of the cylinder prevents fuel leakage between the cylinder and outer shell. The annular space formed between the cylinder and the shell provides the main fuel passage between the valve outlet and inlet for both the refuelling and defuelling operations.

7. Three ports spaced evenly around the cylinder head provide a passage for fuel flow past the piston head during valve operation and eight evenly-spaced 1/8 in. dia. holes through the cylinder shell provide a fuel connection from the main fuel passage in the outer shell to the interior of the piston assembly. This arrangement allows fuel pressure to be applied to the underside of the piston head in order to close the valve and also provides for the relief of pressure from under the piston head for surge conditions.

Piston assembly

General

8. The piston carries a piston head sub-assembly which is a sliding fit over the piston shank and a piston ring sub-assembly locked on to the piston skirt. Two pressure-relief springs positioned between the under surface of the piston head and the skirt of the piston body allow a spring-loaded movement of the piston head relative to the piston body. This provision allows relief through the ports of any temporarily increased fuel pressure on the piston head caused by surges or by thermal expansion of fuel.

Piston head sub-assembly

9. A sub-assembly which consists of the piston head, seal and valve seat locked together by a circlip on the piston head, is free to move as a single unit over the length of the piston shank. A split collar which is locked in a groove on the end of the piston shank limits the forward travel of the piston sub-assembly which is spring-loaded against the split collar by the two pressure relief springs.

Piston skirt sub-assembly

10. The piston skirt forms a mounting for the piston ring assembly. This latter consists of a series of stainless steel sheet piston rings and light alloy washers which are assembled on the piston skirt together with a rubber sealing washer and a piston ring plate as shown in fig. 2. The ring assembly is locked on the skirt by a circlip. When in the closed position the piston is retained on its seating by a helical spring located between a spring seat in the valve body and a shoulder on the piston skirt.

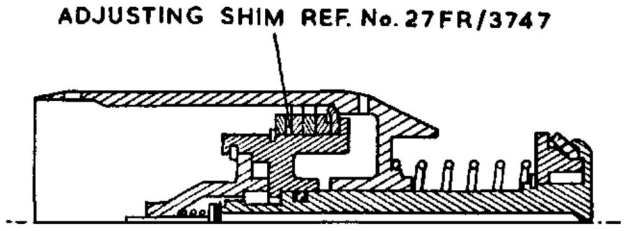

Fig. 2 Piston assembly details, Valve Part No. 1127050

Sequential seating

11. In the 'unoperated' condition the piston skirt seal rests against its seating in the main bore of the cylinder, while the piston head seal contacts the valve head seating in the neck of the cylinder. To achieve a deflection of 0.010 - 0.015 in. of the piston head seal while in this condition a plain washer backed by a laminated shim is inserted between the

face of the piston head and the split collar. The 0.002/0.003 in. laminae are added to or subtracted from the shim (para. 25) to give the correct deflection.

Surge relief adjustment

12. Adjustment to the relief spring loading is achieved by the insertion of shims between the outer relief spring and the piston head. The shim assembly is made up of a number of steel shims, Part No. 1127107, each of thickness 0.005 in. If the total required thickness exceeds 0.125 in. the assembly is to be made up by a single shim of that thickness (Part No. 1127111) supplemented by an appropriate number of 0.005 in. shims.

Fuel expansion

13. Normally, when the valve is in the static condition the refuelling gallery will be filled with fuel trapped between the ground refuelling unit and the valve head. This fuel will expand with increase of temperature and the resultant pressure rise will cause the piston head to move from its seating against the loading of the relief springs and so release fuel through the cylinder ports. Under these conditions the piston head moves relative to the piston body which will remain in place so that the seal on the piston skirt keeps the cylinder main bore closed. A non-return valve sliding in a bushed spider seals off the hollow piston body. Since the valve is lightly loaded it will automatically be lifted from its seat during surge conditions to allow fuel into the valve body. Since the loading of each solenoid spring is greater than that of the valve relief springs no surge pressure will be relieved via the solenoid plunger valves.

Piston mounting

14. The piston assembly is supported in the valve unit, and its freedom of operation ensured, by an open ended cylindrical guide which is a sliding fit inside the neck of the cylinder. The guide is held against the underside of the valve seat by the outer relief spring. It provides a forward bearing for the piston assembly inside the cylinder and also smooths the flow of fuel through the ports when the valve is operated. Fuel leakage between the piston shank and the bore of the piston head is prevented by an O-ring located against the bevelled forward face of the piston head.

Solenoid assemblies

15. Two identical assemblies, one to control the refuelling, the other to control the defuelling operations, are mounted on bosses on the valve body. In each case the boss is counterbored to house a Mk. 1, Series 5, solenoid and plunger assembly retained in its housing by a plate which is, in turn, secured by three UNC bolts locked by tabwashers. Plain washers threaded over each securing bolt between the retaining plate and the boss prevent bowing of the plate when the bolts are tightened. A dished nylon cover secured to the solenoid by a single screw protects each solenoid assembly from dirt and damage.

16. The solenoid plunger is fitted with a seal and while the solenoid remains de-energized the plunger is held on its seating by a spring fitted between the underside of the solenoid and a flange on the base of the plunger. Under these conditions fuel cannot be exhausted from the interior of the valve body to initiate the refuelling or defuelling operations. When either solenoid is energized the appropriate plunger is lifted from the seating against the resistance of the spring so releasing the fuel pressure in the valve body from behind the piston. Fuel leakage between the solenoid and its housing is prevented by an O-ring located on a step on the solenoid. Adjustment of the solenoid plunger travel is provided by the insertion of one or more 0.005 in. steel shims between the O-ring and its seating on the solenoid.

