Chapter 2

ELECTRIC PRESSURE CONTROL UNIT, TYPE L.P.C. SERIES

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

General

1. The electric pressure control unit is a standard unit differing only in regard to installation connections and calibration settings for various engines. A typical type number e.g., LPC 8/6H comprises the basic type designation (LPC 8), followed by a stroke number (/6) which refers to the particular installation requirements, whilst the final letter (H) indicates the calibration code to which the unit must be adjusted and tested.

2. Scrupulous cleanliness is essential during the reconditioning operations and particularly when assembling.

3. It is recommended that slave nuts, washers, connections and other such details be used when components are to be assembled temporarily.

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

Special tools

5.

Part No.	*Description*
G 61548	Setting ring, solenoid air gap
T.140539	Fixture, rocker lever pivot plate
T.151165	Clamping plate, valve chamber leakage test
T.161439	Key spanner, strainer assembly
T.174675	Box spanner, orifice
T.177125	Box spanner, ¼ in. B.S.F. nuts
T.196218	Gauge holder, setting valve gap
T.201777	Box, spanner push rod
T.201778	Box spanner, valve spring adjusting screw
T.204445/H	Dismantling and assembling fixture
T.204445	Adapter plate, dismantling and assembling
T.265753	Extractor, valve chamber cover

DISMANTLING

General

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

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

8. Dismantling should be carried out where possible with the unit mounted on the fixture T.204445/H as shown in fig. 3. This is a standard hydraulic fixture with special adapter T.204445.

9. The dismantled parts should be placed in thin oil in clean metal boxes. The electrical parts must not be placed in oil but should be stored in clean, dry receptacles.

10. The installation connections vary on different types of unit. They consist basically of a connection to pump servo, a return to pump inlet connection and in some instances a drain connection is attached to the solenoid bowl.

11. Cut and remove the locking wire and remove the installation connections and sealing washers. The shock absorber bushes should be removed from the mounting flange and will be renewed on assembly.

Valve chamber

12. The strainer is located in the lower part of the valve chamber in all types, but in the early types the plug, strainer and spring are a combined assembly and must be removed with the spanner T.161439. On some later types the strainer and plug are separate items, in which case remove the nuts and washers from the studs and withdraw the combined plug and cover. Remove the two sealing rings from the cover, then draw out the strainer from the housing. Remove the sealing ring from the lower end of the strainer.

13. Some of the earlier types of L.P.C. have a blanking cover on the base of the valve chamber. Remove the three nuts cover and plain washers and lift the cover, and gasket off the base of the valve chamber.

14. Remove the cap nut, locknut and plain washers then unscrew the adjusting screw out of the valve chamber cover. Remove the sealing ring from the screw on later types.

15. The valve chamber cover varies in design on different types of units. On early types the cover is rectangular and flat and is secured with six studs with a gasket interposed between the cover and the valve

