

## Chapter 1

# BAROMETRIC PRESSURE CONTROL UNIT

## TYPES B.P.C. 3, 7, 8, 15, 17 and 18

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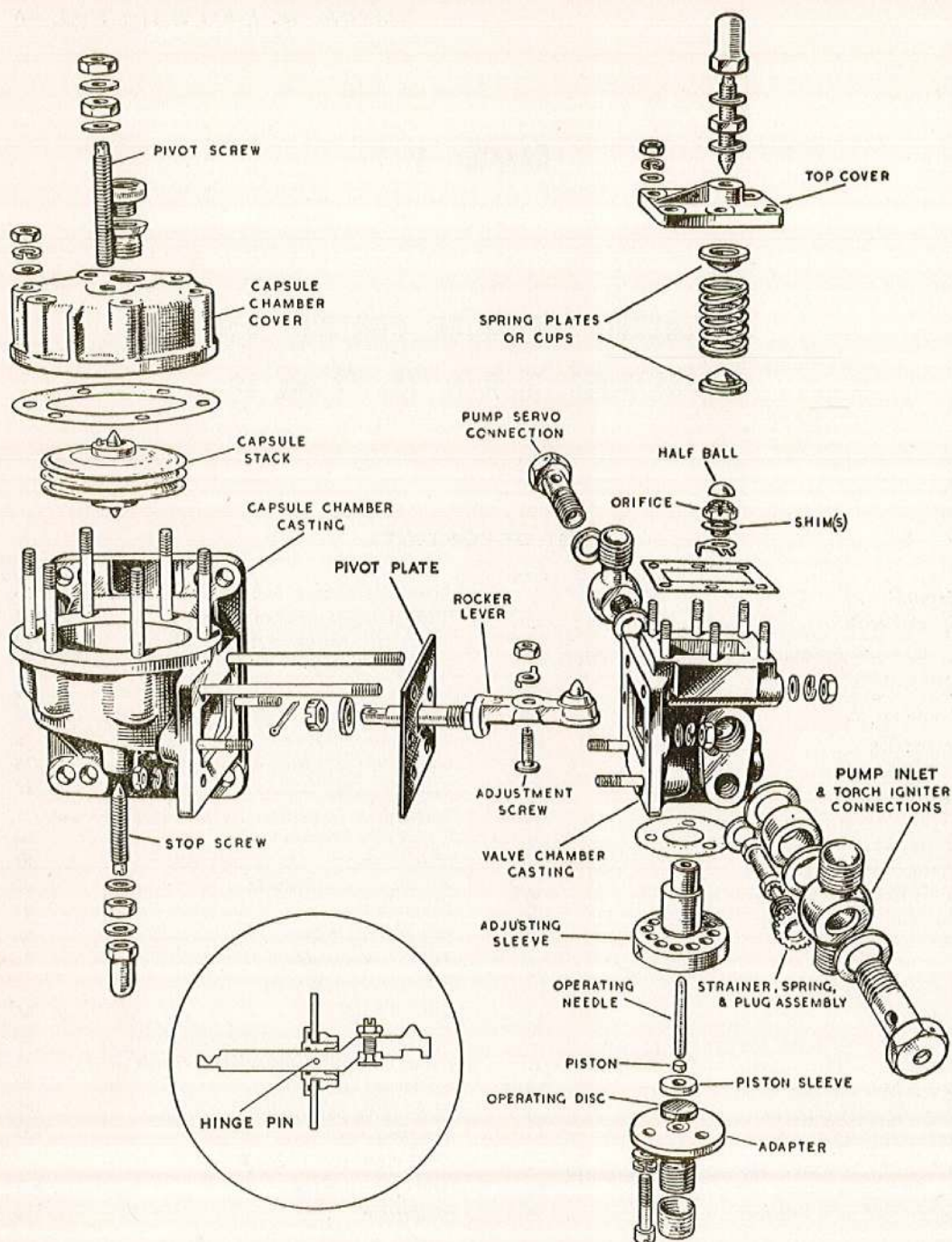


Fig. 1. Dismantled view of unit  
(Inset shows pin-hinge type of rocker lever)

#### General

1. Each of the type numbers given in the title of this chapter covers a series of control units which are basically similar but which have differing installation fittings or calibration settings. The various units

can be identified by the mark number stamped on the nameplate, thus:—B.P.C. 7/14L; the number being made up of the type number "7" followed by the installation number "14" and the calibration letter

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"L." Fig. 1 shows a view of a dismantled B.P.C. 3/2E unit. Other slight differences are:—

- (1) Earlier types of control unit have the rocker lever mounted on a pivot plate whilst on later units it is fitted with a hinge pin (fig. 1).
- (2) The B.P.C.8/16 unit has the position of the capsule chamber and the valve chamber reversed in relation to the mounting flange.

2. During the repair of the control valve unit it is essential that all parts are kept clean. All components should be stored in suitable containers, thus reducing the possibility of loss, damage or corrosion. To prevent damage to nuts and bolts during dismantling and reassembling, box and ring spanners should be used wherever possible.

3. All paper joints or gaskets must be replaced whenever a joint or seal is broken. New split pins and locking wire must always be fitted when assembling the unit. A list of parts which are separately interchangeable is given in para. 79 "Replacements."

4. Slave nuts, washers, gaskets and screws should be used when temporarily assembling components; this will prevent damage to serviceable parts and reduce unnecessary scrap.

#### SPECIAL TOOLS

5. The following special tools are required.—

| Part No. | Description                                    |
|----------|------------------------------------------------|
| T.140539 | Fixture, assembling rocker arm and pivot plate |
| T.151164 | Bracket, test rig                              |
| T.151165 | Sealing plate, pressure test                   |
| T.161439 | Key, removing strainer                         |

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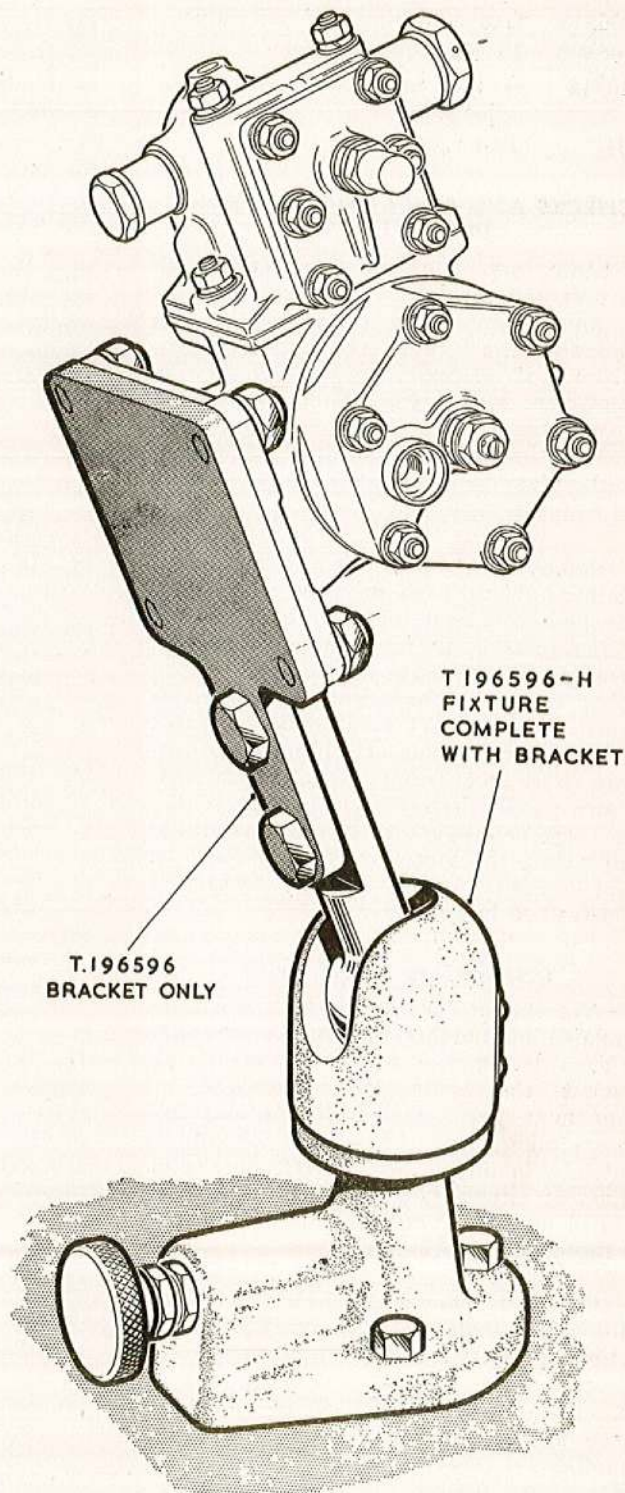


