Chapter 3

HIGH PRESSURE FUEL PUMPS, TYPE G.B. SERIES

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LIST OF SPECIAL TOOLS

Tool No.	*Description*
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G.46590	Setting piece (grade 1)—piston measurement
G.46591	Setting piece (grade 2)—piston measurement
G.46592	Setting piece (grade 3)—piston measurement
G.46593	Setting piece (grade 4)—piston measurement
G.46594	Setting piece (grade 5)—piston measurement

LIST OF SPECIAL TOOLS (*continued*)

Tool No.	*Description*
G.52069	Gauge—clearance check—governor tappet
G.52389	Gauge—clearance check—rotor carbon bearing
G.54243	Gauge—parallelism check—port insert
G.58811	Setting ring (grade 1)—rotor bore measurement
G.58812	Setting ring (grade 2)—rotor bore measurement
G.58813	Setting ring (grade 3)—rotor bore measurement
G.58814	Setting ring (grade 4)—rotor bore measurement
G.58815	Setting ring (grade 5)—rotor bore measurement
T.156533	Ram and guide—retaining washer—rotor quill shaft
T.157039	Extractor, for removing and fitting rotor circlip
T.160988	Spanner, for dismantling diaphragm adjusting screw
T.166109	Fixture—assembly—amp. valve rocker lever
T.171650	Tool—assembly—camplate housing details
T.175555	Tool—assembly—circlip—contral piston seal
T.175556	Tool—assembly—liner—control cylinder
T.175557	Guide—assembly—control piston to cylinder
T.175562	Spanner—blanking plugs—pump body drillings
T.175564	Spanner—retaining sleeve—servo press. restricting orifice
T.175565	Driver—retaining nuts—amplifier valve
T.175566	Gauge—tail lift check—amp. valve rocker lever
T.175567	Tool—assembly—rotor spring guides
T.175568	Fixture—assembly—general
T.175569	Adapter—rig test—control cylinder end cover
T.175570	Sheath—removal and assembly—camplate housing
T.175571	Tool—assembly—end plugs—inlet and outlet passages
T.175572	Fixture—assembly—pump body details
T.175574	Adapter—rig test—outlet connection
T.175575	Spanner—assembly—maximum flow screw
T.175578	Spanner—locknut—minimum flow screw
T.175579	Bleed tool—priming—rig test
T.175580	Extractor—roller bearing—camplate housing
T.175581	Extractor—liner—control cylinder
T.178981	Waiting stand—rotor
T.188739	Fixture—pressure test—oil seal—rotor quill shaft
T.192034	Adapter—rig test—inlet connection
T.192035	Adapter—rig test—overspeed governor
T.193935	Spanner—adjustment screw—maximum flow stop
T.193936	Drift—removal—rotor spring guides
T.193937	Waiting stand—rotor pistons
T.193938	Spanner—locknut—orifice assembly—amplifier valve
T.193939	Spanner—adjusting screw—stall pressure
T.194499	Tool—assembly—piston rod to pump
T.196613	Drift—removal—rotor quill shaft
T.198170	Extractor—amplifier valve assembly
T.198619	Fixture—pressure test—outer oil seal
	Rig, running in
	Rig, calibration

GENERAL

1. The instructions contained in this chapter apply to all 'B' size kerosine fuel pumps with overspeed governors. Additional information on pumps fitted with solenoid-operated servo system isolating valves, is given in para. 293 to 313.

2. Details of the calibration settings and performance tests are given in the Appendices to this chapter. A separate appendix is issued for each calibration code as indicated by the final letter of the pump type number. An explanation of the system of type numbering these pumps is given in detail in the Preface to Section 2 of this Publication.

3. Scrupulous cleanliness is essential at all times and its importance cannot be over-emphasized, particularly when servicing or overhauling.

4. It is recommended that slave nuts, washers, connections and other such details be used in those instances where components are to be assembled temporarily.

5. All paper joint washers, gaskets, banjo washers, split pins, tabwashers and locking wire must be renewed on reassembly whenever they are disturbed.

SPECIAL TOOLS

6. The special tools required for dismantling and rebuilding a pump are listed herewith and in most instances an illustration of the tool in use is provided in the text.

7. Box or ring spanners should be used whenever possible on nuts and hexagon-headed bolts to avoid damage by rounding-off the corners.

CHECKS AND PRECAUTIONS BEFORE DISMANTLING

8. Study any complaints reported with the unit and examine the exterior thoroughly, including all exposed threads, for any signs of damage. Check that all external locking is intact and that all connections have been covered properly to prevent the ingress of foreign matter to the pump interior during transit.

9. If damage to the quill shaft is suspected it is recommended that the concentricity is checked before proceeding further; the gauge G.56623 is provided for this purpose. This gauge is similar to that illustrated in fig. 28, Chap. 2 of this section. Should the gauge fail to register with the quill shaft splines the pump should not be run on the flushing rig or test-rig but should be dismantled and the rotor assembly checked for concentricity as described in para. 107.

10. Remove any dust caps fitted and inspect them internally for signs of foreign matter. If it is suspected that foreign matter has entered the pump, drain the inhibiting oil from the unit as much as possible, mount the unit on the running-in rig and flush thoroughly. Where the normal test rig is used for this purpose however, the pump delivery should be connected to a separate receptacle to avoid inhibiting oil entering the rig supply tank and contaminating the fuel. Do not allow the pump to exceed 500 r.p.m. whilst flushing.

11. Remove the installation fittings and if the pump is in running order, mount it on the test rig as for final calibration. Refer to para. 259 to 286.

12. Calibrate and performance-test the pump as described. The figures obtained will provide a guide to the condition of the unit and will assist in determining which parts may require particular attention. Should any undue noises emanate from the pump, indicating a damaged condition, stop the rig immediately.

13. Following these checks the pump should be dismantled partially or completely in accordance with any faults reported or discovered during the tests. A time-expired pump must be dismantled completely.

DISMANTLING THE PUMP

General

14. The instructions in this section are given in the recommended sequence for the complete dismantling of a pump. The method of removing each sub-assembly is described and is followed immediately in each case by the method of reducing the sub-assembly to its separate details where this is permissible.

15. Complete dismantling may not be necessary in every instance, as where a pump has completed only a short running time the extent of dismantling may be discretionary, depending upon the nature of the suspected defect. In such an instance, where it is necessary to disturb other

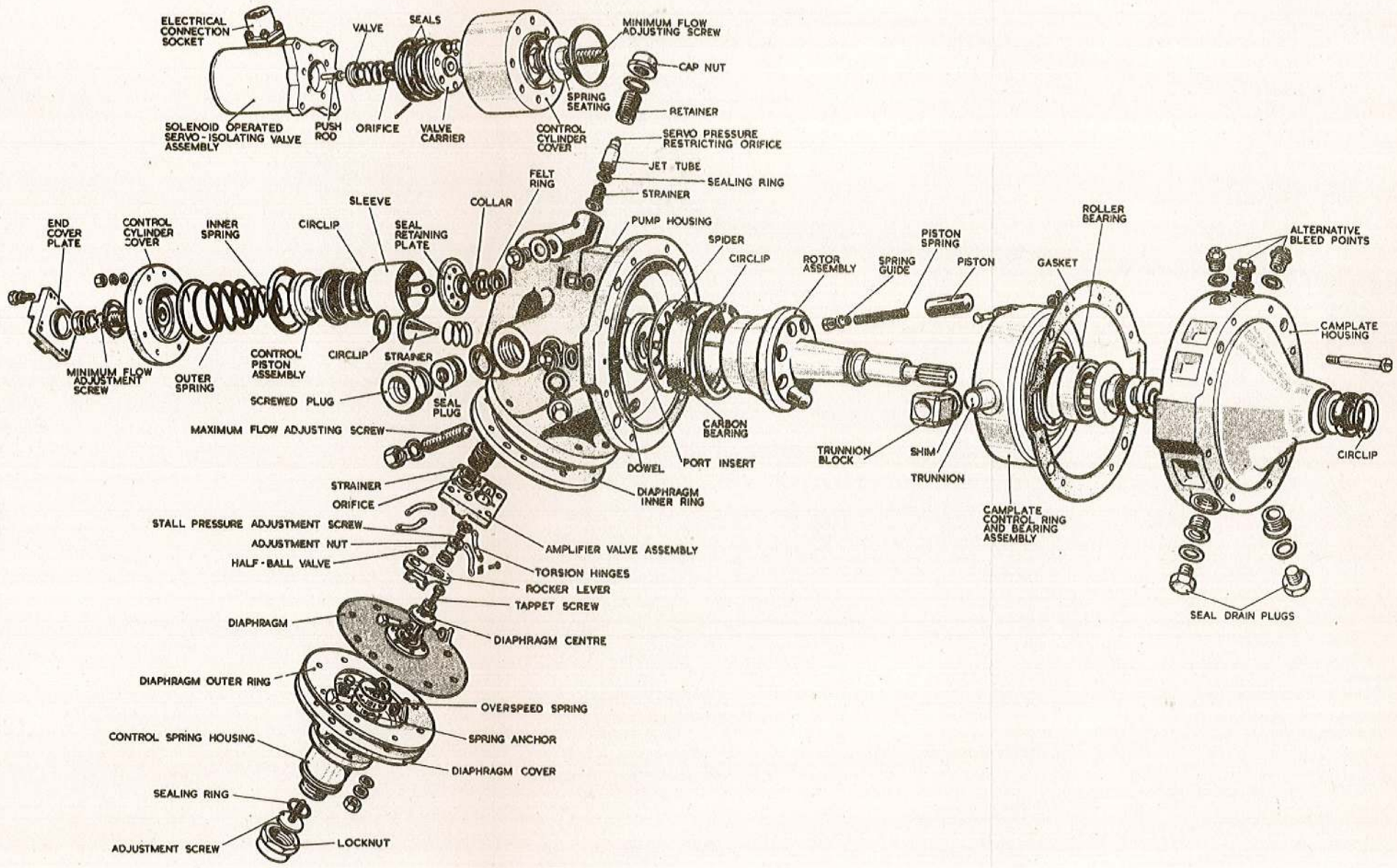

FIG. I DISMANTLED VIEW OF FUEL PUMP

F.S. / 3

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

SPECIAL TOOLS

Tool No.	Description
G.52069	Gauge, clearance check, governor tappet
G.52389	Gauge, clearance check, large carbon bearing
G.54243	Gauge, parallelism check, port insert
G.54619	Setting piece (grade 1)—piston measurement
G.54620	Setting piece (grade 2)—piston measurement
G.54621	Setting piece (grade 3)—piston measurement
G.54622	Setting piece (grade 4)—piston measurement
G.54623	Setting piece (grade 5)—piston measurement
G.56458	Gauge, setting, camplate angle
G.56550	Gauge, checking, slipper/piston clearance
G.56623E	Gauge, concentricity check, quill shaft
G.58351	Gauge, lift check, auxiliary camplate
G.58352	Adapter, lift and angle check, auxiliary camplate
G.59529	Setting ring (grade 1)—rotor bore measurement
G.59530	Setting ring (grade 2)—rotor bore measurement
G.59531	Setting ring (grade 3)—rotor bore measurement
G.59532	Setting ring (grade 4)—rotor bore measurement
G.59533	Setting ring (grade 5)—rotor bore measurement
G.59899	Gauge, clearance check, small carbon bearing
T.156533	Ram and guide, retaining washer, rotor quill shaft
T.157039	Extractor, removing and fitting rotor circlip
T.160988	Spanner, dismantling diaphragm adjusting screw
T.166109	Fixture, assembly, amp. valve rocker lever
T.175172	Fixture, pressure test, non-return outlet valve
T.175555	Tool, circlip assembly, central piston seal
T.175556	Tool liner assembly, control cylinder
T.175557	Guide, assembly control piston to cylinder
T.175562	Spanner, blanking plugs, pump body drillings
T.175564	Spanner, retaining sleeve, servo pressure restricting orifice
T.175565	Driver, retaining nuts, amplifier valve
T.175566	Gauge, tail lift check, amplifier valve rocker lever
T.175567	Tool, assembly, rotor spring guides
T.175568	Fixture, assembly, general
T.175569	Adapter, rig test, control cylinder end cover
T.175571	Tool, assembly end plugs, inlet and outlet passages
T.175572	Fixture, assembly, pump body details
T.175574	Adapter, rig test, outlet connection
T.175575	Spanner, assembly, maximum flow screw
T.175578	Spanner, locknut, minimum flow screw
T.175579	Bleed tool, priming, rig test
T.175581	Extractor, liner, control cylinder
T.178981	Waiting stand, rotor
T.188739	Fixture, pressure test, oil seal, rotor quill shaft
T.190627	Tool, assembly, camplate housing details
T.192034	Adapter, rig-test, inlet connection
T.192035	Adapter, rig-test, overspeed governor
T.193935	Spanner, adjustment screw, maximum flow stop
T.193936	Drift, removal, rotor spring guides
T.193937	Waiting stand, rotor pistons
T.193938	Spanner, locknut, orifice assembly and amplifier valve
T.193939	Spanner, adjusting screw, stall pressure
T.194499	Tool, assembly, piston rod to pump
T.196613	Drift, removal, rotor quill shaft

Tool No.	Description
T.198170	Extractor, amplifier valve assembly
T.198619	Adapter, pressure test, outer oil seal
T.198628	Assembly sheath, camplate housing
T.199561	Turnkey, rotor quill shaft
—	Rig, running-in
—	Rig, calibration

CHECKS AND PRECAUTIONS BEFORE DISMANTLING

7. Study any defect report forwarded with the unit and examine the exterior thoroughly, including all exposed threads, for any signs of damage. Check that all external locking is intact and that all connections have been covered properly to prevent the ingress of foreign matter to the pump interior during transit.

8. If damage to the quill shaft is suspected it is recommended that the concentricity be checked before proceeding further; a receiver gauge G.56623E is provided for this purpose (*fig.* 7, *Chap.* 2). Should the gauge fail to register with the quill shaft splines the pump should not be run on the flushing rig or test-rig but should be dismantled and the rotor assembly checked for concentricity as described in para. 96.

9. Remove any dust caps fitted and inspect them internally for signs of foreign matter. If it is suspected that foreign matter has entered the pump, drain the inhibiting oil from the unit as much as possible, mount the unit on the running-in rig and flush thoroughly. Where the normal test rig is used for this purpose however, the pump delivery should be connected to a separate receptacle to avoid inhibiting oil entering the rig supply tank and contaminating the fuel. Do not allow the pump to exceed 500 r.p.m. whilst flushing.

10. Remove the installation fittings and if the pump is in running order, mount it on the test rig as for final calibration, para. 244 to 270. Calibrate and performance test the pump as described. The figures obtained will provide a guide to the condition of the unit and will assist in determining which parts may require particular attention. Should any undue noises emanate from the pump, indicating a damaged condition, stop the rig immediately.

11. Following these checks the pump should be dismantled partially or completely in accordance with any faults reported or discovered during test in the case of a pump returned for repairs. A time-expired pump must be dismantled completely.

DISMANTLING THE PUMP

General

12. These instructions are given in the recommended sequence for the complete dismantling of a pump. The method of removing each sub-assembly is described and is followed immediately in each case by the method of reducing the sub-assembly to its separate details where this is permissible.

13. Complete dismantling may not be necessary in every instance, as where a pump has completed only a short running time the extent of dismantling may be discretionary, depending upon the nature of the suspected defect. In such an instance, where it is necessary to disturb other components to gain access to or to permit removal of the sub-assembly under investigation, a cross-reference is provided to the relevant paragraphs.

14. It is recommended that only one set of components be present on the bench at any one time in order to avoid the accidental transfer of parts from one pump to another and to reduce the possibility of shortages of the smaller items on rebuild. Tab-washers, split pins and locking wire should be discarded as they are removed.

15. Dismantling and assembling should be carried out at all times with the pump mounted in the appropriate fixture. Fixture T.175568 (*fig.* 2, *Chap.* 3), is used for the general dismantling and assembling of the complete pump whilst the other fixture, T.175572, is used expressly for the removal and fitting of the pump body details.

16. The dismantled components should be placed in clean and dry metal receptacles for safe storage pending inspection and rebuild.

Removing the installation fittings

17. Installation connections are fitted to the seal drain and servo pressure connections and may be fitted to the inlet and outlet ports, depending upon the particular installation. Remove the connec-

components to gain access to or to permit removal of the sub-assembly under investigation, a cross-reference is provided to the relevant paragraph.

16. It is recommended that only one set of components be present on the bench at any one time in order to avoid the accidental transfer of parts from one pump to another and to reduce the possibility of shortages of the smaller items on rebuild. Tab-washers, split pins and locking wire should be discarded as they are removed.

17. Dismantling and assembling should be carried out at all times with the pump mounted in the appropriate fixture. The main fixture T.175568, illustrated in fig. 2, is used for the general dismantling and assembling of the complete pump whilst the other fixture, T.175572 is used for the removal and fitting of the pump body details.

18. The dismantled components should be placed in clean and dry metal receptacles for safe storage pending inspection and rebuild.

Removing the installation fittings

19. Installation connections are fitted to the seal drain and serve pressure connections and may be fitted to the inlet and outlet ports, depending upon the particular installation.

20. Remove the connections and banjo pillars where fitted. Note that certain connections are fitted with an inner rubber joint washer and an outer steel washer. Retain the steel washer but discard the rubber ring which must be renewed on reassembly.