17. A system of fuel ducts, necessary to the correct functioning of the valve is incorporated as follows:-

(1) Separate passages connect the interior of the valve body with the solenoid housings.

(2) A passage consisting of twin parallel ducts connects the refuelling solenoid housing with the refuelling outlet of the valve.

(3) An internal passage, located partly in the outer shell and partly in the valve body, connects the defuelling solenoid housing with the defuelling outlet of the valve.

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Manual defuelling system

18. A manual device is incorporated to provide a means of defuelling when no aircraft electrical power is available to energize the solenoid. The device is installed in a chamber of the valve body and is essentially a manually-controlled by-pass to the defuelling solenoid

plunger valve (fig. 3). A spring-loaded plunger which is depressed from outside the valve protrudes through the casing into an annular chamber. The plunger head is fitted with a rubber seal and controls the means of releasing fuel pressure inside the valve body to allow the piston assembly to move back and open the valve for the defuelling operation. The operation is therefore an alternative to the normal power-controlled defuelling procedure.

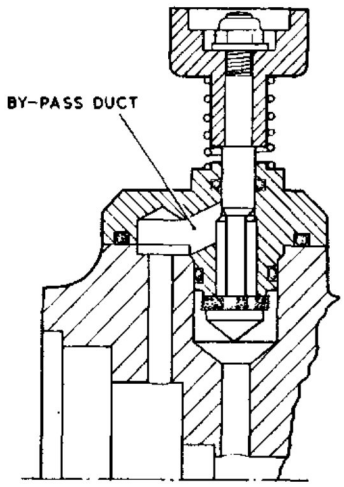

Fig. 3 Manually-operated defuelling plunger

Power supplies

19. An adapter mounted on the valve body adjacent to the manual defuelling plunger carries a 4-pole plug. Fig. 4 illustrates the solenoid lead connections.

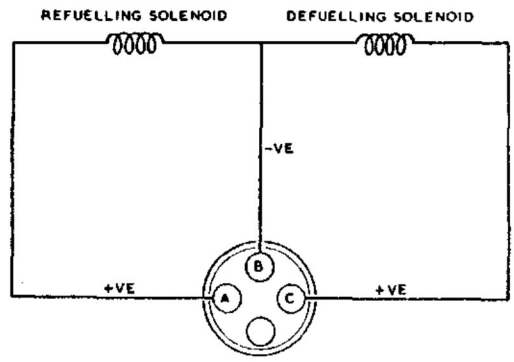

Fig. 4 Electrical connections

Valve, Part No. 1127145

20. This valve is basically similar to the valve, Part No. 1127050, but incorporates the following differences in detail:-

(1) Extreme temperature sealing washers are fitted to the piston head and piston body. These washers are identified Part No. 1127116 and Part No. 1127118, respectively.

(2) A special seal retaining ring, Part No. 1127122, is fitted to support the piston body seal, the sub-assembly being locked on the piston by an additional circlip (fig. 5).

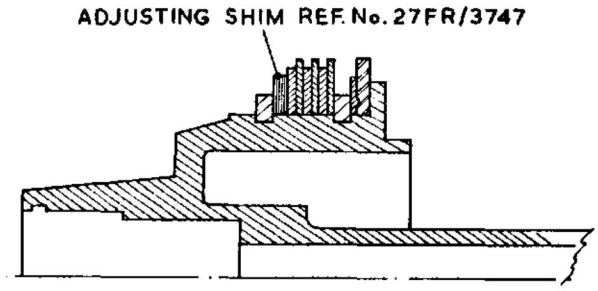

Fig. 5 Piston assembly details, Valve Part No. 1127145

(3) The piston rings fitted (Part No. 1127119) are of brass sheet. The differences in the method of assembly are recorded in the appropriate sub-paragraphs. The test procedure, however, is identical for both valves described in this Unit of Information.

Principle of operation

21. The principle of operation of the valve, illustrated in fig. 6, is described in the following sub-paragraphs, the headings of which indicate the valve condition and the relevant selection required:-

(1) *Static condition – both solenoids de-energized.* In this condition the piston assembly is held in the closed position by the return spring with the piston head sealing the valve throat. Any pressure unbalance on the valve head due to temperature increase in the fuel gallery will be released by compression of the surge relief springs.

(2) *Refuelling flow condition.* . When the refuelling solenoid is energized the solenoid plunger valve is withdrawn from its seating. Pressure in the valve body behind the piston is relieved through the now open exhaust duct. Differential pressure on the piston causes the valve to open so that fuel flows past the valve

