Chapter 4

HIGH PRESSURE FUEL PUMPS, TYPE G.B. 200 SERIES

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General

1. The instructions contained in this chapter apply to all 'B' size slipper type fuel pumps with overspeed governors. Additional information on pumps fitted with solenoid-operated servo system isolating valves is given in para. 280 to 304.

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 type numbering system for these pumps is given in the Preface to Section 2 of this Air Publication.

3. Scrupulous cleanliness is essential at all times and its importance cannot be overemphasized, particularly when servicing or reconditioning.

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. All paper joint washers, gaskets, banjo washers, split pins, tabwashers and locking wire must be renewed on reassembly.

SPECIAL TOOLS

5. The special tools and tests rigs required for dismantling, reassembling and testing these pumps are listed herewith. Many of these tools are similar to those listed and illustrated in Chap. 2 and 3 of this section to which reference should be made where necessary.

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

tions 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 re-assembly.

Removing the camplate housing

18. 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.

19. 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 sheath T.175570 (*fig.* 3, *Chap.* 3) over the quill shaft to avoid damage to the housing oil seal as it passes over the splines. Slacken the remaining two nuts and hold the sheath down against the end of the rotor journal whilst removing the nuts.

20. 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. 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.

21. 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.

22. In either case, when the housing is free, hold the sheath down and raise the housing so that the oil seal slides on to the sheath. Check that as the housing is lifted it comes free of the control ring trunnions and taking care to keep the housing central, lift the assembly off the pump and remove the sheath from the bore.

Dismantling the camplate housing

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

24. To remove the carbon bearing, extract the circlip with a pair of circlip pliers and withdraw the bearing carefully and gently. Lift out the carbon face-seal and its pressure spring and withdraw the bearing locating dowel from the bottom of the counterbore.

25. Invert the housing, remove the seal retaining circlip and lever the seal out with the general utility tool T.157039 taking care to avoid damaging the outer edge of the circlip retaining groove. Shake out the seal drain washer.

Removing the camplate and control ring assembly

26. With the camplate housing removed, as described in para. 18 to 22, the control ring and camplate assembly is retained only by the control piston linkage.

27. Draw the trunnion blocks and any shims present from the control ring trunnions, remove the split pin and washer from the clevis pin in the control ring linkage and withdraw the clevis pin. Raise the control ring centrally and lift it away, checking that the piston slippers do not adhere to the camplate, which they may tend to do under the tension of the fuel film. The pistons should not be drawn out of the rotor at this stage.

Dismantling the camplate and control ring assembly

28. This unit is supplied as a complete assembly and, owing to the special methods required in separating the parts, no dismantling is permissible.

Removing the rotor assembly

29. After removing the camplate housing and the camplate assembly, lift out the complete rotor assembly and place it on the waiting stand T.178981.

Dismantling the rotor assembly

30. The rotor bores are numbered 1 to 7 and a piston stand T.193937 is provided with pegs which are numbered correspondingly, thus enabling the pistons to be stored safely for replacement in their original bores on reassembly.

31. Locate No. 1 piston, invert the rotor assembly and withdraw the piston complete with spring. Replace the rotor on its stand, lift the spring out of the piston then invert the piston and shake out the spring cap. Remove the remaining pistons likewise, storing the springs and spring caps in a clean and dry receptacle ready for inspection.

32. With the pistons removed lift off the auxiliary camplate and draw the spherical seating, shims, spring seating and spring from the rotor shaft. The spring guides should not be removed from the rotor bores unless they are to be crack-tested or the bores are to be checked for wear as described in para. 89 and 90. To remove the guides drive them out with the special drift T.193936 (*fig.* 6, *Chap.* 3).

Removing the rotor quill shaft

33. 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. 97 to 100.

34. 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 (*fig.* 7, *Chap.* 3). 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. 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.

35. 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

36. With the rotor assembly removed, the carbon bearing and port insert is exposed. To remove these, 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 refitted in the same position on reassembly. Remove the insert locating dowels from the facing in the pump housing.

Removing the control piston assembly

37. 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. 38 to 40, whilst a pump which is fitted with a valve should be treated as described in para. 41 to 43.

38. 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.

39. 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.

40. 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.

41. 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.

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

43. 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

44. 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

45. 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.

46. 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

47. 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, Chap. 3 of this section.

48. 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

49. 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

50. A special 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 fitted with a sliding plunger. The use of the gauge is described in para. 101 to 106.

51. 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

52. 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.

53. 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.

54. 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.

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

Checking the rocker lever tail lift

56. 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. 107.

Removing the amplifier valve assembly

57. 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 tool T.175565. Screw in the extractors T.198170 and lift out the assembly. 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 (*fig.* 9 *and* 10, *Chap.* 3).

Dismantling the amplifier valve assembly

58. Reduce the spring load on the rocker lever by rotating the stall pressure adjusting screw anti-clockwise as far as possible, compress the spring slightly and remove the retaining pin, adjusting screw, spring seating and spring (*fig.* 11, *Chap.* 3).

59. Unlock the tabwasher securing the orifice assembly locknut, 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.

60. Mount the assembly on fixture T.166109, unlock the tabwashers securing the setscrews which retain the torsion hinges to the baseplate and remove the setscrews. Transfer the rocker lever and bridge piece to the other side of the fixture. Insert the mandrels to hold the free ends of the hinge blades, unlock and remove the setscrews securing the blades to the lever piec, reverse the lever in the fixture and remove the remaining two blades likewise (*fig.* 24, *Chap.* 3).

Removing the servo-pressure restricting orifice

61. 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, 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 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

62. 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

63. 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

64. When a pump is to be dismantled completely, the remaining details in the pump body consist of the maximum flow adjusting screw, the retaining studs for the sub-assemblies and blanking plugs in the various drilled or cored passages. In addition, where a pump from a dual-pump installation is being serviced, a non-return outlet valve will be fitted in the pump body outlet bore.

65. To remove the maximum flow adjusting screw, unlock the tabwasher, located inside the amplifier valve chamber in the pump body, slacken the locknut and remove the screw with spanner T.175575.

66. Removal of a non-return outlet valve, where applicable, is accomplished by extracting the retaining circlip from the pump body outlet bore, when the valve guide, valve and spring, valve seating and sealing ring may be lifted out separately.

