Chapter 1

H.P. FUEL PUMPS, TYPE G.C. SERIES

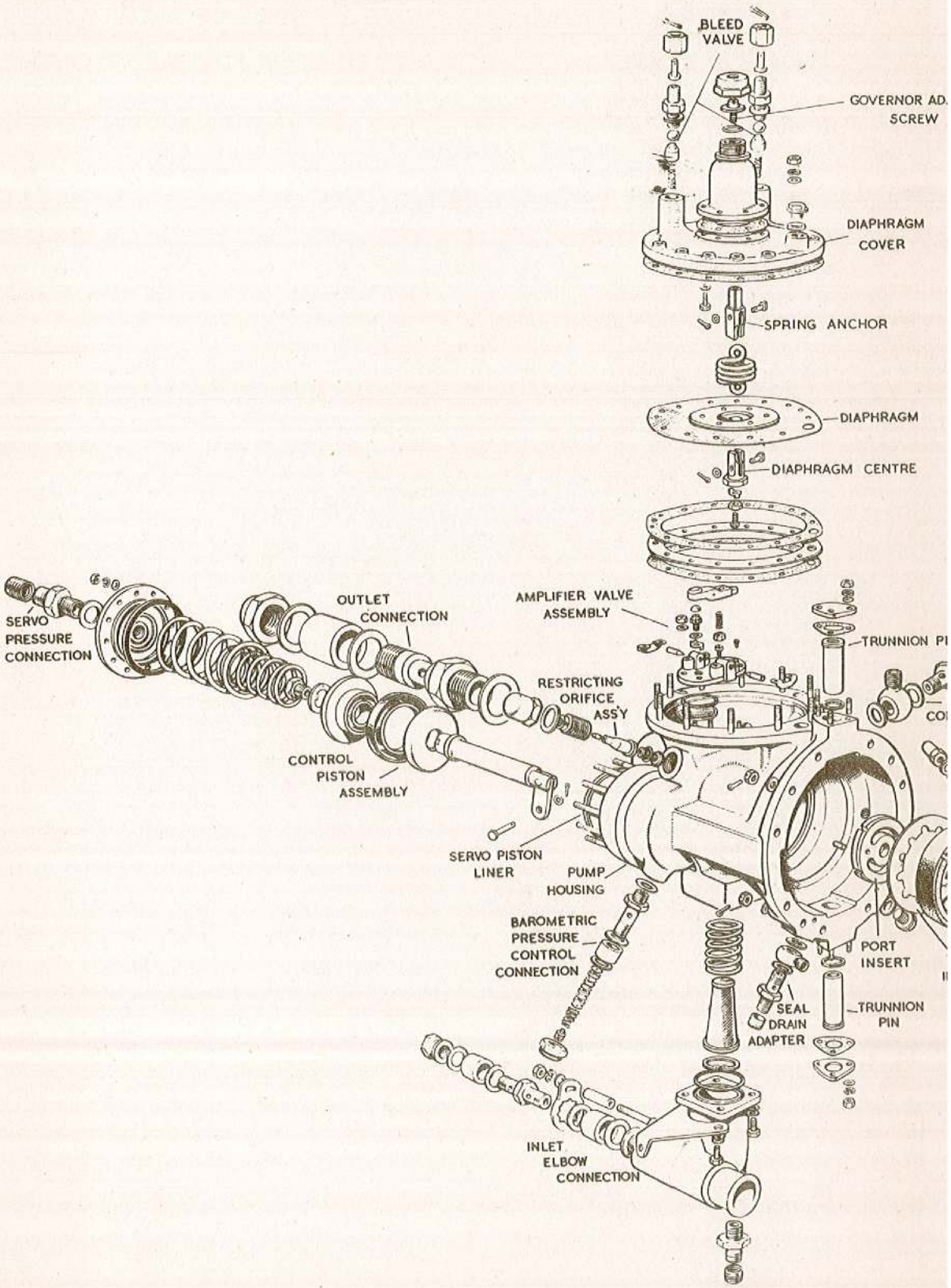
LIST OF CONTENTS

LIST OF ILLUSTRATIONS

GENERAL

1. The instructions given in this chapter are for the G.C. series high-pressure fuel pumps having ball bearing type camplates. Differences will occur due to the various installation fittings and calibration settings. The installation fittings described are typical and must not be regarded as applicable to all types; remote bleed valves are fitted on certain types, while others have only one bleed valve on the diaphragm cover instead of the normal two. Differences in calibration settings are tabulated in the relevant paragraphs. On dual pump installations it is common practice for some pumps to be fitted with solenoid servo isolating valves, while it is recommended that non-return valves be fitted in the outlet connections of all such units. Full details of these sub-assemblies are included in Chapter 2 of this section to which reference should be made.

This leaf issued with A.L. No. 2 , Sept. 1948



F.S. / 2

FIG. 1. DISMANTLED VIEW OF THE GC 12/7

171025 / 65 250 2'57 BBLtd. Gp. 979

2. The log book which accompanies each pump provides a complete record of the history of the unit, and contains all test and clearance figures, running times and complete details of all service, repair and overhaul work effected, together with all replacements made since initial assembly. It is very important to ensure that all further details of this nature are recorded accurately in this log book, after each subsequent period of service, and after repair and overhaul.

3. During all work on the pump extreme cleanliness must be observed, and every precaution must be taken to ensure that all parts are thoroughly clean. To prevent damage to nuts, bolts etc., by rounding off the flats and corners, box spanners must be used whenever possible.

4. All paper joints or gaskets, banjo washers, etc., must be replaced by new ones whenever the seal is disturbed, and new split pins and locking wire must always be used. Parts which are not interchangeable are detailed under " Replacements " (*para* 75).

5. The special tools required for dismantling and assembling the fuel pump are illustrated in the appropriate section of the text, and full details of the tools to be manufactured from local resources, are given in fig. 2 (a) and 2 (b).

6. It is recommended that slave nuts, washers, etc., be used in those instance: where components are only assembled temporarily to enable sound parts to be fitted on final assembly.

SPECIAL TOOLS

7. The repair of fuel pumps necessitates the use of special tools and rigs and these are of two categories, (a) those which are provisioned and (b) those which are to be manufactured from local resources.

8. All the special tools required are detailed in the following " List of Tools ", and fully dimensioned drawings are given for those tools to be manufactured locally, (*fig.* 2 (a) and (b)).

LIST OF SPECIAL TOOLS REQUIRED DURING OVERHAUL

TOOLS TO BE SUPPLIED		TOOLS TO BE MANUFACTURED LOCALLY (fig. 2(a) and 2(b))
Part No.	Nomenclature	Nomenclature
G.38745	Gauge, setting, adjusting tappet clearance	Base, for assembling roller race into cam-plate housing
T.128561	Extractor, removing control cylinder liner	Base, for assembling oil seals into housing
T.128564	Tool, assembling servo piston liner	Bush, locating, for assembling oil seals into housing
T.129661	Fixture, stripping	Clamp, for control piston liner leak test
OT.142853	Extractor, trunnion pin	Drift, for assembling oil seals in housing
OT.142854	Screwdriver, special, removing restriction orifice sleeve	Guide, for assembling roller race into cam-plate housing
OT.142855	Spanner, special, servo piston nut	Guide, for insertion of servo piston in bore
OT.142856	Holder, clock	Guide, quill shaft
G.46439	Gauge, concentricity and depth, for cam-plate housing and quill shaft	Assembly jig for amplifier valve assembling
R.21A	Combined test rig	Plate, blanking for stall pressure check
		Plug, blanking for amplifier valve chamber port
		Plug, blanking for control piston liner leak test
		Plug, expanding, for stall pressure check
		Stand, rotor
		Stand, rotor pistons
		Tool, circlip removal

CHECKS AND PRECAUTIONS BEFORE DISMANTLING

9. The following checks should be made before dismantling :—

(1) Study any complaints reported with the fuel pump, and carefully examine the exterior of the pump for visible signs of damage, e.g., broken locking wire. Check that all parts have been securely covered to prevent the entry of any foreign matter into the interior of the pump.

(2) Examine all exposed threads to ascertain if damage has been caused in transit.

(3) Carefully examine the interior of all dust caps removed; the presence of foreign matter may cause serious damage to the pump. If it is suspected that foreign matter has entered the pump it is advisable first to flush the pump as described in para. 134. The pump will contain inhibiting oil, and this should be drained into a container before running the pump on the test rig.

(4) Remove the installation fittings from the pump, and if the pump is in good running condition it should be mounted on the test rig as for final calibration (*para.* 115).

(5) Proceed to calibrate the pump as described in para. 91 to 97. During initial calibration, the pump should run smoothly and quietly and should any noises be heard which point to a damaged condition the motor on the rig must be stopped and the pump completely dismantled as described in para. 10 to 25. If the pump is functioning correctly the calibration test should be completed. The performance of the pump during this test is a good guide to the condition of the unit and will indicate parts requiring attention.

DISMANTLING

10. The following instructions for dismantling the fuel pump are listed in the recommended sequence. Where the stripping of an assembly is not considered advisable the complete assembly is to be replaced by a new one from stores. Defective pumps must be dealt with according to their reported complaint, complete stripping not being essential in every instance, i.e., where units have completed short running times the stripping of sub-assemblies may be discretionary. It is advisable to have clean metal or wooden trays available in which all small parts such as nuts, washers, bolts, springs, screws, etc., of separate units may be stored with safety. To prevent damage to components sever all exterior locking wire with standard wire-cutters.

Removing the pump outlet connection

11. Remove the end cap off the pump connection body situated in the outlet port of the pump housing, and withdraw the two copper washers and distance piece or banjo, leaving the pump outlet connection body and washer in position in the pump housing.

Removing the pump inlet connection

12. This may be removed complete, as follows :—

Op. 1. Unscrew the four set-screws securing the inlet connection to the pump housing and remove the connection. On some installations the set-screws also support a pipe clip bracket, this is removed with the connection.

2. Remove the seal interposed between the installation connection and the pump housing.

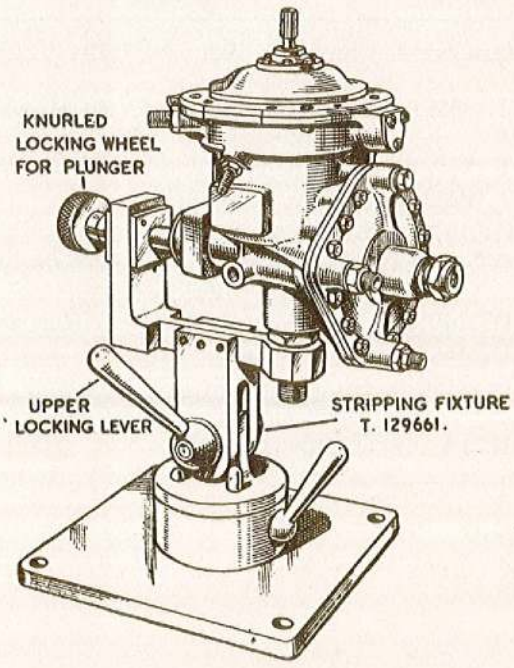
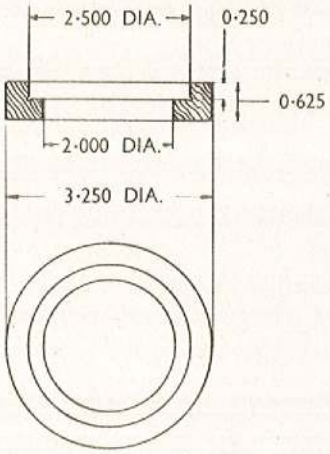
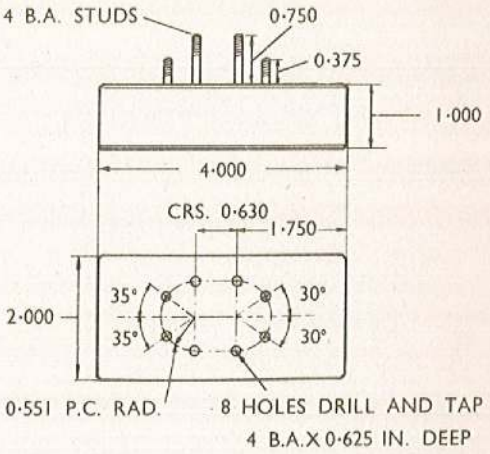


Fig. 3. Pump mounted on stripping fixture



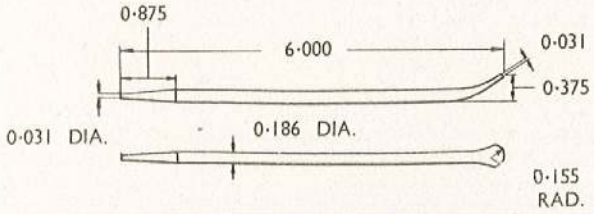
STAND FOR ROTOR

MATL. HARD WOOD OR FIBRE



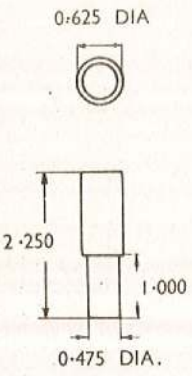
ASSEMBLY JIG FOR AMPLIFIER VALVE

1 OFF M.S.



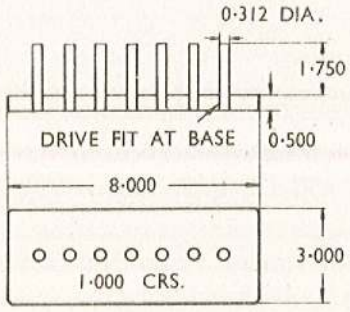
TOOL FOR CIRCLIP REMOVAL

S.S. TOUGHEN



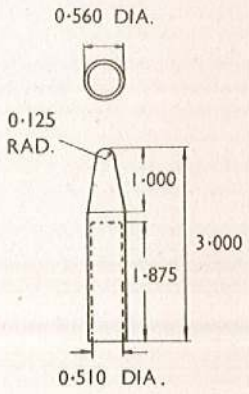
BLANKING PLUG FOR AMPLIFIER VALVE CHAMBER PORT

MATL. FIBRE



STAND FOR ROTOR PISTONS

MATL. HARD WOOD



GUIDE FOR QUILL SHA

MATL. MILD STL.

FIG. 2a TOOLS TO BE MANUFACTURED FRO

ALL DIMENSIONS IN INCHES

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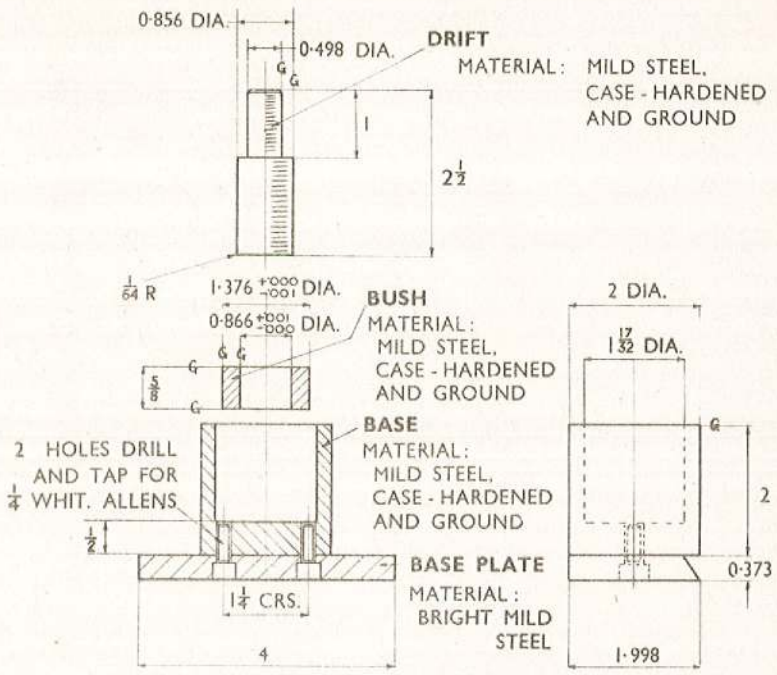
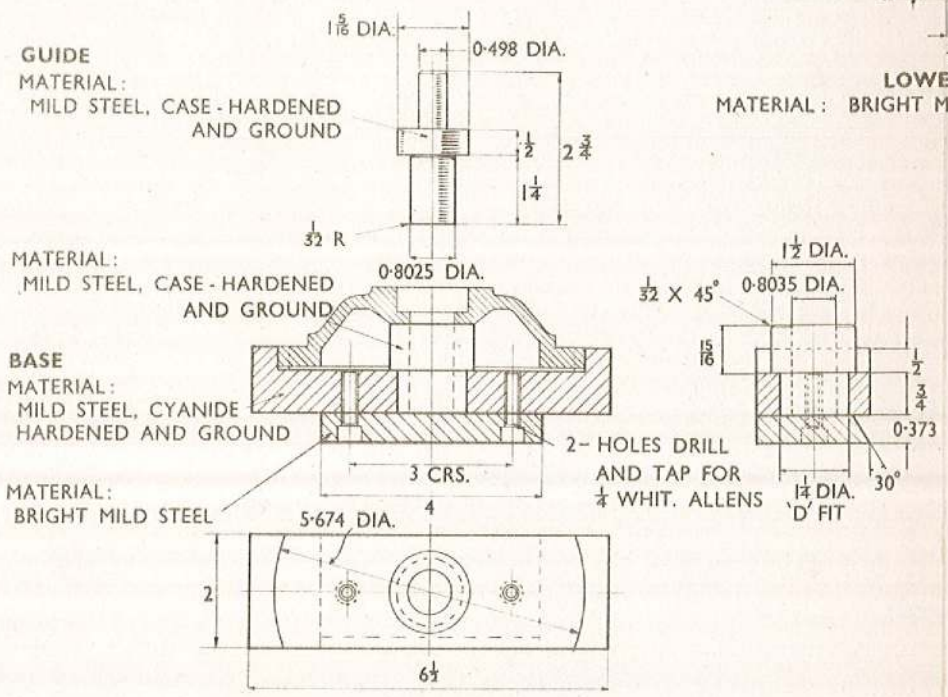
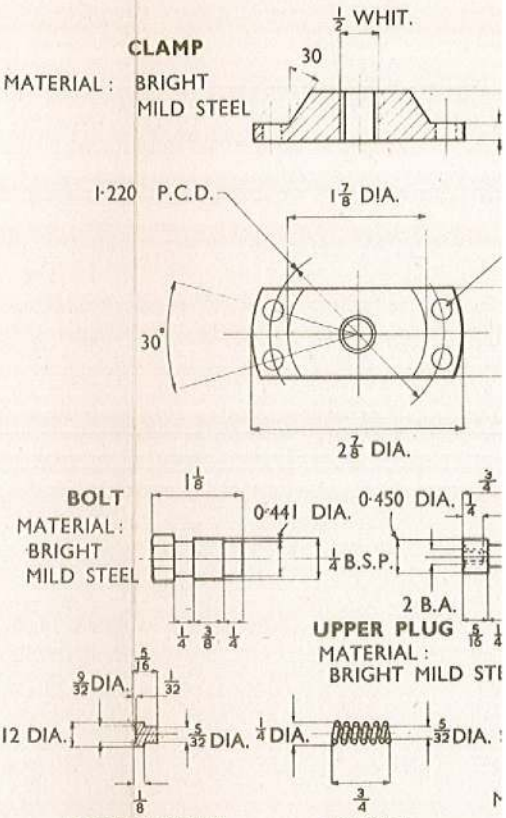


BASE, BUSH AND DRIFT FOR ASSEMBLING OIL SEALS INTO CAM-PLATE HOUSING



BASE AND GUIDE FOR ASSEMBLING ROLLER RACE INTO CAM-PLATE HOUSING



PLUG AND CLAMP F

DIAPHRAGM CHAMBE

2·244

BLANKING

FIG. 2b TOOLS TO BE MANUFACTURED FROM LOCAL

ALL DIMENSIONS IN INCHES

Mounting the pump on the stripping fixture

13. Mount the pump on the special stripping fixture T.129661, (*fig.* 3) as follows :—

Op. 1. Insert the ends of a pair of small-nosed pliers into the holes of the circlip securing the spring loaded filter in the pump inlet passage and withdraw the circlip, the conical filter and the spring.