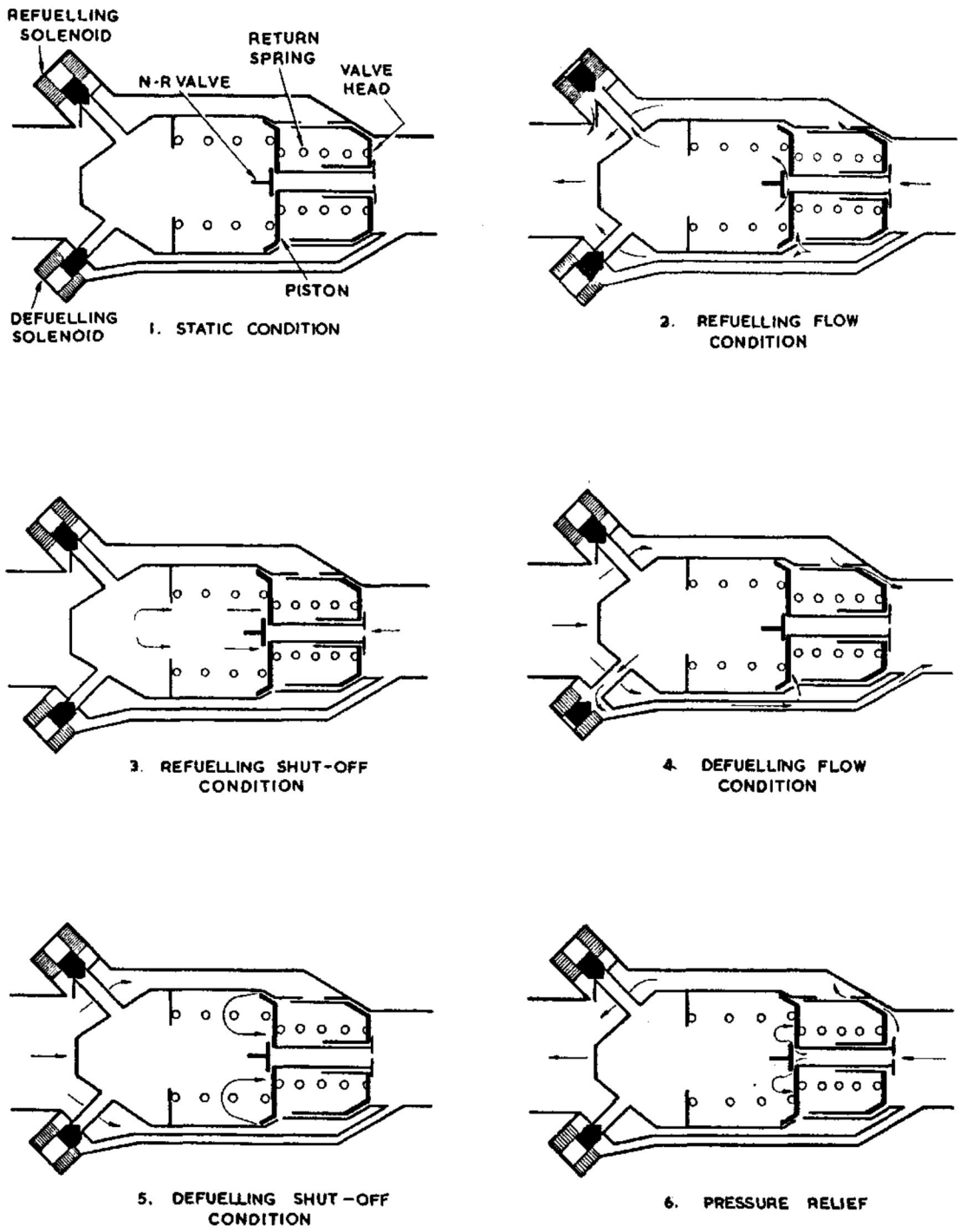

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Fig. 6 Functional diagram

head, through the ports in the cylinder, thence along the annular passage between the cylinder and outer shell to the main fuel passage in the valve body and so into the tank. Fuel evacuated from the valve body behind the piston is joined by that entering the body via the non-return valve and also via the circumferential holes in the cylinder.

(3) *Refuelling shut-off condition.* When the solenoid circuit is broken (by float action or manual switch) the spring-loaded plunger returns to its seating, thus sealing off the exhaust duct. Fuel continues to flow past the non-return valve into the valve body and when pressure behind the piston skirt, supplemented by the return spring loading, has built up

sufficiently, the piston returns to its seating thus shutting off fuel flow into the tank. Simultaneously the non-return valve in the piston is forced back to its seating by fuel pressure and the non-return valve spring.

(4) *Defuelling flow condition.* With the defuelling solenoid energized the solenoid plunger is withdrawn from its seating. Depression in the defuelling line is communicated to the interior of the valve body to exhaust the fuel behind the piston.

(5) *Defuelling shut-off condition.* With the defuelling solenoid circuit broken the solenoid plunger returns to its seating to close off the exhaust duct. Fuel continues to enter the cylinder via the circumferential holes to apply pressure on to the under surface of the piston head. Some of this fuel seeps past the piston ring labyrinth to build up pressure in the valve body on the reverse side of the piston. A differential pressure, supplemented by the return spring loading, is created to move the valve to the closed position.

(6) *Pressure relief.* Pressure in the refuelling gallery as the tanks of a multiple system become filled is automatically applied to the valve head. This increased pressure is relieved by compression of the relief springs thus causing the piston head to move independently of the piston body. The built-up pressure will be relieved when the spring guide moves to uncover the three cylinder ports as in the normal refuelling sequence. Fuel displaced due to mutual movement of the piston halves is exhausted through the cylinder breather holes.

(7) *Manual defuelling.* When the spring-loaded plunger is depressed the opened plunger valve provides a path for the fuel in the valve body to pass into the defuelling exhaust duct via the by-pass. The valve will be opened by differential pressure as in (4) and closed as in (5).

SERVICING

General

22. Servicing of the valve while installed in the aircraft is confined to general attention to cleanliness and also to the security both of the valve body bolts and to the connection of the valve into the aircraft fuel system. Fuel leakage between the valve body and outer shell will indicate a failure of the sealing gasket. At the stipulated servicing period for the system or if malfunctioning is suspected the valve must be removed for visual checking, dismantling and testing.

Dismantling *(fig. 7)*

23. To dismantle the valve proceed as follows:-

(1) Remove the four bolts and spring washers securing the 4-pin plug, withdraw the plug to the full extent of the leads and disconnect the leads.

(2) Remove the plug adapter by unscrewing the four bolts.

(3) Remove the refuelling solenoid cover and the three bolts, washers and nuts securing the retaining plate. Withdraw the solenoid, exercising care in extracting the leads from the valve body passage.