Fig. 2. Assembling and dismantling fixture

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|          |                                    |
|----------|------------------------------------|
| T.174675 | Spanner, restrictor                |
| T.177125 | Spanner, lock and cap nuts         |
| T.196218 | Gauge, setting half-ball valve     |
| T.196596 | Bracket, hydroclamp                |
| G.48312  | Gauge, measuring piston projection |
| R.64     | Test rig                           |

#### CHECKS AND PRECAUTIONS BEFORE DISMANTLING

6. Study any complaints reported with the unit and carefully examine its exterior for any visible signs of damage; also check that the locking wire is not broken. Ensure that all connections which open to atmosphere have been securely covered to prevent the entry of any foreign matter into the interior of the unit. Ascertain whether damage has been caused to threads and connections during transit.

7. Remove the installation fittings from the unit. If the unit is in such condition that it can be operated it should be mounted on the test rig as for a final calibration check (*para.* 109 to 111 and *fig.* 10). If the unit is reported to be leaking, a leak test as described in *para.* 71 to 73 must be made. If the unit is satisfactory, proceed to calibrate it as described in *para.* 109 to 111. If any peculiarities of, or damage to the unit become apparent during this initial calibration, the motor on the rig must be stopped and the unit completely dismantled as described in *para.* 8 to 19.

#### DISMANTLING THE UNIT

8. A suitably partitioned tray must be available for holding the component parts of each barometric pressure control. To prevent the accidental interchange of component parts during dismantling and reassembling, only the parts of one control unit may be on the bench at any one time. Under no circumstances are parts from one control unit to be stored in the same tray as those from other units.

9. Cut and remove the exterior locking wire and mount the unit on the fixture T.196596 (*fig.* 2).

10. Remove the connection to the pump servo at the lower portion of the valve chamber. Remove the pump suction connection and fittings.

11. Using the special spanner T.161439

remove the strainer and spring; on the earlier types these parts were separate.

12. Before the adjusting sleeve assembly can be withdrawn it will be necessary to remove the H.P. adapter. Invert the unit, remove the three 2 B.A. screws retaining the H.P. adapter and withdraw the adjusting sleeve from the valve chamber. On some types the screws are locked with tab-washers.

13. To dismantle the adjusting sleeve assembly withdraw the operating needle from the drilled boss of the adjusting sleeve. Remove the operating disc from the adjusting sleeve and gently tap out the piston and piston sleeve.

14. To dismantle the capsule chamber :—

- (1) Slacken the nuts off the capsule stack upper pivot screw and remove the screw together with washers and nuts.
- (2) Remove the dust cap from the vent hole in the capsule chamber cover.
- (3) Remove the cap-nut and washer from the stop screw and unscrew the latter from the boss in the centre of the bowl of the capsule chamber casting together with the lock-nut and washer.
- (4) Unscrew the six nuts from the studs securing the capsule chamber cover to the casting, remove the grover washers and plain washers, and lift off the top cover together with the gasket or paper joint.
- (5) Carefully remove the barometric capsule from its chamber and invert the casting to empty the oil from the capsule chamber.

15. To dismantle the valve chamber, slacken off the spring adjusting screw in the top of the valve chamber cover to relieve the pressure on the spring then proceed as described in the following operations :—

- (1) Remove the six nuts, grover washers and plain washers) and lift off the cover
- (2) Lift out the spring and spring plates.
- (3) Remove the paper joint or gasket interposed between the top cover and the body casting.
- (4) Slacken the nut on the adjustment screw which is positioned on the rocker lever immediately above the adjusting sleeve. Screw in the adjustment screw sufficiently to ensure that it will clear the adjacent valve chamber face on



withdrawal from the valve chamber casting.

16. To separate the valve and capsule chambers invert the unit, unscrew the nuts, remove the grover washers and plain washers and withdraw the valve chamber from the capsule chamber. If the rubber seal which is bonded to the pivot plate makes the separation difficult, remove the two long studs from the capsule chamber which will then allow the valve chamber to come away either with or without the pivot plate. Withdraw the assembly, if it is still in position on the capsule chamber, and ensure that the half-ball is retained in position in the rocker lever during this operation.

17. Remove the half-ball valve seating from its socket in the end of the rocker lever.

18. The pivot plate and rocker lever must not be dismantled unless it is either defective or damaged. If it is necessary to dismantle this assembly, it must be carried out in the reverse order to that described in para. 85 but note that *the pin hinge type of rocker lever must not be dismantled*. If defective the complete assembly must be renewed.

19. To remove the orifice, bend back the tabs of the lock-washer beneath the orifice in the valve chamber casting and using a box spanner carefully unscrew the orifice. The orifice can then be lifted out together with the shims and tab-washer.

#### CLEANING

20. The bench which is being used for carrying out this work should be covered with zinc sheeting or linoleum, this covering will allow the bench to be kept clean and free from all dirt and swarf. Ensure that suitable clean containers are available for storing dismantled parts.

21. Prior to washing and cleaning, remove all gaskets except that fitted to the mating face of the adjusting sleeve. If however, this is damaged it must be removed and the cover face cleaned.

22. All parts must be thoroughly washed and cleaned before reassembling, for which purpose a para-wash machine having a kerosine bath and spray gun are recom-

mended. *Hard brushes or abrasives of any kind must not be used.*

23. When all the parts are thoroughly cleaned and dried they are to be laid out on the assembly bench ready for inspection.

#### INSPECTION

24. All necessary viewing and inspection checks are contained in this section. A list of dimensions and clearances for new and repair barometric pressure control units is given in the Schedule of Fits, Clearances and Repair Tolerances. Vol. 2, Part 2 of this Air Publication. Each detail must be carefully inspected, if any parts are found damaged or defective they must be rejected and replacements called for. The detail components are grouped as near as possible into sub-assemblies. Separate details which do not form part of a sub-assembly are dealt with nearest to their associated group. The viewing and inspection checks are listed to correspond with the normal dismantling sequence of operations.

#### Distortion checks

25. Distortion checks are not normally necessary, if any parts are distorted they must be replaced.

#### Permissible wear

26. All parts subject to wear should be checked with the dimensions in Vol. 2, Part 2.

#### Redundant and consumable parts

27. Parts rendered redundant by the embodiment of essential modifications must be rejected during inspection. Inspectors must therefore have available all information concerning relative modifications. Tab-washers, split pins, locking wire and gaskets must be rejected during dismantling.

#### Scores and surface damage

28. During inspection it might be noted that joint faces or moving parts are scored. If these scores are in an area where the operating efficiency of the unit might be affected, the part or parts must be rejected. If, on the other hand, the scores are in an area where neither the efficiency nor safety is impaired the part or parts may be accepted, subject to the discretion of the Inspector-in-charge.



### **Installation connections**

**29.** The various connections should be inspected for condition of threads, and joint faces, also for damage and cleanliness. The threads and flats of the bolts used for the installation of the unit must be in good condition. Examine all joint washers for cracks and damage, and ensure that the joint faces of the distance pieces are in good condition.