67. All dowel pins are a push fit and can be withdrawn without difficulty. Blanking plugs should be removed with standard box or ring spanners. Draw the plugs from the inlet and outlet passages with the tool T.175571.

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.

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

69. 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.

70. 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 the defects, the part should be discarded and a replacement demanded.

71. 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 re-assembly.

Permissible wear

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

Redundant and consumable parts

73. 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.

74. Tabwashers, 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

75. 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 normally 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 to seriously impair the efficiency and safety of the unit may be acceptable at the discretion of the Inspector-in-Charge.

Magnetic crack detection

76. In a case of suspected cracks or wherever there is the slightest doubt concerning 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
Pistons
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
Stall pressure adjustment screw

Installation fittings

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

Camplate housing assembly

78. 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.

79. Inspect the small carbon bearing for cracks and chipping on the edges ; examine the bore for scoring and undue wear. The clearance between the bore and the rotor shaft journal should be checked dimensionally with gauge G.59899 as described in para. 94 and 95. Where a new bearing is is to be fitted check the fit between the bearing and the camplate housing bore ;

this must be an easy sliding fit without any slackness.

80. If the garter seal has been removed it must be discarded and a new one fitted on rebuild. Inspect the seal drain washer for cracks. Inspect the carbon face-seal for cracks and chipping particularly on the sealing face. Ensure that the seal thrust spring is free from distortion.

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

Camplate and control ring assembly

82. 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.

83. Examine the trunnions and trunnion block bores for frettage and check them and the control link pin dimensionally in accordance with the tolerances specified.

84. 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

85. Carefully inspect the rotor face, which must be quite flat and clean. Some wear of the 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.

86. 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 relief grooves. If any defect is suspected pencil-mark the upper face of the rotor adjacent to the suspected bore for subsequent closer inspection.

87. 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 slippers for flaking, pitting and severe wear of the plating.

88. Measure the diameter of each piston individually by using a precision dial-type comparator. The comparator must be set to zero according to the grading of the piston to be inspected, a range of five setting pieces being provided for this purpose. 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, and read off from the indicator the amount by which the piston is less than the nominal size stated in the Schedule of Fits and Clearances (*fig.* 14, *Chap.* 3).

SETTING PIECE

Grade	Diameter (in.)	Tool No.
1	0·4323	G.54619
2	0·4333	G.54620
3	0·4343	G.54621
4	0·4353	G.54622
5	0·4363	G.54623

89. The rotor bores are to be measured with a precision dial-type intercheck small-bore gauge (*fig.* 15, *Chap.* 3). Five ring-type setting gauges 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 against the appropriate figures for the pistons.

SETTING RING

Grade	Diameter (in.)	Tool No.
1	0·4325	G.59529
2	0·4335	G.59530
3	0·4345	G.59531
4	0·4355	G.59532
5	0·4365	G.59533

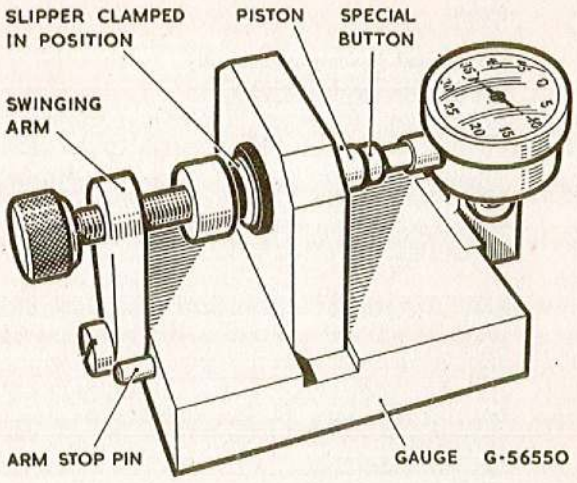

Fig. 2. Checking the slipper/piston clearance

90. Subtract the indicated piston sizes from their respective indicated bore sizes to obtain the clearances, which must be within the limits stated in the Schedule of Fits and Clearances. 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.

91. Check the amount of end play between each piston and its slipper. Insert the piston assembly into the gauge G.56550 as shown in fig. 2, and secure the slipper by tightening the knurled knob in the swinging arm. Push the piston in (towards the slipper) to take up all play, set the dial indicator to zero then pull the piston gently away from the slipper to take up all play in the opposite direction. The total end play as indicated by the gauge must not exceed 0·015 in.

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

93. 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. 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.

94. Check the diametral clearance between the large carbon bearings and the rotor main journal using the checking gauge G.52389 and check the clearance between the small carbon bearing and rotor shaft journal with gauge G.59899. It is convenient for the latter check to be undertaken whilst the rotor is mounted in the gauge G.52389 as shown in fig. 3, to ensure that the rotor end face is protected from damage.

95. In each case move the bearing by finger pressure away from the dial indicator, set the indicator to zero and apply finger pressure on the opposite side of the

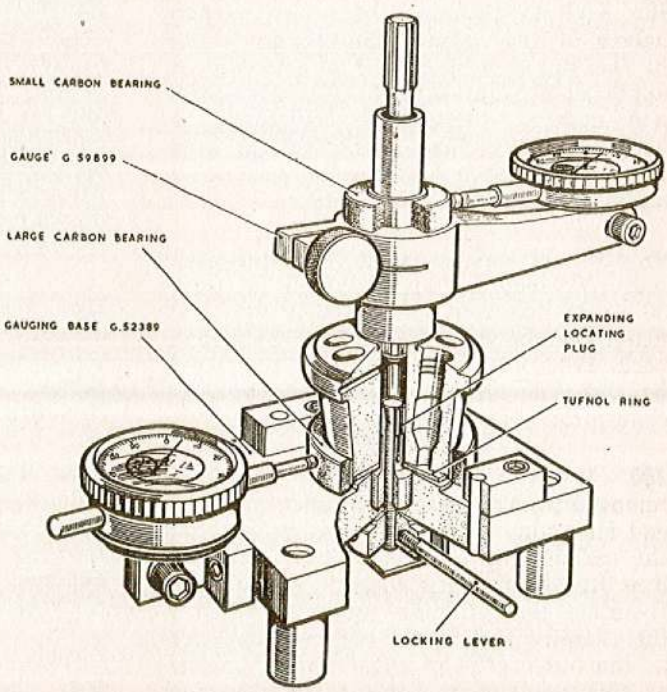

Fig. 3. Checking the rotor carbon bearing clearances

bearing. The indicator will show the maximum clearance between the bearing bore and the journal diameter ; the readings obtained must be within the limits specified in the Schedule of Fits and Clearances.