(4) Lift out the plunger guide, plunger valve and spring, remove the shims and discard the O-ring.

(5) Repeat operations (3) and (4) for the defuelling solenoid assembly.

(6) Remove the two bolts and sealing washers securing the manual defuelling plunger. Withdraw the guide cap with plunger and spring.

(7) Unscrew the stiffnut and remove the washer and operating cap from the plunger. Withdraw the spring and guide cap from the plunger.

(8) Unscrew the stiffnuts and remove the washers and bolts securing the outer shell to the valve body. Remove the outer shell.

(9) Hold the valve body horizontally with the locking wire hole in the cylinder uppermost. Cut off one end of the wire as close as possible and press the cut end down into the blind hole. The cylinder is now free to rotate on the body in one direction only. Grip the free end of the wire and rotate the cylinder through 360 deg. thus ejecting the wire. Remove the cylinder assembly from the body.

(10) Extract the piston return spring and spring seat from the valve body.

(11) Withdraw the piston assembly from the cylinder.

(12) Detach the circlip and remove the non-return valve guide spider, spring and non-return valve from the piston body.

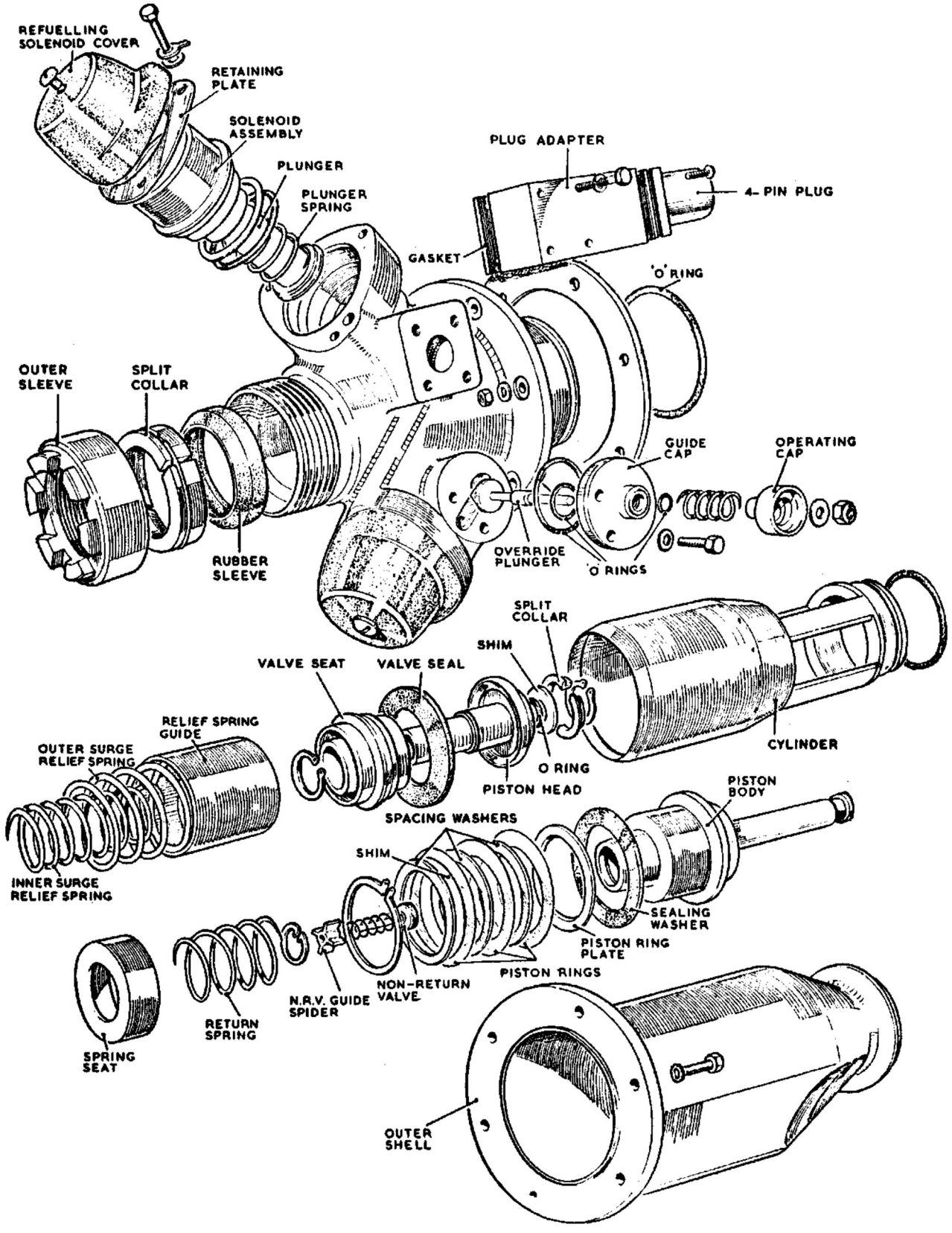

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Fig. 7 Exploded view of valve, Part No. 1127050

(13) (a) *Valve 1127050.* Detach the piston body circlip and remove the shims, piston rings, spacing washers, piston ring plate and sealing washer from the piston body.

(b) *Valve 1127145.* Detach the piston body outer circlip and remove the shims, piston rings and spacing washers. Detach the inner circlip and remove the seal retaining ring and sealing washer.

(14) Place the piston assembly in the press, Part No. FRS.156, using the adapter, Part No. 121-68C (fig. 8). Compress the surge relief springs and detach the circlip, split collar, shims, support washer and O-ring from the piston body shank.