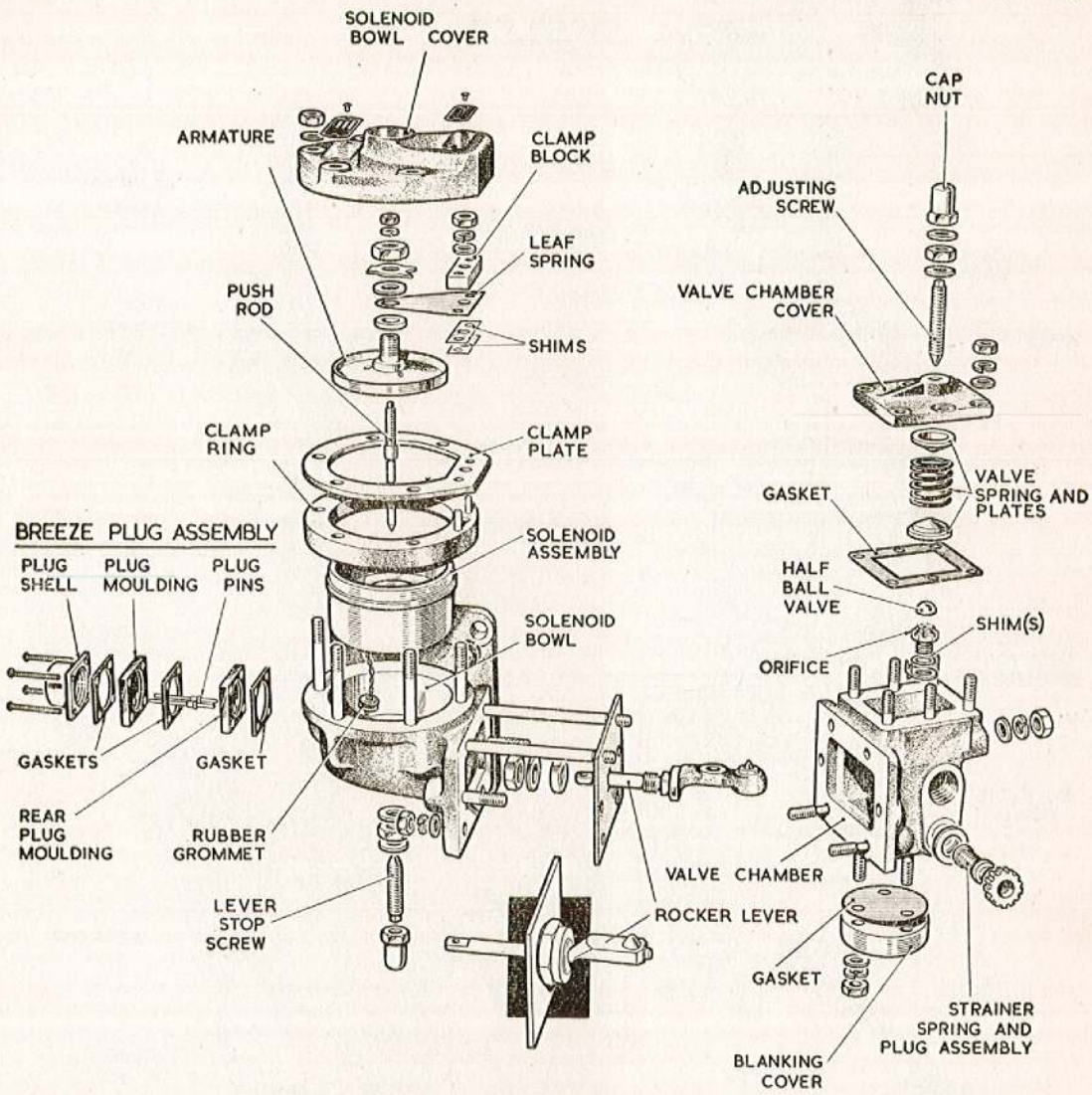

Fig. 1. Electric pressure control unit (early type)

chamber. Remove the nuts, grover and plain washers and lift the cover and gasket off the valve chamber. On later types the cover is triangular and is located in the bore of the valve chamber and sealed with a sealing ring. The extractor T.265753 as shown in fig. 4 is required to withdraw the cover from the valve chamber. Remove the three nuts, grover and plain washers, screw the threaded spindle of the extractor into the adjusting-screw hole in the cover locating the draw plate on the studs at the same time. Screw down the lower portion of the tool to withdraw the cover. Remove the sealing ring from the outer recess round the cover plate.

16. The removal of the valve chamber cover exposes the valve spring which, together with the two end-plates, can now be removed from the valve chamber. Also, if the unit is of the later type, the lever stop-screws should be removed from the side of the valve chamber.