### **Filter, spring and plug assembly**

**30.** The threads of the plug should be examined for damage and cleanliness, the filter for condition of gauze and cleanliness, and the spring for cracks.

### **Adjusting sleeve assembly**

**31.** The adjusting sleeve assembly, which comprises the operating disc, the operating needle, piston, piston sleeve and adjusting sleeve must be examined for general condition.

**32.** Ensure that the piston conforms to the repair limits specified in Vol. 2, Part 2.

**33.** Thoroughly dry the adjusting sleeve, the operating needle, piston and piston sleeve, ensure that the needle moves freely and smoothly in the bore of the adjusting sleeve, also that the piston slides freely in the piston sleeve bore. If these parts are found to be free when dry, it can be safely assumed that all parts will operate freely in kerosine.

**34.** The operating needle and piston should be scrutinised very carefully for flaws and damage, and the operating disc for swelling distortion and damage. If there is any corrosion on the needle in its bore in the adjusting sleeve, or on the piston or its sleeve, the part or parts concerned must be scrapped.

**35.** The H.P. adapter should be examined for damage and its union threads for condition. The threads and leads of the three 2 B.A. screws, which secure the plate to the valve chamber casting, should be inspected for damage and the plain and grover washers for cracks.

### **Main casting details**

**36.** Carefully examine both valve chamber and capsule chamber castings for soundness and condition. All machined faces must be free from damage and scratches, and must

be in such condition that an effective joint can be maintained.

**37.** Ensure that all studs are tight and that the threads are undamaged; also ascertain that the studs, particularly the longer ones, are not bent or distorted. Scrutinise all internal tappings and ensure that these are clean and free from damage.

**38.** Examine all nuts and bolts and ensure that the threads are sound and that the flats are undamaged. Carefully inspect all grover washers and plain washers, scrapping any which are distorted, bent or cracked.

**39.** The threads and slotted heads of the stop screw in the base, and the pivot screw in the top cover of the capsule chamber must be in good condition. Ensure that the pivot point of the lower screw and the centre of the conical seat of the upper screw are sound and free from damage.

### **Capsule stack**

**40.** Inspect the capsule stack for punctures, leaks, damage, corrosion and the presence of foreign matter between the capsules. Ensure that the pivot points are smooth, free from sharp edges, chipping and damage. Place the capsule stack pivot point in its locating socket in the adjusting screw in the capsule chamber and check for lateral movement, similarly place the lower pivot point in its locating socket in the rocker lever and again check for lateral movement. If any movement can be felt, the pivot points and sockets must be inspected for wear, and if worn, the defective part or parts replaced. A similar check must be made between the spring plates and their locating points on the rocker lever and adjusting screw in the valve chamber.

### **Valve chamber cover**

**41.** Examine the top cover of the valve chamber for damage, particularly to the machined face, which if damaged or scratched might affect the seal or joint between the cover and the valve chamber casting.

**42.** Examine the threads of the rocker lever spring adjustment-screw and ascertain that its flats and lower pivoting point are free from damage.

### **Half-ball**

**43.** Ensure that the half-ball orifice valve



swivels freely in its socket in the rocker lever, and that the seating face of the half-ball is optically flat. This should be checked by means of optical flats.

#### **Pivot plate and rocker lever assembly**

**44.** Inspect the assembly for freedom from damage. Ensure that the bonded rubber seal is in such condition that an effective joint can be made between the valve chamber and the capsule chamber. The pivot plate must be securely located on its mating spigot on the rocker lever.

**45.** Check the threads, slotted head, tab-washer and lock-nut of the adjustment screw for damage, ensure that the face of the screw, which is in contact with the operating needle, is not indented or worn. Inspect the spigot of the rocker lever, which locates the spring plate of the rocker lever adjustment spring, also the face at the other end of the lever, which is in contact with the stop screw in the base of the capsule chamber, for wear, corrosion and damage.

**46.** If it is necessary to dismantle the rocker lever assembly, inspect the spigot hole in the pivot plate and its locating spigot on the rocker lever for fretting and wear. Check the plate for distortion and condition of bonded rubber joints.

#### **Note . . .**

*The pin hinge type of rocker lever must not be dismantled. If it is defective the complete assembly must be renewed.*

#### **Orifice**

**47.** Examine the external thread of the orifice for damage and distortion. The lands of the orifice must be smooth and the seating face which mates with the half-ball in the rocker lever must be checked for flatness by using an optical flat. Inspect the adjustment shims for cracks and damage.

#### **Rocker lever adjusting spring**

**48.** Examine the helical spring for damage, distortion or sharp edges. The two spring plates must be clean and must be examined for any signs of damage, cracks or bruises.

#### **Magnetic crack detection**

**49.** The half-ball and adjusting sleeve must be subjected to a magnetic crack detection test. If flaws or cracks are revealed, the part or parts concerned are to be scrapped.

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### **RE-BUILDING THE UNIT**

#### **Note . . .**

*All parts must again be thoroughly cleaned para. 20 to 23) before reassembling. A slight smear of white petroleum jelly on the gaskets or paper joints will retain them in correct location during assembling.*

#### **Setting the clearance between the orifice and the half-ball seating in rocker lever**

**50.** In order to check this clearance it will be necessary temporarily to assemble the valve chamber, the rocker lever assembly and the capsule chamber; first without the orifice and half-ball seating fitted, and again with these parts assembled in position.

**51.** To facilitate assembly, the adjusting screw in the rocker lever should be screwed in as far as possible so that the face of the screw which contacts the operating needle is flush with the lower face of the rocker lever. The stop screw in the base of the capsule chamber should be unscrewed until the point of the screw is flush with the face of the boss inside the chamber casting.

**52.** Place the rocker lever assembly into position with the valve chamber and using two slave nuts, plain and grover washers, temporarily secure the capsule chamber to retain the assemblies together. The rocker lever is now assembled in the neutral or free position.

**53.** Place the holder T.196218 complete with a dial test indicator on the top face of the valve chamber as shown in fig. 3. Adjust the indicator to zero with the measuring button resting on the point of the rocker lever spring seating. Lock the D.T.I. at zero then remove the complete instrument and separate the two chambers.

**54.** Before fitting the orifice, the tabs of the tab-washer must be slightly bent in the direction in which they will be finally locked. The tab-washer should be placed in position and two 0.012 in. shims laid on its upper face, the orifice should then be screwed and tightened in the valve chamber casting with the shims and tab-washer in position between the lower face of the orifice and its mating face on the valve chamber casting. Bend the single tab down against the casting adjacent to the adjusting sleeve bore; access to this tab

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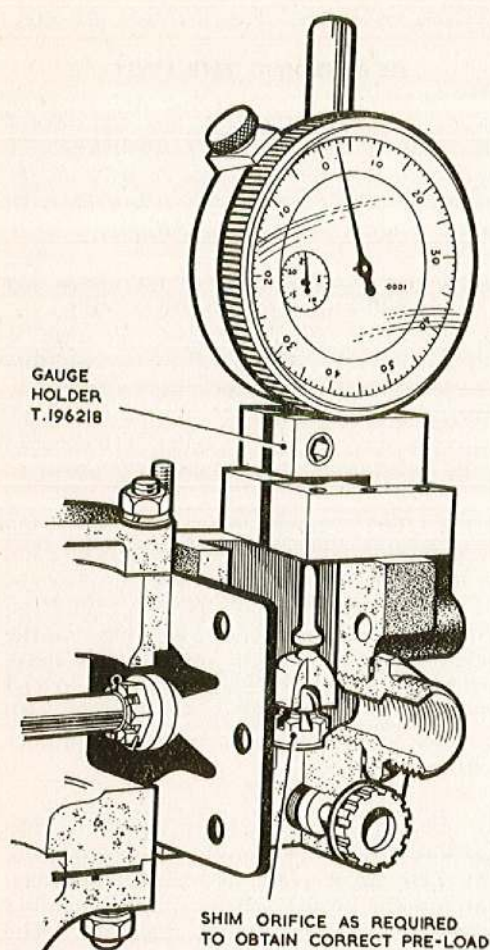


Fig. 3. Setting the rocker lever pre-load

can be gained through the pivot plate aperture.