(15) Release the pressure and detach the piston head from the body. Remove the spring guide, relief springs and shims. Note the exact number of shims for reference during reassembly.

(16) Release the circlip and remove the seal and valve seat from the piston head.

Examination

Note...

Rubber seals, e.g., O-rings and valve head seals cannot reasonably be checked for condition, they should therefore be discarded and replacement items subsequently fitted. Locking devices, e.g., circlips must be treated as normal metal components.

24. When the valve has been dismantled all parts must be cleaned with trichlorethylene or other suitable solvent and the following examination carried out:-

(1) *General.* Examine all metal components visually for the following conditions:-

(a) Cleanliness
(b) Distortion
(c) Cracking
(d) Scoring
(e) Denting
(f) Evidence of wear
(g) Deterioration of protective treatment - corrosion
(h) Serviceability of threads
(j) Security of components not dismantled

(2) *Detail procedure.*

(a) Check the plunger and spring in each solenoid for freedom of operation.

(b) Check the lead insulation for damage or fraying. In the event of damage, any one of the following alternative procedures may be adopted:-

(i) The solenoid may be renewed.

(ii) Damaged leads may be joined by crimping a butt connector to the ends.

(iii) Leads may be twisted together and soldered. The joint must be protected with pvc tubing.

(c) Carry out a dimensional check of working surfaces in accordance with the Schedule of fits, clearances and repair tolerances. Piston rings should be rejected where ovality is such as to bring the permissible worn clearance on the minimum worn diameter outside that laid down in the Schedule. Due to dissimilar materials used in manufacture the ring clearance varies considerably with working temperature and has a direct affect on the pressure drop across the valve.

Assembling

25. After the component parts have been examined and all unserviceable parts renewed the valve must be assembled as detailed in the following sub-paragraphs. At the relevant stages during assembly, replacement O-rings should be treated with a film of Molydest grease, Ref. No. 34B/9425139. Hellerine lubricant, Ref. No. 34B/1225 may be used as a substitute:-

Note...

The piston head and piston body are mated parts. If either is found to be unserviceable, both components must be renewed. Additionally, component parts of the valve are not repairable, all defective or otherwise unserviceable parts must be renewed.

(1) Position the seal and seal seat in position on the piston head with the piston head located in the bush (fig. 8). Place the Spirolox ring on the tapered plug and position the plug over the piston head. Apply pressure to the locking ring via adapter, Part No. 121-67C.

(2) (a) Fit the following items to the piston body in the order shown:-

(i) Replacement seal washer
(ii) Seal retaining ring (Valve 1127145), or
Piston ring plate (Valve 1127050)