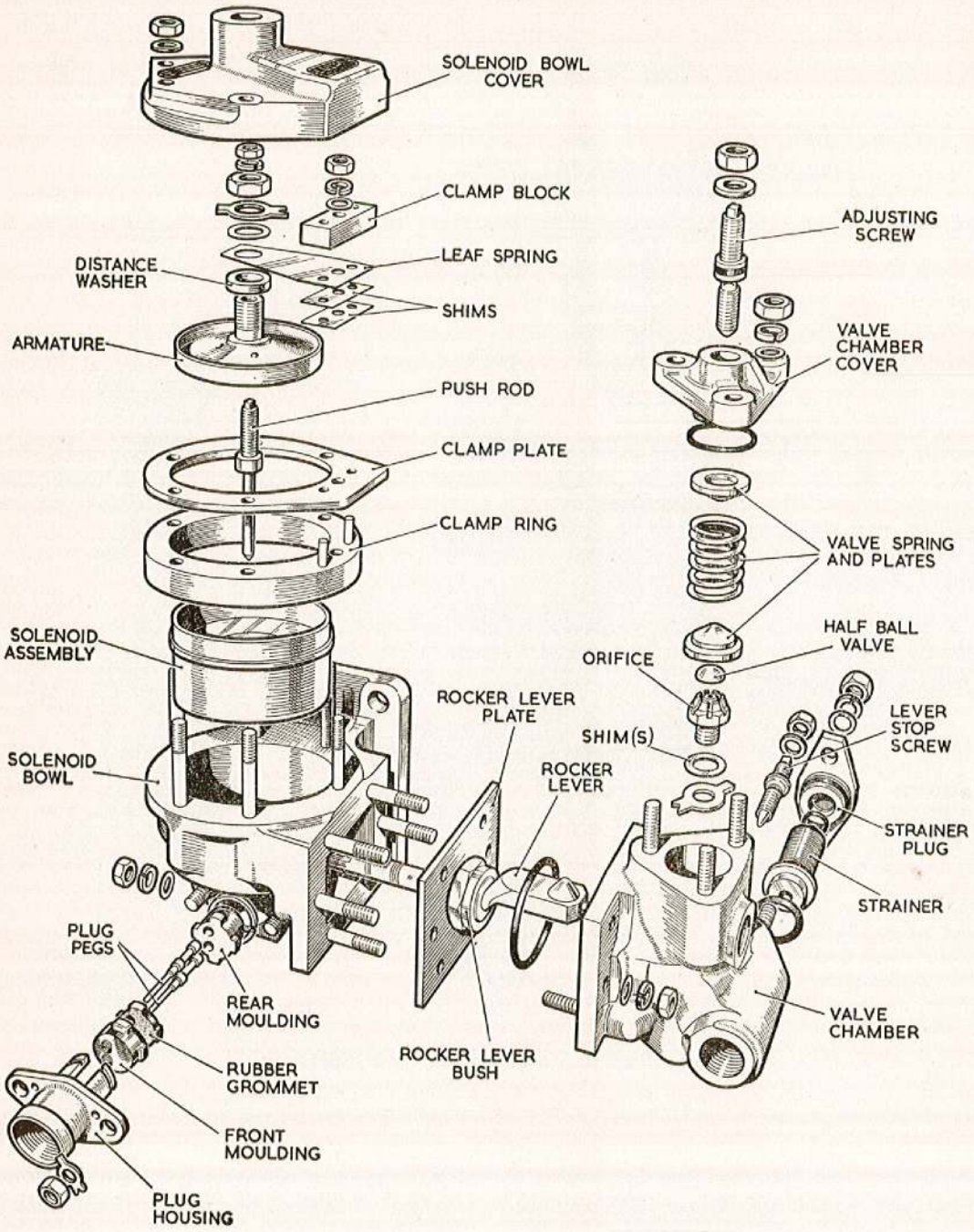

Fig. 2. Electric pressure control unit (later type)