2. The pump outlet connection body in the outlet port should be lowered vertically into the locating boss of the fixture, and the knurled wheel turned to locate its plunger with the inlet port in the pump housing. The quill shaft of the pump must be vertically uppermost and the fixture locked by means of the upper locking lever.

Removal of the cam-plate housing

14. *As two of the screws are* 1·26 *in. long and the other two are* 0·708 *in. long, take note on removal to ensure correct re-assembly.*

Op. 1. Extract the four split pins securing the nuts to the cam-plate housing securing bolts.

2. Using a narrow-shanked screwdriver to avoid damaging the countersunk holes, unscrew the four screws securing the cam-plate housing to the pump housing, holding the nuts on their underside with a spanner, and remove the screws together with the castellated nuts and plain washers.

3. Carefully remove the cam-plate housing. *On no account must any tool be inserted between the contact faces of the cover and the pump housing in an effort to lever this cover free, as serious damage may be caused to the sealing faces.* A series of gentle taps with a hide hammer on the side of the cam-plate cover, in a direction away from the pump housing, will be sufficient to free the cover from the pump housing.

4. Lift off the gasket interposed between cam-plate housing and pump housing flange.

Dismantling the cam-plate housing

15. *The cam-plate is not normally dismantled unless a leakage through the oil seals, or a defective or damaged roller race is reported or suspected.*

Op. 1. If dismantling is considered necessary, sever the locking wire passing through the six slotted hexagon head screws which secure the oil seal housing to the cam-plate housing, and remove the six screws together with the plain washers.

Op. 2. Lift off the oil seal housing, complete with oil seals, and remove the gasket interposed between the oil seal and cam-plate housings.

3. Lift off the oil seal housing spigot plate from the cam-plate housing.

4. Carefully press the roller race out of the cam-plate housing using a hand-press and suitable drifts, *but ensure that the race is not subjected to shock during extraction.*

5. Carefully remove the three rubber oil seals, spacer, and two spacing shims.

Removal of the control ring and bearing assembly

16. *On no account must this assembly be dismantled.* Removal should be effected as follows :—

Op. 1. Remove the cap nut from the flow adjusting screw. The screw is inclined into the pump housing on the side of the pump opposite to the nameplate, and forms a stop which restricts the movement of the control ring, thereby limiting the maximum fuel flow.

2. Slacken the lock-nut, insert a screwdriver in the slotted end of the flow adjusting screw, and unscrew until it is no longer in contact with the control ring.

3. Check the clearance between the control ring face and the pump housing at the trunnion pins by inserting a feeler gauge as shown in fig. 4. The clearance obtained should be 0·006 in. to 0·010 in.

4. Use a pair of small-nosed pliers to extract the split pin from the link pin which secures the piston rod to the control ring lugs. A protective plate should be placed on the pump body flange, adjacent to the link pin, to enable the necessary leverage to be obtained without damaging the machined facing for the cam-plate housing.

5. Carefully drive the link pin clear of the lugs on the control ring and the link, using a drift slightly smaller in diameter than the link pin ; take care to retain the washer inserted on the drilled end of the link pin.

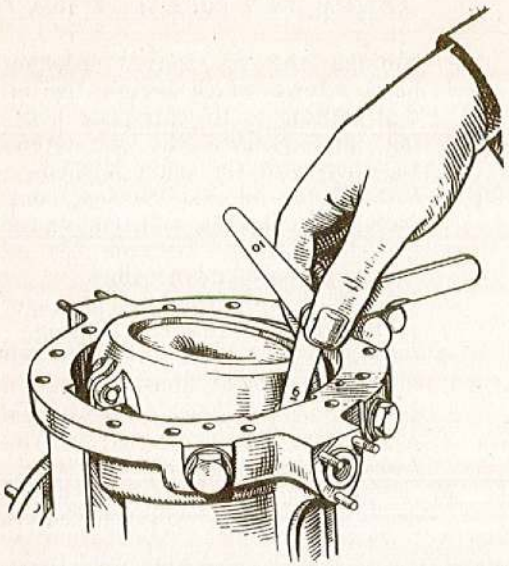


Fig. 4. Clearance check between control ring face and pump housing

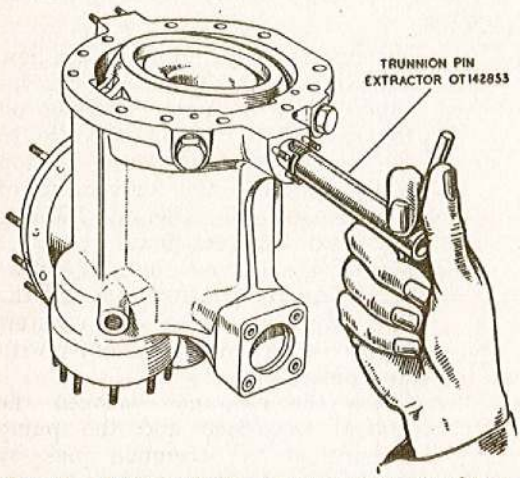


Fig. 5. Withdrawing the trunnion pin from pump housing

Op. 6. Remove the three set screws securing the cover plate of each trunnion pin to the pump housing together with the three grover washers and plain washers. (Note that some pumps may have three studs in the pump body, instead of set screws, each cover plate being secured with three nuts, grover washers and plain washers).

7. Insert the special extractor OT. 142853 into each tapped trunnion pin in turn (*fig.* 5), and withdraw each trunnion pin by pulling the extractor away from the pump housing.

Op. 8. Carefully lift the control ring and bearing assembly out of the pump body.

9. Check the cam-plate lift as shown in fig. 6. If the lift is incorrect (*para.* 39, *Op.* 8) or if the cam-plate is badly worn *do not attempt to strip this assembly* but discard complete.

10. Remove the trunnion pin shims; these are interposed between the control ring and the inner extremity of the trunnion pin bore in the pump housing.

Removal of the rotor

17. With the rotor still positioned in the pump housing, depress and release the pistons in their bores against spring pressure to ensure that they reciprocate freely without slop or binding.

Op. 1. Lift out the rotor assembly complete from the pump housing and immediately place the rotor assembly on the fibre stand (*fig.* 7).

2. Remove the piston and helical springs from the piston bores in the rotor. To ensure correct reassembly, note the bore from which each piston and spring is removed.

3. For aluminium bronze rotors, remove the spring guides from the piston rotor bores by gently tapping clear, using a drift inserted in the small end of the rotor bore; again note the bore from which each guide is removed.

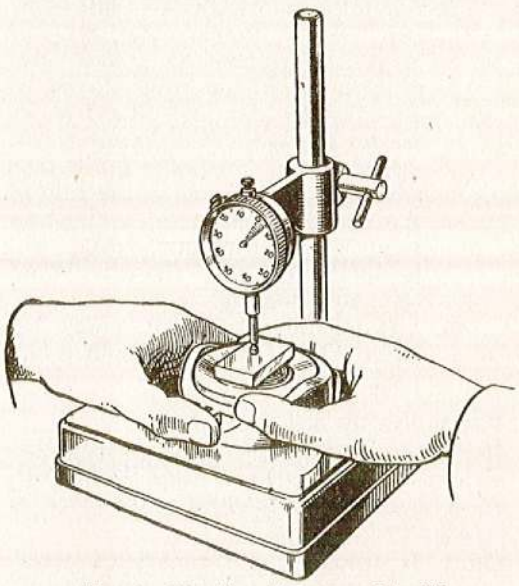


Fig. 6. Checking the cam-plate lift

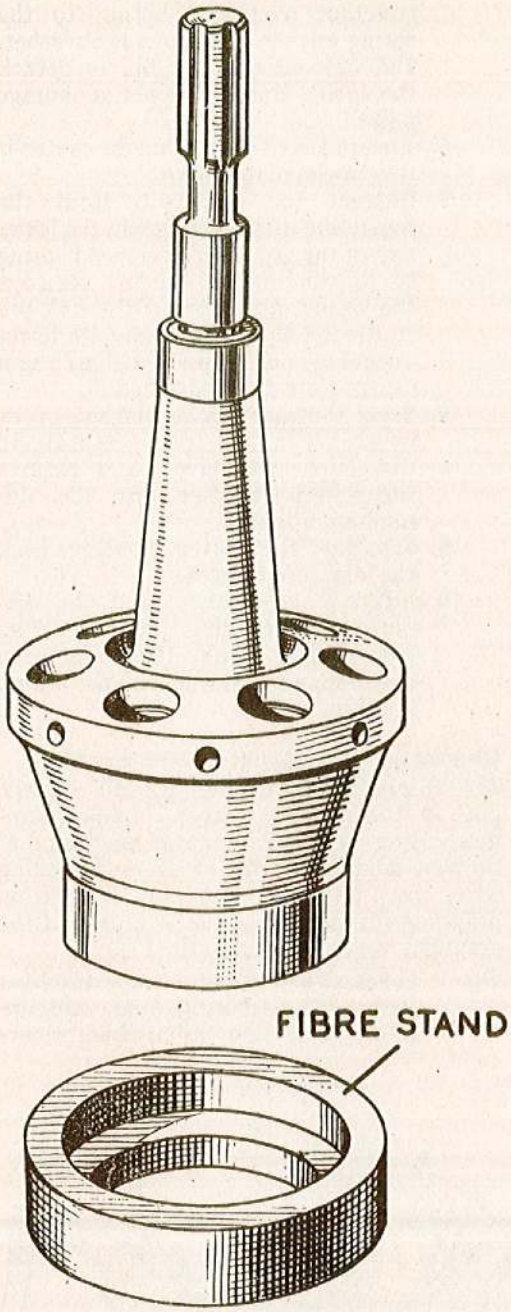


Fig. 7. Stand for rotor

Port insert

18. Access to the port insert is obtained as follows :—

Op. 1. Disengage the circlip which secures the carbon ring, the spider and the port insert inside the pump housing, using special pointed tool (*fig.* 8). The insertion of the pointed end of the tool in the hole of the circlip will enable the circlip to be freed from its groove and withdrawn from the pump housing.

Op. 2. To lift the carbon ring clear from the pump-housing, place the fingers of each hand firmly on the inner diameter of the carbon ring and press outwards and lift at the same time.

3. The other end of the special tool mentioned in Op. 1 may now be used to lift out the spider situated beneath the carbon ring in the pump body.

4. Examine the port insert. *The insert must not be removed unless damage is suspected, and if removal is necessary note carefully its position in the pump housing.* Later types of port insert are marked on their periphery with a dot adjacent to the dowel pin hole. If inserts are not marked in this manner they should be marked immediately on removal (*fig.* 9). By this means the correct replacement of the port insert is assured, the inlet and outlet ports being in alignment with the corresponding inlet and outlet passages in the pump housing on reassembling.

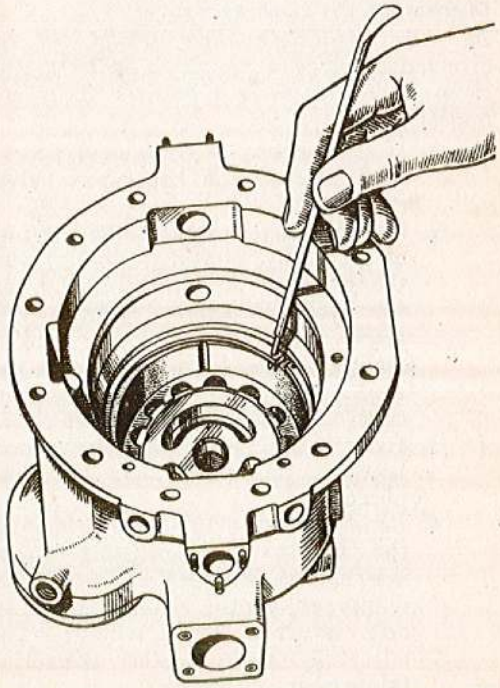


Fig. 8. Use of special tool for removing circlip

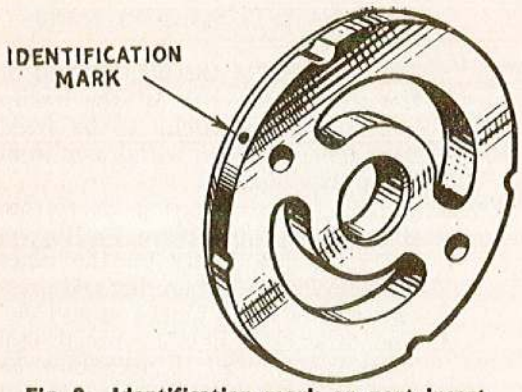


Fig. 9. Identification mark on port insert

Later types of port insert have a stabilising tube fitted in the central hole.

Removal of the diaphragm cover

19. This necessitates swivelling the fuel pump in its stripping fixture.

Op. 1. Slacken the upper locking lever of the stripping fixture and carefully move the vertical centre pillar through 90 deg. until the diaphragm cover of the pump is uppermost. Again tighten the locking lever.

2. Unscrew the twelve nuts, remove the grover washers and plain washers, and carefully lift off the diaphragm cover.

Dismantling the diaphragm cover

20. *The diaphragm cover should not be dismantled unless a complaint indicates the cover or diaphragm is a possible source of trouble.*

Op. 1. If dismantling is considered necessary, remove the two bleed valve assemblies.

2. Unscrew the lock-nut from the top of the spring housing, and unscrew the governor adjusting screw from the spring anchor. Remove the screw together with the rubber sealing washer. The diaphragm assembly is thus detached from the cover itself and may be lowered clear.

3. Remove the gasket joint interposed between the cover and the diaphragm.

4. Bend back the tab-washer locking the nut to the adjusting screw inserted in the underside of the diaphragm centre, slacken the lock-nut, unscrew and remove the adjusting screw together with the tab-washer.

Op. 5. Extract the split pin from the link pin securing the upper end of the governor overspeed spring to the spring anchor. Remove the washer, and tap out the link pin to detach the spring from its upper anchorage point.

6. Ensure that the diaphragm centre is free in the diaphragm.

7. Extract the split pin from the remaining link pin securing the lower end of the governor overspeed spring to the diaphragm centre. Remove the washer and tap out the link pin to detach the spring from its lower anchorage point ; free the diaphragm centre from the diaphragm.

8. Sever the wire locking the six screws which secure the spring housing to the diaphragm cover, and remove the screws together with the aluminium washers.

9. Separate the spring housing from the diaphragm cover.

10. Lift off the gaskets, and the diaphragm outer ring interposed between them, from the diaphragm cover mounting studs in the pump housing.

Dismantling the amplifier valve assembly

21. Insert the fibre plug (*fig.* 10), in the port in the amplifier valve chamber communicating with the pump suction, to prevent small particles of severed locking wire, nuts, screws, split pins, etc. from dropping into it during the stripping of the amplifier valve assembly (*fig.* 11).

Op. 1. Sever all locking wire in the amplifier valve body securing nuts, and unscrew these eight nuts which secure

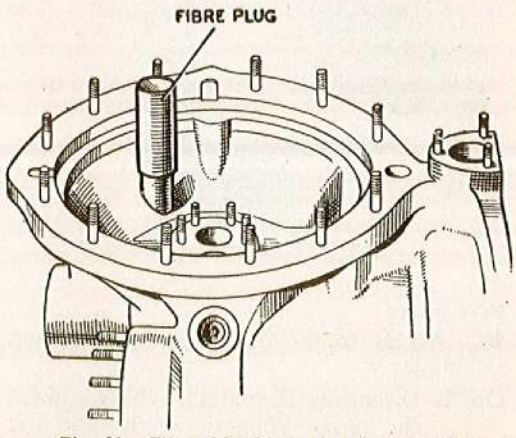


Fig. 10. Fibre blanking plug for amplifier valve chamber suction port

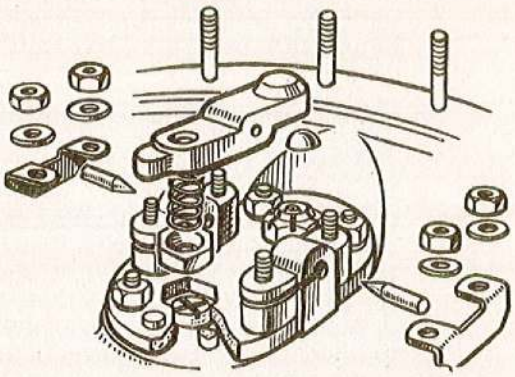


Fig. 11. Dismantled view of amplifier valve assembly

the amplifier valve body to the studs in the pump housing. Carefully lift away the amplifier valve body, together with the eight plain washers, and pivot retaining plates. Note that four of the studs are long and four are short.