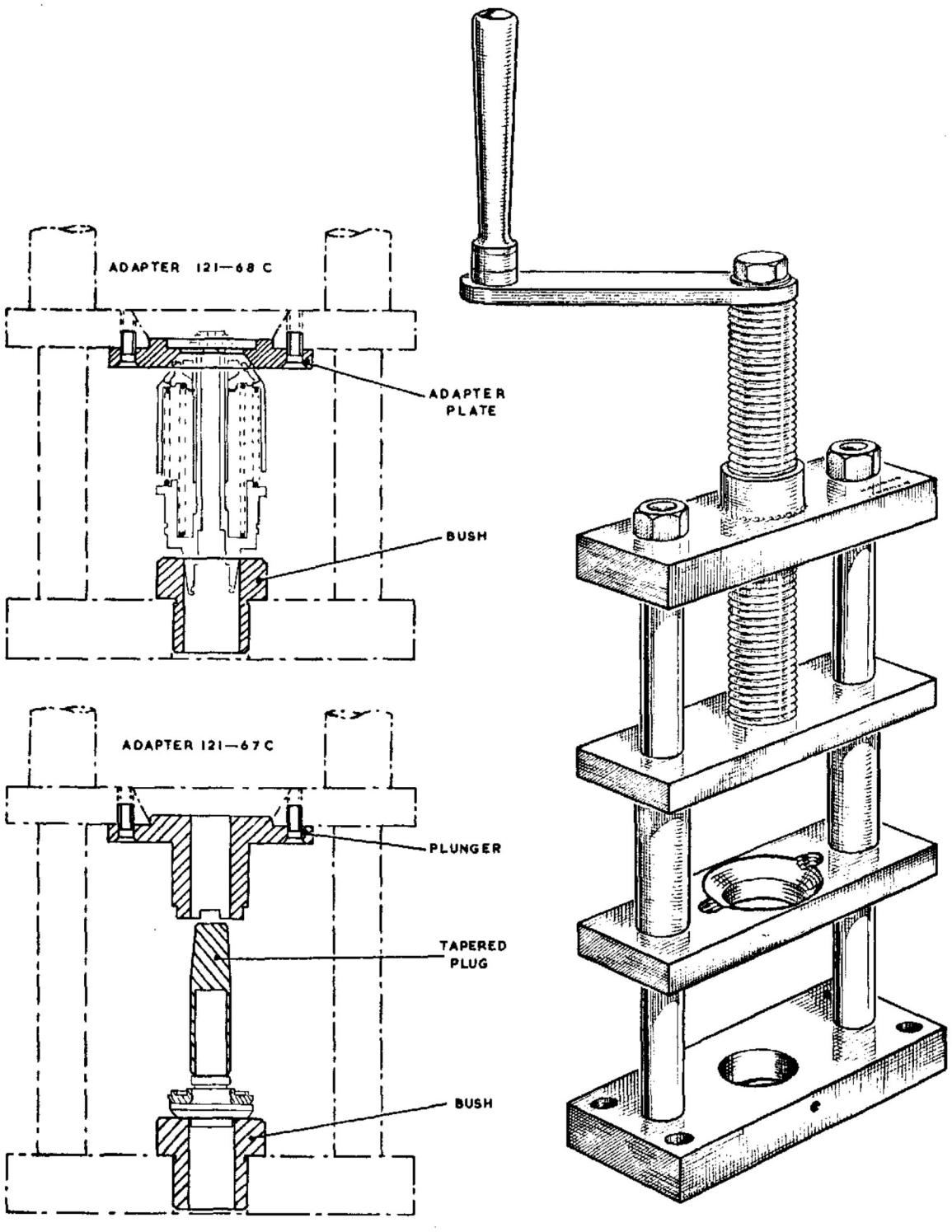

Fig. 8 Piston assembly press, Part No. FRS.156

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(iii) Circlip (Valve 1127145)
(iv) Piston ring
(v) Spacing washer
(vi) Piston ring
(vii) Spacing washer
(viii) Piston ring
(ix) Spacing washer
(x) Circlip

(b) Two types of piston ring may be fitted to the valve, Part No. 1127050. These are identified Ref. No. 27FR/3745 having a maximum external diameter of 1.7495 in. and Ref. No. 27FR/4103 having a maximum external diameter of 1.7475 in. Should the valve performance be found unsatisfactory during the tests the piston body may be dismantled and re-assembled with the alternative type of ring.

(c) The end float of the piston assembly must be as small as possible commensurate with free rotation of the rings. In any case the end float must not exceed 0.010 in. To adjust the float insert the required thickness of laminated shim, Ref. No. 27FR/3747, between ring (item (viii)) and spacing washer (item (ix)). Where necessary pull laminations from the shim.

(3) Adopt the following procedure to obtain the correct sequential seating of the piston head and piston body seals:-

(a) Assemble the piston head and spring guide to the piston body without the relief springs and retain temporarily with the split collar.

(b) Carefully introduce the assembly into the cylinder avoiding damage to the piston rings.

(c) Mount the cylinder vertically on a stand with the piston body uppermost so that only the weight of the assembly will deflect the seals on their seatings. Obtain a positive DTI reading on the piston body upper face (D1).

(d) Carefully remove the assembly from the cylinder, detach the split collar and separate the valve head from the piston. Fit the inner and outer surge relief springs and replace the valve head. Compress the relief springs using the press with adapter, Part No. 121-68C, and fit the O-ring, support washer and shims previously removed. Refit the split collar.

(e) Insert the assembly into the cylinder and repeat the DTI reading (D2). Subtract D2 from D1. Adjust the thickness of shim to be inserted behind the split collar until D1-D2 = 0.010 in. to 0.015 in. Each lamination of the appropriate washer, 27FR/32041, is approximately 0.002 in. thick.

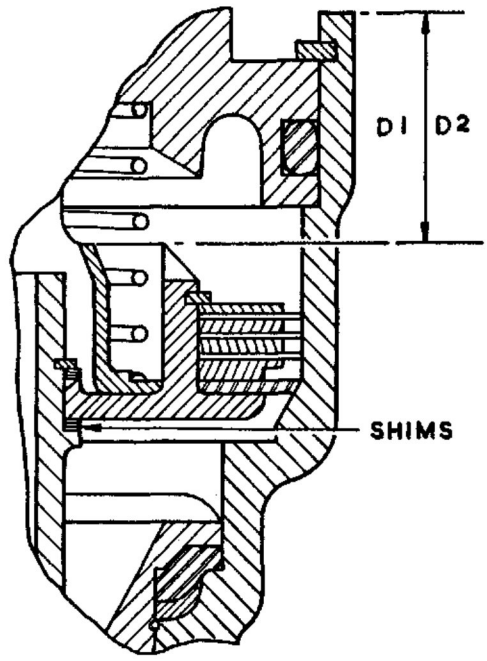


Fig. 9 Sequential seating procedure

(4) Position the non-return valve and spring in the recess in the piston body, fit the guide spider and secure with the circlip.

(5) Fit a new O-ring, Ref. No. 27QA/417, to the groove in the valve body housing, position the spring seat against the step, fit the valve-return spring and assemble the cylinder to the valve body so that the trapwire holes are aligned.

(6) Grip the valve body flange in a vice with the trapwire hole uppermost. Insert a length of 20 swg stainless steel locking wire (Ref. No. 30A/3338), bent at 90 deg., 0.15 in. from the end, hold the wire in line with the circular channel and rotate the cylinder assembly through 360 deg. This will feed the wire through the channel until the end reappears in the locking hole. Extract this end and bend it away from the edge of the hole. Bend the other end in the opposite direction and cut off the surplus from both ends approximately 0.1 in. from the hole. The cylinder is now securely locked to the valve body.

(7) Fit a new O-ring, Ref. No. 27QA/532, to the cylinder head, fit a new gasket to the cylinder flange, align the defuelling exhaust ducts and bolt the valve body to the outer shell.

Note...

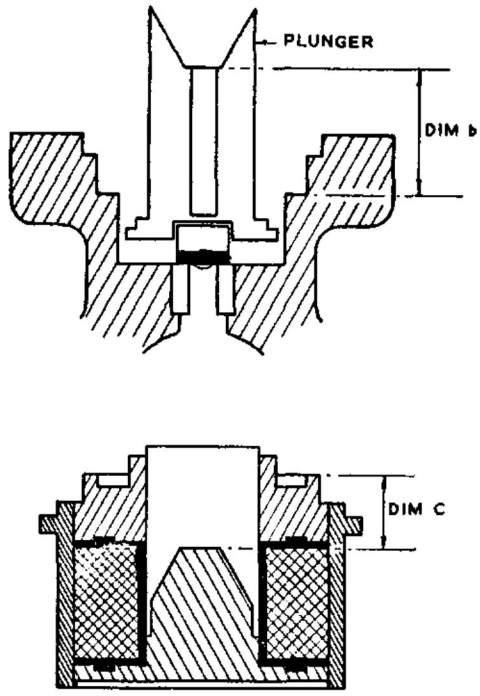
A shakeproof washer must be fitted on either flange of one of the securing bolts to ensure efficient bonding of the two components.