Removing the camplate housing

21. The housing is retained to the pump by four split-pinned nuts, washers and cheese-headed bolts, the bolt heads being below the face of the housing.

22. Mount the pump in the stripping and assembling fixture T.175568, and remove the split pins from the retaining nuts. Remove two opposing nuts and knock out the bolts with a hide hammer. Fit the sheath T.175570 over the quill shaft to avoid damage to the housing oil seals as

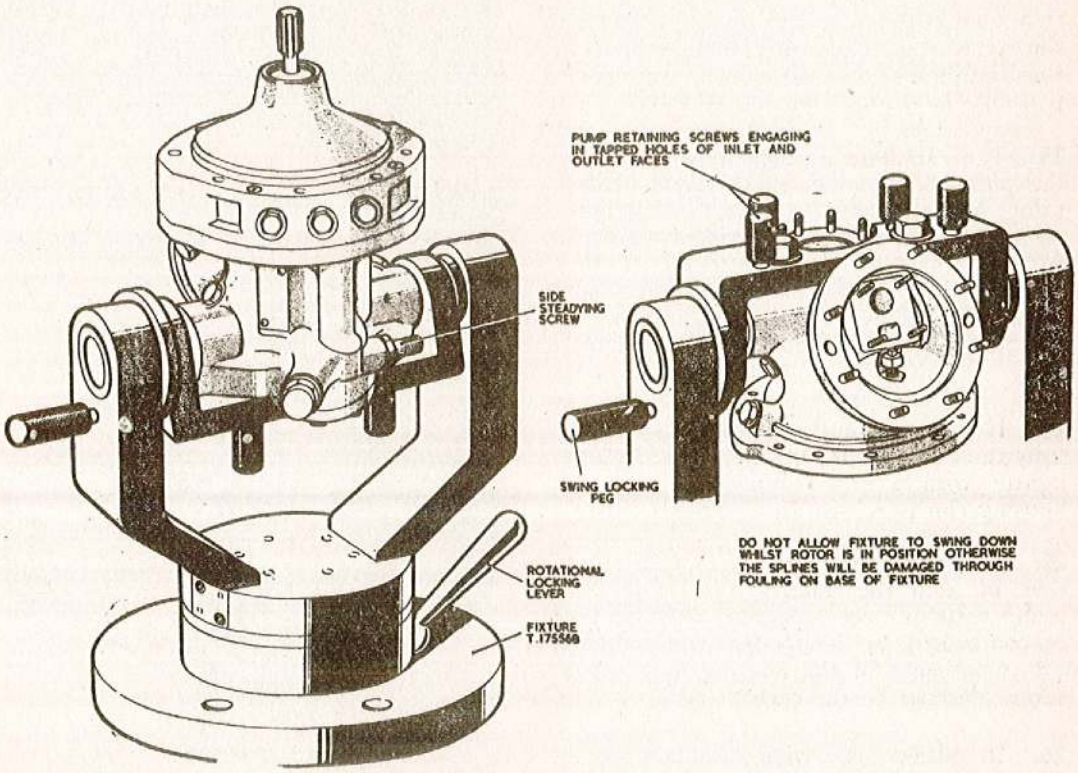

Fig. 2. **Pump dismantling and assembling fixture**

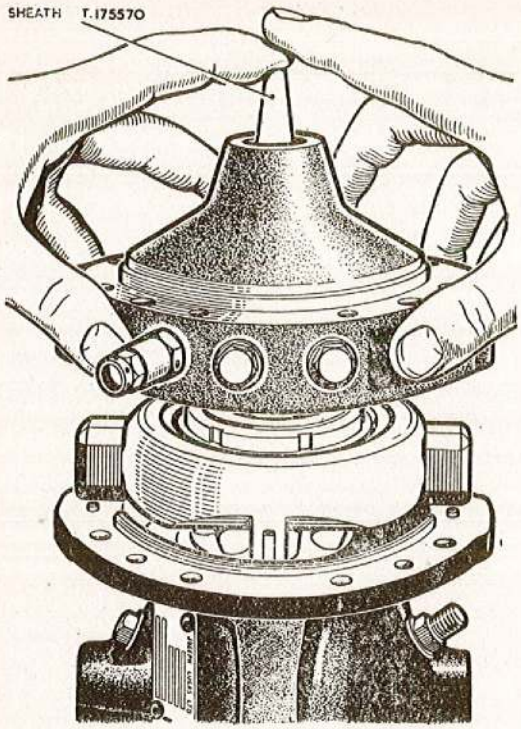

Fig. 3. Removal and assembly sheath—camplate housing

they pass over the splines (fig. 3). Slacken the remaining two nuts and hold the sheath down against the end of the rotor journal whilst removing the two nuts.

23. The camplate housing may rise from the pump body under the pressure of the rotor piston springs acting through the camplate on to the control ring trunnions. In this event release the sheath and hold the housing down until the nuts and bolts have been removed, then hold the sheath down and allow the housing to rise until free.

24. If the housing does not free itself from the body as the nuts are released tap it lightly with a hide hammer around the housing rim to release the spigoted joint.

25. As soon as the spigot is free, take great care to hold the housing central as the pump rotor is now supported only by the carbon bearing at the opposite end and any side movement of the housing may cause severe damage to the carbon bush.

26. In either case, when the housing is free, hold the sheath down and raise the housing so that the oil seals slide on to the sheath. Check that as the housing is lifted it comes free of the control ring trunnions and when the small end face is almost flush with the nose of the sheath, still taking care to keep the housing central, lift the assembly off the pump and remove the sheath from the bore.

Dismantling the camplate housing

27. Normally it should not be necessary to dismantle the camplate housing except in the case of a time-expired unit. The oil seals should not be disturbed unless they are to be removed; this should be necessary only where excessive leakage from the drain has been reported or where a new rotor is to be fitted.

28. The roller bearing may be withdrawn by means of the extractor T.175580 as shown in fig. 4. Notches in the edge of the extractor plate allow this to pass to the back of the rollers; the plate is then rotated slightly to engage behind the rollers and the handle is turned clockwise to draw the bearing from the housing.

29. To remove the oil seals extract the circlip from the outer end of the bore, lever out the outer oil seal with the " spoon " end of the general utility tool T.157039, taking care to avoid damaging the circlip groove, shake out the seal drain washer and press out the two remaining seals and the spacing washer with drift T.171650/1 as shown in fig. 5.

Removing the camplate and control ring assembly

30. With the camplate housing removed, as described in para. 21 to 26, the control

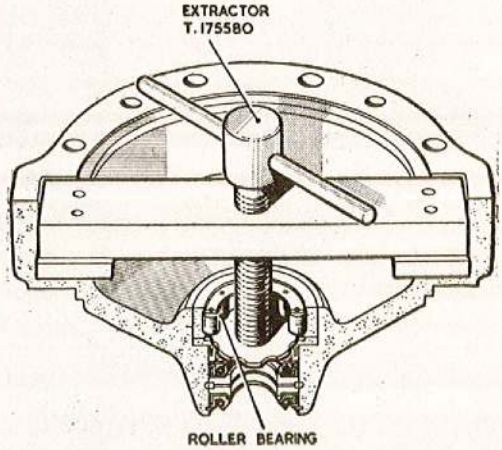

Fig. 4. Extracting the roller bearing from the camplate housing

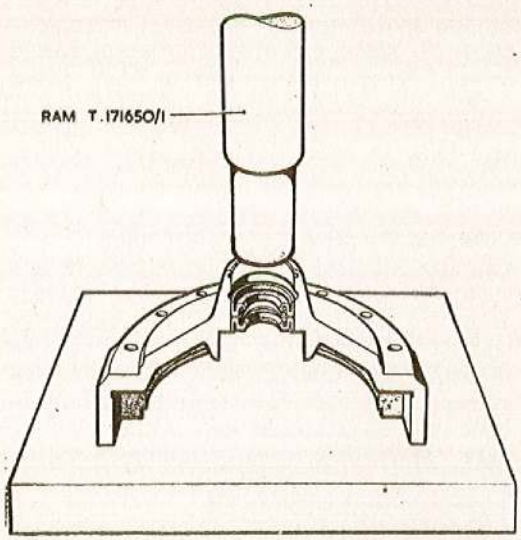

Fig. 5. Removing the camplate housing oil seals

ring and camplate assembly is retained only by the control piston linkage.

31. Draw the trunnion blocks and any shims present from the control ring trunnions, remove the split pin and washer from the link pin in the control linkage and withdraw the link pin, when the assembly can be lifted off the pump. Take care to lift it centrally until it is clear of the rotor quill shaft, as the rotor is now supported only by its carbon bearing, which may suffer severe damage if sideways movement is applied to the end of the rotor. Remove the trunnion block locating dowels from the face of the pump body.

Dismantling the camplate and control ring assembly

32. This assembly is supplied complete and due to the special methods required in its manufacture, no dismantling and reassembling is permissible away from the parent factory.

Removing the rotor assembly

33. After removing the camplate housing (*para.* 21 to 26) and camplate assembly (*para.* 30 and 31) the rotor assembly is free and can be lifted out of the pump body. Take care to avoid tilting the rotor until it is clear of the carbon bush as this can be damaged easily under these conditions. Place the rotor assembly on the stand T.178981.

Dismantling the rotor assembly

34. Withdraw the pistons from the rotor and place them on the special stand T.193937; the locating pegs on the stand are numbered and each piston must be transferred to the peg on the stand corresponding to the rotor bore from which the piston was removed, so that it may be replaced in its original bore on rebuild.

35. Extract the piston springs from the rotor and place them in a metal receptacle where they will be free from any possible damage or distortion.

36. The spring guides normally are not removed from the rotor bores but if necessary they may be extracted, as shown in fig. 6, using tool T.193936.

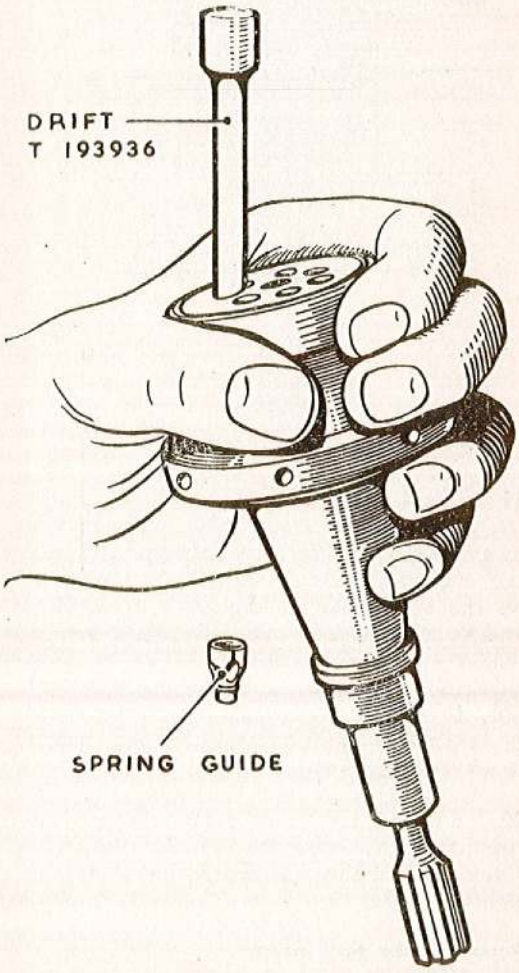

Fig. 6. Removing the piston spring guides

Removing the rotor quill shaft

37. The quill shaft is not removed from the rotor unless the shaft is bent or damaged or there is leakage past the quill shaft sealing ring when subjected to the pressure test described in para. 109 to 112.

38. To remove the shaft, place the rotor in the mounting block of tool T.196613, which should be placed over a hole drilled through a wooden block or through the work-bench, as shown in fig. 7.

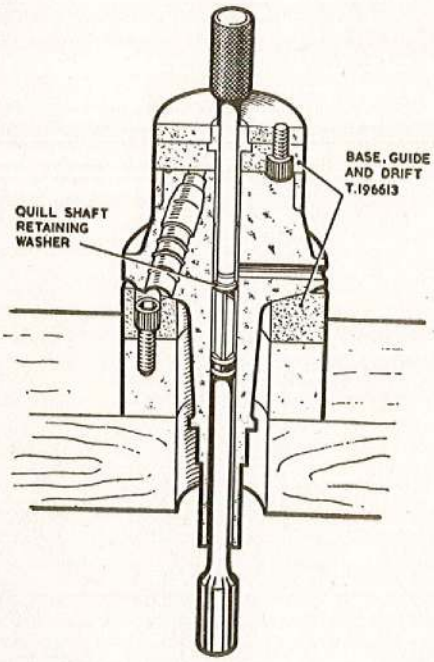

Fig. 7. Removing the rotor quill shaft

39. Insert the tube of the guide plate into the centre bore of the rotor, taking care to avoid scoring the rotor face plating with the end of the tube, seat the guide plate on the rotor face, insert the special drift and knock out the quill shaft, using a hide mallet on the drift as shown. If the quill shaft is serviceable and is being removed only to change the sealing ring, care must be taken to avoid damage to the shaft when it leaves the rotor.

40. Remove the guide plate, remove the rotor from the mounting block, invert the rotor and shake out the quill shaft retaining washer.

Removing the port insert

41. With the rotor assembly removed the carbon bearing and port insert is exposed. To remove these, first remove the retaining circlip, lift out the carbon bearing and retaining spider and lift out the port insert. Mark the edge of the insert adjacent to the dowel to enable the insert to be re-fitted in the same position on re-build.

42. Remove the insert locating dowels from the facing in the pump housing.

Removing the control piston assembly

43. The method of gaining access to the control cylinder is dependent upon whether or not a pump is fitted with a solenoid-operated servo-system isolating valve. In the case of a pump which is not fitted with an isolating valve the removal of the end cover and piston assembly is described in para. 44 to 46, whilst a pump which is fitted with a valve should be treated as described in para. 47 to 50.

44. PUMP WITHOUT ISOLATING VALVE : Remove the four set-screws and washers retaining the square cover plate to the control cylinder end cover, prise back the locking tab from the minimum flow stop locknut and slacken the nut, using spanner T.175578.

45. Slacken the nuts retaining the control cylinder end cover then hold the cover down firmly by hand whilst removing the nuts, spring washers and plain washers. Decrease the hand pressure gently, easing the cover if necessary to release the spigot from the sealing ring, and allow the cover to rise until the control piston springs are extended fully, when the cover can be lifted off the springs.

46. Extract the two springs from the cylinder, align the piston rod-control ring link with the piston rod axis and push down to force the piston head out of the cylinder whence the assembly can be withdrawn complete.

47. PUMP WITH ISOLATING VALVE : Remove the nuts, spring washers and plain washers which retain the solenoid valve assembly to the control cylinder end cover and draw the assembly from the cover. It may be necessary to ease the valve away to release the grip of the sealing rings in the end cover bore.

48. Prise back the lock tab from the minimum flow stop locknut and slacken the locknut with spanner T.175578.

49. Slacken the nuts retaining the control cylinder end cover then hold the cover down firmly by hand whilst removing the nuts, spring washers and plain washers. Decrease the hand pressure gently, easing the cover if necessary to release the spigot from the sealing ring, and allow the cover to rise until the control piston springs are extended fully, when the cover can be lifted off the springs.

50. Extract the two springs from the cylinder, align the piston rod-control ring link with the piston rod axis and push down to force the piston head out of the cylinder whence the assembly can be withdrawn complete.

Dismantling the control piston assembly

51. Remove the seal retaining circlip from behind the piston head, using expanding circlip pliers, remove the retaining ring and draw the seal off the head. If it should be necessary to prise the seal away, use a screwdriver or similar suitable tool from which all sharp edges have been removed with a carborundum stone and insert the edge of the tool between the seal back and piston head. Take great care to avoid damaging the piston.

Dismantling the control cylinder end cover

52. In the case of a cover from a non-isolating valve pump, remove the locknut and tabwasher from the minimum flow stop and unscrew the stop from the cover. Remove the cover sealing rings.

53. Where a cover from a pump fitted with a solenoid valve is involved, remove the sealing rings from the cover and push the spring seating out of the bore from the solenoid end of the cover. Remove the locknut and tabwasher from the minimum flow stop and unscrew the stop from the spring seating.

Removing the control cylinder liner

54. An extractor No. T.175581 is provided for removal of the control cylinder liner, the extractor having two lipped blocks which can be expanded to engage the lips under the inner end of the liner. The extractor handle is then rotated to draw the liner out of the housing as shown in fig. 8.

55. Remove the retaining plate, collar and felt sealing ring from the counterbore at the bottom of the cylinder bore. Remove the large sealing ring from the cylinder bore.

Removing the overspeed governor diaphragm assembly

56. The diaphragm assembly includes the adjusting spring housing and diaphragm cover which retains the assembly in the pump body. Remove the eight retaining nuts, spring washers and plate washers from around the diaphragm cover and lift the assembly from the pump.