Op. 2. Ease the pivot pins slightly outwards in their bores in the amplifier valve body sufficiently to enable the rocker lever to be lifted away, complete with the half ball.

3. Push the pivot pins clear from their bores in the amplifier valve body.

4. *Do not remove the orifice from the amplifier valve body unless it is damaged or shows leakage on subsequent pressure test* (*para.* 95). If removal is necessary bend back the tabs on the tab-washer (beneath the orifice), unscrew the orifice with a $\frac{1}{4}$ in. box spanner, and remove the tab-washer and shim.

5. Lift out the spring, upon which the rocker lever normally rests, from the pump housing, remove the spring cup which normally houses the spring, and unscrew the adjustment screw from the brass insert.

6. Carefully remove the rubber seal situated above the flat filter, using the special pointed tool mentioned in para. 18, Op. 1, and taking care not to damage the filter or bore. Lift out the flat filter.

Removal of the restricting orifice assembly

22. This is located between the pump body flange for the diaphragm cover and the servo control piston cylinder.

Op. 1. Unscrew the restricting orifice cap nut and withdraw the aluminium washer off the orifice sleeve.

2. Unscrew the restricting orifice sleeve by inserting the special box key driver OT.142854 in the groove of the sleeve (*fig.* 12).

3. Extract the orifice together with the jet tube.

4. Remove the wire-wound filter from the restriction orifice port by tilting the pump off the stand to allow the filter to drop into the open hand. Later pumps incorporating modification CP.80 have a synthetic rubber ring interposed between the head of the filter and the jet tube. Ensure that this ring is undamaged. Do not attempt to include a rubber ring in earlier pumps as these are not chamfered to take it.

Removal of the barometric pressure control connection

23. This is located on the outside of the servo control piston cylinder adjacent to the pump inlet.

Op. 1. Remove the cap-nut, and withdraw from the servo connection body, the two washers and the distance piece or banjo interposed between them.

2. Remove the body from the pump housing, unscrew the grub screw and carefully remove the spring and the five orifice plates and the four spacing rings alternated between them.

3. On the C.G. 14 type pump, the B.P.C. connection orifice is blanked off, in which case the blanking plug and washer are removed.

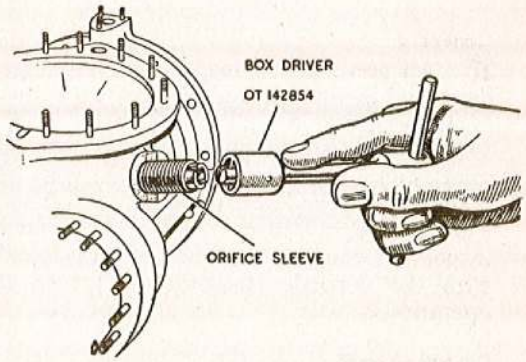


Fig. 12. Restricting orifice removal, use of special box driver

Removing remaining details

24. Remove the remaining external fittings which consist of the pump suction connection, the seal drain plug and washer, and the remaining parts comprising the outlet connection.

Removal of the servo control piston assembly

25. Remove the pump housing from the stripping fixture, and place on the bench, with the flange for the cam-plate housing facing downwards.

Op. 1. Remove the twelve nuts, grover washers and plain washers securing the servo control piston end cover to the pump housing. *These should be slackened off evenly all round, a few threads at a time, otherwise the pressure of the two springs between the end cover and the servo piston will tend to tilt the end cover and cause it to foul the securing studs, with a consequent danger of possible damage to both the threads of the studs and to the locating holes of the cover.* Remove all nuts except two which should be left in diametrically opposite positions on the cover. When removing these two nuts fit a box spanner to the servo pressure connection adapter cap nut in the centre of the cover and maintain a pressure on the cover to take the load of the springs and centralize the cover on the studs until the cover is clear of the pump housing.

Remove the rubber joint ring situated between the end cover and the end of the servo piston chamber in the pump housing.

Op. 3. Lift out the two helical springs from the servo piston cylinder, and invert the pump to allow the kerosine to be emptied from the servo piston cylinder.

4. Ensure that the link riveted to the piston rod is straightened to form a continuous line with the rod, and by inserting the hand in the rotor chamber of the pump housing ease the servo control piston out of its cylinder by applying pressure upon the piston rod. Take care that the link does not foul the servo piston rod bore during the removal of the servo piston and rod assembly. This assembly is not normally dismantled (*para.* 50) but a special box spanner (Pt. No. OT142855) is provided for use on the securing nut, if dismantling is necessary; the assembly being held in the hand, the tab-washer bent back and the nut removed to separate the seal, seal retaining ring, control piston and piston rod.

CLEANING

26. It is important that the bench upon which work is to be done must be scrupulously cleaned and kept free from all dirt, swarf, etc. It is recommended that the bench be covered with zinc sheeting or linoleum and that several clean containers be available in which to keep the various parts removed. All parts must be thoroughly cleaned and washed before re-assembly, using a parawash machine having a kerosine bath and spray gun. *Hard brushes or abrasives of any kind must not be used.*

INSPECTION

General

27. All viewing and inspection checks are described in this section with the exception of those for ball and roller races, (A.P. 1464B). When carrying out any of the dimensional checks, reference should be made to the Schedule of Fits and Clearances, Part 2 of this Volume. The viewing and inspection checks are listed to correspond with the normal dismantling sequence of operations.

Distortion checks

28. Distortion checks are not normally necessary.

Permissible wear

29. All parts subject to wear should be checked with the Schedule of Fits and Clearances, Part 2 of this Volume.

Redundant and consumable parts

30. It is usual during inspection, to reject all parts rendered redundant by the embodiment of essential modifications, and the inspector must therefore have complete information concerning modifications so that redundant parts can be rejected. Tab-washers, split pins, gaskets and other consumable parts will be rejected during dismantling.

Scores and surface damage

31. The standard of acceptance when dealing with scores and other forms of surface damage may vary according to the number of hours the pump is to run, and the issue of up-to-date instructions.

Pump outlet connection

32. Examine the threads of the outlet body for damage, and scrap all washers where the seal is disturbed. Ensure that the radial holes in the outlet body are clean.

Pump inlet connection

33. The oil seal must be discarded if at all swollen or damaged.

Op. 1. Examine the threads of the four securing screws for damage. Examine the grover washers and plain washers. Ensure that the pipe clip bracket is not bent or damaged. (G.C.12 type pump only).

2. Examine the flanged face of the inlet connection and bed down if not flat, or if scored or scratched.

3. Ensure that all threads are undamaged.

Barometric pressure control connection (G.C.12)

34. Examine all threads for damage. Ensure that the spring has no sharp edges and is not fractured or cracked. Examine the five orifice plates ; their faces must be flat and the holes clean and unobstructed. Ascertain that the faces of the spacing rings are flat and undamaged.

Pump suction connection

35. Ensure that the bore and holes of the hollow bolt are clean and that the thread is undamaged. Also examine the thread of the banjo or union nut, and renew the jointing washers.

Pump servo pressure connection

36. Examine the threads of the adapter ; renew the joint washer if it is disturbed when renewing a damaged adapter.

Pump seal drain connection

37. Examine the threads of the seal drain adapter, and ensure the holes in the adapter are clean and unobstructed. On the G.C.12 ascertain that the threads of the banjo are undamaged, and renew the joint-washers if the seal is disturbed. Ensure that the cap nut and washer on the G.C.14 type pump are undamaged.

Cam-plate housing

38. If the cam-plate housing is dismantled (*para.* 15) proceed as follows :—

Op. 1. Examine the sealing face of the cam-plate housing for scratches and marks likely to affect the seal.

2. Ensure that the washers interposed between the six screws and the oil seal housing flange are not cracked and that the screw threads are not damaged.

3. Examine the oil seals and renew if swollen, distorted, or damaged, and ensure that the spacers are flat.

4. Ascertain that the flange of the oil seal housing is flat, and if necessary relap.

5. Examine the seal housing spigot plate and ensure that it is flat and undamaged.

6. Examine the roller race in accordance with the instructions laid down in A.P.1464B.

Cam-plate, control ring and bearing assembly

39. The cam-plate, control ring and bearing assembly is to be inspected without dismantling.

Op. 1. Ensure that the link pin is smooth with no burr, and that the washer is not cracked or damaged. Scrap the split pin.

2. Ascertain that the trunnion pin cover plates bed down evenly, and examine the oil seals for freedom from distortion and damage.

3. Examine the trunnion pins for fretting, wear and damage of any kind ; if replacements are necessary it should be noted that these are a selective assembly, and those selected should be a smooth fit. Note that slight fretting stain is always present on the trunnion pins after running, but this can usually be removed by polishing lightly with rouge or metal polish, which must be thoroughly cleaned off before re-assembling.

4. Carefully examine the trunnion pin shims for damage, wear and cracks.

5. Check that there is no visible damage or pick-up from the crowns

of the rotor pistons on the cam-plate, or excessive discoloration due to overheating on the piston track.

Op. 6. Examine the locking slots and caulking to ascertain that no burr exists.

7. A careful visual examination should be made of the balls and those parts of the track that can be seen, but the actual feel of the bearing is the best indication of the condition of the running tracks, providing the bearing is first thoroughly washed.

8. Check the cam-plate lift as shown in fig. 6; this reading should be 0·002 in. to 0·006 in. If this reading is not obtained, discard the complete assembly and obtain a replacement.

Rotor assembly

40. Carefully examine the port face or underside of the rotor which normally rests against the insert in the pump housing; the face must be quite flat and clean. Some wear of the lead plating always occurs during running, and provided the face is not badly scored or eroded, slight evidence of bronze showing through the plating is not regarded as serious. The following detailed checks must also be made.

Op. 1. Examine both the large and small journal bearing surfaces on the rotor for evidence of pick-up, cracks, or excessive thermal discolouration.

2. Examine the pistons for ease of reciprocation in the bores and note any tightness; examine also for discoloration on the piston sides or crowns. Inspect the piston bores in the rotor for scoring or evidence of pick-up; damaged bores should be indicated with a pencil mark on the upper face of the rotor.

3. Remove each piston in turn and wipe with clean muslin, noting from which bore each piston is removed. It is worthy of note, that by placing the pistons on white paper, excessive discoloration and high spots not otherwise readily discernible, are thrown up. Examine carefully for collapse, wear or pitting of the crowns. After examination each piston should be placed on the piston stand (*fig.* 13).

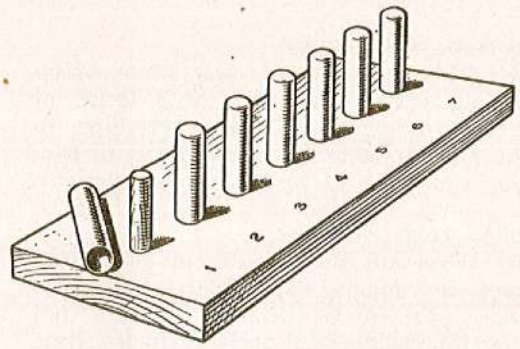


Fig. 13. Stand for rotor pistons

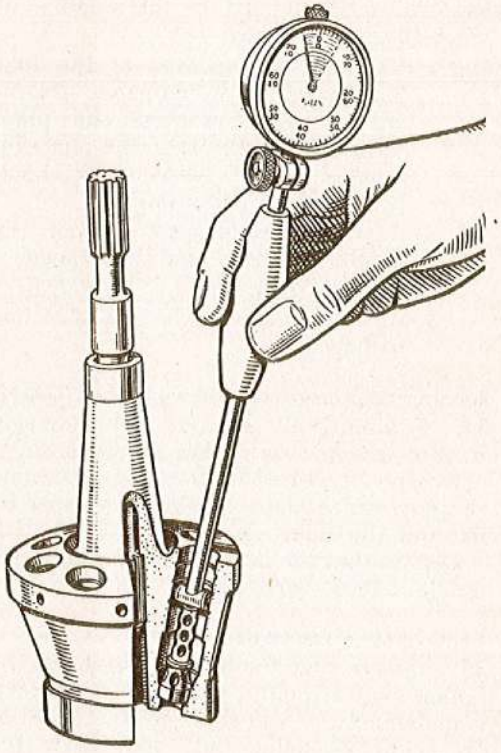


Fig. 14. Checking rotor piston bores for wear

Op. 4. Examine the piston bores for scores and the presence of foreign matter in the oil relief grooves. Ensure that the diameter of the piston bores when measured in four positions with a clock gauge (*fig.* 14), namely when measured diametrically in two positions at 90 deg. to each other at the top and midway down the piston bore conforms with that allowed, and as listed in Part 2 of this Volume. Also ensure that the maximum worn clearance does not exceed that specified.

Op. 5. Examine the helical springs of the rotor pistons for sharp edges and fractures, and ensure that all the radial drillings which radiate from the axial bore of the rotor are clean and free from foreign matter.

6. Examine the piston spring guides for wear, fractures, and any burrs or sharp edges likely to cause damage to the springs.

7. Ascertain that the carbon ring is free from cracks, is not chipped, and that no foreign matter has accumulated on its underside.

8. Ensure that the diametral clearance between the carbon ring and the rotor bearing face is between 0·003 in. and 0·005 in. This is measured by placing the carbon ring on the rotor and inserting a feeler gauge between ring and bearing face as shown in fig. 15.

9. As the carbon ring is a selective fit in the pump body ensure that there is a clearance of 0·0005 in. to 0·0015 in. between the pump housing and the outer face of the ring.

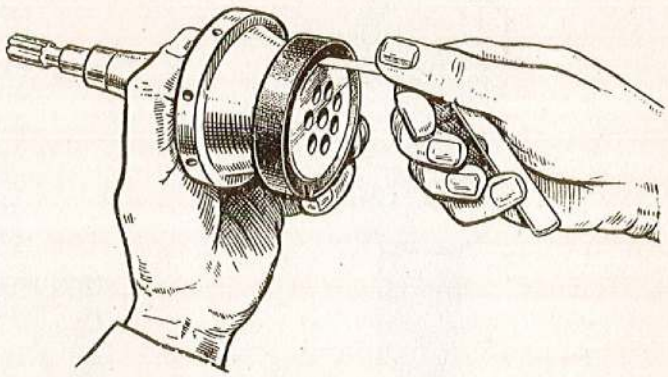


Fig. 15. Checking clearance between the carbon ring and rotor bearing face

Diaphragm cover and diaphragm assembly

41. If the diaphragm cover is dismantled, scrap and renew the rubber sealing washer beneath the head of the governor adjusting screw, and proceed as follows :—

Op. 1. Ensure that the threads of both the governor adjusting screw and the control spring housing are undamaged.

2. Examine the contact faces of the control spring housing and the diaphragm cover to ensure these are not scored or damaged. Defects in these faces would result in leakage of fuel.

3. Examine the piston, ball, and spring of each bleed valve assembly for damage and cleanliness.

4. Examine the threads of the overspeed control plug for damage, and the washer for cracks and damage.

Op. 5. Inspect the diaphragm centre and spring anchor together with the spring anchor pins and washers for general soundness. Scrap and renew the split pins.

6. If the tappet screw is disturbed, scrap and renew the tab-washer.

7. Carefully examine the spring for sharp edges and fractures and examine the diaphragm for distortion and wear.

8. Ensure that the diaphragm centre is free in the diaphragm and inspect the diaphragm outer ring for scores and scratches likely to affect the seal.

9. Scrap and renew all gaskets and examine the twelve nuts, Grover washers and plain washers. Examine the six screws for sound threads, and the aluminium washers for cracks and damage.

Amplifier valve assembly

42. Further checks, in addition to those described below, are effected during the normal assembling of the amplifier valve assembly.

Op. 1. Examine the eight nuts securing the body, and ascertain that the washers are not damaged or cracked.

2. Carefully examine the two pivot retaining plates for fractures, and other damage.

3. Ascertain that the half-ball is free from damage and bruises and that it swivels freely in its socket in the rocker lever. The faces of both the half-ball and the lands of the orifice must be smooth and optically flat.

Fig. 16. View showing lips of spring cup which engage with adjustment screw slots

Op. 4. Examine the pivot pins for damage, fractures and for corrosion.

5. If the orifice is removed, scrap and renew the tab-washer, and examine the thread of the orifice for damage. Ensure that the orifice is clean; blow through the orifice on to a sheet of clean white paper, and take careful note of any particles of foreign matter deposited, as any such foreign matter may indicate a possible source of trouble.

6. Examine the rocker lever spring for sharp edges and fractures.

7. Ensure that the spring cup is undamaged, particularly the lips on its underside (*fig.* 16).

8. Examine the adjustment screw (if removed) for damage to the locating slot and threads.

9. If the rubber seal is damaged or distorted this must be scrapped and renewed.

10. Inspect the flat filter for breakage, damage and the presence of foreign matter which may assist in tracing further trouble.

11. Visually inspect the amplifier valve body for general soundness.

Restricting orifice

43. This must not be confused with that included in the amplifier assembly, and should be dealt with as follows :—

Op. 1. Examine the orifice together with jet tube for cleanliness and freedom from damage.

Op. 2. Inspect the filter for damage and corrosion, and ascertain that the end cap is secure.

3. Examine the cap-nut, and ensure the washer is free from cracks and damage.

4. Ascertain that the threads and slot of the orifice retainer are free from damage and that no burr or rough edges exist.