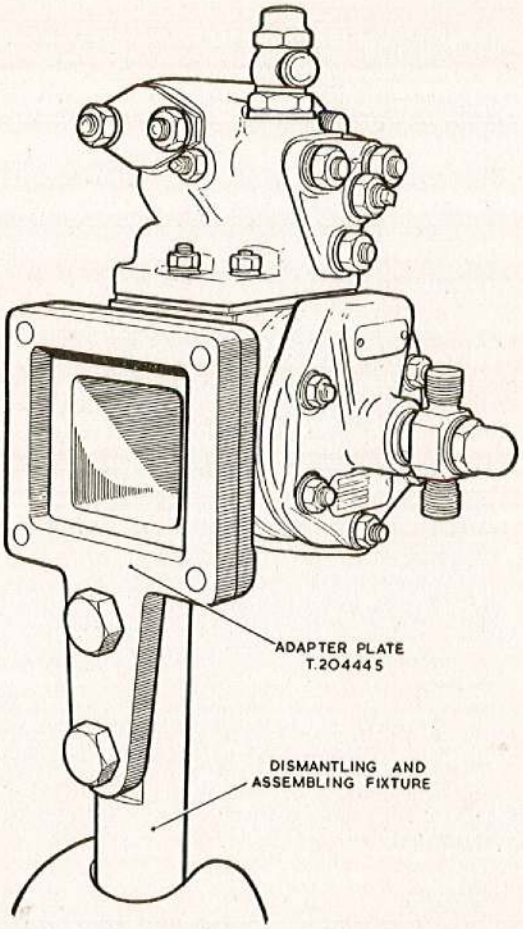

Fig. 3. Dismantling and assembling fixture

17. It is not possible to remove the half-ball and orifice assembly until the valve chamber and solenoid bowl have been separated and the rocker lever assembly withdrawn at a later stage.

Solenoid bowl

18. On earlier units where the lever stop screw is located in the base of the solenoid bowl, this must first be removed.

19. Remove the nuts, grover and plain washers from the securing studs and lift the cover from the solenoid bowl.

Armature assembly

20. Removal of the top cover will expose the nut securing the armature assembly in the unit. Remove the nut, grover and plain washer and lift out the clamping block, armature assembly, and shim. From the securing studs round the casting lift off the clamp plate.

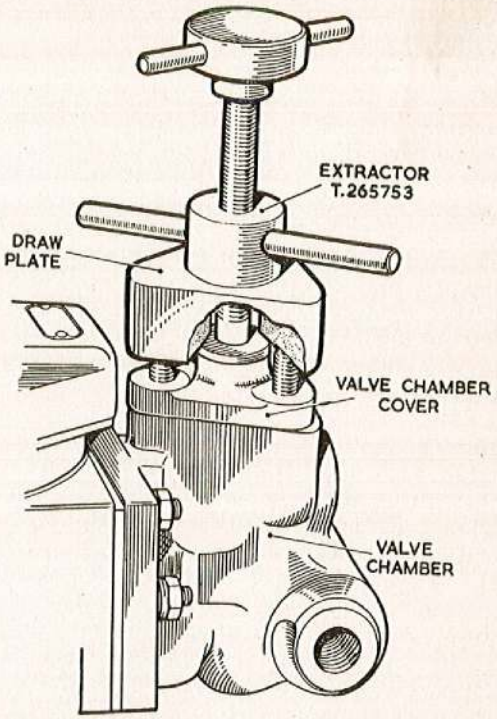

Fig. 4. Removing the valve chamber cover

21. It is necessary to dismantle the armature assembly whether damaged or not in order to enable the solenoid air gap to be re-set on assembly. Remove the small locking nut and washer from the push rod and screw out the push rod from the other side of the armature plate.

22. Bend down the tab of the tab-washer and remove the larger nut followed by the tab-washer, leaf spring and distance washer from the armature. The contacting rivets must not be removed.

Solenoid assembly

23. Removal of the solenoid will involve removal of the electrical connecting socket first and it is recommended that a new electrical connecting socket is fitted on assembly as it is impossible to avoid damage to the socket pins. The position and construction of the electrical connecting socket