**55.** Invert the rocker lever and pivot plate assembly and place the half-ball in its socket in the rocker lever. Invert the valve chamber and place the plate and rocker lever in position. Return to the upright position and ensure the half-ball is correctly in position over the orifice and again temporarily secure the two castings together.

**56.** Carefully tighten the stop screw in the base of the capsule chamber until the half-ball is just made to seat on the orifice and again place the dial test indicator as in para. 53 except that the orifice and half ball will now be fitted. The reading now should be 0.002 in. on the plus side of the dial. Adjust the setting by the addition or removal of shims.

**57.** Again separate the two castings of the unit, and lock over the two tabs upwards against the flats on the head of the orifice.

#### Capsule and valve chambers

**58.** The capsule chamber and rocker lever complete with the half-ball seating can now be finally assembled to the valve chamber. These details should be assembled as described in para. 55, but the whole assembly should be secured with six nuts, plain and grover washers, instead of two.

**59.** Before commencing assembly, ensure that the gasket, which is fixed to the adjusting sleeve face on the underside of the valve chamber casting, is in serviceable condition. If this gasket is torn or damaged it must be replaced; but before replacing it, ensure that all traces of the old gasket are removed, that the face of the valve chamber casting is clean, and that no pieces of the old gasket have lodged in the valve chamber or any of its parts. A thin layer of Hermetite should be smeared on the chamber face; ensure that no jointing compound enters the adjusting sleeve bore, that the new gasket is placed in position, and that the Hermetite is allowed to dry. This will position the gasket during the subsequent re-assembly, and every care must be taken to avoid damaging it during this period.

**60.** Screw in the stop screw in the base of the capsule chamber until it just contacts the rocker lever, then slacken back a few turns to ensure that the rocker lever is free.

**61.** Place the tab-washer over the adjustment screw in the centre of the rocker lever and screw on the locking nut, adjusting the screw until this shows approximately  $\frac{1}{4}$  in. above the nut, lock over the tab which locates on the rocker lever.

**62.** Invert the unit and temporarily assemble into position the eccentric adjusting sleeve, the operating needle, the piston sleeve and piston. Secure this assembly with two slave 2 B.A. screws and plain washers, the screws passing through the adjusting sleeve and tightened into the valve chamber. The "X" marked on the side of the flange of the adjusting sleeve indicates the position of the maximum adjustment hole and the sleeve must be assembled with the "X" positioned as close to and in line with the stop screw in the base of the capsule chamber.



63. Screw in the adjustment screw in the rocker lever until the bottom face of the piston is flush with the bottom face of the piston sleeve. Tighten the lower stop screw of the capsule chamber until the flat face of the half-ball of the rocker lever rests on the orifice.

#### Adjustment of rocker lever

64. With the unit in the inverted position, tighten the stop screw in the base of the capsule chamber a further quarter turn to ensure that the half-ball rests firmly on the orifice face, then adjust the rocker lever adjusting screw until the piston is 0.004 to 0.006 in. proud of its sleeve. A standard dial indicator with a special attachment sleeve (fig. 4) should be used for checking this dimension.

65. Bring the unit back into the upright position again, and ensure that the adjusting sleeve assembly is retained in position, and place a new gasket over the studs and on to the upper face of the valve chamber.

66. Fit the rocker lever adjustment spring and cups, and ensure that the lower cup aligns correctly with its spigot on the upper face of the rocker lever. Lower the top cover of the valve chamber into position and secure with six nuts, plain and grover washers.

67. Tighten the rocker lever spring adjusting screw fully and again check the piston projection, after ensuring that the stop

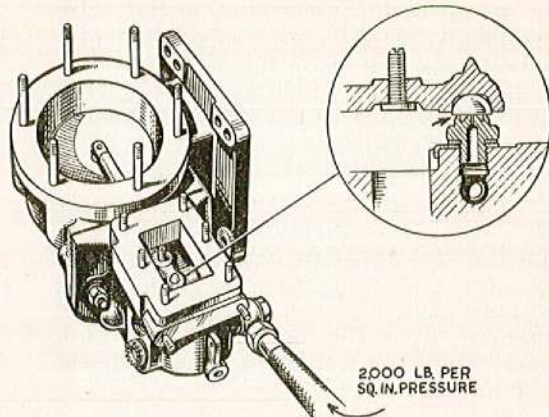


Fig. 5. Orifice valve leakage test

screw in the base of the capsule chamber is not in contact with the rocker lever.

68. Remove the adjusting sleeve, complete with operating needle, piston and piston sleeve from the valve chamber casting and store in a bath of kerosine until required for final assembly (para. 75). Remove the valve chamber cover complete with spring and spring plates.

#### Filter, spring and plug assembly

69. Insert the filter, spring and plug assembly into the smaller of the two holes in the side of the valve chamber and tighten with the special spanner, T.161439.

#### Orifice valve leakage test (fig. 5)

70. Connect a suitable high pressure hand pump to the servo pressure connection in the valve chamber using the standard banjo connection or any other adapter of a suitable size. Kerosine at a pressure of 2,000 lb. per sq. in. should be applied for a minimum period of one minute during which time no leakage should occur past the orifice.

#### Valve body leakage test (fig. 6)

71. Refit the valve chamber cover complete with spring and spring plates. Fit the adapter plate in position to the base of the valve chamber. Blank off, using a suitable size blank, the union connection in the plate and the

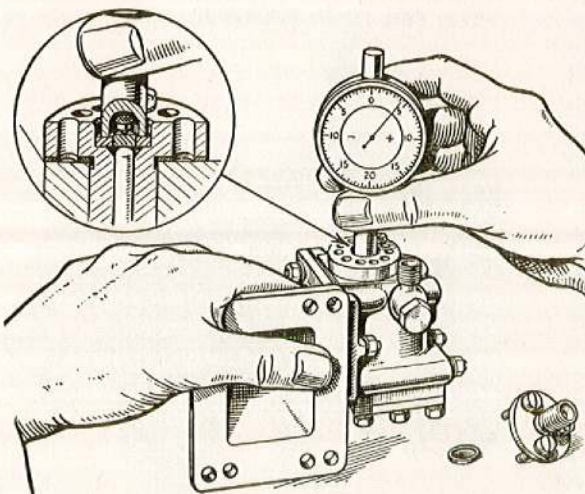


Fig. 4. Adjusting the operating piston



servo pressure connection with a blanking plug. Connect the air pressure line to the pump suction connection in the valve chamber using the banjo or an adapter of a suitable size and submerge the unit in a bath of kerosine. Apply an air pressure of 40 lb. per sq. in. for a minimum period of one minute and examine the unit for leaks. All leaks must be traced and rectified.

72. After the satisfactory conclusion of this test the unit must be thoroughly dried by means of compressed air. It is important that all traces of kerosine are removed from the unit, otherwise such traces might be misleading on subsequent test for leaks.

#### Capsule stack

73. Lower the capsule stack into the chamber with its lower pivot point in correct location with the rocker lever and with the soldered vacuum seal of the capsule stack uppermost.