Checking the governor tappet clearance

57. The gauge G.52069 is provided for obtaining a check on the clearance between the diaphragm tappet and the rocker lever tail. The gauge is in two parts, consisting of a mounting base and a measuring bar

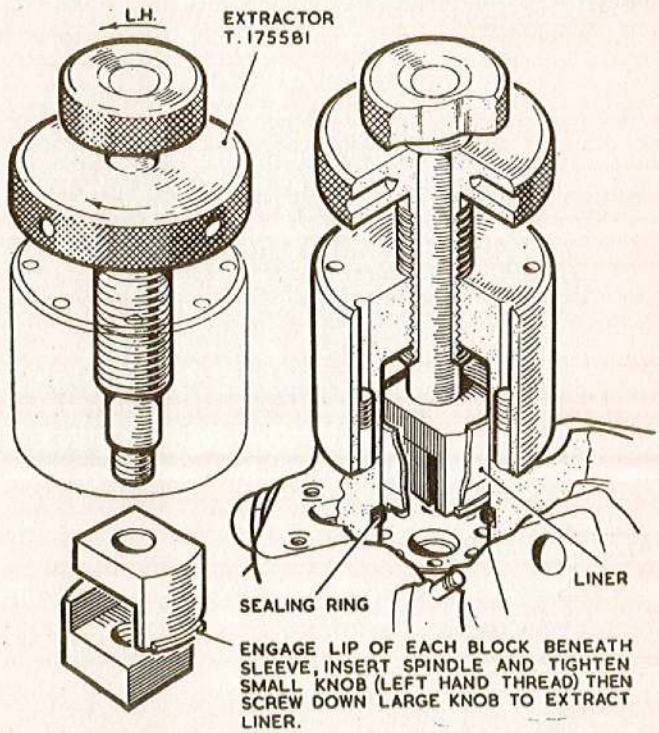

Fig. 8. Withdrawing the control cylinder liner

fitted with a sliding plunger. The use of the gauge is described in para. 113 to 119.

58. The clearance may be found to have reduced slightly during service and if the diaphragm is not being dismantled the tappet should be re-adjusted to the correct clearance before refitting the assembly to the pump.

Dismantling the governor diaphragm assembly

59. Remove the adjusting screw locknut and screw, unlock and slacken the tappet locknut and draw the diaphragm complete with loading spring and spring anchorage from the diaphragm cover and spring housing.

60. Withdraw the split pins from the clevis pins at each end of the spring and remove the clevis pins to separate the spring anchorage and spring from the diaphragm centre.

61. Remove the tappet screw and locknut from the diaphragm centre and withdraw the centre piece from the diaphragm. No further stripping of the diaphragm is permissible, as it is a riveted assembly and is supplied complete.

62. Remove the six wire-locked set-screws and plain washers from inside the diaphragm cover and separate the cover from the spring housing.

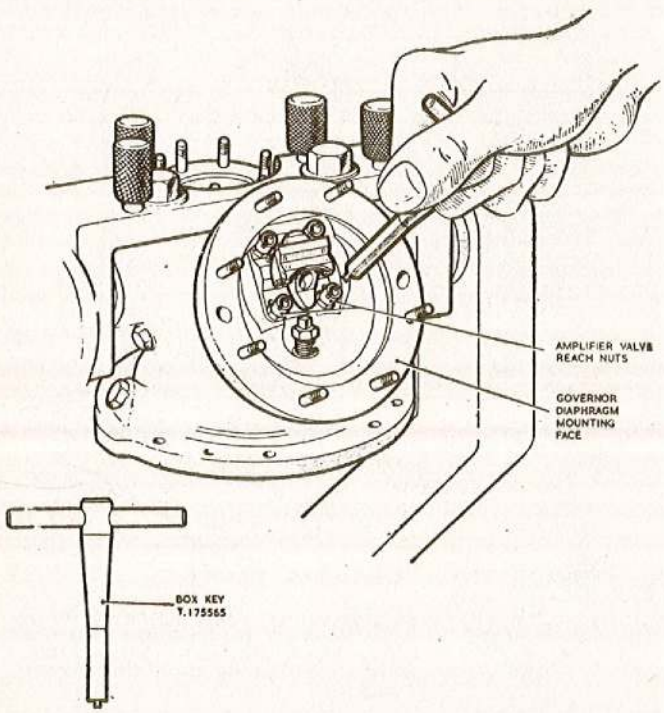

Fig. 9. Removing the amplifier valve reach nuts

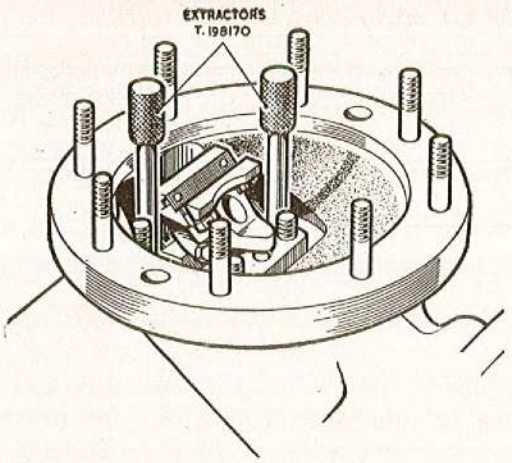

Fig. 10. Withdrawing the amplifier valve assembly

Checking the rocker lever tail lift

63. The tail lift of the rocker lever is checked by clamping a standard dial test indicator in clock holder T.175566. The method is described in para. 120 and 121.

Removing the amplifier valve assembly

64. The amplifier valve assembly is retained to studs in the pump body by four special reach nuts which are secured with tab washers. To remove the assembly unlock the tab washers and remove the nuts with the special tool T.175565, shown in fig. 9. Screw in two extractors T.198170 as shown in fig. 10 and lift the assembly out of the pump body. The assembly may feel slightly tight at first due to the rubber sealing ring on the orifice strainer housing but a steady pull on the extractors will release the seal.

Dismantling the amplifier valve assembly

65. Reduce the spring load on the rocker lever by rotating the stall pressure adjusting screw anticlockwise as far as possible, then compress the spring slightly as shown in fig. 11 and remove the retaining pin, adjusting screw, spring seating and spring.

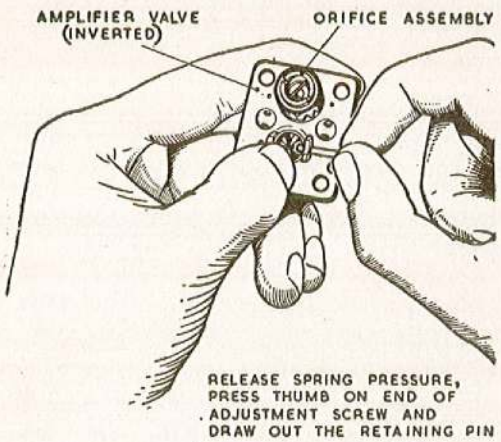

Fig. 11. Removing the stall pressure adjustment

66. Unlock the tabwasher securing the orifice assembly lock-nut, release the nut using spanner T.193938, and remove the orifice and strainer complete. Take care to avoid losing the half ball which will fall out as soon as the orifice is clear of the valve base plate.

67. Mount the assembly on fixture T.166109, unlock the tab-washers securing the setscrews which retain the torsion hinges to the base plate and remove the setscrews.

68. Remove the rocker lever and bridge piece from the base plate and transfer it to the other side of the fixture, as shown in fig. 24. Insert the mandrels to hold the free ends of the hinge blades, unlock and remove the setscrews securing the blades to the lever bridge piece, reverse the lever in the fixture and remove the remaining two blades likewise.

Removing the servo-pressure restricting orifice

69. The restricting orifice assembly is housed in the large boss on the pump body adjacent to the control cylinder. Remove the dome nut and washer and using spanner T.175564, shown in fig. 12, unscrew and remove the orifice retainer. This will expose the end of the orifice jet tube which can be lifted out. The strainer assembly at the bottom of the bore may be held by its sealing ring, in which case the strainer can be drawn out carefully by using the tool T.157039.

Note . . .

The orifice and jet tube are a permanent assembly and must not be separated.

Removing the air bleed valve assembly

70. Remove the bleed valve dome nut and unscrew the valve assembly complete using a standard box or ring spanner. The valve assembly is supplied complete and should not be dismantled.

Removing the inlet strainer

71. The inlet strainer is retained in the housing by a circlip in the mouth of the bore. Release the circlip with circlip contracting pliers but exert a downward pressure as the clip clears the groove to prevent the strainer being ejected by its seating spring. Reduce the pressure gently until the spring is extended fully, then remove the circlip, strainer and spring from the housing.

Removing the remaining details

72. When a pump is dismantled completely, the remaining details in the pump body consist of the maximum flow adjusting screw, the retaining studs for the various sub-assemblies, and blanking plugs in the various drilled passages.

73. To remove the maximum flow adjusting screw, unlock the tab washer which secures the adjusting screw locknut located inside the amplifier valve chamber in the pump body. Slacken the locknut and remove the screw with spanner T.175575 if the threads are tight.

74. All dowel pins should be a push fit and can be withdrawn without difficulty. If any studs are to be removed, standard

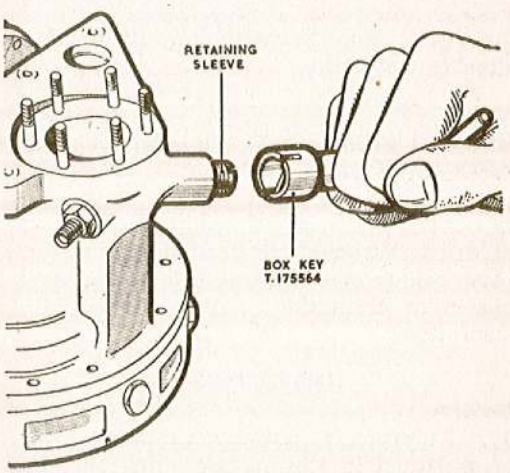

Fig. 12. Removing the restricting orifice retaining sleeve

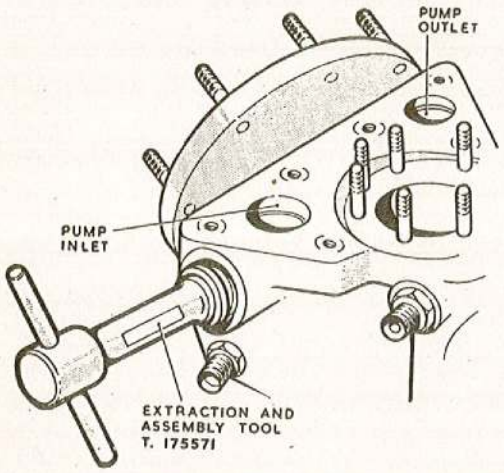

Fig. 13. Withdrawing end plugs from inlet and outlet passages

stud-boxes must be used to avoid damage to the threads.

75. Blanking plugs should be removed with standard box or ring spanners. Draw the plugs from the inlet and outlet cored passages with the tool T.175571 as shown in fig. 13.

CLEANING

Note . . .

If any defect in the pump is suspected to be due to the presence of foreign matter the parts suspected should be inspected before cleaning, otherwise the cause of the defect may be washed away.

76. The components must be cleaned thoroughly by washing in kerosine. It is recommended that they should be pressure-washed using an appropriate bath and spray gun supplied by a pump with adequate filtering facilities.

77. Hard brushes, cloths and abrasives must not be used for cleaning under any circumstances.

78. After cleaning, all components should be dried thoroughly with a compressed air blast, which must be free from water, and placed in clean dry containers ready for inspection.

INSPECTION

General

79. All visual inspection of the components is described in this section. In those instances where dimensional checks of certain components are necessary, the method only is described, the appropriate dimensions being given in the Schedule of Fits and Clearances, Vol. 2, Part 2 of this Air Publication.

80. Each detail should be inspected closely for signs of damage, corrosion or excessive wear and if considered necessary, with due regard to the function of the component and nature of any defects, the part should be discarded and a replacement demanded.

81. Scrupulous cleanliness is essential with regard to the inspection and assembly bench and to all containers and tools in use. It is advisable that the surface of the bench be covered with zinc, linoleum or bakelized fabric to assist in maintaining the high standard of cleanliness required. Following inspection the details should be placed in containers holding a quantity of light oil for safe storage pending rebuild.

Permissible wear

82. All parts subject to wear must be checked dimensionally in accordance with the Schedule of Fits and Clearances.

Redundant and consumable parts

83. It is usual during inspection to reject any parts rendered redundant by modifications; the inspector therefore, must have complete information covering modifications so that these can be embodied on re-assembly and redundant parts rejected.

84. Tab washers, split pins, locking wire, joint washers and other consumable parts are discarded during dismantling; their new replacements should be available for inspection with the main components.

Scores and surface damage

85. In general, scores or surface damage on moving parts and joint faces will impair the operational efficiency of the unit, hence any part so affected should be rejected and a replacement demanded. In certain circumstances however, depending upon the number of hours the pump may be required to run, the purpose and region of operation and the accessibility of spares, certain defects insufficient seriously to impair the efficiency and safety of the unit may be acceptable at the discretion of the inspector in charge.

Magnetic crack detection

86. In a case of suspected cracks or wherever there is the slightest doubt con-

cerning the soundness of the following components, they must be tested for cracks by means of an approved magnetic crack detection equipment.

Rotor (for cracks on steel journals)
Quill shaft
Control ring assembly
Auxiliary camplate
Control piston assembly
Port insert
Overspeed governor spring
Amplifier valve rocker lever
Control piston springs
Minimum flow screw
Maximum flow screw
Pistons
Stall pressure adjustment screw

Installation fittings

87. Inspect all installation adapters and unions for cleanliness and general condition and ensure that threads and joint faces are undamaged.

Camplate housing assembly

88. Examine the joint face of the camplate housing flange for damage and scoring which may affect the seal and examine the housing generally for signs of damage and corrosion. Inspect the roller bearing housing bore for fretting.

89. Inspect the roller bearing for cracks and other defects on the rollers, cage and race. Check the outside diameter of the race for signs of fretting. The diameter of the bearing between opposite rollers is to be checked with the bearing assembled in the camplate housing.

90. Each bearing spacer, drain washer and outer seal retaining circlip should be examined visually for surface defects and undue wear.

91. Check the trunnion block housing pockets dimensionally in accordance with the dimensions specified.

Camplate and control ring assembly

92. Visually inspect the camplate surface for severe overheating, scoring, uneven wear and surface cracks. Examine the remainder of the assembly generally for any obvious defects.

93. Examine the trunnions and trunnion block bores for frettage and check them dimensionally in accordance with the Schedule of Fits and Clearances.

94. The bearing end float and the control link pin are to be checked dimensionally in accordance with the tolerances specified.

95. Inspect the trunnion shims for excessive wear and cracking, assemble the trunnion blocks to the trunnions and fit the assembly to the camplate housing. Check the end float of the camplate assembly in accordance with the Schedule of Fits and Clearances and check that the existing shims are still satisfactory, renewing them if necessary.

Rotor assembly

96. Carefully inspect the rotor face, which must be quite flat and clean. Some wear of the lead plating generally occurs after running and provided the face is not badly scored or eroded, slight evidence of bronze showing through the plating is not regarded as serious. Examine the large and small journal diameters for scoring, cracks, excessive discolouration due to overheating and signs of picking-up.

97. Try the pistons for ease of reciprocation in their respective bores and note any tightness. Examine the rotor bores for damage, severe scoring and signs of picking-up. Ensure that there is no foreign matter in the oil relief grooves. If any defect is suspected pencil-mark the upper face of the rotor adjacent to the suspected bore for subsequent closer inspection.

98. Wipe each piston with clean muslin and lay it on a sheet of white paper; excessive discolouration and high spots not readily discernible can more easily be seen by this method. Examine the piston crowns for pitting and severe wear.

99. Measure the diameter of each piston individually by using a precision dial-type comparator and the five setting pieces as illustrated in fig. 14. Select the appropriate setting piece for the grade marked on the rotor, place it on the anvil of the comparator and adjust the instrument until the indicator needle is set at zero. Pass each piston in turn under the contact point, ensuring that the piston is flat on the anvil,

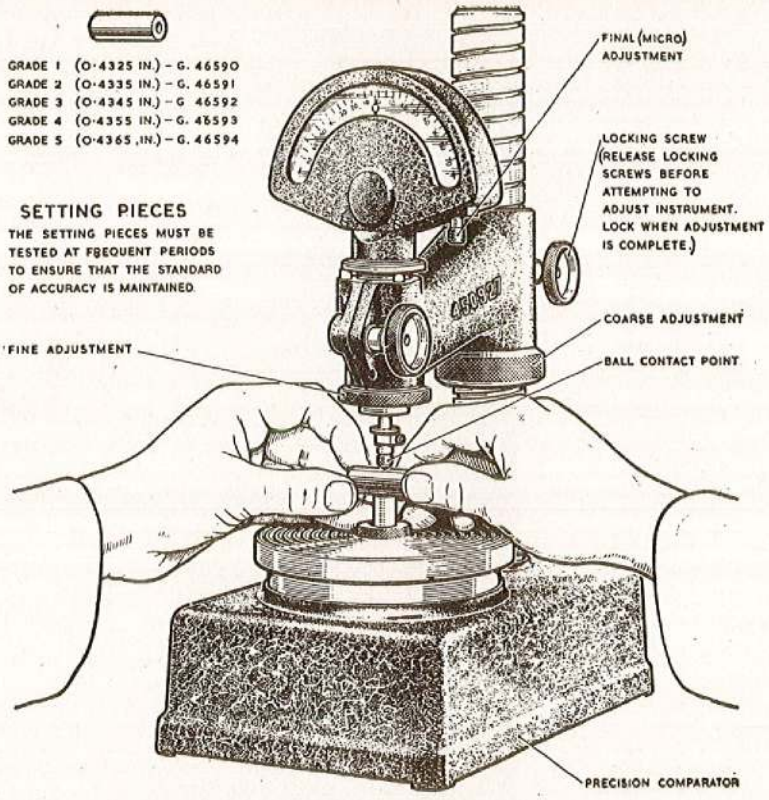

Fig. 14. Checking the rotor pistons

and read off from the indicator the amount by which the piston is less than the nominal size (" DIMENSION—NEW ") stated in the Schedule of Fits and Clearances. Record the figures obtained for each piston (nominal size less the amount of undersize indicated) against the appropriate piston/bore co-relation number; these figures (" DIMENSION—WORN ") must be compared with the figures obtained from checking the rotor bores to arrive at the worn clearance.