96. 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. Should a new quill shaft be required, remove the existing shaft as described in para. 33 to 37, fit the new shaft para. 174 to 177, check the concentricity and pressure test the sealing ring as described in para. 97 and 98.

Pressure-testing the quill shaft sealing ring

97. The quill shaft sealing ring is to be pressure-tested for leakage by placing the assembled rotor and quill shaft in the fixture T.188739 (*fig.* 17, *Chap.* 3). 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 when separating the fixture.

98. 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.

99. Should leakage occur the quill shaft must be removed as described in para. 33 to 37 inspected, para. 100, a new seal fitted and the shaft and rotor reassembled, para. 174 to 177. The pressure-test must be repeated and the shaft checked for concentricity as described in para. 96.

100. 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

101. 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.

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

103. 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.

104. 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. 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 (*fig.* 18, *Chap.* 3).

105. Using feeler gauges, measure the clearance between the diaphragm tappet screw and the end of the measuring bar plunger. The correct clearance is 0·017 in. to 0·019 in.

106. 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 re-fitting the assembly to the pump.

Checking the rocker lever tail lift

107. 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, Chap. 3 of this section, so that the indicator button is in contact with the tail of the rocker lever. 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. 169 and 170.

Diaphragm assembly

108. 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.

109. 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.

110. 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. 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.

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

112. 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 faces are square and the screwdriver slot is undamaged. 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.

113. 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.

114. 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. 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

115. 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.

116. 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.

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

118. 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 colour bands are apparent.

119. 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.

120. 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.

121. Examine the torsion hinges and their retaining setscrews for serviceability. See that the hinge springs are not distorted and inspect them closely for surface cracks.

Control piston assembly

122. 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.

123. 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. The hole in the outer end of the link is checked in conjunction with the control ring during inspection of the camplate assembly. Check that the piston seal retaining plate and circlip are serviceable.

124. Examine the cylinder liner for wear in the bore and remove it for closer inspection if necessary as described in para. 47. If the cylinder liner is removed, examine the piston rod felt seal retaining plate for cracks and distortion and inspect the collar and felt seal for serviceability.

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

126. 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.

127. 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.

128. 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.

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

130. For further information on pumps fitted with servo system solenoid isolating valves refer to para. 280 to 298.

Restricting orifice details

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

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

133. 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. 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.

134. 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 gauge G.54243 on the pump housing face (*fig.* 20, *Chap.* 3). Check at several points across the face of the insert and if the reading obtained is outside the stated figure, remove the gauge and insert, 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.

135. 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

136. 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.

137. 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.

138. 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.

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

140. 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. 93.

141. See that the threads for the maximum flow adjusting screw are clean and in good condition and that all tabwasher locating holes are clean and undamaged.

Remaining details

142. 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.

143. 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. Inspect the non-return outlet valve, where applicable, as described in para. 302.

144. 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.

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

REASSEMBLING THE SUB-ASSEMBLIES

General

146. Prior to assembly it is essential that all sealing rings are immersed completely in kerosine for a period of not less than 24 hours to permit maximum swelling to take place under absorption of fuel.

Pump body and details

Maximum flow adjustment screw

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

Control cylinder liner

148. 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 and insert the liner, chamfered end first, with tool T.175556, pressing the liner in as far as possible (*fig.* 21, *Chap.* 3).

Port insert and carbon bearing

149. 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.

150. Place the insert in the pump housing, locate it on the dowel in accordance with the location marking, para. 36, 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.

151. 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. 134. 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.

152. 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.

153. 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.

154. 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. 93. 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

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

156. 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 fit the circlip. Ensure that the circlip is seated correctly and firmly in its retaining groove (*fig.* 22, *Chap.* 3).

Control cylinder end cover

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

158. 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

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

Camplate housing assembly

160. Ensure that the grooves in the housing bore are clean, locate the housing on the spigoted base of tool T.190627, insert the seal drain washer, flat face upwards, into the housing bore and insert the spigot of the seal guide into the mouth of the bore. Place the seal, garter spring downwards, into the mouth of the guide, and locate the assembly and the ram in a wheel press.

161. Hold the guide lightly between finger and thumb and exert a slight upward pressure on the guide whilst operating the press to force the seal through the guide. As the seal enters the bore the guide will become free and the ram must be raised immediately to avoid forcing the seal too far into the bore. The back face of the seal must be level with or only just below the inner edge of the circlip retaining groove. Remove the housing from the press and fit the seal retaining circlip ensuring that it expands correctly into the groove.

162. Invert the housing and insert the thrust spring, ensuring that it seats correctly on the spigot of the seal drain washer. Fit a new sealing ring to the outside diameter of the carbon face seal and insert the seal, recessed side first, into the housing. Check that the recess in the seal is located over the end of the thrust spring.

163. Insert the carbon bearing carefully and gently; it should be a sliding fit without any slackness. Slide the bearing down until the outer face is flush with or just below the inner edge of the circlip retaining groove and fit the circlip, checking that it seats securely in the groove.

Amplifier valve assembly

164. A special fixture 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, Chapter 3 of this section. 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.

165. 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. 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.

166. 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.

167. 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.

Setting rocker lever tail lift

168. 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.

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.

193. 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 setscrews evenly and securely with a box spanner but do not lock the tabwashers at this stage.

194. 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.

195. 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.

196. Insert a sealing ring into the bore of the end cover, ensuring that the ring locates correctly in the groove mid-way 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

197. Before fitting the rotor assembly ensure that the bores and piston clearances have been checked, para. 88 to 90, and that the journals and carbon bearings have been checked dimensionally and the rotor for concentricity, including the quill shaft, as described in para. 93 to 96.

198. 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. Take care to 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

199. 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 and 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 slippers.

200. 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.