Servo piston assembly

44. Detailed inspection should proceed as follows :—

Op. 1. Examine the piston rod for damage, corrosion and fretting. Some fretting of the piston rod occurs during service and this can usually be removed by polishing lightly with rouge or metal polish which must be cleaned off before reassembling.

2. Examine the servo piston oil seal for distortion, swelling or other damage.

3. Inspect the seal retaining ring and the control piston for any sharp edges, burrs or other damage. Examine for the presence of foreign matter.

4. If the securing nut has been removed for any reason, (*para.* 50 *and fig.* 20) scrap and renew the tab-washer, and examine the threads of the nut for damage.

5. Inspect the rivet securing the link to the end of the piston rod and ensure that it is secure and that no burr or damage exists. Move the link to ensure that there is complete freedom of movement without side play or fouling. Ascertain also that the link is clean and free from burrs.

Remaining details

45. Examine the remaining details adjacent to the servo piston assembly as follows:

Op. 1. Examine the two helical springs for fracture, sharp edges or cavitational erosion.

2. Examine the cover joint sealing ring for distortion, swelling or other damage.

3. Inspect the end cover for cleanliness, and the flange for scores or other damage likely to affect the seal. Ensure that no sharp edges or burr exists.

Pump housing

46. Make a close examination of the pump housing generally including the following:—

Op. 1. Ensure that all machined faces are smooth and unscored, and that all studs are tight and the threads sound.

2. Examine all internal tappings for damage and cleanliness.

3. Examine the servo piston bore for scores and other damage likely to affect the seal of the servo piston.

4. Similarly, examine the bore of the control rod and ensure that the felt washer at the piston end of the control rod bore is sound and not distorted.

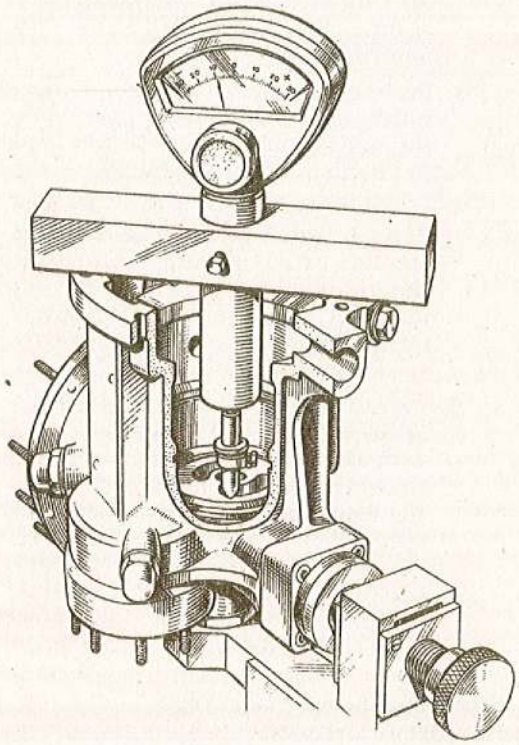


Fig. 17. Testing the port insert for parallelism to the pump housing flange

Op. 5. Examine the port insert *in situ*, and test for parallelism with the pump housing flange using the test bar and clock gauge (*fig.* 17). *Remove the insert only if damage is suspected.* If the insert is removed, examine for cracks, pitting, etc., and the presence of foreign matter.

6. Ensure that the dowel pins in the pump housing are secure.

7. Examine the trunnion pin bores for scores or scale.

8. Ensure that the conical filter is unbroken and is clean and undamaged, and examine the filter spring for sharp edges and fractures.

9. Inspect the securing circlip for distortion and damage, and examine the groove in the pump housing inlet port for burrs.

10. Examine the insert retaining spider for cracks and fractures, and its circlip for distortion and burrs. Ensure the circlip groove in the rotor chamber of the pump housing is undamaged and free from burr.

MAGNETIC CRACK DETECTION

47. If any doubt exists as to the soundness of any of the following parts they should be subjected to a magnetic crack-detection test.

(1) Quill-shaft.
(2) Rotor (steel journals only).
(3) Rotor pistons.
(4) Spring guides.
(5) Port insert.
(6) Pivot pins.
(7) Trunnion pins.
(8) Control piston rod.
(9) Link.
(10) Link pins.
(11) Orifice.
(12) Jet-tube.

Details of the procedure and equipment for electro-magnetic crack-detection are given in A.P.880C.

REBUILDING THE PUMP

REBUILDING SUB-ASSEMBLIES

48. Before the actual building of the pump is commenced, various sub-assemblies must be completed, and these are dealt with first so that the assembling of the pump may be treated in a straight-forward, unbroken sequence of operations.

Assembling the amplifier valve

49. It is recommended that a jig be made locally for assembling the amplifier valve. This jig is illustrated in fig. 18 and dimensions are given in fig. 2.

Op. 1. Mount the amplifier valve body on the jig and loosely place two nuts—

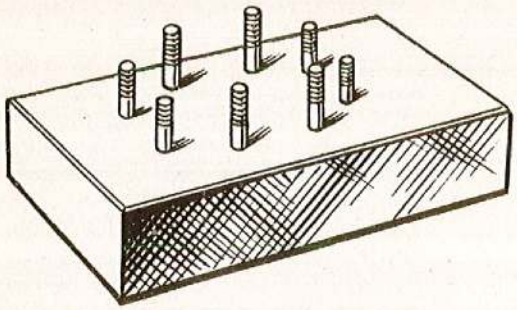


Fig. 18. Amplifier valve assembly jig

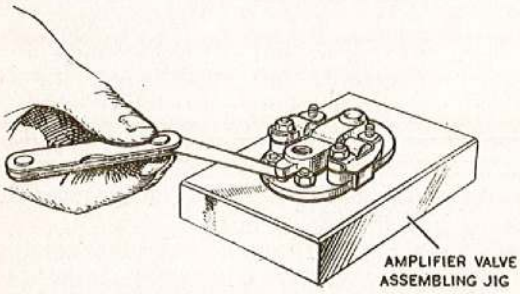


Fig. 19. Measuring the rocker lever tail gap

one on either side of the raised portion of the body on the split end.

Op. 2. If the orifice is being removed, temporarily place a tab-washer over the orifice housing, bending the tabs to suit, then fit a shim (about 0·015 in. thick), and finally screw in the orifice itself.

3. Temporarily insert the pivot pins, one in either side of the amplifier valve body, and place the helical spring in the hexagon recess.

4. Lower the half-ball on to the orifice and locate the rocker lever with the pivot points, the spring and the half-ball.

5. Tighten the nuts, and, whilst tightening, press the outer ends of the pivot pins into the locating holes in the rocker lever with finger and thumb of the left hand or by using the pivot retaining plates. Measure the gap between the underside of the tail of the rocker lever and the stop stud in the base plate of the amplifier valve body with a feeler gauge (*fig.* 19), this gap must be as specified in para. 68. If the desired reading is not obtained, shim, as required, beneath the orifice, and repeat the check until the specified reading is achieved. Remove the assembly from the jig when the gap is correct.

Assembling the piston-rod and control piston

50. It is assumed that the piston-rod (with riveted link) and control piston assembly will normally be available from the stores already built up, but these assembling instructions are given for guidance in instances of extreme urgency, when stocks of the assembly are exhausted, in which event, the piston assembly may be assembled to the piston-rod as follows:—

Op. 1. Clean the inner bore of the piston-rod with a stiff spiral hair brush, and the parawash.

2. With the link facing downwards, slide the seal retaining ring on to the other end of the piston-rod, against the flange, with its cup uppermost.

3. Fit the rubber oil seal, cup downwards, into the retaining ring. Slide the control piston on to the rod to position the seal centrally.

4. If the brass tab-washer has one flat tab, this should be softened on the tip. This operation will enable the tab to be gently bent up on its outer edge, to facilitate subsequent locking and to avoid damage to the control piston flange.

5. Locate the tab-washer on the base of the control piston, its tab locating with the slot in the piston-rod and control piston, and insert and tighten the hexagon-head screw using the special box spanner OT.142855 (*fig.* 20). When the screw is tight, carefully lock the already slightly upturned tip of the tab-washer against the flat side of the screw.

Assembling the diaphragm cover

51. Before assembling the spring housing to the diaphragm cover itself ensure that the

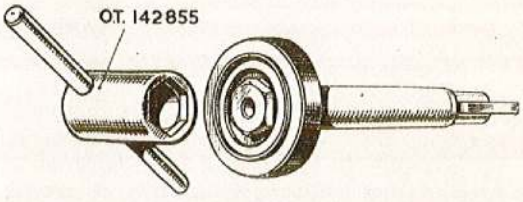


Fig. 20. Special spanner for removing servo piston nut

bottom face of the spring housing is quite flat. Then proceed as follows :—

Op. 1. Locate the gasket with the holes in the flange of the spring housing and retain it in position by smearing white petroleum jelly on the flange.

2. Secure the spring housing to the diaphragm cover with six slotted hexagon-head screws and aluminium washers. These are inserted through the underside of the diaphragm cover and are screwed into tapped bosses in the spring housing flange. The screw heads are then wire-locked.

3. Insert, and secure the plug, together with the aluminium washer, to the remaining, shallower, boss in the diaphragm cover.

4. The diaphragm is supplied as a built-up unit having the larger steel diaphragm ring above, the smaller aluminium diaphragm ring below and the diaphragm itself in between. The three details are secured by six aluminium rivets.

5. Insert the diaphragm centre through the diaphragm assembly so that the flange of the aluminium diaphragm ring locates with the flange of the diaphragm centre.

6. Connect the lower end of the helical overspeed control spring to the upper end of the diaphragm centre by means of the link pin, washer and split pin.

7. Secure the upper end of the helical overspeed control spring to the spring anchor by the link pin, washer and split pin ; ensure that the heads of both link pins are on the same side of the spring.

8. Assemble the tab-washer, adjusting screw and lock-nut into the underside of the diaphragm centre *but leave the tab-washer unlocked.* (This is subsequently locked as detailed in para. 116.)

9. Fit the gasket to the underside of the diaphragm cover taking care that the holes are in correct alignment, and offer up the diaphragm assembly into the cover, guiding the upper anchorage point of the spring into the spring housing.

Op. 10. Place the rubber seal in the groove in the upper face of the spring housing, pass the governor adjusting screw through the hole in the spring housing and tighten into the tapped spring anchor.

11. Fit the adjusting screw lock-nut on to the upper portion of the spring housing.

Assembling the cam-plate housing

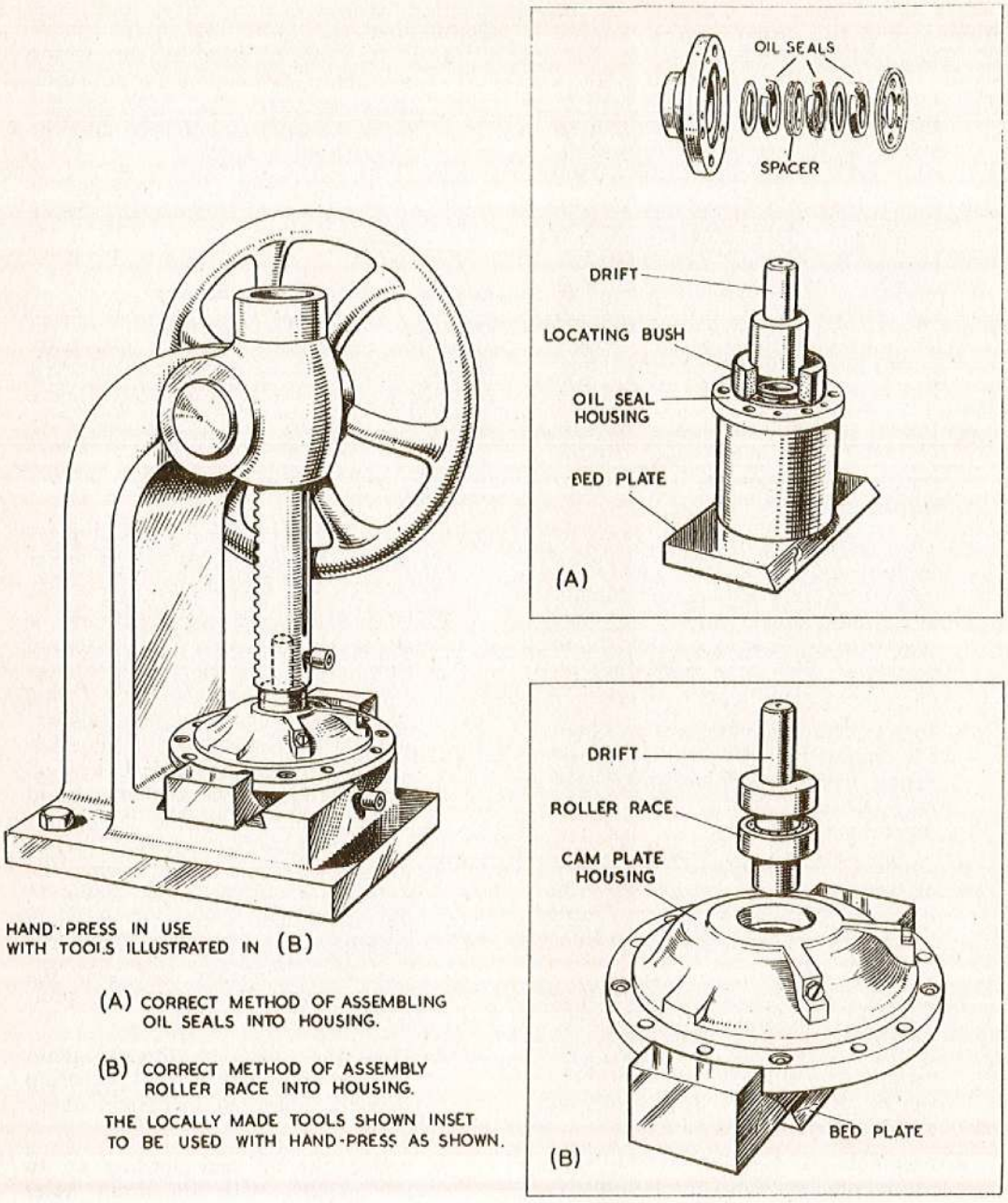
52. If a new roller race has to be fitted press the roller race into the cam-plate housing using a hand-press and the drift and bed plate as shown in fig. 21. Before using the press carefully locate the race with the housing and tap gently all round the race to ensure that it enters the housing squarely.

Op. 1. Place the seal housing spigot plate over the upper face of the roller race in the housing.

2. If it is necessary to renew any or all of the oil seals it is essential that they be assembled in the correct order, with the sealing lips facing as shown in fig. 21. The seals are an interference fit in the housing and must be packed with a good quality high temperature grease and slightly greased on the outside to prevent abrasion on entering. When the seals are assembled (using the hand-press and drifts as shown in fig. 21), they must be carefully examined to ensure that the sealing lips are undamaged and that the garter springs are correctly positioned.

3. Place the gasket on the cam-plate housing around the spigot, ensuring that the holes are in correct alignment.

4. Lower the oil seal housing on to the gasket, with its drain holes corresponding with those in the cam-plate housing, and secure the seal housing to the cam-plate housing by the six slotted hexagon-head screws and plain washers. *Ensure that these screws do not exceed* 0·590 *in. in length, for if these are too long, and are tightened excessively, they may cause damage to the inner face of the cam-plate housing.* The screws are then wire-locked.



(A) CORRECT METHOD OF ASSEMBLING OIL SEALS INTO HOUSING.

(B) CORRECT METHOD OF ASSEMBLY ROLLER RACE INTO HOUSING.

THE LOCALLY MADE TOOLS SHOWN INSET TO BE USED WITH HAND-PRESS AS SHOWN.

Fig. 21. Insertion of oil seals into seal housing and roller race into cam-plate housing

Assembling the control piston liner

53. Where the control piston liner is badly scored or damaged, or a leakage exists between the liner and the pump housing, it will be necessary for a new control piston liner to be fitted. For details of the procedure to be followed in this event see para. 85 and 86.

FITTING SUB-ASSEMBLIES

54. It is assumed at this stage that all parts have been thoroughly inspected and cleaned prior to the actual assembling of the pump. The servo control piston and details are assembled as follows :—

Op. 1. Temporarily fit the servo piston-rod to the control ring and cam-plate

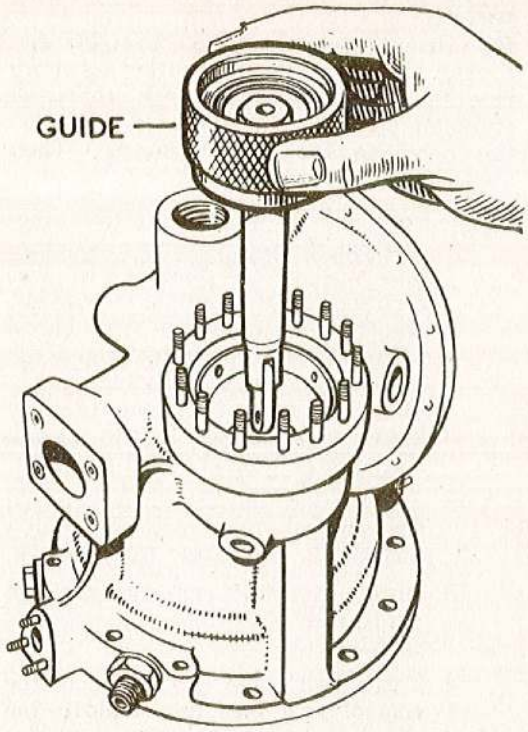


Fig. 22. Inserting the servo piston into the bore, using protective guide

bearing assembly by inserting the clevis pin through the link, the control ring lugs, and the washer, and insert the split pin through the hole in the clevis pin.

Op. 2. Move the control ring or the piston-rod over the full range to ensure that there is complete freedom of movement in all positions without end play, and ascertain that the link does not foul or bind.