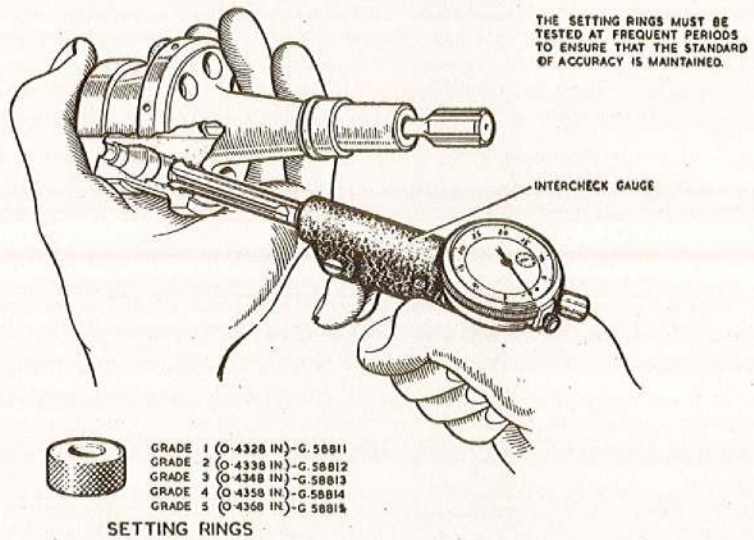

Fig. 15. Checking the rotor bores

100. The rotor bores are to be measured with a precision dial-type intercheck small-bore gauge as shown in fig. 15. Five ring-type setting gauges, G.58811—5, are provided to suit the grading of the rotor bores. Select the appropriate gauge-ring, pass it over the measuring tips of the intercheck gauge and set the gauge dial to zero reading, then measure each bore in turn, recording the figures obtained (nominal bore size plus indicated wear) against the appropriate figures for the pistons.

101. Subtract the indicated piston sizes from their respective indicated bore sizes to obtain the clearances, which must be within the limits stated. Should the clearance in any bore exceed the specified permissible worn amount, the complete rotor and set of pistons must be returned for re-conditioning.

102. Inspect the piston springs for damage and distortion of coils. Check that the spring seats are free from sharp edges and cracks likely to damage the springs.

103. Ensure that the axial bore and radial drillings in the rotor are clean and free from any foreign matter.

104. See that the rotor carbon bearing is clean and free from cracks and chipping at the edges and around the dowel slots in the lower face.

105. Insert the bearing into its housing bore in the pump body to check the fit. The bearing must be a good sliding fit in the body but without any slackness. Where a new bearing is to be fitted this must be selected to give the fit described. Do not attempt to ease a tight bearing; a new bearing must be selected.

106. Check the diametral clearance between the carbon bearing bore and the rotor journal, using the checking gauge G.52389 as shown in fig. 16. Check also the diametral clearance between the rotor small end journal and the roller bearing in the camplate housing (*para.* 89). The figures obtained must conform with the dimensions and clearances specified in the Schedule of Fits and Clearances.

107. Support the rotor journal diameters on vee-blocks and using a dial test indicator, check that both journals, the oil seal diameter and the quill shaft splines are concentric with each other. Any run-out on the spline outside diameter should not exceed 0·008 in. Examine the splines for damage and severe wear.

108. Should a new quill shaft be required, remove the existing shaft as described in para. 37 to 40 fit the new shaft (*para.* 200 to 203), check the concentricity (*para.* 107) and pressure test the sealing ring as described in para. 109 and 110.

Pressure-testing the quill shaft sealing ring

109. The quill shaft sealing ring is to be pressure-tested for leakage by placing the assembled rotor and quill shaft in the fixture

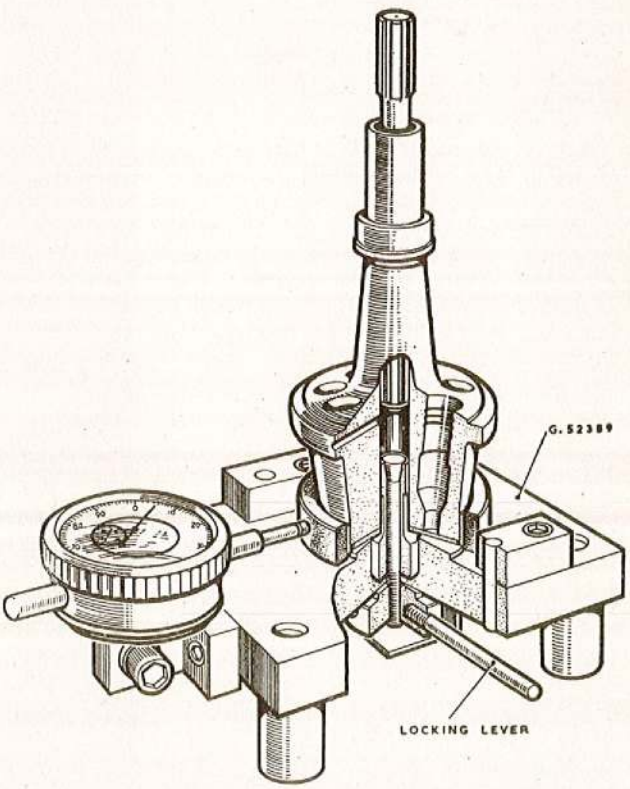

Fig. 16. Checking the rotor carbon bearing clearance

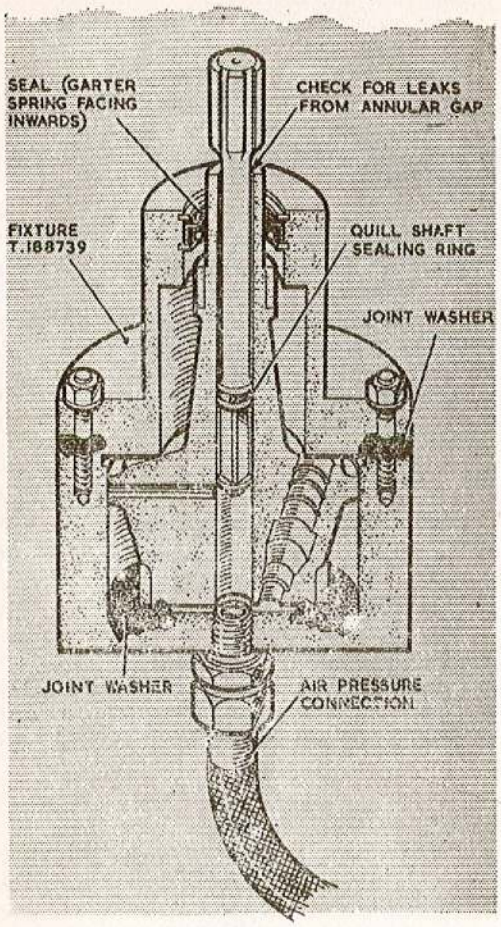

Fig. 17. Pressure-testing the quill shaft scaling ring

T.188739 as shown in fig. 17. When fitting the upper portion of the fixture to clamp the rotor in position the camplate housing assembly sheath T.175570 must be placed over the quill shaft to prevent the splines damaging the seal in the fixture bore. The sheath must be used also when separating the fixture after pressure testing.

110. Tighten the nuts securing the two halves of the fixture, connect an airline to the union in the base of the fixture, apply air at a pressure of 40 lb. per sq. in. and immerse the fixture completely in kerosine ; there must be no leakage from the annular space between the quill shaft and the end of the rotor shaft.

111. Should leakage occur the quill shaft must be removed as described in para. 37 to 40, inspected (*para.* 112), a new seal must be fitted and the shaft and rotor reassembled (*para.* 200 to 203). The pressure-test must be repeated and the shaft checked for concentricity as described in para. 107.

112. When the quill shaft has been removed from the rotor inspect the squared end for undue wear and corrosion, see that the sealing ring groove is clean and that it is free from sharp edges at either side. Examine the retaining washer groove at the extreme end of the shaft for damage at the outer edge of the groove ; damage at this point may prevent the retaining washer from seating correctly. Inspect the shaft generally for damage and severe wear. See that the bore of the rotor is clean.

Overspeed governor assembly

Checking the tappet clearance

113. A special gauge G.52069, is provided for checking the clearance between the diaphragm tappet screw and the rocker lever tail. The gauge is in two parts, consisting of a mounting base and a measuring bar fitted with a sliding plunger as shown in fig. 18.

114. Invert the diaphragm assembly and place it on the mounting base portion of the gauge ; the diaphragm tappet screw will be uppermost.

115. Mount the measuring bar on the face of the diaphragm inner ring, fitted to the pump body, locate the bar on four studs and secure it with two nuts.

116. Slacken the knurled screw at the side of the bar to free the central plunger. Press the plunger down so that the lever end makes contact with the tail of the rocker lever, but be careful to avoid depressing the lever ; the half ball must be seated firmly on the orifice. Tighten the knurled screw to lock the plunger.

117. Remove the measuring bar from the pump body, invert the bar and place it in the inverted position across the face of the diaphragm. Ensure that the dowel pins in the measuring bar locate in two holes in the diaphragm and diaphragm cover and are in alignment with the swing-bolts on the mounting base.

118. Lift the swing-bolts, engage them with the lugs on the measuring bar and tighten the nuts to clamp the bar, diaphragm assembly and mounting base together firmly. Using feeler gauges, measure the clearance between the diaphragm tappet

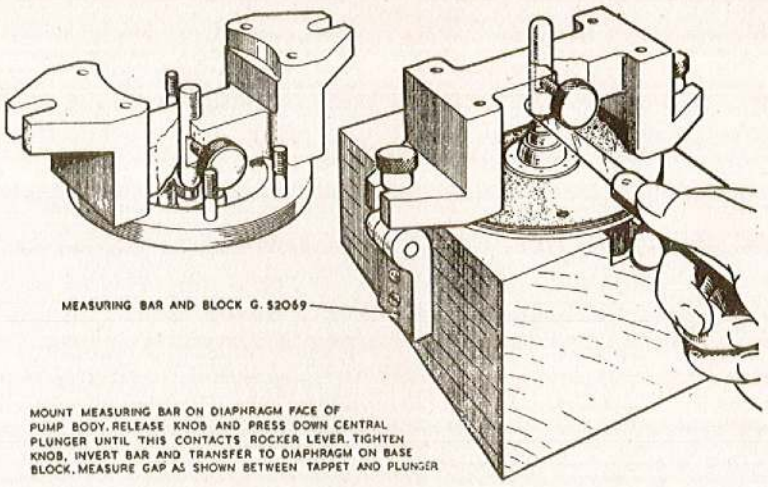

Fig. 18. Checking the overspeed governor tappet clearance

screw and the end of the measuring bar plunger. The correct clearance is 0·017 in. to 0·019 in.

119. The clearance may be found to have reduced slightly during service and if the diaphragm assembly is not being dismantled, the tappet screw should be adjusted to the correct clearance before refitting the assembly to the pump.

Checking the rocker lever tail lift

120. The tail lift of the rocker lever is checked by clamping a standard dial test indicator in clock holder T.175566, and mounting this on the pump body as shown in fig. 19, so that the indicator button is in contact with the tail of the rocker lever when this is depressed fully.

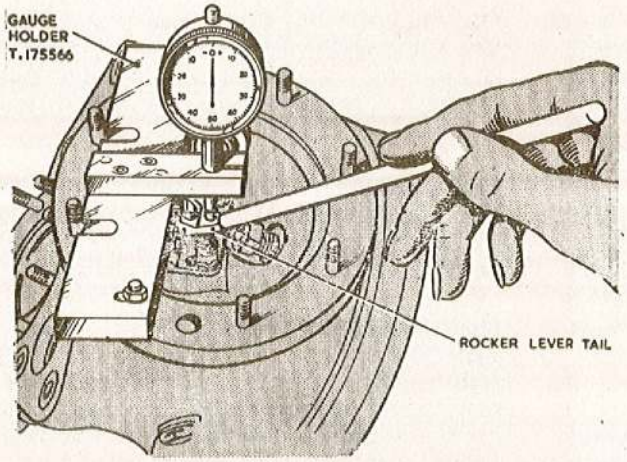

Fig. 19. Checking the rocker lever tail lift

121. Depress the lever fully on to its stop, set the indicator to zero, and release the lever. The amount of lift indicated should be between 0·025 in. and 0·040 in. If the reading is outside these limits a re-adjustment must be effected as described in para. 194 and 195.

Diaphragm assembly

122. Examine the diaphragm for buckling, and for any sign of cracking or splitting. Check that there is no indentation of the diaphragm surface particularly adjacent to the edge, as this may be a source of leakage. Inspect the riveting for any signs of looseness and the diaphragm centre boss and support plate for damage.

123. Check the diaphragm spring attachment generally for damage, ensure that it is a free fit in the diaphragm centre boss and see that the internal threads are in good condition. Inspect the clevis pin holes in the fork for undue wear and for any signs of radial cracks around the holes.

124. Examine the tappet screw for undue wear and pitting on the head; see that the threads of the screw and locknut are clean and in good condition.

125. Inspect the governor spring for surface cracks and corrosion, particularly around the attachment loops, and see that the loops and coils are square and free from distortion.

126. Check the clevis pins for undue wear and corrosion and see that they are an easy push-fit in the spring attachment fork and spring anchorage fork.

127. Inspect the spring anchorage for wear in the clevis pin holes and for cracking around the fork lugs. Ensure that the square-section stem is smooth and free from damage and that the internal threads are clean.

128. Examine the adjusting screw for scoring and other surface damage on the underside of the flange as this is a sealing face and damage may cause leakage. See that the threads are in good condition and that the spanner flats are square and the screwdriver slot is undamaged.

129. Inspect the adjusting screw locknut for damage to the threads and hexagon, check for cracking on the top face and see that the lockwire holes are clear.

130. Check that the sealing ring has been removed from the top face of the spring housing and that all traces of the joint washer have been removed from the bottom face. Ensure that the bottom face is free from scoring or damage which may cause leakage. Check the tapped holes in the flange for serviceability and examine the housing generally for cracks, damage and corrosion.

131. Examine the diaphragm cover generally for damage and see that the top and bottom joint faces are free from scoring and other damage which may cause leakage. Ensure that all traces of joint washers have been removed from the facings.

132. Inspect the diaphragm inner and outer rings generally for damage and for scoring on the faces. Ensure that all traces of joint washers have been removed and that no sharp edges or burrs are present on the inner edge of each face.

Amplifier valve assembly

133. Examine the rocker lever generally for damage and ensure that the bridge piece is attached firmly with no trace of looseness. Check that the half-ball valve recess in the lever is clean and free from damage at the edges. Inspect the upper and lower surfaces of the lever tail for undue wear by the lever stop and diaphragm tappet. See that the tapped holes in the bridge piece are clean and that the threads are serviceable.

134. Inspect the base plate generally for damage and check that the rocker lever stop rivet is secure and not worn unduly. Check the large tapped hole which receives the orifice assembly, ensuring that the threads are clean and in good condition, and check the tapped holes which receive the torsion hinge anchoring setscrews; see that the holes are clean and the threads serviceable. Examine the slot which houses the stall pressure adjustment, ensuring that the edges of the slot are free from sharp edges or burrs and that the sides are not scored.

135. Examine the half ball for undue wear on the face and on the back and check the face for colour registration against an optical flat. Reject the half ball if more than two colour bands are apparent.

136. Inspect the orifice assembly generally for cleanliness, check that the threads are in good condition, and examine the orifice and surrounding lands closely for damage, burrs and corrosion, also check for wear by the half ball. Test the orifice face for flatness, using an optical flat. Reject the orifice if no colour bands are apparent.

137. Check that the sealing ring has been removed from the orifice assembly flange and that the groove is clean. See that the locknut is serviceable.

138. Inspect the stall pressure adjusting screw, spring, spring seating and retaining pin generally for cleanliness, damage and corrosion; see that the screw threads are clean and serviceable.

139. Examine the torsion hinges and their retaining set-screws for serviceability. See that the hinge springs are not distorted and inspect them closely for surface cracks.

Control piston assembly

140. Inspect the control piston rod and piston head generally for severe wear, scoring and other damage. See that there is no cracking developing around the piston, inspect the circlip groove for wear and see that the seal seating is quite clean.

Examine the link at the camplate end of the piston rod for cracks or other damage and inspect the link riveting for security. Inspect the extremity of the piston rod at the piston end for damage and wear due to contact with the minimum flow adjusting screw.

141. The diameter of the piston rod, the bore in the pump body through which the rod runs, and the end play of the link must be checked dimensionally in accordance with the Schedule of Fits and Clearances. The hole in the outer end of the link is checked in conjunction with the control ring during inspection of the camplate assembly.