Adjusting the auxiliary camplate lift

201. Before fitting the camplate housing the lift of the auxiliary camplate must be checked to ensure that the piston slippers will not be trapped between the camplate and the auxiliary camplate.

202. Assemble the adapter G.58352 to the pump body, securing the adapter with four slave camplate housing retaining bolts and tighten fully, ensuring that the trunnion blocks locate correctly on their dowels. The adapter must be centralized with the locating pegs.

203. Engage the splined end of turnkey T.199561 with the quill shaft splines and using only a gentle pressure check that the rotor will turn. Should the assembly be unduly tight, remove the turnkey and adapter, remove the auxiliary camplate and adjust the shims beneath the thrust ball to reduce the total shim thickness. If no shims have been fitted another thrust ball should be selected with slightly smaller height than the existing ball. Rebuild the assembly and check again. The following check on the auxiliary camplate lift requires

the control ring to be set to an angle of 15 deg. and should not be attempted until the rotor assembly is capable of being turned with the gauging adapter fitted.

204. Remove the minimum flow screw access plate from the control cylinder end cover, where applicable, and slacken the locknut. Slacken the locknut on the maximum flow screw within the overspeed governor chamber and rotate the maximum flow screw anti-clockwise whilst tilting the control ring to the maximum flow position. When the flow screw is felt to be out of contact with the control ring, adjust the minimum flow screw clockwise to tilt the control ring, via the control piston, whilst checking the angle with gauge G.56458.

205. When the gauge seats firmly on both control ring and adapter ring, screw in the maximum flow screw to contact the control ring, which will then be held firmly between the minimum and maximum flow screws in a position 15 deg. to the zero flow position. Adjust the flow screws if necessary to ensure that the gauge is seating correctly at each end on the adapter ring and in contact with the full width of the control ring.

206. Remove the plate gauge and fit the gauge G.58351, securing it in position by means of the clamping screw, with the extension rod of the dial test indicator contacting the lowest point of the auxiliary camplate boss.

207. Depress the bush on the top of the gauge. This will force the auxiliary camplate down by means of the two side rods and at the maximum depression set the indicator to zero. Release the knob then depress again and check that the indicator returns to zero at maximum depression. Release the knob again and check the indicator which will be indicating the amount of lift, representing the maximum clearance between the auxiliary camplate and the piston slippers.

208. The figure obtained must be between 0·002 in. and 0·005 in. Should the amount indicated be greater or smaller than that specified remove the control ring assembly. dismantle the rotor assembly, para. 30 to 32, and adjust the thickness of the shims beneath the auxiliary camplate spherical seating; thicker shims are required to decrease the lift and thinner shims to increase the lift.

209. The assembly must be re-built and the auxiliary camplate re-checked, with further adjustments if necessary, until the lift specified is obtained.

210. Remove the gauge and adapter ring, re-adjust the minimum flow screw to allow the control ring to return to the zero flow position and fit the camplate housing. 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

211. 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.

212. 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, 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.

213. Guide the trunnion pockets over the trunnion blocks and when the joint faces of the housing and pump flanges are approximately $\frac{1}{8}$ in. apart, check that the trunnion blocks are engaged with the locating dowels 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.

214. 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

215. 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

216. Before fitting the diaphragm the governor tappet screw should be set to the correct tappet clearance, as described in para. 101 to 106. The tappet locknut must be tightened securely after adjusting, but the tabwasher should not be locked at this stage.

217. Fit a joint washer to the pump housing facing, fit the diaphragm outer ring then fit the diaphragm assembly. 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 facing. Similarly, the diaphragm upper and lower rings are drilled to correspond and must be aligned with the drillings.

218. Ensure that the joint washers 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

219. 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 sealing 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

220. The remaining details consist of the air bleed valve, the inlet strainer assembly and sealing plugs in the drilled passages. In addition, where a pump intended for a dual-pump installation is being re-built, a non-return outlet valve is to be fitted to the pump body outlet bore.

221. 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.

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

223. 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.

224. 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.

225. To assemble the non-return outlet valve, insert a new sealing ring to the pump body outlet bore, insert the valve seating, flat face first, check that it seats against the sealing ring and ensure that they are pushed into the bore as far as possible. Assemble the valve spring over the valve stem and insert the stem in the guide, ensuring that the spring locates correctly in the guide. Insert the assembly into the pump body and rock the guide slightly to engage its spigot with the recess in the valve seating ; the retaining circlip cannot be fitted unless the spigot is engaged fully. Fit the circlip and check that it expands fully into the retaining groove.

RIG-TESTING (PRELIMINARY)

General

226. A basic testing and calibrating procedure is described here which is applicable to all derivations of the basic type of pump covered by this chapter. Specific test conditions and performance requirements however, vary according to the require-