(8) Fit a new O-ring, Ref. No. 27QA/411, to the step of each solenoid plunger guide. Check the air gap between the face of each solenoid core and the inner face of the plunger *(fig. 10)* as follows:-

(a) Mount the valve body on a bench so that the solenoid mounting face is uppermost and parallel with the bench surface. Place the plunger valve in the housing so that the valve pad rests on its seat. Do not fit the spring or solenoid assembly at this stage.

(b) Measure the distance from the inner face of the plunger (i.e. the apex of the conical base) to the step in the mounting.

(c) Measure the distance from the tip of the solenoid core to the face which, on assembly, seats against the mounting.



SOLENOID ASSEMBLY

Fig. 10 Solenoid air gap check

(d) Subtract the dimension obtained in (b) from that obtained in (c). The result should be 0.050 ± 0.005 in. Adjustment to the gap is made with laminations from shim, Ref. No. 27FR/3727.

(9) Carefully feed the solenoid leads through the passage in the valve body. Install the refuelling solenoid and spring over the plunger and secure the solenoid retaining plate lightly to the mounting flange with the three bolts. If the gap between the plate and the flange exceeds 0.020 in. but is less than 0.040 in., fit one 4BA thin washer, Part No. SP10B, over each attachment bolt between the plate and the flange. Fit two washers to each bolt if the gap exceeds 0.040 in. Tighten the attachment bolts and lock with the tabwashers.

(10) Repeat item (9) with the defuelling solenoid.

(11) Carefully withdraw the solenoid leads to their full extent from the valve body, fit a new gasket, Part No. 5R/5426, thread the leads through the plug adapter and secure it to the valve body with the four bolts.

(12) Fit a new gasket, Part No. 3504637, to the adapter face, connect the leads as shown in fig. 4 and secure the plug.

(13) Assemble the rubber seal to the defuelling plunger and fit the following new O-rings:-

(a) One O-ring, Ref. No. 27QA/393, to the annular groove.

(b) One O-ring, Ref. No. 27QA/528, to the groove on the under surface.

(c) One O-ring, Ref. No. 27QA/397, to the groove on the spigot.

(14) Assemble the plunger, guide cap, spring and spring seat. Secure the assembly with the 4BA stiffnut and washer. Insert the assembly into its housing on the defuelling solenoid boss and secure the guide cap with the two 4BA bolts. Lock the bolt heads together with 20 swg stainless steel wire, Ref. No. 30A/3338.

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Testing

General

26. A suitable test rig is shown diagrammatically in fig. 11. The pressure gauge tapping must be a cleanly-drilled 1/16 in. dia.

hole, without rough edges and positioned as close as possible to the valve inlet. The supply pipe upstream of this tapping must consist of at least 1 ft. of $1\frac{1}{4}$ in. dia. pipe. A by-pass flowmeter should be installed so that fuel leakage through the valve, when in the closed position, may be determined.

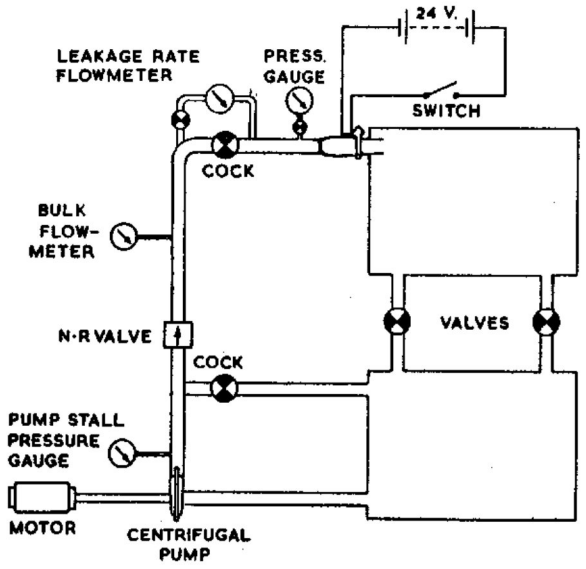

Fig. 11 Fuel flow test rig

Electrical tests

27. (1) Test the insulation of the solenoids and leads. The resistance between the valve body and any one lead must not be less than 20 megohms at 500 volts.

(2) Connect the valve to a d.c. electrical supply variable between 16 volts max. and 14 volts min. Apply a voltage, appropriate to the ambient temperature, across the solenoid terminals and check that the solenoid plungers 'click' without hesitation when each solenoid circuit is completed and broken at least six times in rapid succession. Table 1 gives the minimum voltage required to operate each solenoid compatible with variations in room temperature.

(3) Carry out a bonding check to ensure that the resistance between any two external components is not more than 0.050 ohms.

(4) Before installation in the aircraft repeat the insulation resistance test given in (1), using the values stated below. It is pointed out that the resistance value given in (1) is in accordance with the manufacturer's official test schedules, while the following test values are as recommended by the respective Service:-

(a) The insulation test for non-rotating equipment operating on less than 100 volts is to be made at 250 volts. For RN equipment the insulation value is to be 0.5 megohms and for RAF equipment the value is to be 5.0 megohms.