3. If the movement is satisfactory, remove the split pin and extract the clevis pin, taking care to retain the washer.

4. Carefully lower the piston-rod into its bore in the pump housing, ensuring that the link is straight to avoid damage to the felt ring in the top of the piston-rod bore, and use a protective guide (*fig.* 22) to prevent damage to the rubber seal of the servo piston during its insertion into the servo piston liner in the pump housing. Push the piston to the bottom of the liner by applying the pressure of the thumb inside the guide on the crown of the piston.

Op. 5. Lower the rubber seal into position in the groove provided in the pump housing around the top of the servo piston liner.

6. Locate the two servo piston springs with the crown of the piston, one spring being fitted inside the other.

7. Lower the end cover on to the studs protruding from the pump housing around the servo or control piston chamber, locating the springs with the groove provided, and exert an even pressure on the end cover to overcome the force of the springs.

8. Extreme care should be taken to ensure that the cover enters the control piston chamber evenly and centrally to avoid damage to the sealing ring or to the studs through malalignment. Pumps on which modification CP37 is incorporated have a chamfered cover to facilitate assembly. It is recommended that two grover washers, plain washers and nuts be first fitted in diametrically opposite positions, one on either side when starting, and the remainder then added. Tighten the nuts down evenly a few threads at a time, exerting a pressure on the end cover meanwhile, to facilitate tightening of the nuts.

Checking the depth of the quill shaft

55. The rotor and details must be fitted next as follows to allow the depth of the quill shaft to be checked :—

Op. 1. Fit the port insert into the pump housing with the identification mark adjacent to the dowel pin (*para.* 18, *Op.* 4).

2. Locate the insert retaining spider, with its dowel pin, in the pump housing.

3. Lower the carbon ring on to the insert retaining spider ensuring its slot is in alignment with the dowel pin. *Do not use force to insert the carbon ring as it is relatively fragile and may crack ; if the ring is inserted squarely, finger pressure will be sufficient.*

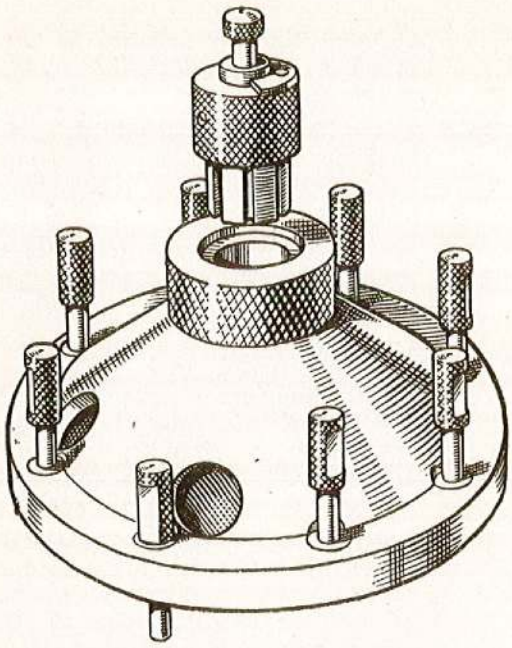


Fig. 23. Concentricity and depth gauge for pump housing and quill shaft

Op. 4. Lock the insert, the retaining spider and the carbon ring by inserting the circlip in the groove provided in the pump housing, using the special pointed tool (*fig.* 8) inserted in the hole in the circlip to facilitate assembly into the groove.

5. Lower the rotor assembly into the body, and check the height of the quill, using the special gauge G46439 (*fig.* 23). For this check the cam-plate housing (complete with gasket) must be fitted to the pump housing. With the gauge mounted on the flange of the cam-plate housing, lower the locating pins into the holes in both cam-plate housing and pump body, engaging the inner sleeve slots with the splines of the quill shaft and ensure that the sleeve is lowered fully "home". Observe that the quill shaft is of the correct depth, indicated by the top of the plunger gauge being between the steps formed around the top face of the sleeve. If the rotor assembly does not pass this test it must be renewed. Again remove the rotor assembly from the pump housing, subsequently refitting it as described in para. 58.

Testing the clearance and freedom of movement of the control ring, cam-plate and bearing assembly

56. Before commencing to assemble the control ring cam-plate and bearing assembly into the pump housing ensure that the trunnion pins are a smooth sliding fit in the bores in the pump housing. Then proceed as follows :—

Op. 1. Temporarily fit the control ring, cam-plate and bearing assembly into the pump housing; to test clearance and freedom of movement. Insert the trunnion pins (with shims between the pump housing and the control ring on the trunnion pins). Shims of equal thickness must be used on either side of the control ring and cam-plate bearing assembly.

2. Ensure that the clearance between the control ring and the pump housing is 0·006 in. to 0·010 in.

3. Insert the clevis pin through the piston-rod link and the control ring lugs.

4. Test the freedom of the link in the control ring lugs and remove the clevis pin; ease the trunnion pins out slightly to enable the control ring to be lifted out, and refit the control ring in the inverted position, with its cam-plate facing away from the pump. Again insert the trunnion pins, shims and clevis pin, and test for freedom of the link, thus ensuring that the link operates freely in all positions.

5. The clevis pin, trunnion pins, shims and control ring and cam-plate bearing assembly are again removed, and all parts of the pump including the main partially assembled housing must then be subjected to a thorough washing in paraffin, and cleaned with an air-line, as already described in para. 26, before the assembling of the pump is continued.

Mounting the unit on the stripping fixture

57. Temporarily insert the pump outlet connection body, complete with aluminium washer, into the pump outlet port, and screw finger-tight, thus enabling the pump body to be secured to the stripping fixture (*para.* 13, *fig.* 3).

58. Lower the spring guides into the rotor bore and use a drift of convenient size to

drive them fully home squarely. Position the piston springs and pistons into the rotor bores and again thoroughly clean on the parawash machine. Lower the rotor assembly into the pump housing.

Fitting the control ring, cam-plate and bearing assembly

59. Assemble the control ring, cam-plate and bearing assembly into the pump as described in para. 56, Op. 1 to 3 and place a washer over the end of the clevis pin before securing it with a split pin. Then proceed as follows :—

Op. 1. To ensure that full movement of the control ring will not cause it to foul the cam-plate housing, fit the slotted slave cam-plate housing (*fig.* 24) to the flange of the pump housing. When the full range of movement has been ensured remove the slave cam-plate housing. The slave housing can be made from a scrapped cam-plate housing by cutting out a segment about 0·75 in. wide.

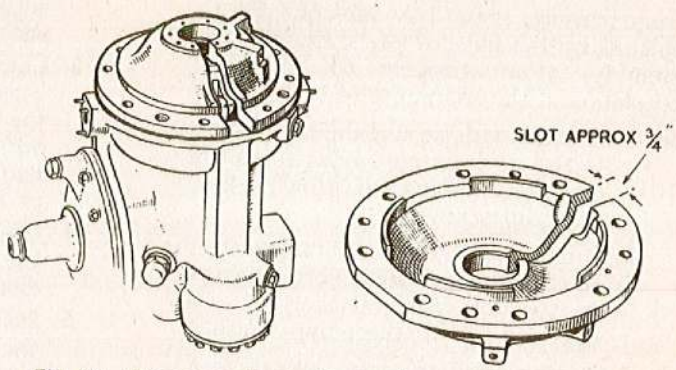


Fig. 24. Clearance check of cam-plate and housing using slotted cam-plate housing

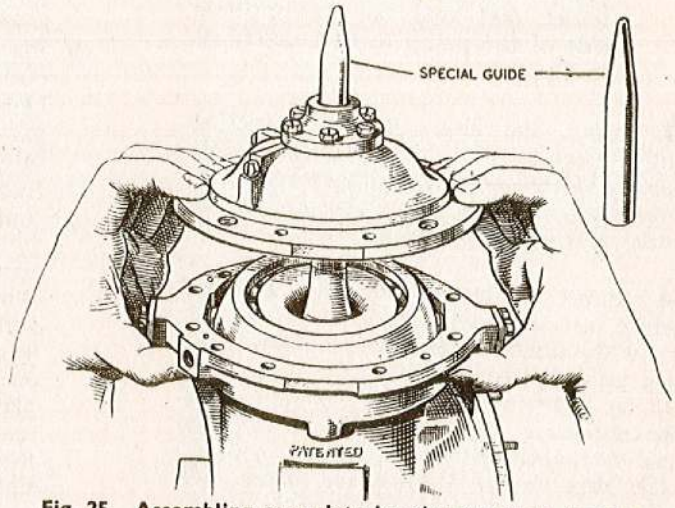


Fig. 25. Assembling cam-plate housing to pump housing, using special guide

2. Fit a gasket around the bore of the trunnion pins in the pump housing, and place a rubber seal in the groove on the outer end of each trunnion pin. Position a trunnion plate over each pin and secure each plate to the pump housing with either three nuts or hexagon-head screws, grover washers and plain washers.

Flow adjusting screw

60. Insert the flow adjusting screw for a few threads into the inclined port in the pump housing, then fit washers, lock and cup nuts.

Cam-plate housing

61. When fitting the cam-plate housing to the pump housing a guide or protective cap (*fig.* 2 *and* 25) must be used to avoid damage to the oil seals.

Op. 1. Lower the gasket on to the cam-plate housing flange of the pump housing, aligning its holes with those in the pump housing.

2. Position the guide or protective cap over the splined quill shaft (*fig.* 25). As frequent use may result in this guide being damaged at its tapered edge, its face must be smoothed off regularly to ensure that the seals slide easily over the joint between the guide and the quill-shaft.

3. Lower the cam-plate housing into position on the pump housing, and secure with four bolts, washers and nuts. Remove the guide from the quill-shaft.

62. Fit the following slave parts to the pump housing, these may subsequently be replaced by the finished parts, during final assembly, after stripping on successful completion of the endurance test (*para.* 99).

Op. 1. A plug, with an aluminium washer, to the oil drain port adjacent to the cam-plate housing and below the flow adjusting screw.

2. A union, with an aluminium washer, to the other oil drain port adjacent to the cam-plate housing on the opposite side of the pump housing.

3. A plug, with an aluminium washer, in the pump section port in the pump housing adjacent to the pump outlet port and on the opposite side of the pump to that described in Op. 1.

63. Insert the filter in the restricting orifice port in the pump housing; this port is located adjacent to the diaphragm cover flange in the pump housing, at the outlet end of the pump (*fig.* 1).

64. Insert the jet-tube together with its orifice into the restricting orifice port, and screw the orifice sleeve into the pump housing, using the special box driver (*para.* 22, *Op.* 2). *It is of the utmost importance that the restricting orifice assembly is correctly and thoroughly tightened, as any leakage, other than through the metering orifice, will adversely affect the performance of the pump.* Blank off this assembly with the aluminium washer and the dome nut.

65. Slacken the upper locking lever of the stripping fixture and swivel the vertical pillar downwards through 90 deg. so that the pump housing flange for the diaphragm cover is uppermost, and again secure the stripping fixture by means of the locking lever.

Fitting the amplifier valve assembly

66. When fitting the amplifier valve assembly insert the fibre plug (*para.* 21) in the port in the diaphragm chamber which connects with the pump inlet. Then proceed as follows:—

Op. 1. Place the flat filter over the fuel entry passage, in the base of the diaphragm chamber in the pump housing, and position the rubber seal over the filter.

Op. 2. Screw the amplifier valve rocker lever adjustment screw into the brass insert in the pump housing.

3. Lower the amplifier valve body assembly on to the securing studs in the diaphragm chamber with the orifice over the filter, and secure with four nuts and plain washers to the shorter studs.

4. Lock over the tab-washer beneath the orifice, if the orifice has been disturbed.

5. Insert the rocker lever pivots in their bores. Locate the hexagon-shaped spring cup with its lipped underside in alignment with the groove in the adjustment screw, and drop the spring into the cup.

6. Place the half-ball on the orifice, position the rocker lever correctly over both half-ball and spring, and press the points of the pivot pins into the rocker lever.

7. Ensure that the half-ball is placed centrally over the orifice and locate the pivot retaining plates with their securing studs.
While securing with the four nuts and plain washers press lightly but firmly with the finger and thumb on each of the pivot retaining plates, so that the pivot points are made to hold the rocker lever firmly without undue friction. After tightening the nuts check that the rocker lever moves smoothly but without slackness.

Checking the lift at the rocker lever pivots

67. Check the lift at the rocker lever pivot points by using a clock gauge (*fig.* 26). The rocker must be held firmly down upon the orifice with the left hand, while pressure is applied with the index finger of the right hand (*fig.* 26) and then released to obtain the play at the pivot points. Ensure that end play at the pivot points only is measured, for unless care is taken it is possible for some degree of tail lift to be included, thus giving a false reading. The reading obtained should be 0·001 in. to 0·002 in. This can be adjusted until correct by slight movement of the pivot retaining plates towards or away from the rocker lever.

Checking the total tail lift of the rocker lever

68. Check the total tail lift of the rocker lever, with the clock gauge, at the end

remote from the valve. The reading obtained for this check should be 0·030 in. to 0·040 in. ; the fore-finger of the right hand being applied to the end of the rocker ' lever which should be depressed fully and released to obtain the total tail lift, the index finger of the left hand meanwhile holding the rocker lever firmly down to close the valve.

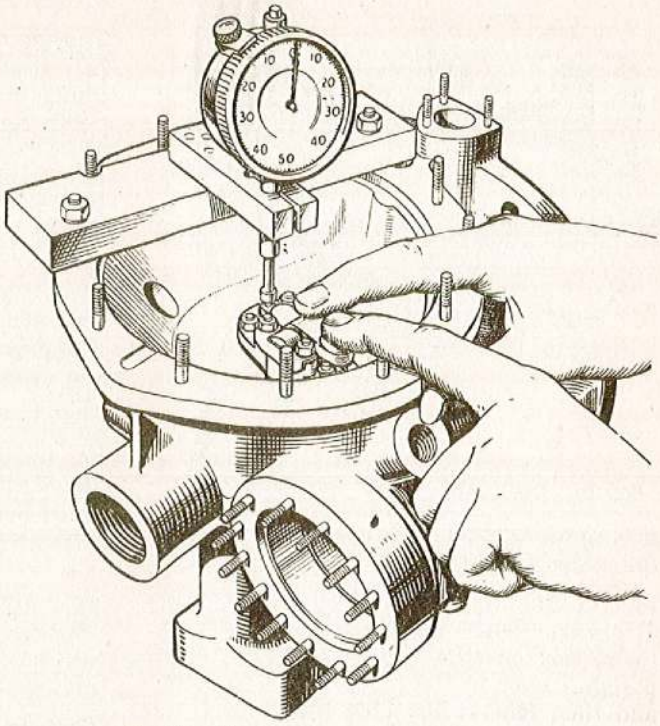


Fig. 26. Rocker lever pivot lift check

Tappet clearance check

69. Use the special gauge G.38745 for this check and proceed as follows :—

Op. 1. Mount the tappet clearance gauge across the studs in the pump housing, to which the diaphragm cover is normally fitted, and secure as shown in fig. 27. Slacken off the knurled locking screw in the side of this gauge to free the central plunger. Then press the plunger down until it just makes contact with the rocker lever in its seated position, and tighten the knurled screw to lock the plunger.

2. Invert the detached diaphragm cover and place on the other half of the setting gauge (*fig.* 28) ; remove the tappet clearance gauge from the pump housing studs and place in the inverted position on the lower half of the gauge. The dowel pins in the tappet clearance gauge must be in correct alignment with the holes in the diaphragm cover.

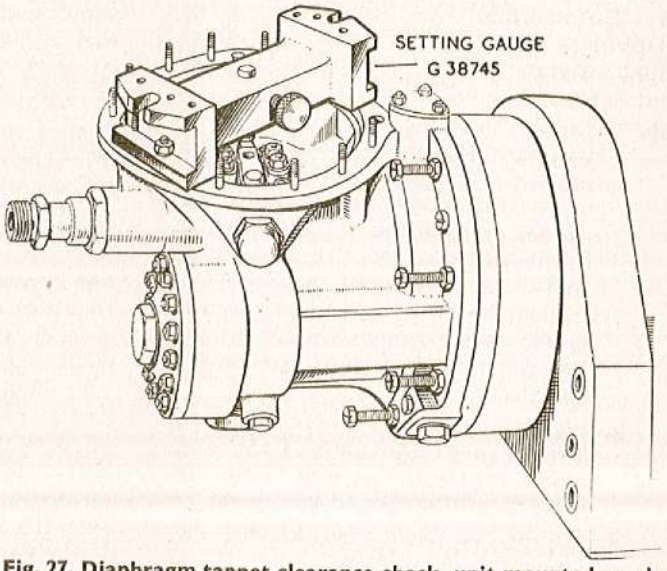


Fig. 27. Diaphragm tappet clearance check, unit mounted on rig

3. Pull up the swing bolts to pull the two halves of the gauge together and sandwich the diaphragm cover by tightening the knurled locking nuts.

4. The clearance between the plunger of the gauge and the button of the diaphragm cover must then be measured by using a feeler gauge (*fig.* 28) ; the clearance should be between 0·017 in. and 0·019 in. This gap will be found to have reduced somewhat after service, and

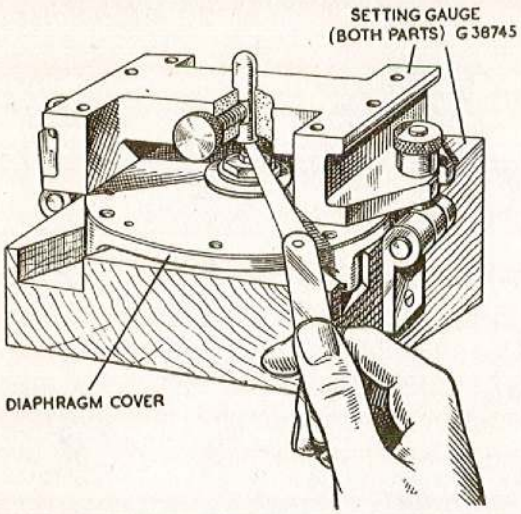


Fig. 28. Diaphragm tappet clearance check

the tappet should be readjusted to give the correct clearance.

70. Locate the two gaskets, with the diaphragm outer ring interposed between them, on the studs for securing the diaphragm cover to the pump housing flange, and then remove the fibre plug.