142. Check that the piston seal retaining plate and circlip are serviceable.

143. Examine the cylinder liner for wear in the bore and if necessary remove it for closer inspection as described in para. 54.

144. If the cylinder liner has been removed examine the piston rod felt seal retaining plate for cracks and distortion and inspect the collar and felt seal for serviceability.

145. Inspect the inner and outer springs closely for distortion and surface defects.

146. Inspect the minimum flow adjusting screw for wear or damage on the inner end due to contact with the end of the piston, check that the threads are clean and in good condition and see that the locknut is serviceable.

147. See that the control cylinder cover is free from cracking and corrosion and that the joint faces are undamaged. Make sure that the facing in the bottom of the counterbore which provides the spring seating is clean and that the threads in the bore are clean and in good condition. In the case of a non-solenoid valve pump, check that the tapped holes in the outer face are clean and that the threads are satisfactory.

148. Note that in pumps fitted with solenoid isolating valves the spring seating, which carries also the minimum flow adjusting screw, is a separate detail and should be inspected for surface damage, sharp edges which may damage the inner spring, and for cleanliness and general condition of the internal threads. See that the sealing rings have been removed from the outer counterbore and that the grooves are clean.

149. Inspect the minimum flow adjustment access cover for general condition and see that the joint face is clean and undamaged.

150. For further information on pumps fitted with servo system solenoid isolating valves refer to para. 293 to 313.

Restricting orifice details

151. The details comprise a dome nut, retaining sleeve, orifice and jet tube and a strainer.

152. Inspect the jet tube for damage and general condition, see that the orifice is secure in the end of the tube and ensure that the orifice bore is quite clean and unrestricted.

153. Examine the strainer element closely for damage and distortion and see that it is quite clean. Ensure that the end pieces are secure.

154. Check that the retaining sleeve is in good condition, that the threads are clean and undamaged and that no sharp edges or scores which could damage the orifice or jet tube are present. Inspect the dome nut generally for serviceability.

Port insert

155. Examine the insert closely for chipping at the edges of the ports and around the periphery and for signs of surface cracks. See that no severe wear has occurred to the working face.

156. The thickness of the insert and the parallelism of the faces relative to each other must be measured in accordance with the dimensions stated in the Schedule of Fits and Clearances.

157. To check the parallelism of the insert place it in the pump body, ensuring that it is located correctly on the dowels, and place the test bar and indicator G.54243 on the pump housing face as shown in fig. 20.

158. Check at several points across the face of the insert. If the reading obtained is outside the stated figure, remove the test

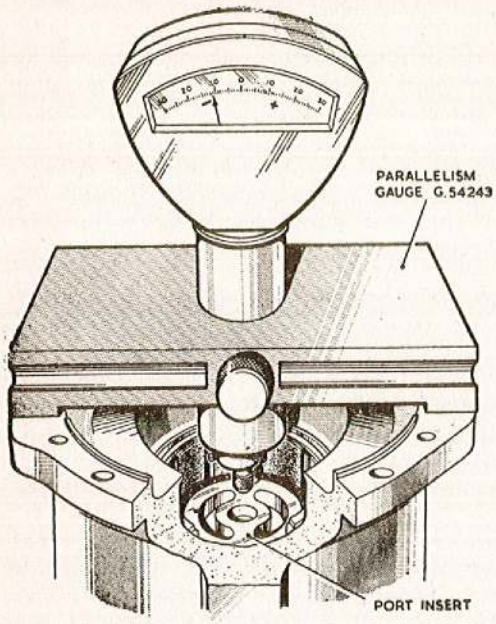

Fig. 20. Checking the parallelism of the port insert

bar and insert and make sure that the seating face of the insert and its seating in the pump housing, the pump flange and the underside of the test bar are all quite clean. Also check the dowels and the dowel holes in the insert and body for cleanliness. Replace the insert and test again; if the result is still unsatisfactory remove the insert and check the seating face in the housing for parallelism relative to the pump flange by lowering the gauge in the test bar. The same limits apply as for the check on the insert

159. Should this last test prove the pump housing to be unsatisfactory a new housing must be introduced, but if the housing is in order, the port insert must be rejected and a new insert fitted. In either case, the parallelism test must be repeated.

Pump housing

160. Inspect the housing generally for damage to the casting and studding, see that all joint faces are in good condition and free from scoring or other potential sources of leakage, and that no signs of corrosion are visible.

161. Ensure that all traces of joint washers have been removed from the facings, check that all rubber sealing rings have been removed and that their grooves are clean. Examine the spot-faces around all blanking plug tapped holes and see that they are clean and free from scoring or damage which may result in leakage.

162. Check all drillings for cleanliness and freedom from any restriction. See that the dowel holes at the trunnion positions in the camplate mounting flange and in the port insert seating are clean and free from foreign matter, which may prevent the dowels from entering fully.

163. Inspect the control piston rod bore for scoring and check it dimensionally in accordance with the Schedule of Fits and Clearances.

164. Check the diametral clearance between the rotor carbon bearing and its housing bore in the pump body; the clearance must be as described in para. 112.

165. See that the threads for the maximum flow adjusting screw are clean and in good condition and that all tab-washer locating holes are clean and undamaged.

Remaining details

166. Inspect the maximum flow adjusting screw and locknut for condition and cleanliness of the threads, examine the dome end of the screw for damage or pitting from contact with the control ring and see that the adjusting square at the opposite end is in good condition.

167. Examine the inlet strainer for damage, fractures or tears in the gauze and soundness of the seam and of the joints at each end. See that the circlip is free from cracks and undistorted.

168. Check all blanking plugs for condition of the faces under the heads as scoring or damage may result in leakage. See that their threads are clean and in good condition and that the lockwire holes are clean and free from sharp edges.

169. Examine all dowel pins for frettage, wear and any signs of corrosion and check all nuts, bolts, setscrews, washers and shims for cleanliness and general condition.

REASSEMBLING THE SUB-ASSEMBLIES

Pump body and details

Maximum flow adjustment screw

170. Fit the maximum flow adjusting screw, inserting it dome-end first from inside the governor housing, fit a new tab-washer and the locknut to the squared end.

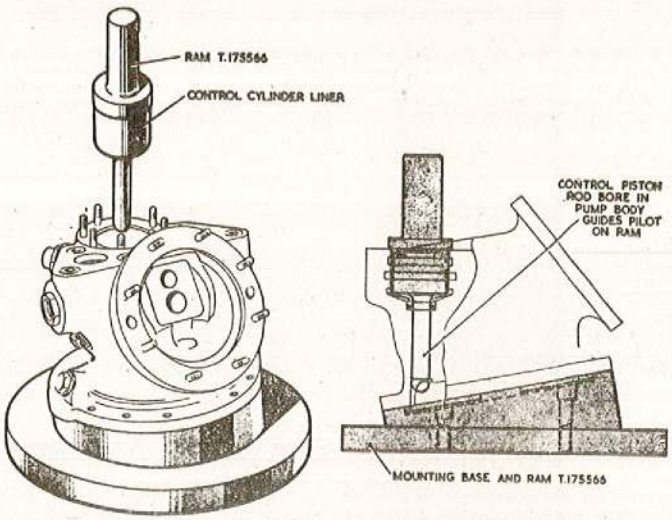

Fig. 21. Inserting the control cylinder liner

Control cylinder liner

171. When fitting the control cylinder liner, insert the control piston rod felt seal, collar and retaining plate in that order to the small counterbore at the bottom of the cylinder bore, fit a new sealing ring to the groove mid-way down the bore end and insert the liner, chamfered end first, with tool T.175556, as shown in fig. 21 pressing the liner in as far as possible.

Port insert and carbon bearing

172. Check that the dowel holes in the insert seating face of the pump housing are quite clean and insert the dowel fully. Inspect the insert for cleanliness, particularly in the dowel holes, and if a new insert is being fitted remove any sharp edges around the ports and central hole, using a fine grade carborundum stone. Take care to avoid chamfering the edges.

173. Place the insert in the pump housing, locate it on the dowel in accordance with the location marking (*para.* 41) and seat it firmly by finger pressure. The insert must not be forced by the use of a hammer and punch or other such means, finger pressure only is permissible.

174. When seated the face of the insert must be checked for parallelism with the pump housing flange, using the dial indicator and test bar G.54243 as described in para. 157 and 158. The parallelism indicated must be within the limits stated in the Schedule of Fits and Clearances where an insert is being refitted. In the case of a new insert the parallelism must be within 0·00012 in.

175. If the degree of parallelism specified cannot be obtained, remove the insert and check the seating face in the pump body. The same limits apply as for the insert and if the housing is unsatisfactory it must be returned for reconditioning.

176. When the insert is satisfactory fit the retaining spider, locating the spider on the carbon bush retaining dowels in the face surrounding the insert. Ensure that the bore of the spider engages correctly on the land on the periphery of the insert.

177. Insert the bearing into the housing, locate the slots in the end face over the dowels in the housing and push down fully. Check the bearing clearance in the housing as described in para. 105.

178. Fit the bearing retaining circlip, after making sure that the groove is quite clean; ensure that the circlip seats correctly in the groove and that the chamfered side is uppermost.

Control piston assembly

179. Normally the control piston rod and link are supplied as a complete assembly.

180. Fit the piston seal, flat side towards the piston face, passing it over the piston rod and pressing it gently with the fingers on to the piston. Follow this with the seal retainer, large diameter towards the seal, then secure the assembly with the circlip as shown in fig. 22. Ensure that the circlip is seated correctly and firmly in its retaining groove.

Control cylinder end cover

181. Where a cover is being assembled for a pump without a solenoid-operated servo isolating valve, screw the minimum flow stop into the tapped hole in the centre of the cover, place a new tabwasher over the slotted end of the stop, ensuring that the locating tab enters the locating hole in the

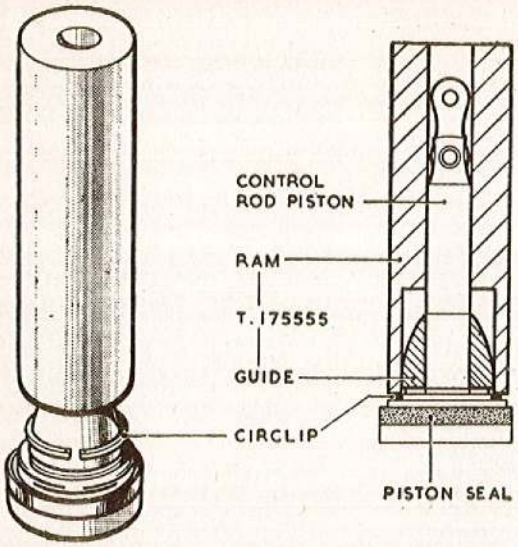

Fig. 22. Fitting the control piston seal retaining circlip

face of the cover counterbore and fit the locknut finger-tight.

182. In the case of a pump which is fitted with a solenoid valve, screw the minimum flow stop into the control piston spring seating, fit a new tabwasher over the outer end of the stop, ensuring that the locating tab enters the locating hole in the face of the seating flange, and fit the locknut finger-tight. Insert the spring seating, flange first, into the spigoted end of the control cylinder cover and push in firmly.

Camplate and control ring assembly

183. The camplate and control ring assembly is supplied complete therefore no sub-assembly instructions are necessary.

Camplate housing assembly

184. Ensure that the two grooves in the bore of the housing are quite clean, locate the housing on the pilot in the base of tool T.171650, fig. 23, place the sleeve T.171650/2 over the pilot and push the sleeve down fully into the housing counterbore. Insert the small shank of tool T.171650/1 into the ram of a wheel press, place an oil seal, sealing edge uppermost, over the base pilot and slide the seal down so that it enters the mouth of the sleeve. Place the assembly in the press and operate the ram to force the oil seal into the housing bore as far as possible. Withdraw the punch and fit the spacing washer to the housing bore.

185. Slide the second oil seal, sealing edge first, over the pilot, insert it into the sleeve and press in until it abuts the spacer washer.

186. Withdraw the punch, remove the sleeve T.171650/2 and fit the bearing spacer washer to the counterbore. Place the roller bearing over the pilot and central-

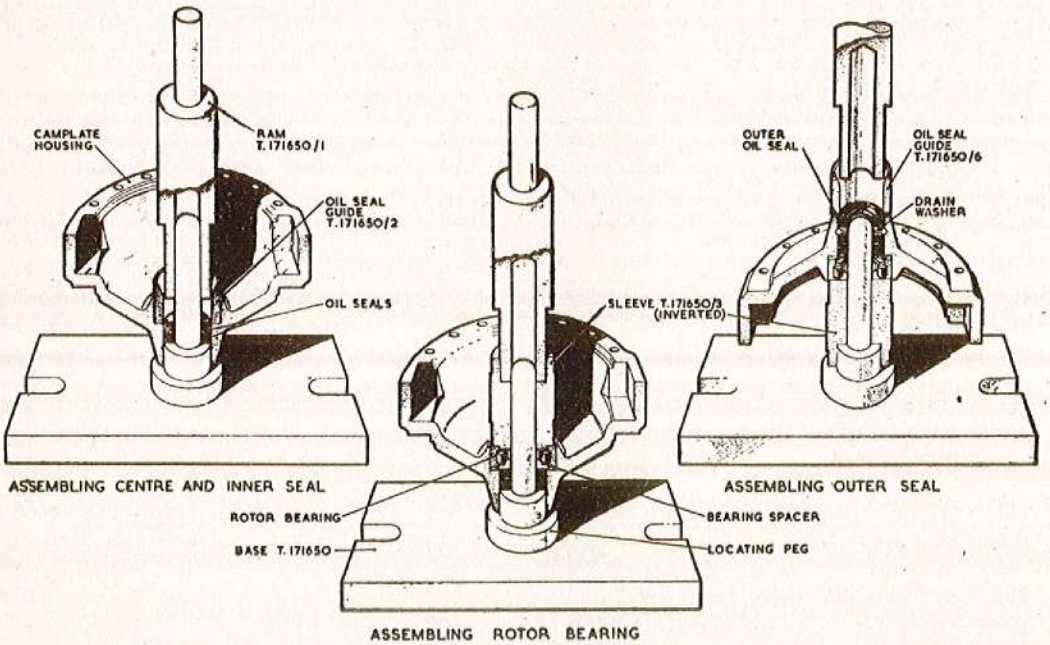

Fig. 23. Assembling the camplate housing seals and roller bearing

ize the bearing race with the counterbore. Fit the large sleeve T.171650/3, spigoted end first, to the pilot and locate the spigot in the bearing race. Lower the punch into the sleeve counterbore and press the bearing into the housing.

187. Remove the housing and base from the press, withdraw the sleeve and housing from the base. Invert the sleeve and assemble it to the base, locate the counterbore on the base of the pilot, invert the housing and lower it on to the sleeve, again engaging the sleeve spigot and bearing race. Insert the seal drain washer into the bore of the housing, fit the spigoted sleeve T.171650/6 to the housing and insert the remaining oil seal, sealing lip first, to the sleeve. Replace the assembly on the press and force the seal into the housing.

188. Remove the assembly from the press, remove the small sleeve and draw the housing from the base, then fit the seal retaining circlip after making sure that the groove to receive it is quite clean.

Amplifier valve assembly

189. A special fixture No. T.166109 is used for the assembly of the rocker lever to the baseplate. Invert the rocker lever and place it on one side of the fixture as shown in fig. 24. Assemble the two inner torsion hinge blades to the lever bridge piece and retain them with the setscrews, which should be fitted with new tabwashers. Before tightening the setscrews locate the free end of each blade with a mandrel as shown then tighten the screws and secure by locking up the tabs. Reverse the lever assembly in the fixture and fit the two outer blades likewise.

190. Place the amplifier valve base plate on the other side of the fixture as shown and transfer the rocker lever, reverting it to the correct position with the bridge piece at the top, and place it on the base plate.

191. Align the holes in the spring blade with the tapped holes in the base plate and rotate the knurled screw to lower the vee-block on to the bridge piece. Tighten just sufficiently to locate the lever and align the spring holes correctly. Insert the retaining setscrews complete with new tabwashers and tighten fully. Lock the tabwashers and remove the assembly from the fixture.

192. Fit the locknut and a new tabwasher to the orifice assembly, invert the lever assembly so that the base plate is uppermost and place the half-ball valve in the lever recess, then screw the orifice assembly into the base plate until the orifice just contacts the half-ball. Tighten the locknut finger tight and do not lock at this stage.

193. Assemble the spring seating to the stall pressure adjusting screw and assemble these together with the spring and retaining pin, to the valve base plate.

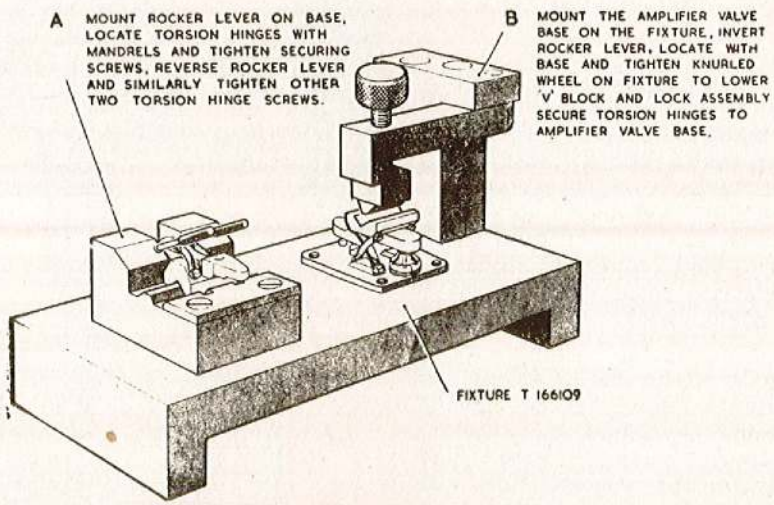

Fig. 24. Assembling the amplifier valve

Setting rocker lever tail lift

194. Release the locknut on the orifice assembly and screw the orifice in or out until the gap between the tail of the rocker lever and the stop pin, measured with a feeler gauge, is between 0·025 in. and 0·040 in. with the head of the lever depressed to seat the half ball firmly on the orifice face.