Leakage tests

28. (1) *Solenoids.* Blank off the refuelling outlet and remove the solenoid covers. Energize the solenoids and apply a gradually increasing fuel pressure up to 165 lbf/in^2 to the refuelling inlet. Maintain this pressure for a period of 2 minutes. There must be no external leakage.

(2) *Reverse leakage test.* Hold the manual plunger in the open position. Depress the valve head and gently allow it to return to its seat. Release the plunger. Mount the valve vertically and fill the refuelling outlet with fuel. After a settling period of 2 minutes the leakage must not exceed 10 cc. during the following 5 minutes.

(3) *Head relief test.* With both solenoids de-energized, apply a gradually increasing fuel pressure to the refuelling inlet. At a recorded pressure between 5 lbf/in^2 and 65 lbf/in^2 the leakage should not exceed 50 cc/min., but the valve must be open when the pressure has reached 75 lbf/in^2.

(4) *Servo relief test.* Energize the refuelling solenoid and apply a gradually increasing fuel pressure at the defuelling inlet, tending to lift the defuelling solenoid plunger from its seat. There must be no leakage up to 65 lbf/in^2 but the plunger must be fully open at 110 lbf/in^2.

Refuelling tests

29. (1) Energize the refuelling solenoid and with a pump stall pressure of 5 lbf/in^2 pass fuel through the valve at a flow rate of 3 gal/min. Close the valve by de-energizing the solenoid. The leakage rate, measured on the flowmeter 2 minutes after the valve has closed must not exceed 50 cc/min.

(2) Energize the refuelling solenoid and pass fuel through the valve at a flow rate of 50 gal/min. with a pump stall pressure

of 55 lbf/in^2. At this rate of flow the valve inlet pressure must not exceed 4 lbf/in^2. De-energize the solenoid to close the valve; the time taken for the valve to close must not exceed 3 seconds. The leakage rate, measured on the flow-meter 2 minutes after the valve has closed must not exceed 100 cc/min.

(3) Energize the refuelling solenoid. Pass fuel through the valve at a flow rate of 100 gal/min. with a stall pressure of 55 lbf/in^2. The pressure loss at this rate of flow must not exceed 15 lbf/in^2. The valve must close when the solenoid is de-energized and open fully to 100 gal/min. when the solenoid is re-energized.

Defuelling tests

30. On completion of the refuelling tests, disconnect the valve from the test rig and install it in the reverse attitude preparatory to the defuelling tests.

(1) Energize the defuelling solenoid. Pass fuel through the valve at a flow rate of 3 gal/min. with a pump stall pressure of 3 lbf/in^2. The valve must close when the solenoid is de-energized and the leakage rate, measured 2 minutes after the valve has closed, must not exceed 20 cc/min.

(2) Energize the defuelling solenoid. Pass fuel through the valve at a flow rate of 50 gal/min. with a pump stall pressure of 25 lbf/in^2. The pressure at the inlet to the valve while fuel is flowing must not exceed 4 lbf/in^2. Close the valve by de-energizing the solenoid. The time taken for the valve to close must not exceed 6 seconds and the leakage rate measured 2 minutes after the valve has closed must not exceed 20 cc/min.

(3) Energize the defuelling solenoid. Pass fuel through the valve at a flow rate of 75 gal/min. with a pump stall pressure of 25 lbf/in^2. The valve must shut off when the solenoid is de-energized.

(4) Repeat tests (1), (2) and (3) using the manual defuelling plunger.

Final electrical test

31. Repeat the insulation tests detailed in para. 25.

Storage and transit

32. Reference should be made to DEF 124 and to A.P.830, Vol.2, Chapters 2, 3 and 4 for general information on Storage, Packaging and Transportation of equipment and also to the relevant Detail Leaflet in the Volume for its specific application to any particular component. When possible a refuelling valve being prepared for transit should be packed in the original carton in which it was received. If this is not possible the component must be packed in a suitable box lined with corrosion-preventive paper and partitioned to protect the valve against shock loads.

WARNING...

When blanking off the valve orifices reference should be made to DDM(A)97, or 218 for information on approved blanking devices. Blanking caps must on no account be manufactured from materials which are friable, fragile or which may be chemically affected by vapour from the tank contents. For this reason, blanks made from paper, masking tape, rag or similar materials are prohibited.

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Table 1 Solenoid minimum operating voltage

Room temp. deg. C	Min. operating voltage
5	14.3
10	14.7
15	15.0
20	15.3
25	15.6
30	15.9

Table 2 Spring data

Description of Part	Free length (in.)	Installed	
		Length (in.)	Load (lb.)
VALVE HEAD RETURN SPRING	1.80	1.04	1.27 ± 0.127
SOLENOID PLUNGER SPRING	1.30	0.39	2.55 ± 0.125
INNER RELIEF SPRING	2.46	1.93	38.0 - 41.0
OUTER RELIEF SPRING	2.35	1.25	38.0 - 41.0

Schedule of fits, clearances and repair tolerances

Parts and Description	Dimension New	Permissible Worn Dimension	Clearance New	Permissible Worn Clearance
PISTON RING IN CYLINDER				
Cylinder bore i/d	$\frac{1.7520}{1.7510}$	1.7525		
Piston ring (27FR/3745)	$\frac{1.7495}{1.7490}$	1.7460	$\frac{0.0030}{0.0015}$	
Piston ring (27FR/4103)	$\frac{1.7475}{1.7470}$	1.7440	$\frac{0.0050}{0.0035}$	0.003
Piston ring (Part No. 1127119)	$\frac{1.7485}{1.7470}$	1.7440	$\frac{0.0050}{0.0025}$	