Assembling the bleed valves

71. Ensure that the two ports in the diaphragm cover, into which the bleed nipples are assembled, are thoroughly clean, and assemble as follows :—

Op. 1. Lower the spring, the piston and the ball into the port. The piston must move freely, and must return fully under the spring load when depressed by inserting a wire or a rod through the union. If the piston sticks out of position in any subsequent bleeding operation, it will provide a permanent leakage across the governor and may prevent its operation.

2. Place an aluminium washer on the lower end of the union body and screw the body securely into the housing of the diaphragm cover.

3. Repeat the above operations for the remaining bleed valve.

4. Subsequently (*para.* 133, *Op.* 4), the blanking nipples, nuts and split pins will be added to complete the bleed valve assemblies.

Fitting the diaphragm cover

72. Lower the diaphragm cover into position on the studs in the pump housing, and temporarily secure with four nuts, Grøver washers and plain washers, spaced at even intervals, on the securing studs.

Blanking off the seal drains

73. Insert the two seal drain plugs, complete with aluminium washers, into the pump housing beneath the oil seal drain connections from the cam-plate housing. Insert the two screws, with aluminium tab-washers, into the seal drain tappings, in the cam-plate housing, and lock the tab-washers.

Removing the pump from the stripping fixture

74. Slacken the upper locking lever of the stripping fixture and swivel the pillar into the vertical position, in which it should be locked. Slacken the knurled locking wheel to allow the plunger to be withdrawn from the pump inlet, and lift the pump clear of the stripping fixture. This will allow the helical spring, conical filter and the retaining circlip to be inserted in the pump inlet.

REPLACEMENTS

75. All paper joints or gaskets and banjo washers must be replaced by new ones whenever the seal is disturbed, and new split pins and locking wire must always be used.

Cam-plate housing

76. The cam-plate housing is normally supplied as a built-up assembly, complete with roller race, seal housing spigot plate, oil seals, spacers and oil seal housing, but all parts are separately interchangeable.

Control ring, cam-plate and bearing assembly

77. The control ring, cam-plate and bearing are supplied as a built-up unit, and in the event of damage to any part the complete assembly must be renewed.

Rotor assembly

78. Where a quill shaft or rotor is damaged, a new assembly comprising rotor, quill shaft, guides, pistons, springs and carbon ring should be fitted, but the guides, springs and carbon ring may be renewed separately. It is important, however, that when a replacement carbon ring is fitted, one must be selected to give a clearance of between 0·0005 in. to 0·0015 in. between the pump housing and the outer face of the ring. Individual pistons can be renewed provided the replacements are of the correct size. There are five nominal sizes of piston, and the rotor is etched with its corresponding nominal size. The corresponding rotor dimensions are, Size 1 : 14·0 mm. ; Size 2 : 14·025 mm. ; Size 3 : 14·05 mm. ; Size 4 : 14·075 mm. ; Size 5 : 14·1 mm.

Port Insert

79. A replacement port insert may be fitted separately.

Diaphragm cover

80. The diaphragm cover is supplied as a completely built-up assembly, but all parts are separately interchangeable. If any parts are renewed effect the check as described in para. 69.

Diaphragm assembly

81. The diaphragm is supplied as a built-up assembly comprising metal rings or plates between which is interposed the diaphragm, the whole being secured with rivets.

Trunnion pins

82. The trunnion pins are a selective assembly.

Amplifier valve assembly

83. All parts are separately interchangeable, but if the orifice is renewed make the check as described in para. 68 while if the pivot pins are renewed effect the check as described in para. 67.

Control piston assembly

84. The control piston assembly is normally supplied as a built-up unit complete with riveted link.

Servo control piston liner

85. A badly scored or leaking liner must be removed by using the special tool

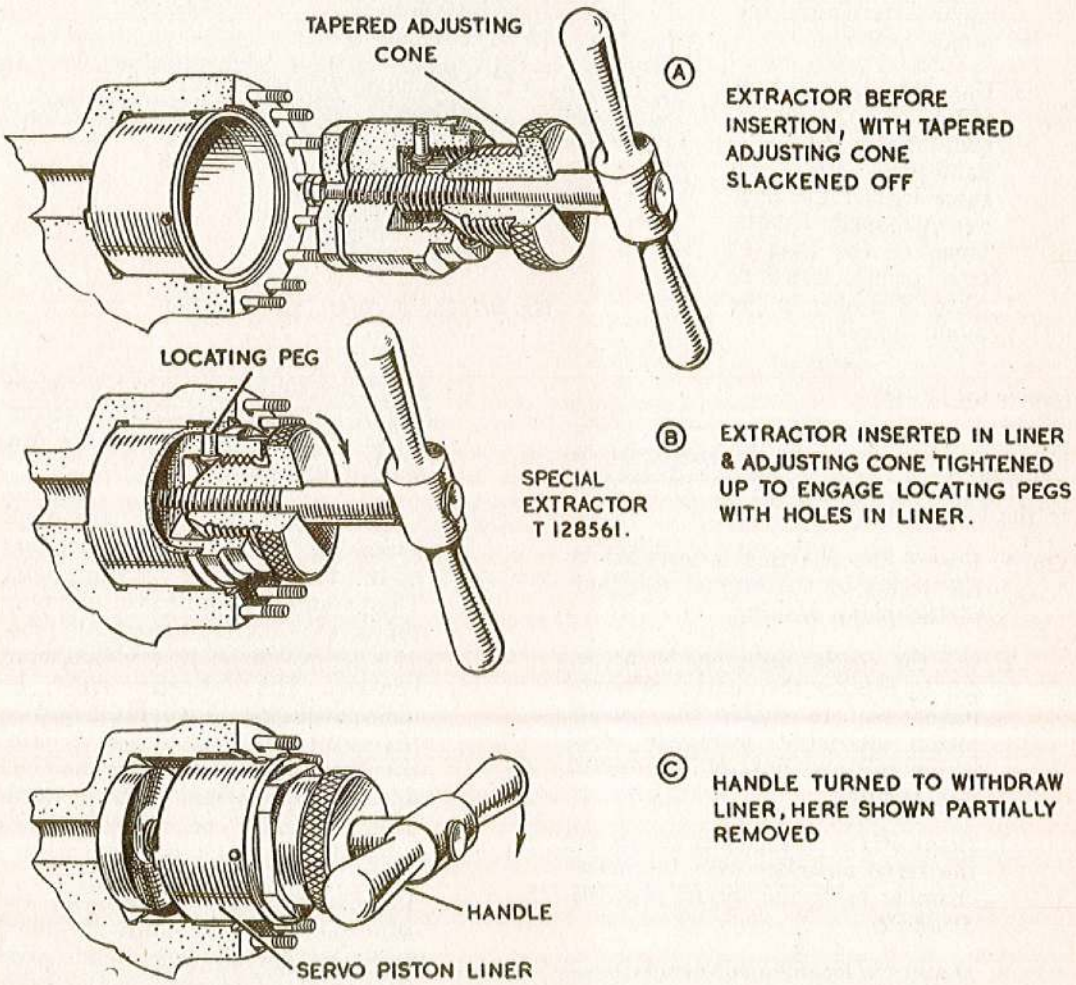


Fig. 29. Servo piston liner removal, using special extractor

T.128561 (*fig.* 29); the new liner must be inserted by using the special tool T.128564 (*fig.* 30); the following procedure must be adopted :—

Op. 1. Inspect the edges of the liner for burrs due to impact damage, and where necessary remove the damage with a smooth file, and thoroughly clean the liner by means of the parawash.

2. Insert the liner in the pump housing, and using a hide hammer, gently tap in evenly all round, sufficiently to give the liner a square start into the pump housing.

3. Use the special tool (*para.* 85, *fig.* 30), in conjunction with a hand-press, until the three legs of the liner are pressed firmly home to the base of the servo control piston chamber in the pump housing.

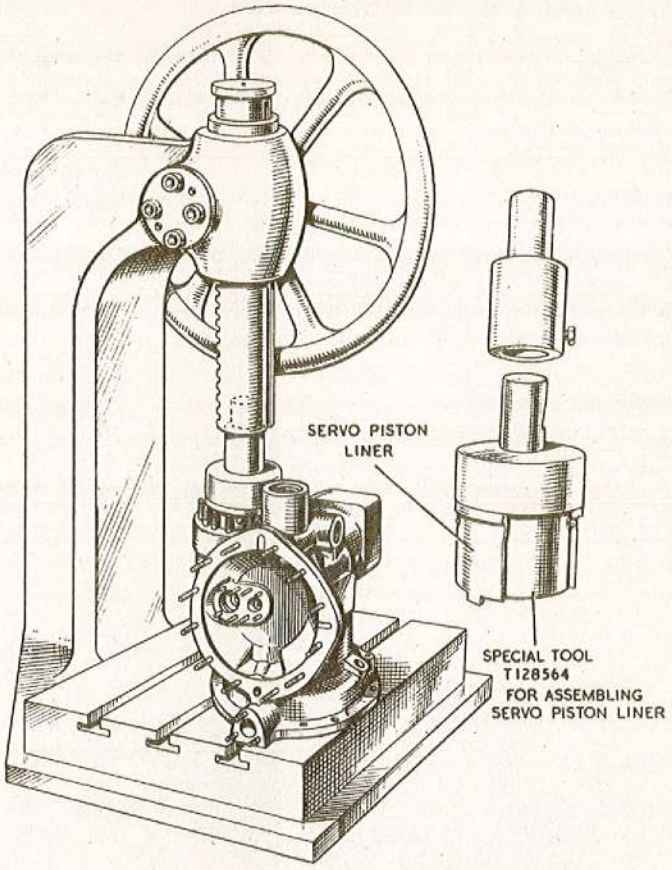


Fig. 30. Servo piston liner insertion

Pressure test for liner

86. The pump housing, with the newly installed liner must then be subjected to a 100 lb. per sq. in. pressure test as detailed in the following operations :—

Op. 1. Ensure the felt ring is installed in the recess in the control rod bore of the pump housing.

2. Use the special assembly bush (*fig.* 22) to protect the control or servo piston seal to enable the control piston assembly (complete with piston rod and link) to be lowered into position.

3. Blank off the passage way connecting the servo chamber with the orifice chamber using the special plug (*fig.* 31 *and* 2).

4. Mount the locally made clamp (*fig.* 2) on to the studs in the pump body around the control piston cylinder to ensure that the control or servo piston is held down at the bottom of its stroke while the pressure test is being effected.

Op. 5. Connect the pump to the hand pump (*fig.* 31) and apply a pressure of 100 lb. per sq. in. to the pump. The paraffin is supplied to the pump through the normal barometric pressure control connection in the pump housing. The pressure must be maintained for 15 minutes, and in the event of failure, a leak is indicated, and the liner must be removed and a replacement again fitted. The test must be repeated until a satisfactory liner is found.

6. Remove the fuel pump from the hand pump, remove both the clamp and the special plug, and press the piston rod, complete with control piston, out of the pump housing.

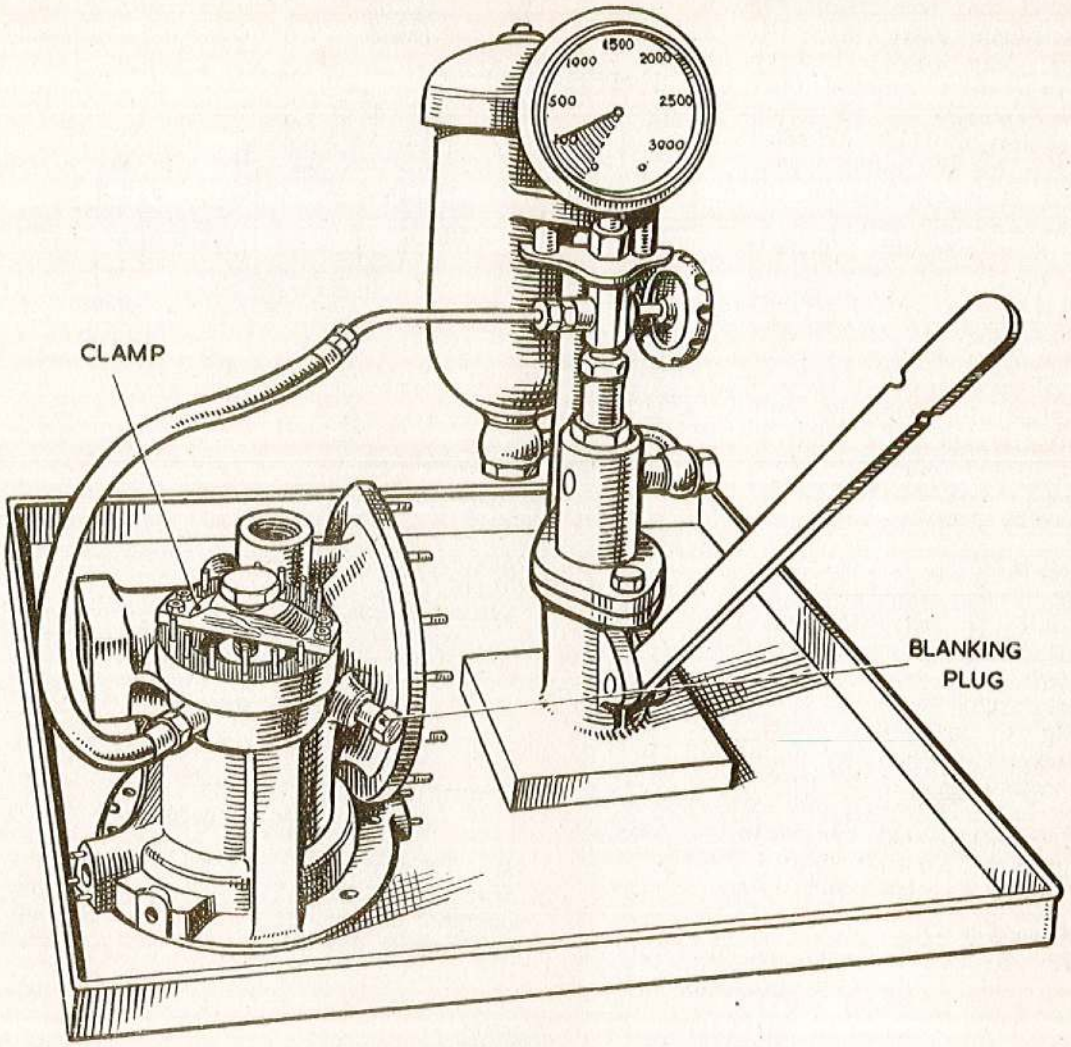


Fig. 31. Control piston liner leak test

TEST PROCEDURE

General notes for running-in, calibration, and endurance tests

87. The pump must now be tested, the duration of tests to be effected differing according to the extent of repair as follows :—

(1) Major overhauls

Instances of major overhaul which involve the replacement of one or more of the following assemblies, must undergo a full 7 hours straight running endurance test and one hour governing test.

(a) Rotor assembly.

(b) Cam-plate, control ring and bearing assembly.

(c) Port insert.

(2) Minor overhauls

Instances of minor overhaul which involve the replacement of quill shaft seals or servo piston parts must be subjected to a straight running endurance test of 2 hours duration and one hour governing, other minor replacements require a one hour governing test only.

88. Carefully record all calibration and test results for subsequent entry into the pump log book. Before effecting any running tests always ensure that the pump is thoroughly bled. To bleed and prime the pump effectively, it is essential for the ball valve and piston to be at first partially depressed to bleed the underside of the diaphragm, and then fully depressed to bleed the upperside of the governor diaphragm. Fuel should be allowed to spill, in both instances, until all signs of air have disappeared, otherwise the action of the governor may be erratic.

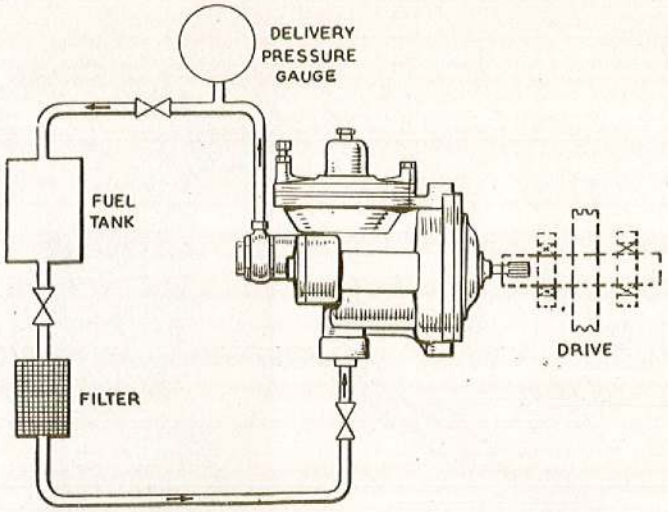


Fig. 32. Diagrammatic layout of test rig (running in)

Test fluid

89. Unless stated otherwise the fuel used through the following tests is to be aviation turbine fuel to specification D. Eng. R.D. 2482 (Latest Issue), the limits of its temperature to be 20 deg. C. minimum and 26 deg. C. maximum. Note that the air pressure passing fuel from the tank is constant for all tests, namely 1 to 5 lb. per sq. in., unless specifically stated otherwise. The fuel should be checked at regular intervals to ensure that it complies with the above specification.

Running-in test

90. Mount the pump on the test rig (*fig.* 32) and run at the following conditions.

Period in minutes	R.P.M.	Delivery pressure lb. per sq. in.
10	500	50
30	—	500

PRELIMINARY CALIBRATION

91. The pump must now be given a preliminary calibration test for which it must be mounted on the test rig and connected up as shown in fig. 33.