Note . . .

Before rotating the orifice assembly to adjust the tail lift, depress and hold down the tail of the lever; this will eliminate any risk of scoring the faces of the half ball and orifice by rotation of the latter whilst they are in contact. When checking the gap however, the head of the lever must be depressed to ensure that the half ball is seated firmly on the orifice face.

195. Tighten the orifice locknut. Place the assembly in position on the pump housing and secure with a washer and nut on two diagonally-opposite studs. Set up a dial test indicator and holder T.175566 and check the tail lift as shown in fig. 19. It is recommended that a lift of 0·028 in. will provide the most desirable pre-load; the valve assembly should be removed from the pump and the orifice adjusted until the desired setting is obtained with the orifice locknut tightened fully. Do not lock the tabwasher at this stage.

Overspeed governor diaphragm assembly

196. Fit a sealing ring to the groove behind the flange of the diaphragm centre and assemble to the centre the tappet screw, complete with locknut and tabwasher.

197. Insert the centre assembly into the diaphragm centre plate, insert the spring loop at one end of the governor spring into the diaphragm centre fork, fit a clevis pin, place a plain washer over the protruding end of the pin and insert a split pin. Open the split pin and turn the legs around the end of the clevis pin to secure the assembly. Assemble the spring anchor likewise to the opposite end of the spring.

198. Fit a joint washer to the face of the governor spring housing, fit the housing to the diaphragm cover and insert the retaining setscrews, complete with plain washers. Tighten the setscrews fully and secure them with 26 s.w.g. stainless steel locking wire.

199. Place a joint washer on the face of the diaphragm housing, fit the diaphragm top plate, insert the spring anchor and spring into the housing and guide the spring anchor stem into the square hole in the top of the housing. Fit a sealing ring to the groove in the housing end face and insert the spring adjusting screw. Hold the diaphragm against the face of the cover and run the adjusting screw down until it is in contact with the sealing ring, fit the locknut and tighten finger tight. Align the holes in the diaphragm with those in the cover flange by rotating the diaphragm carefully about its centre.

Fitting the rotor quill shaft

200. Where the rotor quill shaft has been removed the method of re-fitting is identical with the method of fitting a new shaft.

201. Insert the ram and guide tool T.156533 into the ram of a wheel press and place a new retaining washer, concave side upwards, on to the guide tip, which protrudes from the ram as shown in fig. 25. The ram is magnetized to retain the washer in position.

202. Fit a new sealing ring to the quill shaft, insert the shaft into the rotor bore

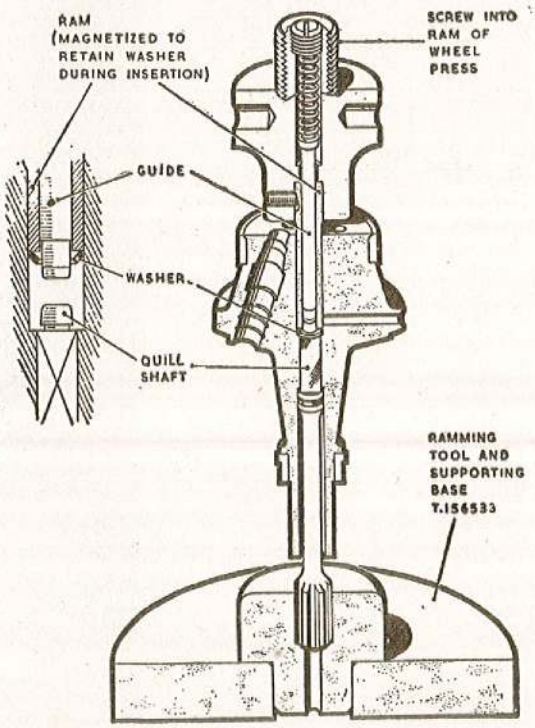

Fig. 25. Fitting the quill shaft retaining washer

and inverting the assembly locate the end of the quill shaft in the hole in the supporting base. Centralize the rotor under the ram and operate the press gently to lower the ram into the rotor central bore, taking care to avoid hitting the tip of the ram on the rotor face plating. Lower the ram fully then operate the press firmly to force the washer over the end of the quill shaft and into the groove as shown, until the washer feels quite solid.

203. Remove the assembly from the press, check the rotor and quill shaft concentricity as described in para. 107 and pressure-test the sealing ring as described in para. 109 to 111.

Rotor assembly

204. If the spring guides have been removed, insert the guides into the rotor piston bores as shown in fig. 26, using the tool T.175567. Place the springs in the bores and insert the pistons, ensuring that each piston is returned to its appropriate bore according to the co-relation numbers.

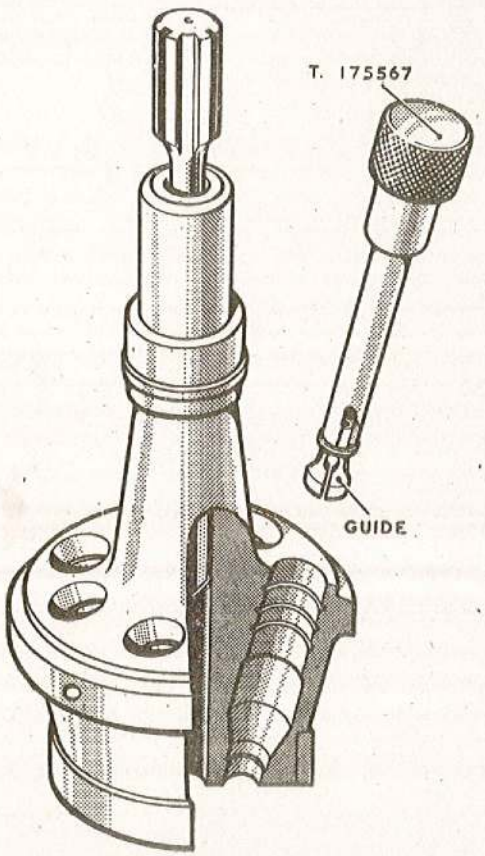

Fig. 26. Inserting the rotor spring guides

ASSEMBLING THE PUMP

Setting the control ring trunnion block clearance

205. The following instructions, para 206 to 212, apply particularly where new trunnion blocks or a new camplate housing is to be fitted. It is advisable however, to carry out the check where existing components are being refitted to ensure that the assembly is quite satisfactory.

206. Place each trunnion block in the camplate housing and check that it is a good sliding fit. If one block appears tighter than the other, change them about and if there is no improvement, provided that the looser of the two is a good fit, remove the tight block and rub the sides lightly on super-fine polishing paper to remove any surface flaws. Should either block be too free in the housing another block must be selected.

207. Following the check for tightness place one block in its appropriate pocket, ensure that the block is seating correctly and, using a standard depth micrometer, measure the difference in height between the camplate housing upper face and the block. The block must be not less than 0·002 in. below the face of the housing. This is to ensure that when assembled the blocks are not " nipped-up " tight. Check the other block in a similar manner.

208. Should the clearance be less than 0·002 in., rub the bottom face of the trunnion block lightly on super-fine emery paper, checking the block frequently until the clearance is obtained. Care must be taken to avoid rubbing the block face " off-square " with the opposite face.

209. When the fit of the blocks in the housing is satisfactory, remove them from the housing and assemble them to the control ring trunnions. Note that when looking on the camplate housing joint face the position of the rim which has three adjacent tapped holes is the top and when looking on the camplate face the control piston lug is the top; the trunnion block which has been selected for the left side of the housing must be fitted to the left hand trunnion on the camplate and the right hand block correspondingly.

210. Place the camplate assembly into the camplate housing, move the control ring and both trunnion blocks bodily to one side of the housing, along the trunnion axis, and at the opposite side measure with feeler gauges the clearance between the trunnion block and the housing. The correct clearance is 0·006 in. to 0·010 in.

211. If the clearance stated is not obtainable remove the trunnion blocks and rub the back face of each on fine polishing paper to remove any surface flaws. Check the clearance again. Continue to polish until the correct clearance is obtained.

212. Should the clearance however, be excessive, then the difference between the actual clearance and the specified clearance must be measured, divided equally, and shims of corresponding thickness must be interposed between the trunnion block and face of the control ring on both sides.

Fitting the control piston assembly

213. Straighten the link on the control piston rod so that the link is aligned with the rod axis and insert the link rod into the control rod bore in the pump body. Guide the piston seal gently into the cylinder liner, using guide T.175557, as shown in fig. 27, and push the piston in as far as possible using the tool T.194499.

214. The assembly of the end cover to the control cylinder is dependent upon whether or not the pump is fitted with a solenoid-operated servo-isolating valve, consequently the following instructions (*para.* 215 to 217) refer to pumps *without* isolating valves whilst pumps which are fitted with such valves should be treated as described in para. 218 to 220.

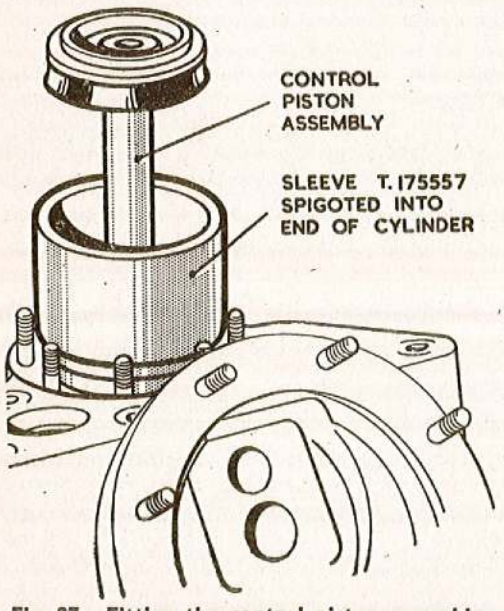

Fig. 27. Fitting the control piston assembly

215. PUMP WITHOUT ISOLATING VALVE : Adjust the minimum flow stop in the control cylinder end cover so that the stop projects approximately 0·125 in. from the inner face of the end cover and tighten the locknut with spanner T.175578. Do not lock the tabwasher at this stage, as the stop is to be adjusted on the test-rig.

216. Fit a rubber sealing ring to the recess in the mouth of the control cylinder bore, insert the two springs, ensuring that they seat correctly on the piston, place the end cover, spigoted end first, over the springs, ensuring that they are seating correctly, and force down by hand against the spring pressure until the retaining nuts can be fitted. Assemble a plain washer, spring washer and nut to two opposing studs and tighten the nuts finger tight. Fit washers and nuts similarly to the remaining studs and tighten the nuts evenly with a box spanner.

217. Place a rubber sealing ring in the recess in the mouth of the end cover bore, fit the square cover plate and secure this with four tabwashers and setscrews. Tighten the set-screws evenly and securely with a box spanner but do not lock the tabwashers at this stage.

218. PUMP WITH ISOLATING VALVE : Adjust the minimum flow stop so that it projects approximately 0·150 in. from the end of the spring seating stem and tighten the locknut with box spanner T.175578. Do not lock the tabwasher at this stage.

219. Fit a rubber sealing ring to the recess in the mouth of the control cylinder bore, insert the two springs, ensuring that they seat correctly on the piston, place the end cover, spigoted end first, over the springs, ensuring that the springs are seated correctly on the seating within the cover, and force the cover down by hand to compress the springs until a plain washer, spring washer and retaining nut can be fitted to two opposing studs. Once the cover spigot has entered the sealing ring, the cover must not be allowed to rise as this will disturb

the sealing ring. These nuts must be fitted to two of the short studs. Screw the nuts down finger tight to retain the cover in position, fit similar washers and nuts to the two remaining studs and tighten the nuts evenly and securely with a box spanner.

220. Insert a sealing ring into the bore of the end cover, ensuring that the ring locates correctly in the groove midway down the bore, place a sealing ring in the recess in the mouth of the bore and fit the isolating valve assembly, registering the holes in the retaining flange with the four long studs projecting from the end cover. Assemble a plain washer and retaining nut to each stud and tighten evenly.

Fitting the rotor assembly

221. Before fitting the rotor assembly ensure that the bores and piston clearances have been checked (*para.* 99 to 101) and that the journals, carbon bearing, roller bearing and quill shaft have been checked dimensionally and for concentricity, as described in para. 105 to 107.

222. Ensure that the faces of the port insert and rotor are clean and lower the rotor assembly gently into the pump housing taking care to hold the assembly central as the journal enters the carbon bearing; avoid forcing the rotor sideways at this and successive stages until the camplate housing is fitted to support the rotor assembly.

Fitting the camplate and control ring assembly

223. Fit a joint washer to the flange face of the pump housing, insert the trunnion block dowel pegs into the pump housing flange, remove the trunnion blocks end shims from the control ring trunnions and place the camplate assembly over the rotor, lowering the assembly until the camplate is resting on the piston heads.

224. Rotate the control ring to align the lug and the control piston link and connect them together with the clevis pin. Place a plain washer over the end of the clevis pin and insert a new split pin, turning the legs of the split pin round the end of the clevis pin to secure the assembly.

225. Assemble the shims and trunnion blocks to the control ring trunnions and locate the trunnion blocks over the dowels in the pump facing.

Fitting the camplate housing

226. Before attempting to fit the camplate housing the assembly sheath T.175570 must be placed over the rotor quill shaft to protect the seals from damage in passing over the splines and to assist them on to the shaft sealing diameter.

227. Place the sheath in position with its end face abutting the end of the rotor, lower the camplate housing over the sheath and press down as shown in fig. 4, ensuring that the trunnion pockets are located over the control ring trunnion blocks and that the three adjacent tapped holes in the housing periphery are over the control piston linkage.

228. Guide the trunnion pockets over the trunnion blocks and when the joint faces of the housing and pump flanges are approximately $\frac{1}{4}$ in. apart, check that the trunnion blocks are engaged with the locating dowel in the pump flange. Press the housing down on to the pump facing and holding it down insert a bolt adjacent to either trunnion, fit a plain washer and slotted nut and tighten lightly to hold the housings together, insert a bolt on the opposite side of the housing and tighten likewise.

229. Remove the assembly sheath, fit the remaining bolts, plain washers and nuts and tighten evenly and fully. The securing split pins are not fitted until final assembly following the initial endurance test and inspection.

Fitting the amplifier valve assembly

230. Assemble a rubber sealing ring to the groove on the orifice body and fit the complete assembly to the mounting face and retaining studs in the pump housing. It is advisable to smear the sealing ring lightly with white petroleum jelly or kerosine to facilitate its entry into the housing bore. Fit two double tabwashers to the studs, fit the four reach nuts and tighten fully. The tabwashers are not to be locked until final assembly.

Fitting the governor diaphragm assembly

231. Before fitting the diaphragm the governor tappet screw should be set to the correct tappet clearance, as described in para. 113 to 119. The tappet locknut must be tightened securely after adjusting, but

the tabwasher should not be locked at this stage.

232. Fit a joint washer to the pump housing facing, fit the diaphragm outer ring then fit the diaphragm assembly.

233. The diaphragm cover has two diametrically-opposed external bosses on the top surface, each boss containing a passage which transfers the fuel at centrifugal pressure to the outer surface of the diaphragm. Each passage is fed by a drilled hole in the face of the diaphragm cover and there are two corresponding holes in the diaphragm which must be registered with the drillings in the cover facings.

234. Similarly, the diaphragm inner and outer rings are drilled to correspond and must be aligned with the drillings in two cast passages one on each side of the amplifier valve chamber.

235. Ensure that the joint washers and outer ring also are registered correctly with the centrifugal pressure drillings, fit the diaphragm assembly to the retaining studs, fit the plain washers, spring washers and retaining nuts and tighten fully and evenly.

Fitting the servo-pressure restricting orifice

236. Insert the strainer assembly, large end first, into the orifice drilling in the pump body, fit a rubber sealing ring and push this into the bore gently with a blunt tool so that the ring seats on the strainer flange. Insert the jet tube and orifice assembly, large end first, and screw in the retaining sleeve tightly using tool T.175564. Assemble a rubber seating ring and outer steel washer to the exposed threads of the retaining sleeve and fit the dome nut, which should be tightened on to the steel washer.

Fitting the remaining details

237. The remaining details consist of the air bleed valve, several sealing plugs and the inlet filter assembly.

238. Assemble a rubber sealing ring and outer steel washer to the lower threads of the bleed valve assembly and screw into one of the three tapped holes at the top of the periphery of the camplate housing, tighten fully and fit the dome nut.

239. Fit a light alloy washer to the small sealing plugs and screw the plugs lightly into the tapped holes in the pump body.

240. Place a light alloy washer over the threads of the two slightly larger plugs and screw these plugs into the two oil seal drain holes in the camplate housing.