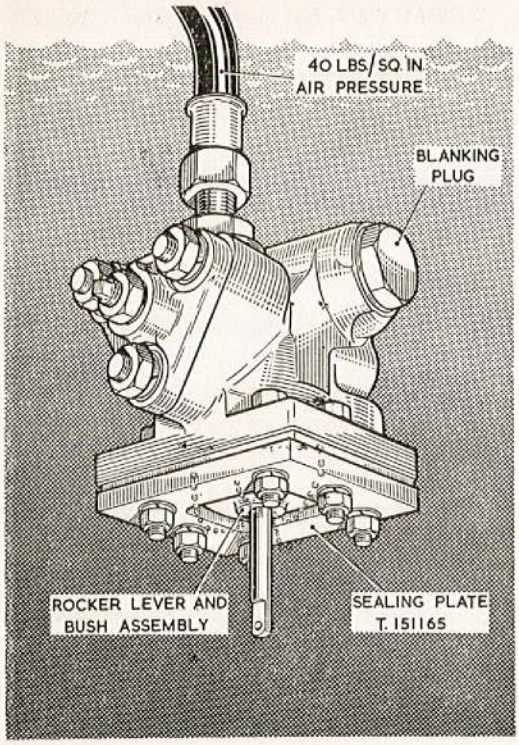

Fig. 7. Rocker lever assembly leakage test

assembly, fit a new pivot plate and repeat the test. If the type incorporating a rocker lever and bush assembly is being tested and leaks occur, then the assembly must be discarded, a new one fitted and the test repeated.

82. Detach the rocker lever assembly from the valve chamber and remove the blanking plugs. Clean the valve chamber in kerosine and dry it with compressed air. Bend up the tabwasher on the rocker lever nut.

Fitting the orifice and setting the valve gap

83. The setting of the half-ball valve relative to the orifice should be within $\pm$ 0·002 in. of the neutral or free position of the rocker lever. To obtain this setting, assemble the lever stop screw either to the bottom of the solenoid bowl or to the side of the valve chamber, according to the type of unit, and fit the locknut and washer, finger tight only. Temporarily assemble together the two housing, interposing the rocker lever assembly between them; the half-ball and orifice are not fitted at this stage.