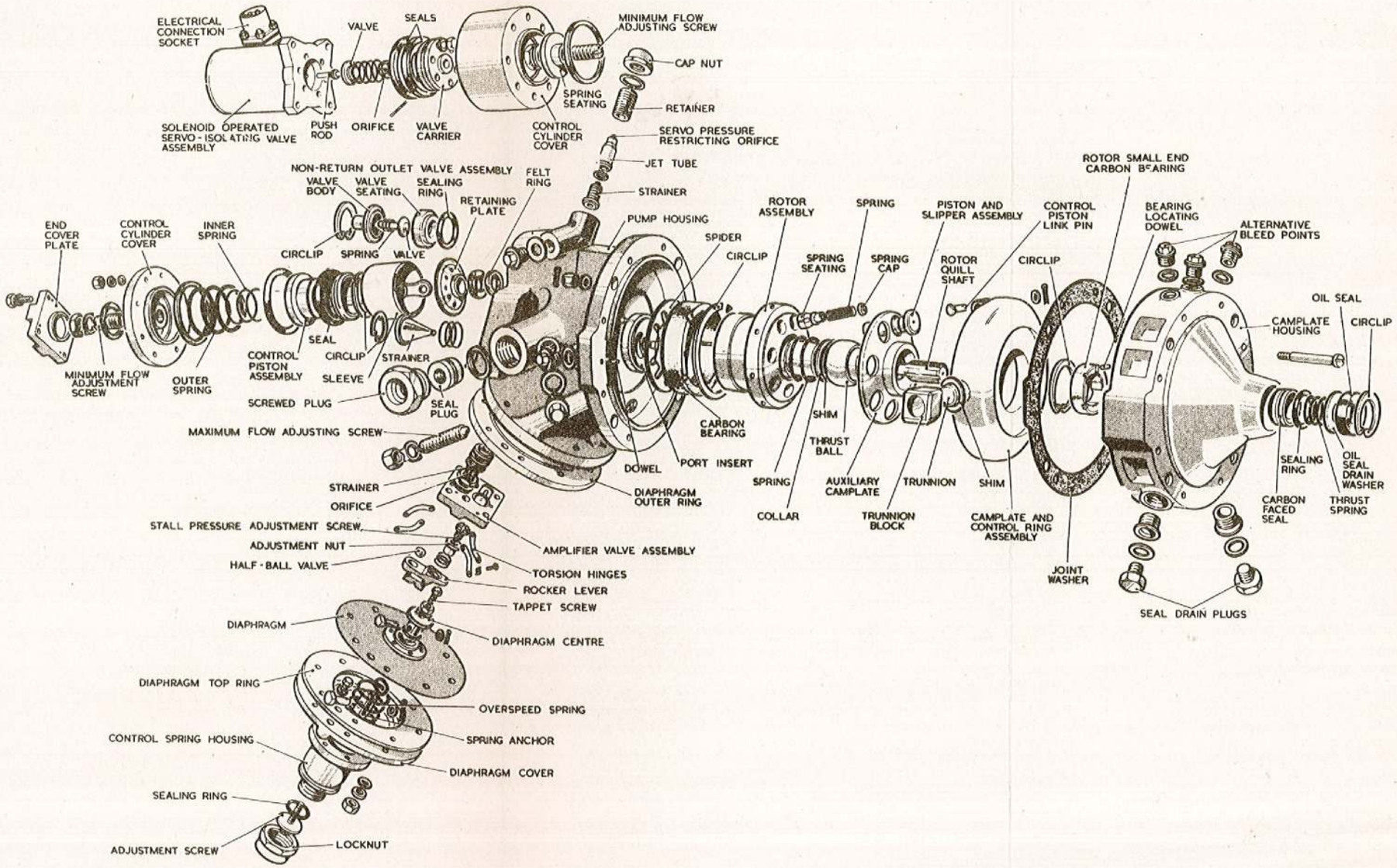

FIG. 1. DISMANTLED VIEW OF FUEL PUMP

FS./3

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

ments of different calibration codes ; these particular details are provided in separate Appendices to this chapter.

227. 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 and tool provided for this purpose. The valve should spill fuel until all signs of air bubbles have disappeared. (*fig.* 29, *Chap.* 3).

228. 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.

229. 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. Before making any adjustments to the pump on test see that the inlet cock is turned OFF.

Test rig adapters

230. 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. In addition, fit a $\frac{1}{8}$ in. B.S.P. union to the tapping off the inlet passage.

Running-in

231. The pump should be mounted on the running-in rig and must be operated at increasing speeds and periods as stated in the relevant appendix.

Preliminary calibration

232. Before proceeding with the initial endurance test the pump must be calibrated. This consists of setting the minimum flow para. 246, the maximum flow para. 249, setting the stall pressure para. 254, checking the volumetric efficiency para. 256, setting the governing speed para. 257, and checking the governing cycle para. 260.

Initial endurance test

General

233. For this and all subsequent testing, except air pressure tests, the pump must be mounted on the test rig.

234. The initial testing consists of a straight endurance test followed by a cyclic endurance test of the pump, a cyclic endurance test of the overspeed governor control, a starting test and a calibration check to confirm that the performance is satisfactory.

Straight endurance test

235. Run the pump at the conditions specified in the appendix for straight endurance running, which consists of two periods at different speeds and delivery pressures. During the first period the temperature of the fuel is to be allowed to rise to the value stated, then reduced to the normal temperature before the start of the second period.

Pump cyclic endurance test

236. Following the straight endurance test the pump is to be cyclic tested, the number and period of the cycles to be regulated as specified.

Governor cyclic endurance test

237. The overspeed governor is to be adjusted to the speed stated for ' point A ' in the governor cycle check, para. 260, then the pump speed is to be varied regularly to operate the governor in accordance with the periodic cycles specified.

Starting test

238. Following the governor cyclic test the pump is to be stopped, started, run to idling speed and stopped periodically ; the number of the cycles is stated in the appendix. The pump should be adjusted to the correct idling conditions if necessary before commencing the test, during which no further adjustment should be made.

Performance check

239. Check the stall pressure, para. 254, check the volumetric efficiency, para. 256, check the governor operating cycle, para. 260, and the governor recovery time, para. 263.

STRIP INSPECTION

240. 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 during the initial endurance test. Pistons, rotor (steel journals), auxiliary camplate, port insert and control piston must be crack-tested if a defect is suspected, para. 76.

241. All dismantling must be carried out in accordance with the instructions given in the relevant paragraphs of this manual under the section ' Dismantling.'

CLEANING

242. Before final re-assembly 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

243. The re-assembly of all components must be carried out in accordance with the instructions given in the relevant paragraphs of this manual in the sections " Re-assembling the sub-assemblies " and " Assembling 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 testing.

RIG-TESTING (FINAL) AND CALIBRATION

General

244. The final rig-test and calibration consists of a second preliminary calibration, para. 232, a second cyclic endurance test of the overspeed governor, setting the various adjustments to obtain the performance required in accordance with the specific calibration schedule 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

245. Repeat the governor endurance test described in para. 237.

Setting the minimum flow adjustment

246. Remove the governor diaphragm assembly as described in para. 49, and remove the access cover on the end of the control cylinder end cover, para. 38 or 41.

247. Run the rig at the conditions stated in the 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.

248. 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 up the lockwasher tab to secure the nut. Refit the control cylinder end cover plate and proceed to adjust the maximum flow.

Note . . .

The duration, when running under the above conditions, must not exceed 2 minutes.

Setting the maximum flow adjustment

249. Adjust the rig to provide the speed, inlet pressure and delivery pressure stated in the 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, *Chap.* 3).

Checking the centrifugal pressure rise

250. 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.