74. Fit the circular gasket on the cover face of the capsule chamber, fit the capsule chamber cover and secure the assembly with six nuts, plain and grover washers. To avoid damaging the capsule stack and to ensure that the socket of the pivot screw in the chamber cover is correctly located with the upper pivot point of the capsule stack, the following procedure should be adopted when fitting the cover. Screw the pivot screw into the cover as far as possible and place the socket of the pivot screw over the upper pivot of the capsule. Holding the cover in the hand, screw out the pivot screw, then gradually lower the cover, keeping the socket and capsule point in correct location until the cover is correctly positioned on the capsule chamber. Avoid using undue force during this operation. After the cover has been secured, loosely position a plain washer and lock-nut on both top and bottom pivot screws.

#### Adjusting sleeve assembly

75. Thoroughly clean all parts of the adjusting sleeve assembly. Invert the valve and capsule chamber assembly and fit the adjusting sleeve, complete with operating needle, piston and piston sleeve, into its bore in the valve chamber casting. The sleeve should be positioned in the same way as described in para 62, i.e., with the "X" marking in line with the centre line of the joint flange. Place the operating disc into position on the adjusting sleeve,

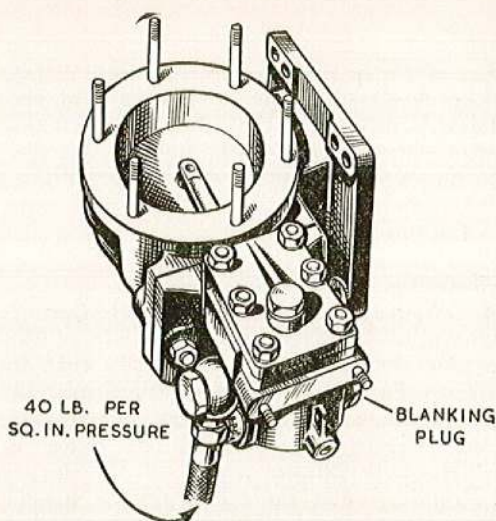


Fig. 6. Valve body leakage test

fit the H.P. adapter and secure the adapter and adjusting sleeve assembly with three 2 B.A. screws. These screws pass through the adapter and the holes in the adjusting sleeve, and tighten into three tapped holes in the valve chamber casting. Tab-washers are used for locking the screws when the adapter is drilled for this purpose, plain and grover washers are used on the other types.

#### Installation connections

76. Before fitting the connections to pump inlet and torch igniters, ensure that all the joint faces and joint washers are clean and undamaged. With the joint washers,

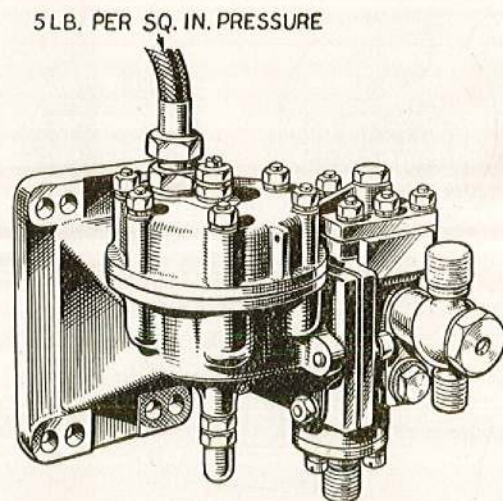


Fig. 7. Capsule chamber cover leakage test

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distance piece, banjo and plug adapter arranged as shown in fig. 1, screw and tighten the plug adapter into the valve chamber casting. Fit and secure the dust caps in position.

**77.** The pump servo connection and fittings should be inspected and fitted in a similar manner into the other side of the valve chamber as shown in fig. 1. Fit and secure the dust cap in position.

#### Capsule chamber cover leakage test

**78.** Connect an air line to the air vent of the capsule chamber cover (fig. 7) and submerge the unit in kerosine. Apply an air pressure of 5 lb. per sq. in. and inspect the capsule chamber cover joint for leaks which will be indicated by air bubbles. Slight leakage around the pivot screw in the capsule chamber cover is permissible but all other leaks must be traced and rectified.

#### Note . . .

*On no account must this 5 lb. per sq. in. air pressure be exceeded, otherwise the unit may be made unserviceable by the capsule pivot points becoming disengaged from their mating sockets.*

### REPLACEMENTS

**79.** Irrespective of condition all lock-wires and split pins must be replaced. If a joint or seal is broken, the gasket seal or joint washer must be renewed, the only exception is the adjusting sleeve joint on the base of the valve chamber casting, which, if sound and undamaged, may be used again.

#### Installation connections, valve chamber and capsule chamber

**80.** Installation connections, valve chamber and top cover, capsule chamber and cover are separately interchangeable.

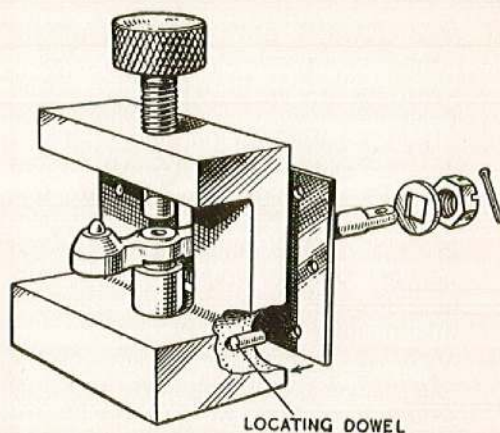
#### Filter

**81.** If either the filter, spring or plug is damaged the complete assembly must be rejected and a replacement fitted.

#### Adjusting sleeve assembly

**82.** All parts of the adjusting sleeve assembly are interchangeable but if a replacement needle or piston is fitted the piston projection must be checked as described in para. 64.

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**Fig. 8. Assembling rocker lever and pivot plate**

#### Capsule stack

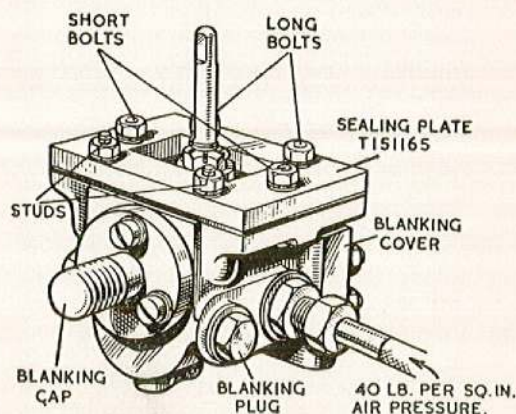
**83.** If the capsule stack is damaged, fit a complete replacement stack.

#### Half-ball and orifice

**84.** The half-ball and orifice are separately interchangeable. If it is necessary to replace either or both of these parts ensure that the seating faces of the replacements are flat (para. 43 and 47).

#### Rocker lever assembly

**85.** Normally the rocker lever and pivot plate assembly will be carried as an assembled spare, but all the components, with the exception of those on the pin hinge type of rocker lever, are separately interchangeable. If it is necessary to build up this assembly from separate components, the method, the fixture (T.140539) and



**Fig. 9. Pivot plate leakage test**

(A.L. 44, Nov. 56)

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tools to be used are described in the following operations and are illustrated in fig. 8.