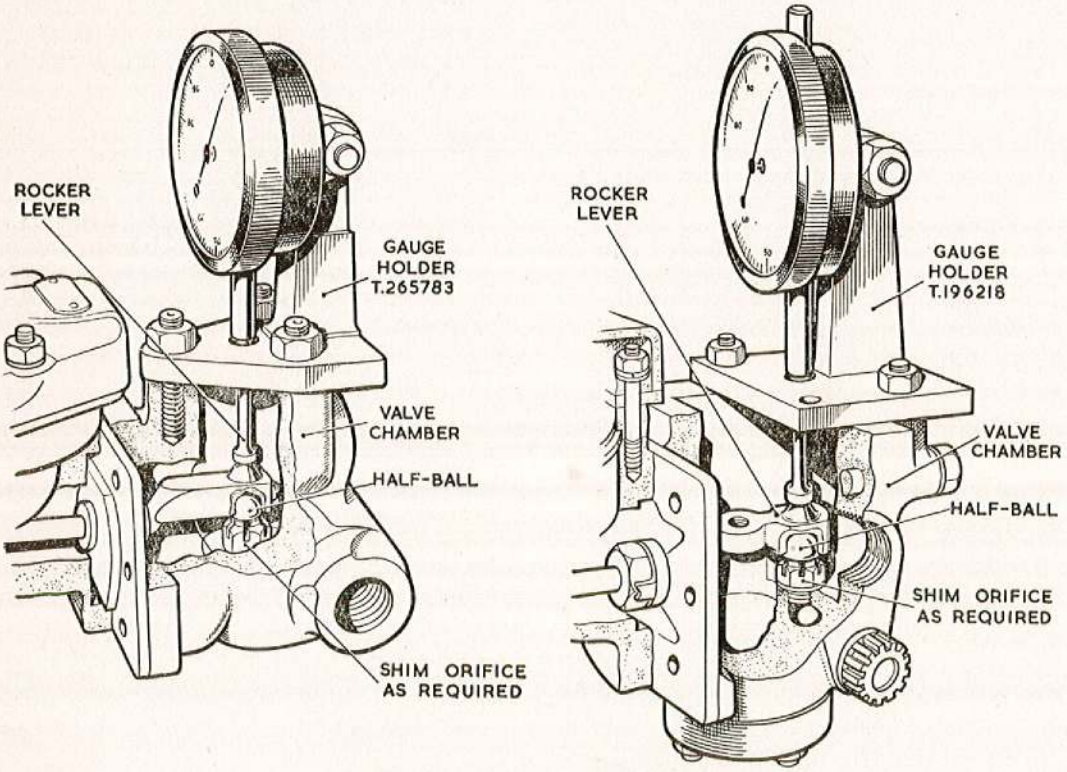

Fig. 8. Setting the valve gap

84. Place the dial test indicator and the holder T.196218 on the top face of the valve chamber as shown in fig. 8 but without the half-ball and orifice fitted. Adjust the indicator to zero, with the measuring button resting on the point of the rocker lever spring plate seating. Lock the indicator at the zero setting and remove it and the holder from the valve chamber. Separate the two castings and withdraw the rocker lever assembly.

85. Lower the orifice, tabwasher, and shims into the base of the valve chamber casting, screw the orifice into the base and tighten it with box spanner T.174675 (*fig.* 6).

86. Invert the rocker lever assembly, place the half-ball in the rocker lever socket, invert the valve chamber casting, pass the rocker lever into it until the half-ball locates on the orifice face. Temporarily secure the two castings together again and screw in the lever stop screw until the half-ball is made to just seat upon the orifice.

87. Place the dial test indicator and holder on the valve chamber again (*fig.* 8). The reading on the dial should now be 0·002 in. on the positive side of the dial. Correct this setting if necessary by addition or removal of the shims under the orifice. When correct, separate the two castings, loosen the lever stop screw, withdraw the rocker lever assembly and lock the tabwasher beneath the orifice.

Fitting the rocker lever

88. The rocker lever assembly must now be fitted to the valve chamber and the assembly of the valve chamber completed, after which a valve leakage test and a valve chamber leakage test are to be made.

89. The valve chamber leakage test involves the total immersion of the unit in kerosine and this is not permissible with the solenoid and electrical socket fitted to the solenoid bowl. If these were removed when dismantling, then fit the rocker lever assembly and the solenoid bowl to the valve chamber and secure them with plain washers, grover washers and nuts (*fig.* 9). If they were not removed when dismantling, then secure the rocker lever assembly to the valve chamber by means of the clamping plate T.151165 (*fig.* 7). Complete the assembly of the valve chamber as detailed in the following paragraphs.

90. Position the valve spring between the spring plates and place it in the unit, taking care to locate the lower spring-plate on the lever.

Valve chamber cover

91. Fit the adjusting screw to the cover and screw it down until the coned end protrudes slightly.

92. Place the rectangular gasket and cover over the studs on the valve chamber, locate the coned end of the adjusting screw in the spring upper plate then press the cover down and secure it with nuts, grover and plain washers. On later types the cover is triangular and is fitted with a rubber sealing ring.

93. Advance the adjusting screw sufficiently to close the orifice and then fit the washers, locknut and dome nut, finger tight only.

Strainer

94. Insert the strainer assembly and washer into the smaller of the two holes in the valve chamber casting and tighten it with the spanner T.161439. Where the strainer and plug are separate items as on later units, assemble the inner and outer sealing rings to the plug cover, place the strainer and sealing ring in the bore, fit the plug cover and secure it with grover washers, plain washers and nuts.

Valve leakage test

95. Connect a pipe line, from a high pressure fuel supply fitted with a pressure gauge, to the servo pressure connection as shown in fig. 9. Ensure that the valve is closed by loading the spring by means of the adjusting screw. Apply a kerosine pressure of 1,500 lb. per sq. in. for approximately one minute duration; any leakage through the valve will be shown by a fall in pressure on the gauge. The test should be repeated at least three times. If the valve leaks, fit a new orifice, or half-ball, or both.