241. Assemble a sealing ring to each of the two flanged plugs, insert the plugs into the pump inlet and outlet passage tapped bores at each side of the housing, fit the threaded hexagon-headed retaining plugs and tighten fully.

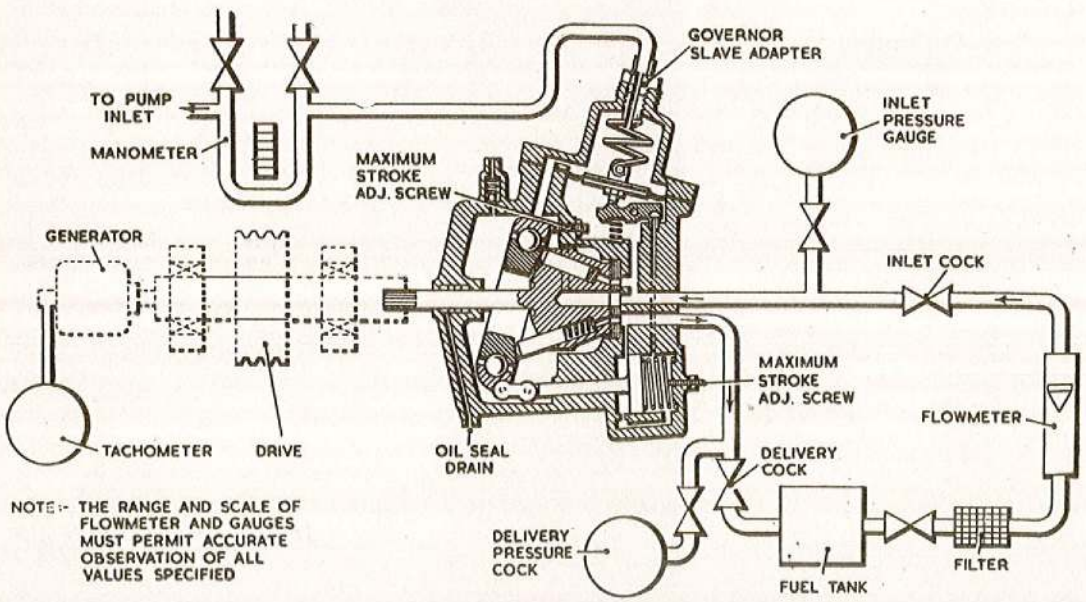

Fig. 28. Diagrammatic layout of test rig

242. Insert the inlet strainer seating spring into the inlet bore of the pump housing, insert the strainer assembly, compress the spring and fit the retaining circlip, making sure that this is located correctly in the groove.

RIG-TESTING (PRELIMINARY)

General

243. The testing and calibrating procedure which is described in the following paragraphs is applicable to all derivations of the basic type of pump covered in this chapter. Specific test conditions and performance requirements vary according to the requirements of different calibration codes the particular details of which are provided in separate Appendices to this chapter.

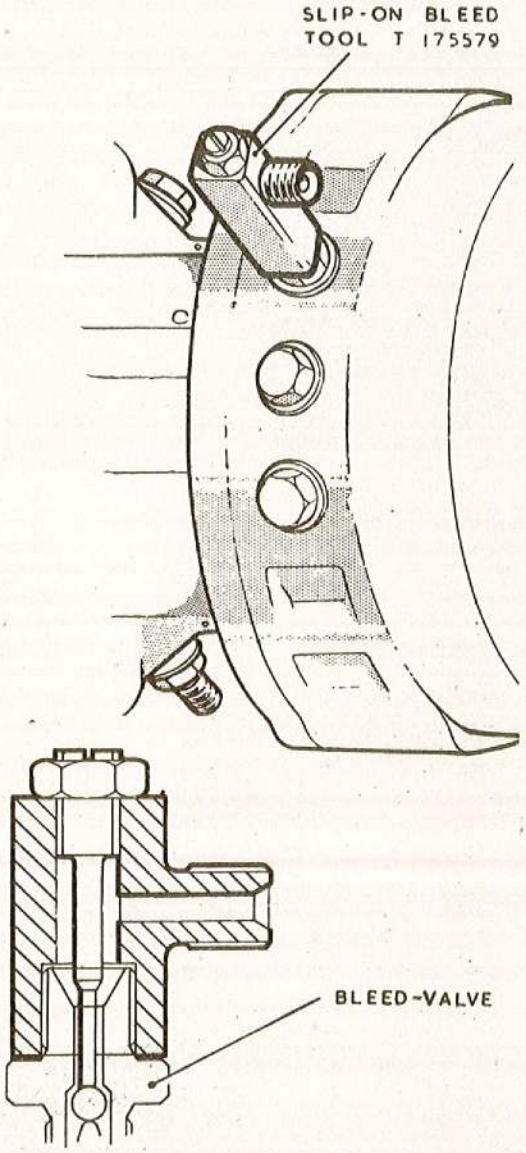

Fig. 29. Bleed tool in position on bleed valve

244. Before attempting to run a pump on the rig the fuel inlet cock must be opened and all air must be released from the pump by means of the bleed valve, shown in fig. 29, which is provided for this purpose. The valve should be allowed to spill fuel until all signs of air bubbles have disappeared.

245. Unless stated otherwise the fuel used throughout these tests is to be aviation kerosine to Specification D.Eng. R.D. 2482 LATEST ISSUE and is to be maintained at a temperature of 20 deg. to 26 deg. C. The fuel should be checked at regular intervals to ensure that it complies with the above specification.

246. The fuel pressure at the pump inlet is constant at 1-5 lb. per sq. in. throughout these tests unless specifically stated otherwise for a particular condition.

Test rig adapters

247. The pump must be adapted to the test rig connections by the use of certain adapters in place of the normal installation connections. Two adapters T.192034 and T.175574 are fitted to the inlet and outlet connections respectively, and an adapter plate T.175569 is fitted to the outer facing of the control cylinder end cover in place of the normal access cover to the minimum flow adjustment screw on solenoid valve pumps in place of the isolating valve assembly, as shown in fig. 30. In addition fit a $\frac{1}{8}$ in. B.S.P. union to the tapping off the inlet passage.

Running-in

248. It is recommended that for initial lubrication and running-in, the pump should be mounted on the combined running-in rig.

249. Mount the pump on the rig and run the pump at the conditions specified in the relevant appendix. The fuel to be used during the running-in period is aviation kerosine to Specification D.Eng. R.D. 2482 LATEST ISSUE.

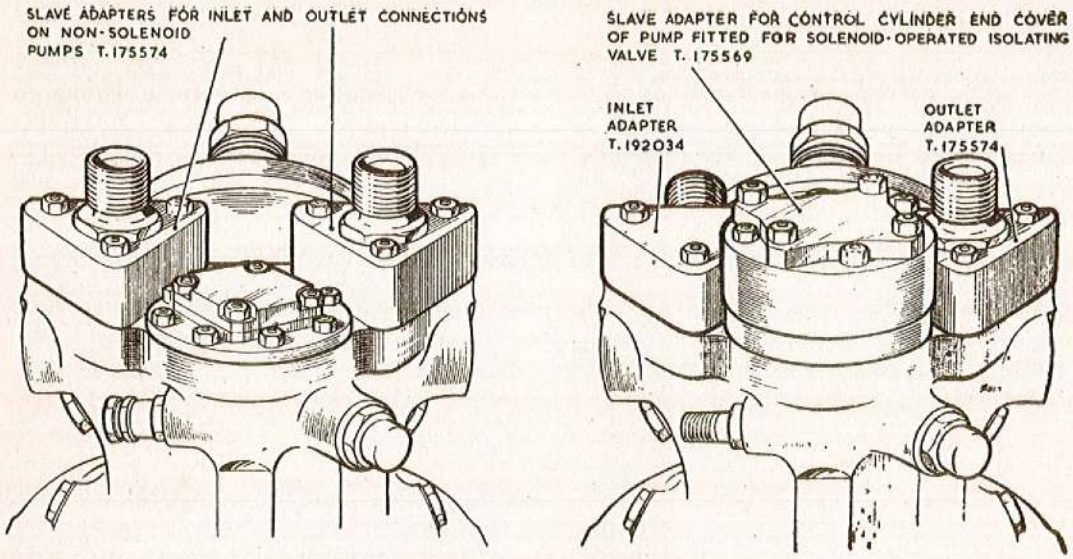

Fig. 30. Test rig adapters

Preliminary calibration

250. Before proceeding with the first endurance test a preliminary calibration must be carried out. This consists of setting the maximum flow (*para.* 264) setting the stall pressure (*para.* 267 and 268) and setting the governing speed (*para.* 273 to 275) in accordance with the data specified in the relevant appendix.

Initial endurance tests

251. For this and all subsequent testing and calibrating the pump must be mounted on the test rig. The initial testing consists of a cyclic endurance test of the overspeed governor followed by a general endurance test to check that the pump has been rebuilt satisfactorily.

Governor cyclic endurance test

252. The governor is to be endurance tested by running the pump at the conditions stated in the relevant Appendix and varying the speed to provide the specified number of governing cycles.

253. Before commencing the test, the pump must be run at the stated conditions and the governor adjusted to control the pump at the specified r.p.m. Rotate the governor adjusting screw clockwise to raise and anticlockwise to lower the governing speed, fig. 31.

Pump endurance test

254. Following the governor cyclic endurance test, adjust the rig to provide the conditions stated in the relevant Appendix and run the pump for the period specified.

STRIP INSPECTION

255. The pump is to be partially or wholly dismantled for inspection, the extent of which will be at the discretion of the inspector-in-charge according to the condition of the pump, the extent of servicing carried out and the behaviour of the unit

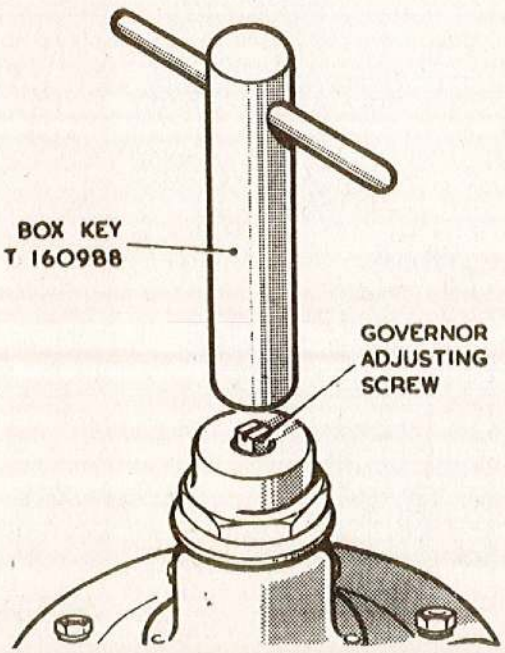

Fig. 31. Adjusting the overspeed governor

during the initial endurance test. Pistons, rotor (steel journals), port insert and control piston must be crack detected, refer to para. 86.

256. All dismantling must be carried out in accordance with the instructions given in the relevant paragraphs of this Chapter under " Dismantling."

CLEANING

257. Before final reassembly all components must be cleaned thoroughly in kerosine, preferably applied by a spray nozzle fed by a pump having adequate filtering facilities. After cleaning the parts should be dried in a compressed air blast which must be free from water.

FINAL ASSEMBLY

258. The re-assembly of all components must be carried out in accordance with the instructions given in the relevant paragraphs of this Chapter under the headings " Rebuilding the sub-assemblies," and " Rebuilding the pump." In addition all internal locking of tabwashers, locknuts, etc., must be completed at this stage, except for those which may require adjustment during final rig-testing.

RIG-TESTING (FINAL) AND CALIBRATION

General

259. The final rig test and calibration consists of a second preliminary calibration (*para.* 250), a second cyclic endurance test of the overspeed governor, setting the various adjustments to obtain the performance required in accordance with the specific calibration code in the Appendix to which the pump is to conform, and a thorough test of the complete unit to check that the performance results and mechanical condition are satisfactory.

Governor cyclic endurance test

260. Repeat the governor endurance test (*para.* 252 and 253). Note that the pump must first be re-calibrated (*para.* 250).

Setting the minimum flow adjustment

261. Remove the governor diaphragm assembly as described in para. 56, and remove the access cover on the end of the control cylinder end cover. (*Para.* 44 or 47).

262. Run the rig at the conditions stated in the relevant Appendix and adjust the maximum flow screw from within the amplifier valve chamber to reduce the pump stroke until the inlet pressure specified is obtained. It may be necessary to screw the minimum flow screw in the control cylinder cover out slightly to allow the control piston and camplate control ring to move sufficiently under the influence of the maximum flow screw.

263. When the required inlet pressure is obtained, screw in the minimum flow screw until it contacts the end of the control piston, tighten the locknut fully and prise

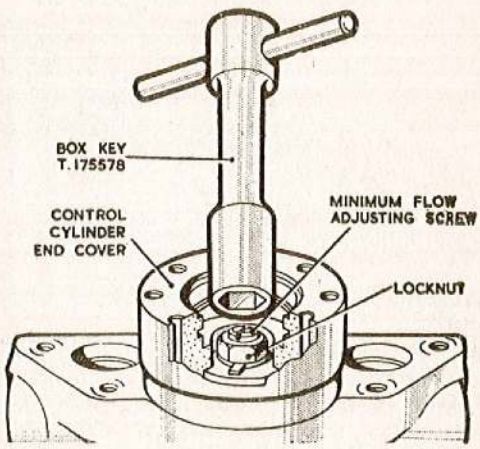

Fig. 32. Adjustment of the minimum flow stop

up the lockwasher tab to secure the nut (*fig.* 32). Refit the control cylinder end cover plate and proceed to adjust the maximum flow.

Setting the maximum flow adjustment

264. Adjust the rig to provide the speed, inlet pressure and delivery pressure stated in the relevant Appendix and screw out the maximum flow adjusting screw until the specified flow is obtained. Tighten the locknut fully and prise up the tab of the lockwasher to secure the nut. (*fig.* 33).

Testing the volumetric efficiency (varying delivery pressure)

265. The volumetric efficiency with varying delivery pressure is checked by running the pump at the stated speed and high delivery pressure then reducing the delivery pressure to the low value, when any increase in flow must be within the specified limit.

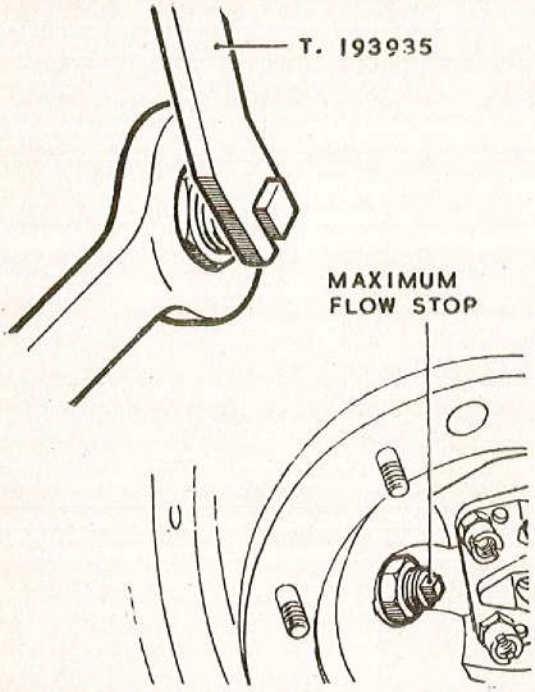

Fig. 33. Adjustment of the maximum flow stop

Testing the volumetric efficiency (varying inlet pressure)

266. To check the volumetric efficiency with varying inlet pressure, run the pump at the stated speed and delivery pressure then reduce the inlet pressure from the normal to the depression value (in. Hg.) when the decrease in flow must not exceed the specified limit.

Setting the stall pressure adjustment

267. Check the stall pressure by running the pump at the speed and inlet pressure stated then increase the delivery pressure, by restricting the outlet, until the pump stalls, denoted by a rapid decrease in flow. The delivery pressure at which the pump stalls must be within the limits stated.

268. Should the stall pressure be above or below that specified, insert spanner T.193939 into the aperture in the tail of the amplifier valve rocker lever as shown in fig. 34 and rotate the stall pressure adjusting screw clockwise to increase or anti-clockwise to decrease the pressure at which the stall occurs. The pressure is altered by approximately 50 lb. per sq. in. for each one-quarter turn of the adjusting screw.

Checking the centrifugal pressure rise

269. Remove the blanking plug from the pump body immediately behind the fuel inlet connection and screw in a suitable pipe union, connecting to this the pipe from the outlet side of the test-rig manometer.