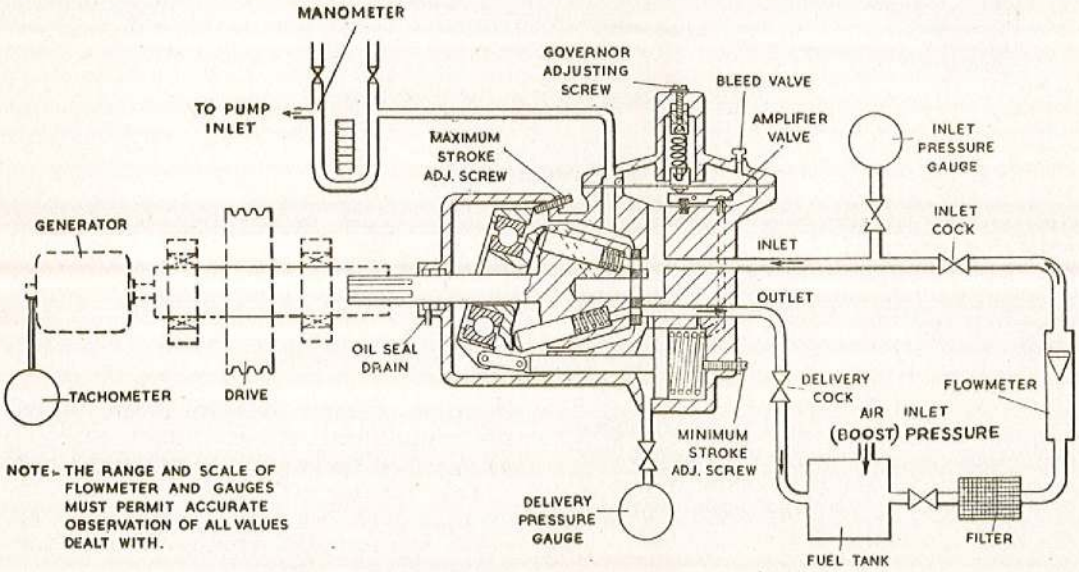


Fig. 33. Diagrammatic layout of test rig (calibration)

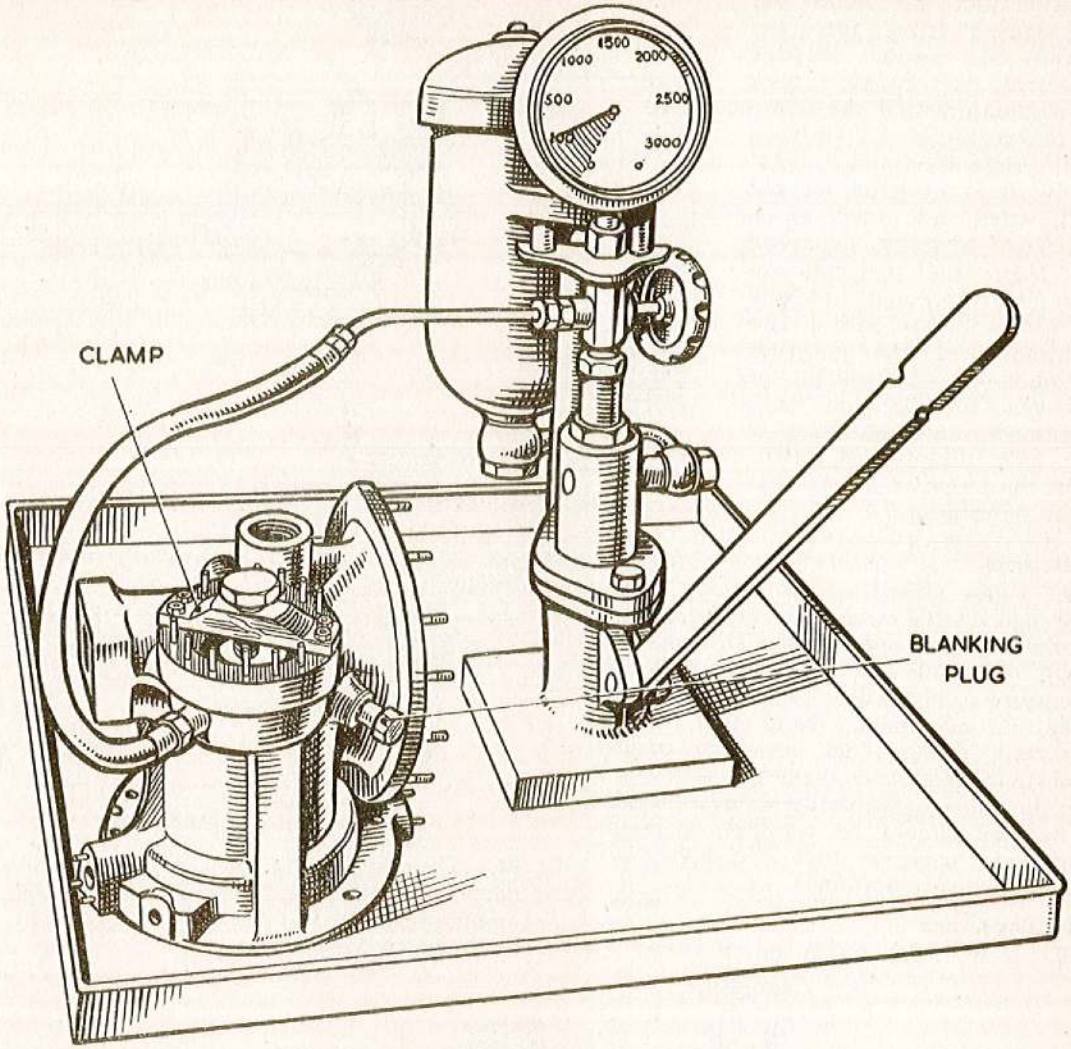


Fig. 31. Control piston liner leak test

TEST PROCEDURE

General notes for running-in, calibration, and endurance tests

87. The pump must now be tested, the duration of tests to be effected differing according to the extent of repair as follows :—

(1) Major overhauls

Instances of major overhaul which involve the replacement of one or more of the following assemblies, must undergo a full 7 hours straight running endurance test and one hour governing test.

(a) Rotor assembly.

(b) Cam-plate, control ring and bearing assembly.

(c) Port insert.

(2) Minor overhauls

Instances of minor overhaul which involve the replacement of quill shaft seals or servo piston parts must be subjected to a straight running endurance test of 2 hours duration and one hour governing, other minor replacements require a one hour governing test only.

88. Carefully record all calibration and test results for subsequent entry into the pump log book. Before effecting any running tests always ensure that the pump is thoroughly bled. To bleed and prime the pump effectively, it is essential for the ball valve and piston to be at first partially depressed to bleed the underside of the diaphragm, and then fully depressed to bleed the upperside of the governor diaphragm. Fuel should be allowed to spill, in both instances, until all signs of air have disappeared, otherwise the action of the governor may be erratic.

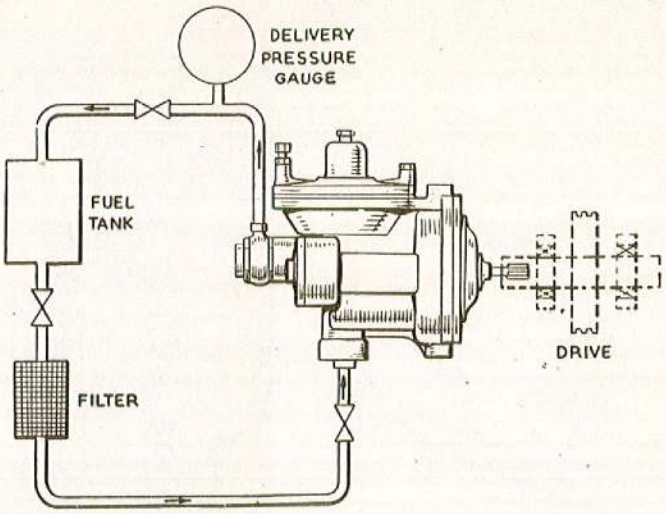


Fig. 32. Diagrammatic layout of test rig (running in)

Test fluid

89. Unless stated otherwise the fuel used through the following tests is to be aviation turbine fuel to specification D. Eng. R.D. 2482 (Latest Issue), the limits of its temperature to be 20 deg. C. minimum and 26 deg. C. maximum. Note that the air pressure passing fuel from the tank is constant for all tests, namely 1 to 5 lb. per sq. in., unless specifically stated otherwise. The fuel should be checked at regular intervals to ensure that it complies with the above specification.

Running-in test

90. Mount the pump on the test rig (*fig.* 32) and run at the following conditions.

Period in minutes	R.P.M.	Delivery pressure lb. per sq. in.
10	500	50
30	—	500

PRELIMINARY CALIBRATION

91. The pump must now be given a preliminary calibration test for which it must be mounted on the test rig and connected up as shown in fig. 33.

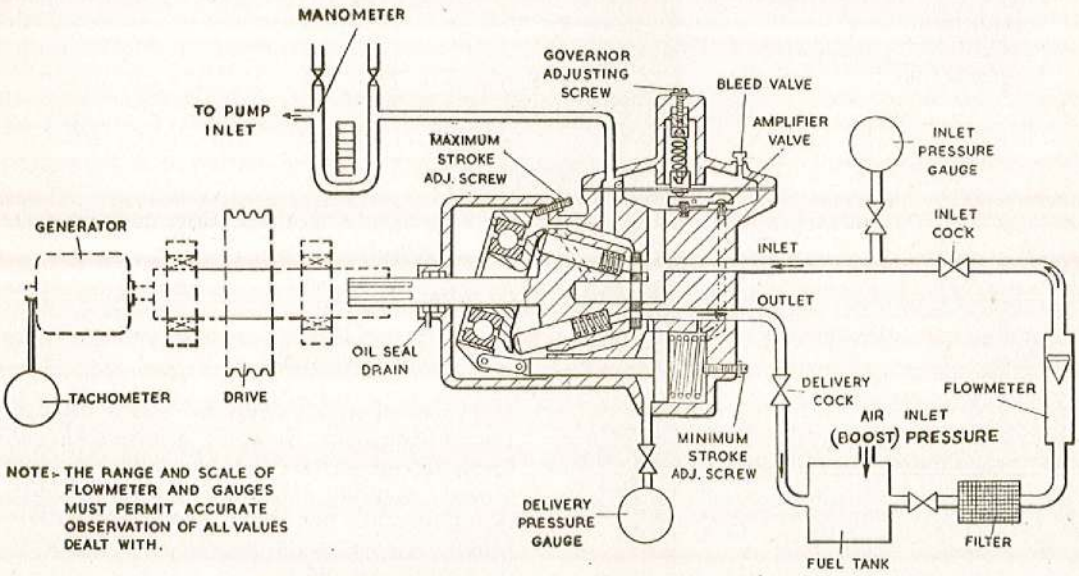


Fig. 33. Diagrammatic layout of test rig (calibration)

Rocker lever movement check

92. Remove the four nuts, grover washers and plain washers, carefully lift the diaphragm cover from the pump housing, and again check the rocker lever setting, using the special tappet gauge (*para.* 69, (*fig.* 27 *and* 28).

Fuel flow check

93. Set the minimum flow by running the pump at the conditions specified in table below, and varying the maximum stroke adjusting screw to reduce the pump stroke until the specified inlet pressure is obtained with a closed inlet. . The minimum stroke adjusting screw is then locked in position to provide a positive stop.

Calibration	R.P.M.	Inlet Pressure lb. per sq. in.	Delivery Pressure lb. per sq. in.	Remarks
H	3,000	1 to 5	1,200 to 1,300 at servo flow using blank servo restrictor	Servo spill to atmosphere
J	3,500	0 to 1 in. depression	—	—
K	—	—	—	Test not applicable no minimum stroke adjustment screw fitted
M	—	—	—	
N	3,500	0 to 1 in. depression	—	—

Fit the special expanding blanking plug (*fig.* 34) in the port communicating the diaphragm chamber with the pump suction passage, fit the plate and seal made to the dimensions given in fig. 2 to blank off the centrifugal pressure passage from the rotor chamber. Then proceed as follows :—

Op. 1. Start the rig, and with a setting of 1 to 5 lb. per sq. in. air pressure in the fuel tank, and the delivery cock fully open, slowly increase the pump speed to about 3,500 r.p.m.

2. While increasing the pump speed watch the fuel delivered by the pump as indicated by the flowmeter. To adjust the fuel flow remove the cap-nut, slacken the lock-nut and either *tighten* the flow adjusting screw to *decrease* the flow, or *slacken* the screw to *increase* the flow. The following results must be obtained:—

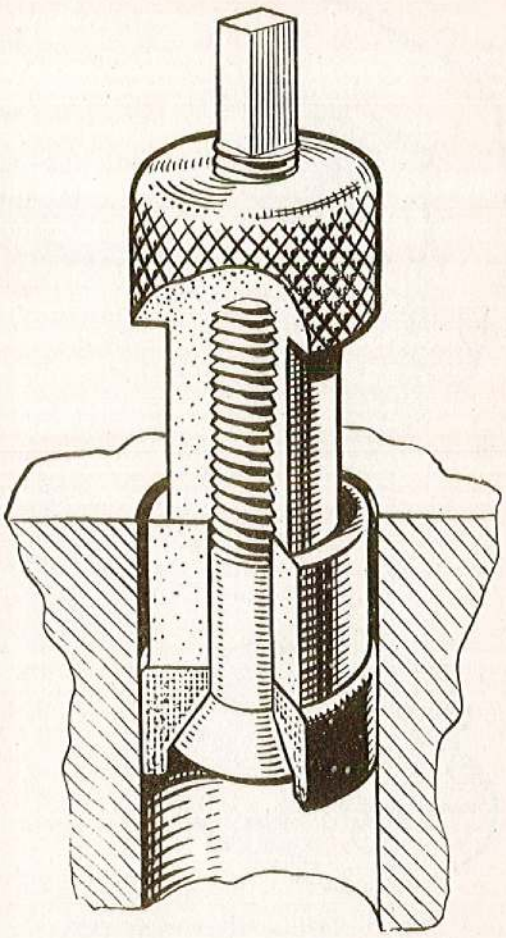


Fig. 34. Blanking-off suction port in amplifier valve chamber, using special expanding plug

Pump calibration	Fuel flow gall. per hr.	R.P.M.	Delivery pressure lb. per sq. in.
H	500 to 510	2,900	1,250
J	500 to 510	3,500	1,000
K	600 to 610	3,500	1,500
M	650 to 660	2,900	500
N	830 to 840	3,500	1,000

When the flow settings are satisfactory, tighten the lock-nut and refit the cap-nut.

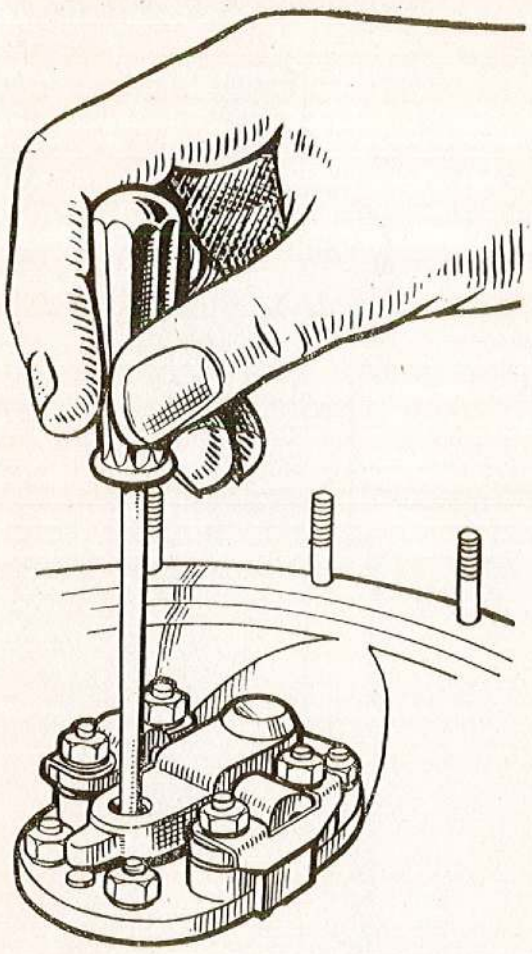


Fig. 35. Stall pressure adjustment

Stall pressure check

94. The stall pressure is the maximum delivery pressure which the pump is allowed to build up, before the servo valve opens to reduce the flow by causing the control piston to move to restrict the delivery, and must be as specified below :—

Op. 1. The stall pressure must be between 1,800 and 2,100 lb. per sq. in. for any pump speed for calibrations H, J, K and N ; a speed of 3,500 r.p.m. may be used for this check. For calibration M the stall pressure must be between 700 and 800 lb. per sq. in., and the speed 2,900 r.p.m. Close the delivery cock slowly until fuel commences to leak from the amplifier valve and the main delivery flow commences to fall. Note the pressure at which this occurs and adjust the stall setting as described in the following para.

Op. 2. If the stall pressure is too low insert a narrow-shanked screwdriver through the hole in the rocker lever into the slotted head of the adjustment screw in the pump housing (*fig.* 35) and turn the screw in an anti-clockwise direction to increase the compression of the spring. *One quarter of a turn of the adjusting screw represents approximately* 50 *lb. per sq. in. difference in the stall pressure reading.* The screw must be turned in a clockwise direction to reduce the stall pressure.

3. Open and close the delivery cock alternately slowly and rapidly not less than ten times, and ensure that a constant stall pressure reading is obtained.

4. When the stall pressure has been set to the correct value, open the delivery cock and allow the servo valve to reseat.

5. Drain the fuel collected in the diaphragm chamber.

Amplifier valve pressure check

95. The amplifier valve must be tested for leakage as follows :—

Op. 1. *Pump calibrations H, J, K and N.* Slowly increase the delivery pressure up to 1,000 lb. per sq. in. and watch the amplifier valve for any signs of leakage. There should be no leakage of fuel from this valve up to this pressure. If leakage does occur the amplifier valve must be dismantled and the half-ball orifice re-lapped ; then repeat the test and ensure that the valve remains leak-proof up to 1,000 lb. per sq. in.

Note . . .

For pump calibration M the above pressures should be 500 *lb. per sq. in.*

2. Remove the blanking plug, plate and seal, refit the diaphragm cover, and secure the cover with the complete set of twelve nuts, grover washers and plain washers.

Efficiency check

96. To check the efficiency of the pump, run at the following conditions and in each case note the readings on the flowmeter. The difference in the two readings indicates the volumetric efficiency of the pump.