Valve chamber leakage test

96. Blank off the servo pressure connection and attach the air supply line to the connection to pump inlet on the valve chamber (*fig.* 10). Submerge the unit in a bath of kerosine. Apply an air pressure of 40 lb. per sq. in. for 5 minutes and examine

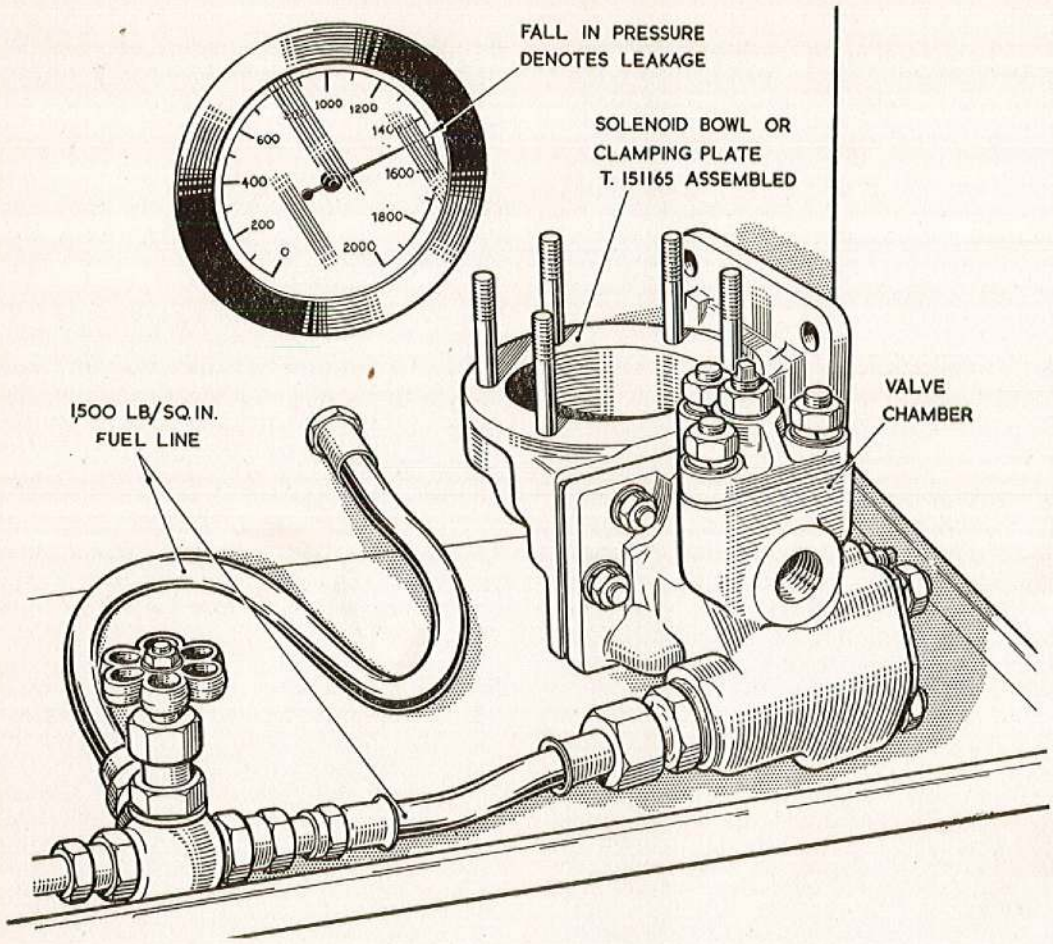

Fig. 9. Valve leakage test

for leaks. Any leakage must be traced and rectified.

97. If the clamping plate was used for this test, remove it and fit the solenoid bowl, securing this with plain washers, grover washers and nuts.

Solenoid

98. Insert the rubber grommet in the base of the chamber where the solenoid leads are to pass through to the electrical plug (early units only). Lower the solenoid assembly into the solenoid bowl and pass the wire leads through the grommet. Press the solenoid down firmly and evenly in the housing and ensure that the collar round the yoke is seating evenly on the flange face of the housing.

99. Fit the clamp ring and clamp plate to the housing allowing the short stud to pass through the hole between the two locating pegs. See that both components are seating correctly.

Setting the solenoid air gap (*fig. 11*)

100. Using a depth micrometer, measure the amount by which the seating rivets stand proud of the armature face, and record the measurement as dimension A.