251. Remove the governor adjusting screw locknut and remove the adjusting screw. Fit the special adapter T.192035 in place of the adjusting screw and connect the other side of the manometer to this adapter.

252. Run the pump at the condition stated in the Appendix and check that the centrifugal pressure rise indicated on the manometer is in accordance with that specified in the Appendix. Where the test calls for the delivery pressure to be reduced by re-setting the governor adjusting screw, the adjustment is to be made by rotating the special adapter (*fig.* 35, *Chap.* 3).

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

Setting the stall pressure adjustment

254. 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.

255. 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 (*fig.* 34, *Chap.* 3) 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.

Testing the volumetric efficiency

256. 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 with the specified limit.

Checking the governor range

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

258. Run the pump at the lower 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 satisfactory at the specified r.p.m.

259. Increase speed to the higher r.p.m. stated, release the adjusting screw locknut and rotate the screw anti-clockwise until the governor will operate with the pump running at the higher speed. Tighten the locknut and check the governor operation again.

Checking the governor cycle

260. To check the governor cycle run the pump at a given r.p.m. and delivery pressure, termed ' point A ', then increase speed until the governor operates. This will cause a sudden fall in flow and in delivery pressure (' point B'). Reduce speed immediately but carefully until the delivery pressure is at 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.

261. 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 amplifier valve opens.

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

Checking the governor recovery time

263. A stop watch is required for this test. Run the pump to the condition stated for point ' A ' in the previous test, hold the watch in readiness and increase the pump speed until the governor operates. Reduce speed to obtain ' point C ' then start the watch and simultaneously reduce the pump speed as rapidly as possible 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

264. 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).

Note . . .

The duration of this test must not exceed 2 minutes.

Self-priming test

265. Run the pump at the speed stated in the 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.

Leakage tests

Fuel leakage test (pump assembly)

266. 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)

267. In the case of a pump with a solenoid-operated servo isolating valve run the pump at the condition stated in the 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.

Air pressure test (pump assembly)

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

Air pressure test (outer oil seal)

269. The outer oil seal is to be pressure-tested by bolting to the pump mounting face the special adapter T.198619. A joint washer should be interposed between the adapter and pump faces. Connect a compressed air supply to the union in the adapter and apply air at the pressure and for the period stated in the Appendix with the pump and adapter immersed completely in kerosine.

Final leakage test

270. The pump is to be re-mounted on the test-rig for final leakage tests after the locking of all adjustments has been completed. Take care to avoid disturbing any settings when locking them. The leakage test is to be a repeat of that described in para. 266.

Insulation test (solenoid valve)

271. 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.

Pressure-test (non-return outlet valve)

272. To pressure-test the non-return outlet valve, assemble the valve into the special fixture T.175172 as shown in fig. 4. Connect a fuel supply to the fixture on the outlet side of the valve and apply the pressure stated in the Appendix, checking for leakage from the other side of the fixture.

Restriction test (non-return outlet valve)

273. To test the valve for restriction to flow the valve is assembled into the fixture as for the previous test. In this case the fixture adapter on the inlet side of the valve is connected to a suitable fuel supply whilst the opposite end of the fixture is connected to a flowmeter. The two tappings on the side of the fixture are connected to pressure gauges. The fuel flow stated in the Appendix is to be applied and the difference between the inlet and outlet pressures, as indicated by the pressure gauges, must not exceed that specified in the Appendix.

PREPARING FOR DESPATCH

Inhibiting

274. 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

275. 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

276. Examine the unit for correctness of locking, check that all exposed connections

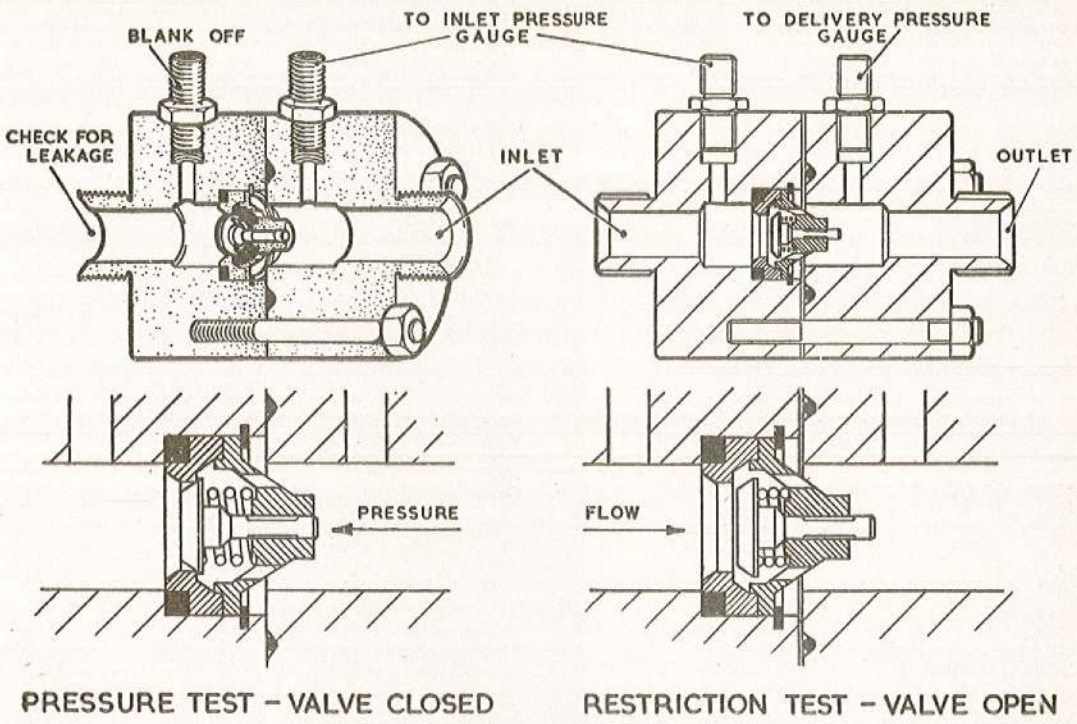

Fig. 4. Testing the non-return outlet valve

have been sealed and ensure that any spare sealing washers required for use on installation are attached securely.

277. 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.