Pump calibration	Condition	R.P.M.	Delivery pressure lb. per sq. in.
H	A	2,900	1,000
H	B	2,900	100
J	A	3,500	1,000
J	B	3,500	100
K	A	3,500	1,000
K	B	3,500	130
M	A	2,900	500
M	B	2,900	70
N	A	3,500	1,000
N	B	3,500	100

The flow reading noted at condition (B) should not exceed that recorded at condition (A) by more than 28 gallons per hour for calibrations H, J, K and N, and 18 gallons per hour for calibration M.

Testing the governor setting

97. Check the governor range by running the pump at the following conditions.

Pump calibration	Condition	R.P.M.	Delivery pressure lb. per sq. in.
H	Governor range	2,500 to 3,700	1,250
H	A	3,200	1,250
H	B	3,260 to 3,350	150
H	C	3,160 to 3,200	1,250
J	Governor range	2,000 to 3,700	1,000
J	A	3,580	1,000
J	B	3,610 to 3,680	70
J	C	3,550 to 3,580	1,000
K	Governor range	2,500 to 3,700	1,250
K	A	3,500	1,250
K	B	3,560 to 3,650	150
K	C	3,460 to 3,500	1,250
M	Governor range	2,500 to 3,500	500
M	A	2,880	500
M	B	2,930 to 2,980	70
M	C	This is not applicable	
N	Governor range	2,500 to 3,700	1,250
N	A	3,510	1,000
N	B	3,570 to 3,635	100
N	C	3,470 to 3,510	1,000

Op. 1. Check the governor range by increasing the speed of the pump until it governs. This is indicated by a rapid fall in delivery pressure.

2. If necessary, vary the setting of the governor adjusting screw in the centre of the diaphragm cover to obtain the correct governing range. Turn the screw in an anti-clockwise direction to give a reduced reading or clockwise for an increased reading.

3. Check that the pump governs at condition (A).

4. Increase the speed of the pump until the delivery pressure falls below that stated in condition (B), then slowly decrease the speed until the delivery pressure recovers to the exact pressure given in condition (B) and note that the pump speed is within the limits given.

5. Slowly decrease the speed until the delivery pressure is built up to that stated in condition (C) and note that the speed is within that specified. As this is a snap reading, care must be taken to ensure its accuracy.

Note . . .

Op. 5 does not apply to pump calibration M.

Endurance tests

Governor endurance (one hour)

98. Mount the pump in the inverted position, with the governor on its underside, on the test rig. The rig must be capable of operating the pump through the full governing cycle (*described in para.* 97). This cycle is to be repeated continuously 240 times in the hour, each cycle being of 15 secs. duration.

Straight running endurance

99. Mount the pump on the test rig and with the flow, speed and delivery pressure as given in para. 93, Op. 2, subject the pump to an endurance test for the period specified in para. 87.

100. The pump must now be completely stripped for final inspection.

Strip inspection after endurance test

101. The dismantling operations already described in para. 10 to 25 are applicable in this instance, except that installation fittings will not be incorporated, and no

parts, except the spring housing securing screws, will be wire-locked. *In instances of minor overhaul the extent to which the pump is stripped will be at the discretion of the inspector in charge.* The final inspection tests are also applicable, but particular attention should be given to the following points :—

Op. 1. Ensure that the diaphragm is clean and free from damage, and that the diaphragm centre is free in the diaphragm.

2. Examine the diaphragm cover. Check the locking wire through the heads of the screws securing the spring housing to the diaphragm cover—*it is necessary to disturb the spring housing from the diaphragm cover itself only in instances of definite failure.*

3. Remove the lock-nut for the governing adjusting screw at the top of the spring housing and ensure that the rubber seal is included.

4. Examine the spring for any sharp edges or corners and inspect all loose items, studs, etc., for damage of any kind.

5. Ensure that the piston-rod link is free in the control ring lugs trying it in both positions (*para.* 56, *Op.* 4 *and* 5), and ensure that the trunnion pins are free in the control ring.

6. Inspect the control ring, cam-plate generally for cleanliness and damage, and check the bearing for ease of movement. If the cam-plate is badly pitted or excessively discoloured along the piston-track, if the cam-plate does not rotate freely, or if the lift in the cam-plate is not within the specified limits (*para.* 39, *Op.* 8) the cam-plate must be discarded and a new one fitted. A badly pitted or excessively discoloured piston track on the cam-plate will indicate a tight or seized piston or pistons in the rotor bores (*para.* 40, *Op.* 2), and is generally associated also with a damaged cam-plate bearing.

7. Ensure that the pistons reciprocate freely in the rotor bores. Carefully inspect the pistons, springs and bores for cleanliness, and ensure that no wear or distortion is evident. In the aluminium bronze rotors ensure that the spring guides are sound and clean. Effect the checks as described in para. 40, Op. 4. Seized or tight pistons should be renewed (*para.* 78).

Op. 8. Examine the pump housing carefully, ensuring that the servo piston liner is clean and free from scores and that no particles of metal resulting from the insertion of the piston liner (if removed) exist.

9. Examine the circlip, which normally retains the carbon ring in position, for sharp edges, and ascertain that no cracks or chips exist in the carbon ring. Ensure that the insert retaining spider is sound.

10. Take great care to ensure that both bedding faces of the insert are clean and free from pick-up. Both the rotor and the insert must then be sent together for a final magnetic crack detection test in all instances.

11. The two plugs in the servo piston housing and the cam-plate housing flanges need not be disturbed, but must be examined for tightness.

12. Ensure that the rocker lever is not damaged in any way, and that the half-ball swivels freely in the rocker lever.

13. Examine the orifice and ensure that it is clean and undamaged.

14. Examine the amplifier valve rocker lever pivot points and the pivot pins for wear and cleanliness.

15. Examine the locating lips on the base of the spring cup (*fig.* 16) and ensure that they are sound; check the spring for sharp edges and breakage.

16. Ensure that the rubber seal is not damaged or distorted, and that the amplifier valve orifice filter is clean and the gauze unbroken.

17. Ascertain that the pivot retaining plates are free from sharp edges and cracks.

18. Do not disturb the position of the rocker lever adjustment screw which was set during the initial calibration (*para.* 94, *Op.* 2).

19. Examine the pump housing and ensure that all studs, tappings, etc., are undamaged.

REBUILDING THE PUMP AFTER STRIP INSPECTION

102. Proceed as detailed in para. 48 to 74. If any working parts are replaced as a result of strip examination effect a further running-in test as described in para. 87 under the direction of the inspector in charge.

103. The pump must now undergo a first calibration after rebuild.

FIRST CALIBRATION AFTER REBUILD

104. This calibration is similar in some respects to the preliminary calibration and where the test procedure is similar reference is made to the appropriate para. for the instructions already given.

Fuel flow adjusting screw setting

105. Set the fuel flow adjusting screw to give the specified flow as described in para. 93, Op. 2.

Efficiency test

106. Test the efficiency of the pump as described in para. 96.

Depression test

107. With the pump running at the condition stated in the following table, restrict the fuel inlet to give the specified depression. Note the flow recorded on the flowmeter; this must be within the specified number of gallons per hour below that of the flow at the unrestricted inlet of 1 to 5 lb. per sq. in., without change in speed or delivery pressure. *The duration of this test must not exceed 5 minutes, or damage may be caused to the pump through its running in a cavitating condition.*

Calibration	R.P.M.	Delivery pressure lb. per sq. in.	Inlet restriction	Flow drop gall. per hr.
H	3,200 to 3,210	1,250	12 in. Hg.	30
J	3,580 to 3,590	1,000	12 in. Hg. depression	30
K	3,000	1,250	12 in. Hg.	45
M	(a) 2,880 to 2,900	500	12 in. Hg. depression	40
	(b) Run for 5 minutes at 2,780 to 2,800	500	12 in. Hg. depression	—
	(c) Then check at governed speed	500		
N	3,510 to 3,520	1,000	12 in. Hg. depression	210 –220

If the correct readings are not obtained, the pump must be subjected to the porosity test described in paragraphs 129 and 130.

Stall pressure setting

108. Set the stall pressure as described in para. 94.

Governor setting

109. Set the governor as described in para. 97.

Recovery test

110. A stop watch is required for this test.

Op. 1. Adjust the speed of the pump until governing has occurred and re-set the speed carefully as at point "B" (*para.* 97, *Op.* 4).

2. Start the stop watch and simultaneously reduce the speed of the pump rapidly to about 3,400 r.p.m., or 2,900 r.p.m. for calibration M. The time taken for the pressure to recover from point "B" to point "A" (*para.* 97, *Op.* 1) is known as the "recovery time". This must be 2 to 3 seconds for calibrations H, J, K and N, and 2 to 4·5 seconds for calibration M. *If the recovery time is appreciably greater than that specified the governor must be examined for stiffness or other sluggishness in the mechanism. If the time is less than that specified, a leakage in the servo mechanism, either past the control piston or past the parts comprising the restrictor assembly is indicated, and must be rectified.*

Centrifugal pressure rise test

111. *Pump calibrations H, J, K and N.* Adjust the pump speed to 3,500 r.p.m. and the inlet pressure from 10 to 15 lb. per sq. in. Bleed the pump and manometer, then stall the pump to 50 per cent. of its maximum flow, and check the

stability of the amplifier valve. With no restriction, set the datum of the manometer and then increase the delivery pressure to 1,300 lb. per sq. in. The centrifugal pressure must remain constant or increase with increasing delivery pressure.

Note . . .

For pump calibration M the pump speed should be 2,900 *r.p.m. and the delivery pressure should be* 500 *lb. per sq. in.*

112. Run the pump for three minutes to check the stability of the centrifugal pressure, then govern the pump down to 1,000 lb. per sq. in. by adjusting the loading on the overspeed governor spring. If a negative reading is recorded (indicated by the centrifugal pressure falling with an increase in delivery pressure), the pump must be again stripped and the bedding faces of both insert and rotor inspected for flatness—a new rotor being fitted if necessary.

Note . . .

For pump calibration M the pressure stated above should be from 350 *to* 400 *lb. per sq. in.*

Priming test

113. Reduce the pump speed to 500 r.p.m., fully close the inlet cock, and note the depression on the gauge. An inlet depression of at least 24 in. Hg. (representing 6 in. Hg. Absolute or less) and observed on the gauge must be achieved, the test lasting not longer than one minute, or serious damage may be caused by the pump running dry.

Note . . .

If this figure is not obtained, a leakage either through the oil seal, or through the various joints or flanges is indicated, and must be traced and rectified.

Governor endurance test

114. On completion of the foregoing tests the pump must undergo a further governing test of one hour's duration as described in para. 98. The installation fittings should then be replaced.

FINAL CALIBRATION

115. This calibration is similar in many respects to the preliminary calibration and the first calibration after rebuild, and where the test procedure is similar, reference is made to those para. which are applicable. If during the course of calibration the amplifier valve assembly is disturbed in any way a repeat governor endurance test must be effected before the final calibration test is made.

Rocker lever settings

116. Check the rocker lever settings as described in para. 67 and 68 and when satisfactory lock the tab-washer on the diaphragm tappet adjusting screw.

117. Place the fibre plug in the port connected to the pump suction and secure the amplifier valve assembly with the approved lock-wire.

118. Apply compressed air into the orifice chamber and ensure that it is quite clean, and refit the diaphragm cover as described in para. 95, Op. 2.

119. Carefully bleed the pump, and check that the specific gravity and temperature of the fuel are as specified (*para.* 89).

Flow setting check

120. Set the fuel flow as described in para. 93.

Efficiency check

121. Check the efficiency of the pump as described in para. 96.

Stall pressure check

122. Check the stall pressure as described in para. 94.

Depression test

123. Test as described in para. 107.

Governor setting test

124. Check the governor setting as described in para. 97.

Recovery test

125. Effect a recovery test as described in para. 110.

Final governor setting

126. Test the governor setting under the same conditions as detailed in para. 107. Finally check the governor setting to the conditions specified in para. 97.

Priming test

127. Effect a priming test as described in para. 113.

Leak test

128. Adjust the speed of the pump to 3,400 r.p.m., the delivery pressure to 1,500 lb. per sq. in. and the air inlet pressure in

the fuel tank to 20 lb. per sq. in. Ensure the pump is thoroughly dried externally then run for a period of not less than ten minutes. A close watch must be kept on all oil seals, drain plugs and joints for any visible signs of leakage. If any leakage is evident this must be rectified.

Porosity test

129. The pump must now undergo a porosity test (*fig.* 36). This test is to be of 15 minutes duration and the following connections must be blanked off :—

Op. 1. Fit a suitable blanked off banjo to the connection body at the pump outlet.

2. Fit a plate of convenient size over the cam-plate housing and insert $\frac{1}{4}$ in. dia. nuts and bolts between the existing ones securing the cam-plate housing to the pump housing. Tighten the nuts evenly. This plate is used merely to prevent damage to the machined face of the cam-plate housing, while the additional nuts and bolts are fitted to ensure that an even seal is made round the cam-plate housing joint during this test.

3. Two suitable blanking caps are fitted to the bleed points on the diaphragm cover plate.

4. Connect a suitable airline adapter to the return to pump suction port.

5. Suitable blanking caps are fitted to the pump inlet, and to the servo and barometric pressure control connections.

130. A pressure of 40 lb. per sq. in. is applied to the interior of the pump through an airline connected to the adapter on the suction port. The pump is then immersed slowly into a tank of kerosine, and a close watch kept for any bubbles which may rise to the surface. The pump must remain immersed for 15 minutes, and in the event of any bubbles being seen, the leakage must be traced and rectified.

Final wire-locking

131. Ensure that all the installation parts have been fitted, then complete the external wire-locking of the pump (with the exception of the two bleed points on the diaphragm cover).

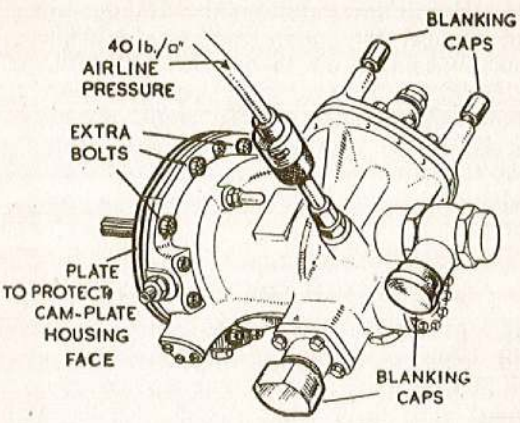


Fig. 36. Porosity test

Second porosity test

132. A further porosity test must now be made after the installation fittings have been fitted and wire-locking has been completed; the only difference between this test and the test already described is that the air is supplied through the fitted installation elbow in the pump inlet instead of through the return to pump suction port in the pump housing.

Final leak test

133. Mount the pump on the calibration rig and run at the following conditions.

Pump calibration	Duration in mins.	Inlet press. lb. per sq. in.	R.P.M.	Delivery press. lb. per sq. in.	Fuel flow gall. per hr.
H	5	15 to 20	2,900	1,250	450 to 460
J	5	15 to 20	3,500	1,000	500 to 510
K	10	20	3,400	1,500 to 2,000	—
M	10	20	2,750	450 to 500	—
N	5	15 to 20	3,500	1,000	830 to 840

Thoroughly clean and dry the exterior of the pump and watch closely for any signs of leakage. Finally, fit the cap-nuts and split pins to the two bleed points on the diaphragm cover.

INHIBITION

134. Mount the pump on the flushing rig and connect the pump inlet to a storage tank containing oil to specification DTD 587D (latest issue). Seal off the inlet elbow with a Viscap seal, blank off all exposed ports with dust caps, and ensure that the two spare copper washers for installation purposes are attached to the pump.

PREPARATION FOR DESPATCH

135. Check that all lock-wiring is secure and complete, and that all exposed ports are blanked off. All test readings, running times and inspection records must be entered on an approved record sheet, from which details are to be extracted and entered (preferably type-written) into the pump log-book for future reference. Any defects found in the pump must also be included, together with a report on all parts renewed.

Concentricity and quill depth gauge tests

136. Mount this special gauge (*fig.* 23) on the cam-plate housing of the pump, and ensure that the open cam-plate holes are concentric by lowering the locating pegs into position. Test the quill shaft for correct depth using the gauge provided.

PACKING FOR DESPATCH

137. It is recommended that a special wooden box (*fig.* 37) be used for storage or despatch. The pump must be rigidly bolted to the sliding partition of the box, with the main housing locating with a felt-lined block in the base of the box; ensure the log-book is included and fasten the lid securely by means of four countersunk-head screws.

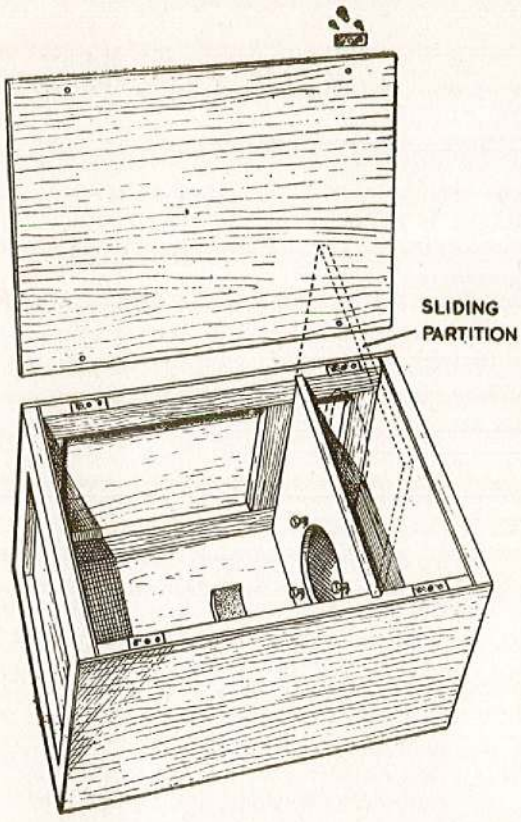


Fig. 37. Special wooden box for storage or despatch