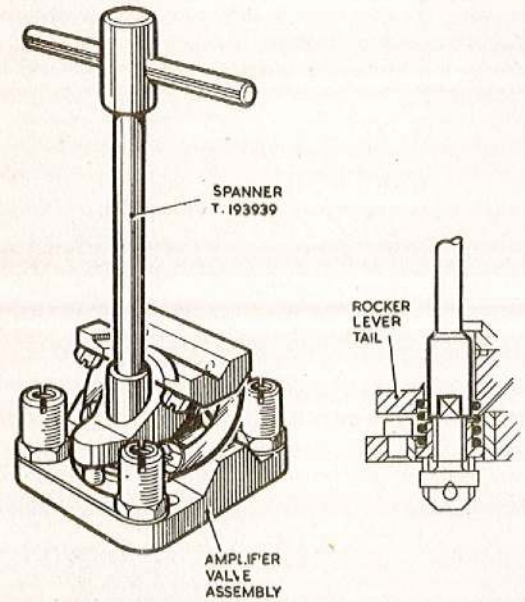

Fig. 34. Adjusting the stall pressure

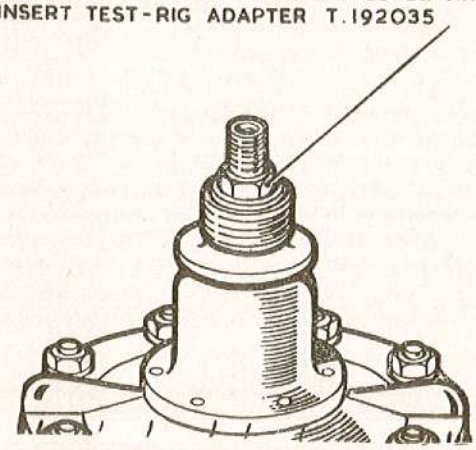

Fig. 35. Checking the contrifugal pressure rise

270. Remove the governor adjusting screw locknut and remove the adjusting screw. Fit the special adapter T.192035 in place of the adjusting screw as shown in fig. 35, and connect the other side of the manometer to this adapter.

271. Run the pump at the condition stated in the relevant Appendix and check that the centrifugal pressure rise indicated on

the manometer is in accordance with that specified in the Appendix. Where the test schedule calls for the pump delivery pressure to be reduced by re-setting the governor adjusting screw, the adjustment is to be made by rotating the special adapter.

272. When a satisfactory result is obtained, disconnect the manometer, remove the union and special adapter, refit the blanking plug to the pump body and re-fit the adjusting screw and locknut.

Checking the governor range

273. The governor range is to be checked by running the pump at the conditions stated in the relevant Appendix and increasing the pump speed until the governor operates, denoted by a rapid decrease in delivery pressure.

274. Run the pump at the higher limit of the speed range specified and rotate the governor adjusting screw clockwise if the governor operates before the stated speed is obtained or anti-clockwise if the governor has not operated. Adjust the screw so that the pump is governed at the stated r.p.m. Tighten the locknut and check several times by decreasing the speed, then increasing it to ensure that the governor is operating satisfactorily at the specified r.p.m.

275. Reduce speed to the lower r.p.m. stated, release the adjusting screw locknut and rotate the screw anti-clockwise until the governor again operates with the pump running at the lower speed. Tighten the locknut and check the governor operation again.

Checking the governor cycle

276. To check the governor cycle run the pump at a given r.p.m. and delivery pressure, termed point " A " in the relevant Appendix, then increase speed until the governor operates. This will cause a sudden fall in flow and in delivery pressure, which should fall to less than 100 lb. per sq. in., termed point " B " in the Appendix. Reduce speed immediately but carefully until the delivery pressure rises to the value specified for point " C." Reduce the speed again until the governor tappet disengages and the delivery pressure rises to the value specified for point " D," when the speed must be within the limits stated.

277. When increasing speed from point " A " the flow meter and delivery pressure gauge must be watched constantly and immediately the governor operates, action must be taken to reduce speed in order to prevent the r.p.m. rising excessively owing to the reduction in load consequent upon the fall in flow and pressure when the governor operates.

278. Throughout the governing cycle the conditions obtained must conform with the appropriate values for points ' A,' ' C ' and ' D ' specified in the relevant Appendix.

Checking the governor recovery time

279. A stop watch is required for this test. Run the pump to the condition stated for point ' A ' in the previous test, hold the stop watch in readiness and increase the pump speed until the governor operates. Reduce speed to obtain point " C " then start the stop watch and simultaneously reduce the pump speed as rapidly as possible to return to the point " D " condition. Stop the watch immediately the pump recovers to the delivery pressure stated for point " D." The stop watch then indicates the recovery time and this must not exceed the time stated in the Appendix. Check the recovery several times to ensure that it is satisfactory.

Checking the governor with pump inlet depression

280. The pump is to be run at the inlet and outlet pressure conditions stated in the Appendix, when the pump speed must be within the specified limits with the outlet pressure maintained, (i.e. the governor must not operate under the given conditions).

Self-priming test

281. Run the pump at the speed stated in the relevant Appendix and close the inlet cock. The pump must be capable of producing the inlet depression specified.

Note . . .

The duration of this test must not be allowed to exceed 2 mins. to avoid possible damage to the pump through running dry.

Leakage tests

Air pressure test (static)

282. Remove the pump from the test rig and complete all locking.

283. Connect an airline to the pump connection, blank off all other connections except for the oil seal drains, immerse the pump completely in fuel and apply air at the pressure and for the time specified in the appendix. No leakage is permissible. Should any leakage occur the offending joint must be rectified and the pump re-calibrated if necessary.

Fuel leakage test (pump running)

284. Wipe the exterior of the pump, particularly around all joints, dry off thoroughly with a compressed air blast and run the pump at the conditions stated in the appendix. No leakage is permissible. Any leakage which may occur must be rectified.

Fuel leakage test—solenoid valve

285. In the case of a pump with a solenoid-operated servo-isolating valve run the pump at the condition stated in the relevant Appendix, the outlet being restricted to increase the delivery pressure, and stall the pump. There must be no leakage from the outlet of the solenoid valve.

Insulation test—solenoid valve

286. Where a pump is fitted with a solenoid valve, the solenoid insulation must be tested by connecting the leads of a Megger to the solenoid connections and applying a potential of 500 volts. The resistance must be not less than 1 megohm.

PREPARING FOR DESPATCH

Inhibiting

287. Mount the pump on the inhibiting rig, the oil tank of which must contain oil to Specification D.T.D.587 (latest issue). With the pump running at a speed of 500 r.p.m. raise the delivery pressure sharply to stall pressure; this ensures that the oil reaches all parts of the pump including the amplifier valve.

Note . . .

The duration of the inhibiting operation must not exceed 2 minutes.

Fitting the installation connections

288. Remove the pump from the rig, remove the special rig-testing adapters and fit the installation connections. These differ according to the requirements of the particular installation for which the pump is intended; the method of fitting the connections however, is straight-forward, no special instructions being required. Seal off all apertures by fitting dust caps or masking tape.

Final checks

289. Examine the unit for correctness of locking, check that all exposed connections have been sealed and ensure that any spare sealing washers required for use on installation are attached securely.

290. Check that the record certificate has been completed and approved. All test readings, running times and inspection records, together with a defect report and details of all parts renewed, must be included in the record certificate. See that all relevant details on the record certificate are entered in the pump log book for future reference.

291. See that the pump name plate details are correct in accordance with the calibration schedule to which the pump has been tested, with the installation connections fitted and with any modifications which have been embodied during overhaul.

Packing

292. It is recommended that a special box, illustrated in fig. 42, should be used for storage and transportation. Ensure that the protective cover for the quill shaft is bolted to the unit before lowering into the box. The log book must be included before the box lid is fitted; the box lid should be secured with strong gummed-paper tape or some similar means.

SOLENOID-OPERATED SERVO-ISOLATING VALVES

General

293. Where installations employ dual pumps it is common practice for one pump to be fitted with a solenoid-operated servo isolating valve, which is mounted on the outer face of the control cylinder end cover.

294. Slight variations in design may affect the electrical connection and the mounting flange of the unit, but basically all valves are similar and the following instructions apply to all types.

Special tools

295. There are no special tools required for the overhaul of the solenoid valve.

Checks and precautions before dismantling

296. Examine the complete unit externally for any signs of damage and if it appears to

be in good condition proceed to test the unit in accordance with the following paragraphs.

297. Refit the valve unit to the fuel pump as described in para. 310 and 311 and mount the pump on the test rig. Remove the dust cap or blanking medium (if fitted) from the solenoid valve outlet connection and run the pump at the conditions specified in the appendix.

298. Energize the solenoid by connecting a 16 volt D.C. supply and restrict the pump outlet to increase the delivery pressure until the pump stalls.

299. This test must be effected several times and there must be no leakage of fuel from the solenoid valve outlet connection when the valve is closed.

300. In the event of leakage, examine the unit for foreign matter between the valve plate and orifice as described in para. 302, 305 and 306. If this is not the cause of the leakage, or if the solenoid fails to operate, discard the whole valve unit and fit a complete replacement.

Note . . .

Whenever a unit is rejected it must be returned for investigation and repair.

Dismantling the solenoid valve

301. To gain access to the orifice and valve plate for inspection of the seating faces, remove the complete valve assembly from the pump control cylinder end cover as described in para. 47.

302. Unlock the six setscrews retaining the valve carrier to the solenoid housing flange, remove the setscrews, withdraw the valve carrier, complete with orifice, and withdraw the spring, valve and push rod from the body of the unit. Remove and discard the two sealing rings from the bore of the control cylinder end cover. Do not disturb the orifice.

Cleaning

303. All parts except the solenoid housing should be cleaned thoroughly by washing in kerosine and dried off by means of a compressed air blast. The solenoid housing should be wiped with a clean cloth, which must be free from any loose threads. The push rod guide bore may be cleaned by applying a blast of compressed air.

Inspection

304. Examine the push rod for cleanliness, damage and corrosion and check that it moves freely in its guide. Check that both ends of the rod are quite smooth. The ends may be polished lightly to remove any corrosion but on no account may an abrasive be used which may shorten the length of the rod as the clearance between the end of the rod and the solenoid armature is set on initial assembly and must not be altered.

305. Inspect the valve generally for cleanliness and ensure that the sealing face is smooth and flat. If there is any doubt the face should be checked for colour registration against an optical flat.

306. Examine the orifice assembly for cleanliness, ensure that the bore is quite free from any restriction and see that the sealing face is quite smooth and flat.

307. See that the valve spring is in good condition and free from distortion, with no corrosion or surface defects.

308. Check that the retaining setscrews are clean, that their threads are in good condition and that the heads are undamaged. Inspect the remaining details for cleanliness and general condition.

Note . . .

Do not replace individual components with the exception of seals, washers, nuts and screws. The complete unit must be renewed in the event of a defect and the defective unit returned for investigation.

Re-assembling the solenoid valve

309. Insert the push rod into its guide, place the spring in position in the valve carrier, which should be inverted so that the orifice is uppermost, and place the valve on to the spring, ensuring that the valve spigot locates in the bore of the spring. Lower the solenoid unit on to the valve assembly, taking care that the push rod does not fall out, and when the valve carrier spigot has entered the bore of the solenoid casing, press them together firmly, fit the setscrews, complete with new tab-washers, and tighten fully and evenly. Secure the assembly by locking the tab-washers.

310. Before refitting the solenoid valve, the pump should be run on the rig and the setting of the minimum flow stop checked as described in para. 261 to 263.

311. Following a satisfactory check of the minimum flow setting, fit two new sealing rings to the bore in the pump control cylinder end cover and refit the solenoid valve, plain washers, spring washers and retaining nuts as described in para. 220.

Testing

312. Rig test the unit as described in para. 285, and test the solenoid insulation as described in para. 286.

Preparing for despatch

313. Fit a dust cap to the connection on the control cylinder end cover (solenoid valve outlet) and to the "Breeze" connection.

CALIBRATION CODE 'C'

Introduction

The following schedule contains details of the specific conditions required for testing a pump to Calibration 'C.' Each requirement is prefixed by a paragraph number corresponding to the appropriate paragraph in the basic test schedule.

The fuel throughout the tests is to be Aviation Kerosine to Specification D.Eng. R.D. 2482 LATEST ISSUE, and the temperature of the fuel is to be maintained at between 20 deg. and 26 deg. C.

Running-in (*para.* 248)

1. Run-in at a speed of 500 r.p.m. for 10 minutes at a delivery pressure of 50 lb. per sq. in. followed by a period of 30 minutes at 500 lb. per sq. in.

Initial endurance test (*para.* 251 to 254)

Governor cyclic endurance test (*para.* 252 *and* 253)

2. The governor is to be endurance tested by performing 240 cycles consecutively at a governing speed of 5250 r.p.m. and at a delivery pressure of 1000 lb. per sq. in.

Pump endurance test (*para.* 254)

3. The pump is to be endurance tested by running it continuously for a period of 7 hours at a speed of 5,250 r.p.m. with a delivery pressure of 1,250 to 1,300 lb. per sq. in. and with a flow of 600 g.p.h.

Strip inspection (*para.* 255)

4. The pump is to be dismantled, inspected, cleaned and re-built in accordance with the instructions in the basic schedule, para. 222 to 224.

Governor second endurance test (*para.* 260)

5. The governor initial endurance test (*para.* 252) is to be repeated.

Calibration

Setting the minimum flow adjustment (*para.* 261 to 263)

6. The minimum flow adjustment is to be set whilst the pump is running at a speed of 3,000 r.p.m. with the inlet closed; the adjustment is to be locked to provide an inlet depression of 0 in. to 1 in. Hg. (29·921 in. to 27·89 in. Hg. Absolute).

Setting the maximum flow adjustment (*para.* 264)

7. The maximum flow adjustment is to be set whilst the pump is running at a speed of 5,250 r.p.m. with a delivery pressure of 1,250 lb. per sq. in.; the adjustment is to be locked to provide a flow of 600 to 610 g.p.h.

Testing the volumetric efficiency (varying delivery pressure) (*para.* 265)

8. The volumetric efficiency is to be checked by running the pump at 5,250 r.p.m. with a delivery pressure of 1,000 lb. per sq. in. then reducing the delivery pressure to 100 lb. per sq. in.; any increase in flow must not exceed 20 g.p.h.

Testing the volumetric efficiency (varying inlet pressure) (*para.* 266)

9. The volumetric efficiency is to be checked by running the pump at 3,000 r.p.m. with a delivery pressure of 1,000 lb. per sq. in.; then reducing the inlet pressure from 1 to 5 lb. per sq. in. to 18 in. Hg. Absolute (12 in. Hg. depression); any decrease in flow must not exceed 40 g.p.h.

Setting the stall pressure adjustment (*para.* 267 *and* 268)

10. To obtain the stall pressure the pump is to be run at a speed of 5,250 r.p.m. then the outlet is to be restricted to raise the delivery pressure. The delivery pressure at which the pump stalls (i.e. the flow suddenly falls to zero) must be between 1,800 and 2,100 lb. per sq. in.

Checking the centrifugal pressure rise (*para.* 269 to 272)

11. To check the centrifugal pressure rise run the pump at a constant speed of between 3,500 and 3,600 r.p.m. with an inlet pressure of 10 to 15 lb. per sq. in. and an outlet pressure of 1,250 lb. per sq. in. Reduce the delivery pressure to 1,000 lb. per sq. in. by adjusting the overspeed governor adjusting screw. There must be no decrease in the centrifugal pressure.

Checking the governor range (*para.* 273 to 275)

12. The governor range is to be checked by running the pump with a delivery pressure of 1,250 lb. per sq. in. and at a speed of 4,000 r.p.m., the governor being adjusted so that governing occurs at this

speed. The governor is to be re-adjusted to govern at a speed of 5,500 r.p.m. Governing, denoted by a sudden drop in delivery pressure, must be obtained at the minimum and maximum speeds specified.

Checking the governor cycle (para. 276 to 278)

13. To test the governor cycle run the pump at a speed of 5,250 r.p.m. with a delivery pressure of 1,250 lb. per sq. in. (" Point A "). Increase the speed to operate the governor (" Point B ") then reduce speed slightly to obtain 100 lb. per sq. in. delivery pressure at 5,330 to 5,370 r.p.m. (" Point C "). Reduce speed until the delivery pressure recovers to 1,250 lb. per sq. in., when the speed must be between 5,210 and 5,250 r.p.m. (" Point D ").

Checking the governor recovery time (para. 279)

14. The recovery time of the governor cycle is to be between 2 and 3 seconds.

Checking the governor with pump inlet depression (para. 280)

15. The performance with a pump inlet depression condition is to be checked by setting the outlet restriction to provide a delivery pressure of 1,250 lb. per sq. in. and closing the inlet cock whilst increasing the pump speed. An inlet depression of 12 in. Hg. (18 in. Hg. Absolute) must be obtained, at which the pump speed must be between 5,250 and 5,270 r.p.m. and the delivery pressure must be maintained at 1,250 lb. per sq. in.

Self-priming test (para. 281)

16. With the pump running at 500 r.p.m. and the inlet closed, an inlet depression of 6 in. Hg. Absolute or less (24 in. Hg. or more) must be obtained.

Air pressure test (static) (para. 283)

17. An air pressure of 40 lb. per sq. in. maximum is to be applied for a period of 5 minutes, during which there must be no leakage.

Fuel leakage test (para. 284 and 285)

18. The pump is to be run at a speed of 5,000 r.p.m. with a delivery pressure of 1,250 lb. per sq. in. and with an inlet pressure of 20 lb. per sq. in. There must be no leakage.

19. Where fitted the solenoid-operated isolating valve is to be checked by running the pump at 5,250 r.p.m. with a delivery pressure of 1,250 lb. per sq. in. then operating the solenoid to close the valve and raising the pump delivery pressure to stall pressure (between 1,800 and 2,100 lb. per sq. in.) There must be no leakage from the solenoid valve with the solenoid energized by a potential of 16 volts.

Insulation test—solenoid valve (para. 286)

20. The solenoid-operated isolating valve, the solenoid and " Breeze " plug insulation is to be tested with a 500 volt " Megger." The resistance must be not less than 1 Megohm.