278. 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

279. It is recommended that a special box 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 - SYSTEM ISOLATING VALVES AND NON-RETURN OUTLET VALVES

Solenoid valves

280. 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 and for one or both pumps to incorporate a non-return valve in the pump outlet connection.

281. In the case of the solenoid valve 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

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

Checks and precautions before dismantling

283. 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.

284. Refit the valve unit to the fuel pump as described in para. 196 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.

285. 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. 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.

286. In the event of leakage, examine the unit for foreign matter between the valve plate and orifice as described in para. 288, 291 and 292. 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

287. 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. 41.

288. 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

289. 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

290. 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.

291. 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.

292. Examine the orifice assembly for cleanliness, ensure that the bore is quite free from any restriction and see that the sealing face and lands are quite smooth and free from corrosion.

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

Reassembling

294. 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.

295. 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. 246 to 248.

296. 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. 196.

Testing

297. Rig test the unit as described in para. 267 and test the solenoid insulation as described in para. 271.

Preparing for despatch

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

Non-return outlet valves

Special tools

299. No special dismantling and assembling tools are required but a special fixture must be used for testing the complete assembly as described in para. 272 and 273.

Dismantling

300. The valve is not a self-contained assembly, the details being assembled separately into the pump body and dismantled likewise therefrom; removal and dismantling of the assembly is described in para. 63.

Cleaning

301. The details should be cleaned as described in para. 68 and 69 observing the precaution of inspecting for foreign matter if necessary before cleaning.

Inspection

302. Examine the valve head for any corrosion or pitting of the conical surface and indentation. See that the stem is clean and free from corrosion. Inspect the valve guide for corrosion in the bore and examine it closely for signs of cracking in the webs between the drillings. Check the valve seating for pitting or chipping on the sealing edge and for corrosion on the sealing ring contact face. The valve spring and circlip must be free from distortion and cracks. See that the spring is clean between the coils.

Reassembling

303. As the details are assembled separately into the pump body, the assembly is described in para. 225. Before fitting the valve to the pump however, it must be assembled in a special fixture and tested for flow restriction when open and leakage when closed.

Testing

304. The special fixture T.175172 is required for testing the valve assembly; the method is described in para. 272 and 273 and is illustrated in fig. 4.

APPENDIX 1

CALIBRATION CODE 'C'

Note . . .

The values quoted in this appendix must be rigidly adhered to when calibrating fuel pumps and reference must be made to the particular paragraph quoted.
Throughout the tests the fuel used is to be Aviation Kerosine to Specification D.Eng. R.D.2482 (latest issue) and the temperature of the fuel, unless otherwise stated, is to be maintained at between 20 and 26 deg. C.
Unless stated otherwise the inlet pressure throughout these tests is to be maintained at 1-5 lb. per sq. in.

Running-in (*para. 231*)

1. Run-in at the following increasing speeds, delivery pressures and times, noting that the maximum flow is to be set before carrying out the final run of 15 minutes duration.

Speed (r.p.m.)	Delivery pressure (lb. per sq. in.)	Duration (minutes)
500	100	2½
1,000	100	2½
1,500	200	2½
2,000	300	2½
2,500	400	2½
3,000	500	2½
3,500	600	5
4,000	700	5
4,500	800	10
5,000	900	10

Set max. flow to 610 g.p.h. at 1,000 lb. per sq. in. delivery pressure and 5,250 r.p.m.

5,250 r.p.m.	1,000 lb. per sq. in.	15 minutes

Preliminary calibration (*para. 236*)

2. Set the minimum and maximum flow stop, para. 246 to 249, set the stall pressure, para. 254, and check the volumetric efficiency, para. 256, the governor cycle, para. 260, and the governor recovery time, para. 263.

Straight endurance test (*para. 235*)

3. The pump is to be straight-endurance tested by running initially for 1¼ hours at 5,250 r.p.m. with a flow of 450 g.p.h. at a delivery pressure of 1,600 lb. per sq. in. During this run the fuel temperature is to be allowed to rise to 36-38 deg. C. and then reduced again to normal. Following this run the speed is to be increased to 5,400 r.p.m. and maintained for 15 mins. at a delivery pressure of 2,000 lb. per sq. in.

Pump cyclic and endurance test (*para. 236*)

4. The pump is to be cyclic-endurance tested by running for 5 mins. at 5,250 r.p.m., 1,800-2,100 lb. per sq. in. delivery pressure (stall pressure) and delivering a flow of 450 g.p.h. followed by 10 mins. at 1,000 r.p.m. and 1,250 lb. per sq. in. delivery pressure with a flow of 20 g.p.h. This sequence is to be repeated 12 times.

Governor cyclic endurance test (*para. 237*)

5. The overspeed governor is to be endurance tested by running the pump at 5,250 r.p.m. with a delivery pressure of 1,250 lb. per sq. in. then increasing speed until the governor operates and decreasing speed until the governor recovers. The cycle is to be repeated 240 times at regular intervals.

Starting test (*para. 238*)

6. The pump is to be started, run to 1,000 r.p.m. with a flow of 20 g.p.h. at a delivery pressure of 1,250 lb. per sq. in. and stopped. This starting cycle is to be repeated 25 times. No adjustments are to be made during the test.

Performance check (*para. 239*)

7. Check the stall pressure, para. 254, the volumetric efficiency, para. 266, the governor operating cycle, para. 260, and the governor recovery time, para. 263.

Strip inspection (*para. 240*) **and final assembly** (*para. 243*)

8. The pump is to be dismantled, inspected, cleaned and rebuilt as required in accordance with the test schedule.

Final endurance test (*para. 245*)

9. The initial governor cyclic endurance test, para. 237, is to be repeated.

Final calibration

General

10. From the beginning of the final calibration a careful watch should be kept for leakage from all joint faces and for

excessive leakage from the rotor shaft seal drain. Should leakage be suspected the calibration should be discontinued and leakage tests carried out as applicable in accordance with para. 266, and if leakage is confirmed it must be rectified and the calibrations so far completed should be re-checked to ensure that they have not been disturbed.

Minimum flow adjustment (*para. 246*)

11. The minimum flow adjustment is to be set so that with the pump running at a speed of 3,000 r.p.m. an inlet depression of 0 to 1 in. Hg. is obtained.