- (1) First place the pivot plate, which has a rubber seal bonded to both its joint faces, against the dowelled face of the assembling fixture (T.140539) locating it by its holes and the dowel pins in the fixture. In instances where the thickness of the bonded rubber seal on either side of the plate is not equal, the thicker side must always be assembled facing the high pressure side, i.e., towards the orifice, otherwise subsequent leakage may result.
- (2) With the spring-plate spigot of the rocker lever pointing upwards, pass the rocker lever through the hole in the centre of the assembling fixture, locating the square boss on the lever with the square hole in the pivot plate. Fit the reinforcing washer on to the lever and secure the whole assembly with the nut, which at this stage should not be tightened.
- (3) Tighten the knurled screw of the assembling fixture until the lower face of the adjustment screw boss on the rocker lever is seating squarely on its mating boss on the fixture. Check the pivot plate to see that it is free on the locating dowels and that the joint face is square with the face of the assembling fixture. If the location is satisfactory finally tighten the nut.
- (4) Remove the pivot plate and rocker lever from the assembling fixture and fit it to a valve chamber. The valve chamber should have its top cover fitted and all ports, with the exception of the one to which the air line is fitted, blanked off. Place the sealing plate (T.151165) as shown in fig. 9, on the outer face of the pivot plate and locate it on the two studs of the valve chamber, fit plain and grover washers over the studs and secure with two nuts. Four bolts of a suitable size and length should be passed through the flange of the valve chamber and sealing plate. Nuts, plain and grover washers should be fitted to the bolts and all six nuts tightened, care being taken to avoid distorting the flange and sealing plate.
- (5) Connect an air line to the open port in the valve chamber and submerge the assembly in a bath of kerosine. Apply an air pressure of 40 lb. per sq. in. for a minimum period of one minute

and examine the joints between the pivot plate and rocker lever, valve chamber casting, and sealing plate for leaks.

- (6) If leakage occurs, strip the assembly and rebuild with a replacement diaphragm group and repeat the test until no leakage results. When satisfactory, lock the rocker lever and slotted securing nut with a  $\frac{3}{16}$  in. diameter split pin.

#### PRELIMINARY RIG TESTS

##### General notes

86. Carefully record all calibration and endurance test results for subsequent entry into the official test record sheet.

87. Unless stated otherwise the fuel used throughout these tests is to be AVTUR. The limits of the temperature of the fuel must be between 20 and 40 deg. C. Checks should be made at regular intervals to ensure that the fuel conforms to these standards.

##### Barometric pressure correction procedure

88. The barometric pressure control unit regulates the pump delivery pressure in accordance with barometric pressure. As barometric pressure readings vary from day to day, and all recorded pump delivery pressures must be based upon a standard barometric pressure of 30 in. mercury Absolute, observed pump pressures must be converted to the standard barometric pressure.

89. To obtain the corrected pump delivery pressure under ground level conditions, the difference between the barometric pressure of the day and the standard barometric pressure (30 in. mercury Absolute) must be added to or subtracted from the specified capsule pressure. For instance if the barometric pressure of the day is 29.5 in. mercury Absolute, 0.5 in. mercury must be added to the specified capsule pressure; if on the other hand the barometric pressure of the day exceeds the standard pressure, the excess amount must be subtracted from the specified capsule pressure.

90. For altitude conditions, correction is made by employing a manometer fitted with a sliding scale graduated in divisions giving Absolute pressures. When this scale is set to the prevailing barometric pressure of the day and the mercury column set to the desired capsule pressure,



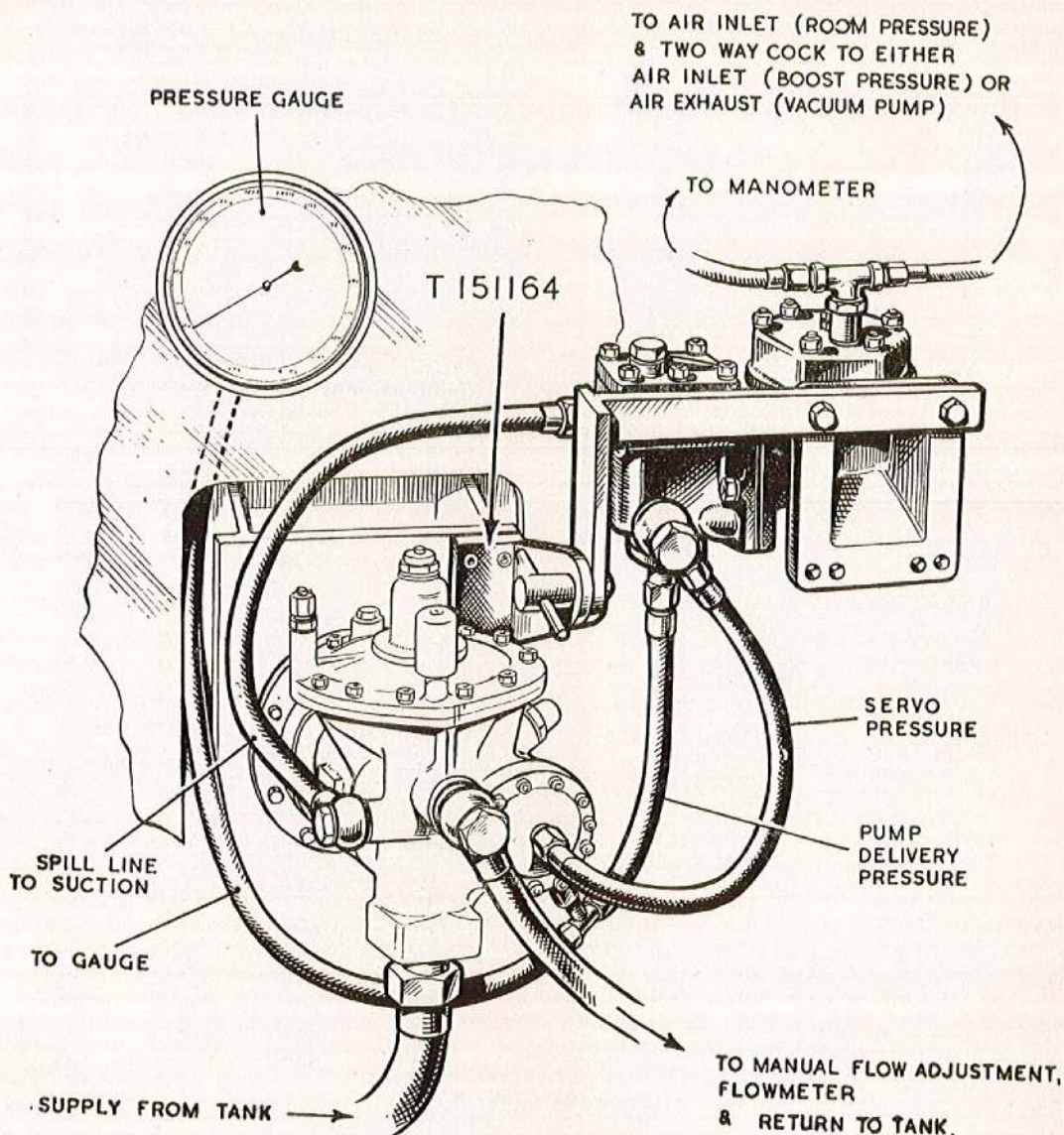


Fig. 10. Unit mounted on test rig

the corrected pump delivery pressure can be read straight off.

91. When checking the barometric pressure control unit at specified altitudes, the specified capsule pressure must be corrected for the barometric pressure of the day in the same way as it is corrected under ground level conditions. Hence, if the altitude reading is represented by a capsule pressure of 10 in. mercury Absolute and the day barometric pressure is 29.5 in.

mercury Absolute, the manometer mercury levels must be adjusted to give a capsule pressure of 10.5 (10+0.5) in. mercury Absolute or a manometer reading of 19.5 (30 - 10.5) in. mercury Vacuum—namely, the difference between the two mercury levels.

#### Setting the capsule and spring pre-loads

92. Assemble the barometric pressure control unit on to the rig R.64 and connect as shown in fig. 10.



93. Start the pump motor and adjust the flow of fuel by means of the downstream restriction to the required figure in the following table.—

| Calibration | Flow<br>Galls. per hr. |
|-------------|------------------------|
| AA          | 920                    |
| AB          | 920                    |
| E           | 450                    |
| G           | 450                    |
| K           | 500                    |
| L           | 410                    |
| N           | 450                    |
| S           | 450                    |
| U           | 500                    |
| W           | 500                    |
| Z           | 410                    |

94. Set the pre-load of the rocker lever spring by fitting shims between the head of the spring adjusting screw and the valve chamber cover until the following pressure is obtained and record the observed pressure on the test card.

| Calibration | lb. per sq. in. |
|-------------|-----------------|
| AA          | 1,900 to 2,000  |
| AB          | 1,850 to 1,900  |
| E           | 1,600 to 1,700  |
| G           | 1,700 to 1,800  |
| K           | 1,450 to 1,500  |
| L           | 1,350 to 1,400  |
| N           | 1,850 to 1,920  |
| S           | 1,325 to 1,375  |
| U           | 1,700 to 1,800  |
| W           | 1,700 to 1,800  |
| Z           | 1,400 to 1,450  |

**Note . . .**

Shims of 0.012 in. are equivalent to a pressure variation of approximately 40 lb. per sq. in.