Maximum flow adjustment (*para. 249*)

12. The maximum flow adjustment is to be set so that with the pump running at 5,250 r.p.m. with a delivery pressure of 1,250 lb. per sq. in., the flow obtained will be 600-610 gall. per hour.

Centrifugal pressure rise (*para. 250*)

13. Check the centrifugal pressure rise. Run the pump at 3,500-3,600 r.p.m. and adjust the inlet pressure to 10-15 lb. per sq. in. with the delivery unrestricted (zero delivery pressure). Adjust the restrictor cock to increase the delivery pressure to 1,250 lb. per sq. in., note the centrifugal pressure on the manometer then reduce the delivery pressure to 1,000 lb. per sq. in. There must be no decrease in the centrifugal pressure.

Stall pressure adjustment (*para. 254*)

14. Set the stall pressure so that with the pump running at 5,250 r.p.m. and the restrictor cock providing a delivery pressure of 1,800-2,100 lb. per sq. in. the pump stalls within this range. Operate the delivery cock to stall and recover 10 times, when the stall must occur within the same range.

Volumetric efficiency (*para. 256*)

15. Check the volumetric efficiency by running the pump at 5,250 r.p.m. with a delivery pressure of 1,000 lb. per sq. in. then reduce the delivery pressure to 100 lb. per sq. in. The difference in flow between the two delivery pressures must not exceed 22 g.p.h.

Governor range (*para. 257*)

16. Check the overspeed governor operating range. Run the pump at 4,000 r.p.m. and 1,250 lb. per sq. in. delivery pressure, adjust the governor setting (screw IN) until the governor operates. Re-adjust the governor setting (screw OUT) until 5,500 r.p.m. can be obtained and re-set governor to operate at this speed. Correct governor operation must be obtained at both speeds.

Governor cycle (*para. 260*)

17. Check the governor operating cycle. Set governor adjustment to operate at 5,250 r.p.m. Adjust pump speed (test-rig control) to 5,250 r.p.m. and obtain a delivery pressure of 1,250 lb. per sq. in. (Point 'A'). Increase speed until the governor operates (Point 'B') then adjust speed to 5,285-5,350 r.p.m. when the delivery pressure should be approximately 150 lb. per sq. in. (Point 'C'). Decrease speed to 5,210-5,250 r.p.m., when the governor must recover and the delivery pressure must return to 1,250 lb. per sq. in. Check the cycle several times to ensure accuracy and record the speeds and delivery pressures obtained at Point 'A', 'C' and 'D.'

Governor recovery time (*para. 263*)

18. Check the time taken for the pump to recover from the conditions at 'Point C' to the conditions at 'Point D' in the previous check. The recovery time is to be between 2 and 3 seconds.

Governor with pump inlet depression (*para. 264*)

19. The governor performance with a pump inlet depression condition is to be checked by adjusting the outlet restrictor to provide a delivery pressure of 1,250 lb. per sq. in. at 5,000 r.p.m. and closing the inlet cock, then increasing the pump speed to obtain an inlet depression of 12 in. Hg. (18 in. Hg. Abs.), at which point the pump speed must be between 5,250 and 5,270 r.p.m. and the delivery pressure of 1,250 lb. per sq. in. must be maintained. *This test must not exceed 2 minutes.*

Self-priming (*para. 265*)

20. The pump is to be checked for its self-priming ability by running at 500 r.p.m. with the inlet cock closed. An inlet pressure of 6 in. Hg. Abs. (24 in. Hg. depression) must be obtained. *This test must not exceed 2 minutes.*

Fuel leakage test-pump running (*para. 266*)

21. Wipe the exterior of the pump to remove surplus kerosine and dry off with compressed air. Run the pump at 5,000 r.p.m. with an inlet pressure of 20 lb. per sq. in. and a delivery pressure of 1,500

lb. per sq. in. and maintain these conditions for 5 minutes. During this test there must be no leakage other than from the rotor shaft seal drain; the drain leakage must not exceed 5 c.c. per hour.

Fuel leakage test-solenoid valve (*para. 267*)

22. Where applicable the solenoid-operated isolating valve is to be checked by running the pump at 5,000 r.p.m. with a delivery pressure of 1,800-2,100 lb. per sq. in. and 300 g.p.h. flow then energizing the valve at a potential of 16 volts followed by an increase in delivery restriction to obtain zero flow at 1,800-2,100 lb. per sq. in. (stall) when the valve must be energized again. The cycle must be repeated 10 times during and after which there must be no leakage past the valve.

Air pressure test (static) (*para. 268*)

23. The pump is to be removed from the test rig, drained thoroughly of fuel and a compressed air line connected to an adapter inserted into the pump body in place of one of the body blanking plugs. All other connections including the seal drains must be blanked off and the pump immersed completely in kerosine with an air pressure of 40 lb. per sq. in. applied for a period of 5 minutes. There must be no leakage.

Air pressure test-outer oil seal (*para. 269*)

24. Connect compressed air supply to the union in the end face of the special test adapter and remove the blanking plugs from the seal drains. Immerse the pump and adapter completely in kerosine and apply an air pressure of 5 lb. per sq. in. for a period of 5 minutes. There must be no leakage from the seal drains.

Final leakage test (*para. 270*)

25. Following satisfactory completion of all calibrations and tests all tabwashers and other locking devices on the various adjustments are to be locked securely, taking care to avoid disturbing the adjustments and the leakage test-pump running (*para.* 266) is to be repeated.

Electrical insulation test-solenoid valve (*para. 271*)

26. Where fitted the solenoid valve insulation is to be tested for continuity by connecting the 'Megger' across the Breeze plug pins and between each pin and the socket casing. In each case 500 volts is to be applied and the resistance must be not less than 1 Megohm.

Pressure test-non-return outlet valve (*para. 272*)

27. Apply fuel to the valve outlet at a pressure of 2,000 lb. per sq. in. for a period of 1 minute. Any leakage from the normal inlet connection must not exceed 20 c.c.

Restriction test-non-return valve (*para. 273*)

28. Apply a fuel flow of 500 galls. per hour to the valve inlet. The difference between the inlet and outlet pressure gauges must not exceed 25 lb. per sq. in.