95. Whilst the unit is subjected to this pressure inspect the high pressure adapter at the base of the valve chamber for fuel leaks. If any leaks, however slight, are noted they must be traced and rectified.

96. Adjust the capsule pivot screw until the pump delivery pressure at 30 in. mercury Absolute corrected (para. 89), is as follows:—

| Calibration | lb. per sq. in. |
|-------------|-----------------|
| AA          | 1,330 to 1,380  |
| AB          | 1,455 to 1,485  |
| E           | 1,250 to 1,300  |
| G           | 1,115 to 1,165  |
| K           | 1,060 to 1,090  |
| L           | 980 to 1,030    |
| N           | 1,315 to 1,365  |
| S           | 1,020 to 1,050  |
| U           | 1,230 to 1,270  |
| W           | 1,160 to 1,210  |
| Z           | 1,040 to 1,070  |

**Preliminary calibration**

97. Two series of test figures are taken during this calibration, one after the first fifteen minutes of the test and the second, which must be under the inspector's supervision, after the barometric pressure control has completed two hours test. The figures observed during these tests must strictly conform to the figures contained in the accompanying calibration table, with the exception that readings starred are included in the second test only. These readings are obtained by operating the two-way cock (fig. 10) which allows the additional mercury boost to be given to atmospheric pressure.

**CODE "AA" CALIBRATION TABLE**  
(Nominal amplification ratio 61.8 : 1)

| CAPSULE PRESSURE | PUMP DELIVERY PRESSURE<br>(lb. per sq. in.) |                 | FLOW<br>Gall. per hr. |
|------------------|---------------------------------------------|-----------------|-----------------------|
|                  | In. mercury Absolute                        | Minimum Maximum |                       |
| 40               |                                             | 1,615 1,695     | 920                   |
| 35               |                                             | 1,475 1,535     | 840                   |
| 30               |                                             | 1,330 1,380     | 760                   |
| 25               |                                             | 1,180 1,230     | 680                   |
| 20               |                                             | 1,040 1,080     | 600                   |
| 15               |                                             | 890 920         | 520                   |
| 10               |                                             | 740 780         | 420                   |
| 5                |                                             | 595 615         | 300                   |

**CODE "AB" CALIBRATION TABLE**  
(Nominal amplification ratio 64.2 : 1)

| CAPSULE PRESSURE | PUMP DELIVERY PRESSURE<br>(lb. per sq. in.) |                 | FLOW<br>Gall. per hr. |
|------------------|---------------------------------------------|-----------------|-----------------------|
|                  | In. mercury Absolute                        | Minimum Maximum |                       |
| 40               |                                             | 1,775 1,815     | 920                   |
| 35               |                                             | 1,612 1,648     | 830                   |
| 30               |                                             | 1,455 1,485     | 750                   |
| 25               |                                             | 1,295 1,323     | 670                   |
| 20               |                                             | 1,135 1,162     | 580                   |
| 15               |                                             | 978 1,000       | 500                   |
| 10               |                                             | 818 849         | 406                   |
| 5                |                                             | 660 680         | 265                   |

**Note . . .**

Calibration is to be effected on a rig having a single 'D' size fuel pump giving a servo flow of 9 to 10.5 g.p.h. at 1,000 lb. per sq. in. and 150 g.p.h. main flow.

**CODE "E" CALIBRATION TABLE**  
(Nominal amplification ratio 81.5 : 1)

| CAPSULE PRESSURE | PUMP DELIVERY PRESSURE<br>(lb. per sq. in.) |                 | FLOW<br>Gall. per hr. |
|------------------|---------------------------------------------|-----------------|-----------------------|
|                  | In. mercury Absolute                        | Minimum Maximum |                       |
| 35               |                                             | 1,445 1,500     | 450                   |
| 30               |                                             | 1,250 1,300     | 450                   |
| 25               |                                             | 1,055 1,100     | 400                   |
| 20               |                                             | 860 895         | 350                   |
| 15               |                                             | 665 695         | 300                   |
| 10               |                                             | 470 495         | 250                   |
| 5                |                                             | 275 295         | 200                   |

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**CODE "G" CALIBRATION TABLE**  
(Nominal amplification ratio 90.2 : 1)

| CAPSULE PRESSURE | PUMP DELIVERY PRESSURE<br>(lb. per sq. in.) |                      | FLOW<br>Gall.<br>per hr. |
|------------------|---------------------------------------------|----------------------|--------------------------|
|                  | In. mercury<br>Absolute                     | Minimum      Maximum |                          |
| *40              |                                             | 1,545      1,615     | 450                      |
| *35              |                                             | 1,335      1,390     | 400                      |
| 30               |                                             | 1,115      1,165     | 360                      |
| 25               |                                             | 900      940         | 315                      |
| 20               |                                             | 685      715         | 265                      |
| 15               |                                             | 465      490         | 210                      |
| 10               |                                             | 240      265         | 150                      |
| 8                |                                             | 175      155         | 105                      |

**CODE "K" CALIBRATION TABLE**  
(Nominal amplification ratio 56.1 : 1)

| CAPSULE PRESSURE | PUMP DELIVERY PRESSURE<br>(lb. per sq. in.) |                      | FLOW<br>Gall.<br>per hr. |
|------------------|---------------------------------------------|----------------------|--------------------------|
|                  | In. mercury<br>Absolute                     | Minimum      Maximum |                          |
| *40              |                                             | 1,330      1,380     | 500                      |
| *35              |                                             | 1,200      1,250     | 500                      |
| 30               |                                             | 1,060      1,100     | 500                      |
| 25               |                                             | 930      960         | 500                      |
| 20               |                                             | 795      820         | 500                      |
| 15               |                                             | 660      670         | 500                      |
| 10               |                                             | 525      535         | 400                      |

Note: Calibration K is to be effected on a single pump rig with 0.027 in. dia. servo orifice. Refer to para. 1.

**CODE "L" CALIBRATION TABLE**  
(Nominal amplification ratio 54 : 1)

| CAPSULE PRESSURE | PUMP DELIVERY PRESSURE<br>(lb. per sq. in.) |                      | FLOW<br>Gall.<br>per hr. |
|------------------|---------------------------------------------|----------------------|--------------------------|
|                  | In. mercury<br>Absolute                     | Minimum      Maximum |                          |
| 35               |                                             | 1,105      1,165     | 450                      |
| 30               |                                             | 980      1,030       | 450                      |
| 25               |                                             | 850      890         | 400                      |
| 20               |                                             | 720      755         | 350                      |
| 15               |                                             | 595      625         | 300                      |
| 10               |                                             | 465      490         | 250                      |
| 5                |                                             | 335      355         | 200                      |

**CODE "N" CALIBRATION TABLE**  
(Nominal amplification ratio between 63.3 and 70 : 1)

| CAPSULE PRESSURE | PUMP DELIVERY PRESSURE<br>(lb. per sq. in.) |                      | FLOW<br>Gall.<br>per hr. |
|------------------|---------------------------------------------|----------------------|--------------------------|
|                  | In. mercury<br>Absolute                     | Minimum      Maximum |                          |
| *40              |                                             | 1,630      1,700     | 450                      |
| *35              |                                             | 1,470      1,530     | 420                      |
| 30               |                                             | 1,315      1,365     | 380                      |
| 25               |                                             | 1,155      1,205     | 360                      |
| 20               |                                             | 995      1,035       | 300                      |
| 15               |                                             | 835      865         | 240                      |
| 10               |                                             | 670      700         | 175                      |
| 5                |                                             | 515      535         | 120                      |

**CODE "S" CALIBRATION TABLE**  
(Nominal amplification ratio 66 : 1)

| CAPSULE PRESSURE | PUMP DELIVERY PRESSURE<br>(lb. per sq. in.) |                      | FLOW<br>Gall.<br>per hr. |
|------------------|---------------------------------------------|----------------------|--------------------------|
|                  | In. mercury<br>Absolute                     | Minimum      Maximum |                          |
| 35               |                                             | 1,170      1,205     | 450                      |
| 30               |                                             | 1,010      1,040     | 450                      |
| 25               |                                             | 850      875         | 400                      |
| 20               |                                             | 690      710         | 350                      |
| 15               |                                             | 530      550         | 300                      |
| 10               |                                             | 370      385         | 250                      |
| 5                |                                             | 210      220         | 200                      |

Maximum hysteresis must not exceed 10 lb. per sq. in.

**CODE "U" CALIBRATION TABLE**  
(Nominal amplification ratio 67.2 : 1)

| CAPSULE PRESSURE | PUMP DELIVERY PRESSURE<br>(lb. per sq. in.) |                      | FLOW<br>Gall.<br>per hr. |
|------------------|---------------------------------------------|----------------------|--------------------------|
|                  | In. mercury<br>Absolute                     | Minimum      Maximum |                          |
| 40               |                                             | 1,555      1,600     | 500                      |
| 35               |                                             | 1,390      1,435     | 500                      |
| 30               |                                             | 1,230      1,270     | 500                      |
| 25               |                                             | 1,065      1,100     | 500                      |
| 20               |                                             | 900      935         | 500                      |
| 15               |                                             | 740      770         | 500                      |
| 10               |                                             | 575      605         | 400                      |
| 5                |                                             | 415      435         | 350                      |



**CODE "W" CALIBRATION TABLE**  
(Nominal amplification ratio 62 : 1)

| CAPSULE PRESSURE | PUMP DELIVERY PRESSURE<br>(lb. per sq. in.) |                 | FLOW |
|------------------|---------------------------------------------|-----------------|------|
|                  | In. mercury Absolute                        | Minimum Maximum |      |
| 40               |                                             | 1,460 1,520     | 500  |
| 35               |                                             | 1,310 1,365     | 500  |
| 30               |                                             | 1,160 1,210     | 500  |
| 25               |                                             | 1,005 1,050     | 500  |
| 20               |                                             | 855 900         | 500  |
| 15               |                                             | 705 745         | 500  |
| 10               |                                             | 560 595         | 350  |
| 5                |                                             | 410 440         | 250  |

**CODE "Z" CALIBRATION TABLE**  
(Nominal amplification ratio 61 : 1)

| CAPSULE PRESSURE | PUMP DELIVERY PRESSURE<br>(lb. per sq. in.) |                 | FLOW |
|------------------|---------------------------------------------|-----------------|------|
|                  | In. mercury Absolute                        | Minimum Maximum |      |
| 35               |                                             | 1,190 1,230     | 380  |
| 30               |                                             | 1,040 1,070     | 350  |
| 25               |                                             | 890 920         | 310  |
| 20               |                                             | 745 765         | 265  |
| 15               |                                             | 595 615         | 215  |
| 10               |                                             | 450 465         | 160  |
| 5                |                                             | 305 320         | 85   |

**98.** Set the unit at the maximum capsule pressure, and with the corresponding flow as listed, record the pump delivery pressure.

**99.** Reduce the capsule pressure and the flow to the second calibration point and again record the pump delivery pressure.

**100.** Repeat the above process for each calibration point down to the lowest capsule pressure to ensure the full range is covered.

**101.** Repeat the above series of readings in the reverse order, namely, from the lowest to the highest capsule pressure.

**Note . . .**

*It will be necessary to wait for a short time before taking the delivery pressure readings in order that the flow may become stabilized. The corrected pump delivery pressure (para. 88 to 91) must be, at every calibration point, within the limits specified in the calibration table.*

**Adjusting the pump delivery pressure**

**102.** The pump delivery pressure is varied by rotating the adjusting sleeve in its bore in the valve chamber casting. When it is required to alter this pressure, the H.P. adapter must first be removed as described in para. 12, care being taken not to disturb the operating disc. The sleeve, which is assembled in the maximum delivery pressure position, i.e., with its "X" marking opposite the capsule chamber stop screw, should be moved in an anti-clockwise direction to reduce the pressure. Movement of the adjusting sleeve one hole, represents a difference in pressure of approximately 40 lb. per sq. in. Refit the H.P. adapter and repeat the checks described in para. 92 to 96. It should be noted that whenever the adjusting sleeve is re-set the checks described in these paragraphs must be repeated.

**103.** In every instance the pump delivery pressure recorded at any calibration point when decreasing the capsule pressure must not vary by more than 10 lb. per sq. in. from that recorded at the same calibration point during increasing capsule pressure.

**104.** On successful completion of this calibration test, set the lever stop screw by adjusting the capsule pressure to the minimum value, namely 5 in. mercury Absolute (*see table after para. 97*), and adjust the stop screw half a turn out from the point at which it just makes contact with the lever.

**Endurance test**

**105.** Ensure that the unit is inverted during this test as it will enable any foreign matter to be more readily returned to the suction side of the pump away from the adjusting sleeve assembly,

**106.** Set the capsule pressure at 30 in. of mercury Absolute and the corresponding flow as listed in the calibration table. Steadily drop the capsule pressure from this reading down to the minimum listed in the calibration table and up again to 30 in. of mercury Absolute, thus completing the full cycle. Repeat this process for at least sixty cycles, i.e., every two minutes for two hours. During the period of test no manual adjustment to the flow of fuel will be necessary.

**107.** A steady change of pump delivery pressure must be observed, but at any



particular point this will not necessarily conform with that observed in the preliminary calibration above, since no adjustment to the flow is made.

**108.** Fluctuating pressure readings will indicate that either the piston or the operating needle is sticking; or that the operating disc or diaphragm group is faulty. To rectify this trouble the barometric pressure control must be stripped, these parts checked, and if defective, rectified or replaced. Sticking pistons and operating needles should be inspected for cleanliness, roughness and high spots; if any of these defects are noted they should be rectified or the parts replaced. Before refitting them to the unit the needle adjusting sleeve, piston and its cylinders must be passed through a demagnetizing coil. Faulty diaphragm groups and operating discs must be replaced. After the control unit has been reassembled the tests described in para. 86 to 108 must be repeated.

#### FINAL RIG TEST

##### Final calibration test

**109.** Repeat the preliminary calibration test procedure (*para. 97 to 104*) and carefully record the corrected values of pump delivery pressure at each calibration point.

**110.** These values must not vary by more than 10 lb. per sq. in. from those recorded during the preliminary calibration test; if this margin is exceeded, proceed as described in para. 108.

**111.** After successful completion of the final calibration, take note of the position of the eccentric adjusting sleeve and record its position in the form of the number of holes moved from the maximum adjustment position (*para. 102*). Transfer the test and calibration figures to the official test record sheet.

**112.** Using a force feed lubricator, inject 50 c.c. of silicone fluid DC. 200/100 through the vent hole in the capsule chamber top cover then fit a dust cap to the vent.

#### INHIBITION

**113.** Remove the connection fittings from the upper hole in the side of the valve chamber and fill with oil OM-11. Refit the connection details and blanking caps.

**114.** Complete all installation connections, fit dust caps, and wire-lock the unit.



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