101. Locate the setting ring G.61548 on the clamp plate and secure it with plain washers and nuts. Screw the push rod into the armature to the full extent of its thread and position the distance washer over the armature stem. Rest the armature assembly on the solenoid yoke with the seating heads of the rivets resting on the armature sleeve. Measure with the depth micrometer the distance from the face of

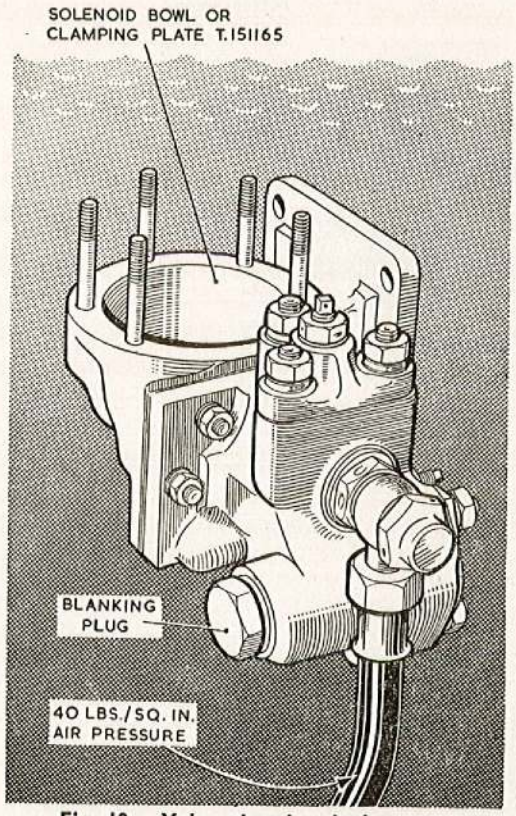

Fig. 10. Valve chamber leakage test

the setting ring to the face of the distance washer and record the measurement as dimension B.

102. Measure the thickness of the leaf spring, and record the measurement as dimension C.

103. Lower the rectangular shim over the short stud and locate it on the two pegs. Fit the leaf spring to the armature assembly followed by the tabwasher and nut, tighten but do not lock the nut. Lower the armature assembly into the unit, locating the leaf spring on the stud and the two pegs, followed by the clamp block. Secure them with a plain washer, grover washer and nut.

104. Now measure from the face of the setting ring to the face of the leaf spring, and record the measurement as dimension D.

105. The sum of C and D subtracted from the sum of A and B will give the existing air gap. Adjust the shims between the leaf spring and clamp plate to give an air gap of 0·030 in.

106. The setting ring should not be removed from the unit nor the solenoid chamber cover fitted until after the calibration tests.

107. Loosely fit the grover washer and nut to the end of the push rod which protrudes through the armature stem.

Electrical connection

108. On early types of unit, roll back the cable sleeving and thread it over the solenoid leads followed by the plug gaskets and rear plug moulding. Insert each lead into the hollow end of a plug pin and secure it with crimping pliers. Locate the rear moulding in the casting, feed back the leads and pass the plug pins through the moulding and plug shell interposing a gasket on either side of the moulding. Slip the cable sleeving over the end of the plug rear moulding and roll over the outside edge of the sleeve. Secure the assembly to the unit with the four screws. Blank off the alternative position for the electrical plug with the blanking cover, nuts, screws and tabwashers.

109. On later types of unit, thread the solenoid leads through the circlip, then through the plug rear moulding and insert each lead into the hollow end of a plug pin. Secure them with crimping pliers. Thread the rubber grommet on to the pins followed by the front moulding and then fit the plug housing over the assembly and secure it with the circlip. Attach the assembly to the unit and secure it with two tabwashers and nuts.

TESTING

110. Fit slave unions and washers to the servo inlet and pump inlet connections. Fit new shock absorber bushes to the mounting flange and mount the unit on the test-rig.

111. Early types of unit are calibrated on pressure differences and are connected as shown in fig. 12, whilst later types are calibrated on flow differences and are connected as shown in fig. 13.

112. The unit is then to be tested in

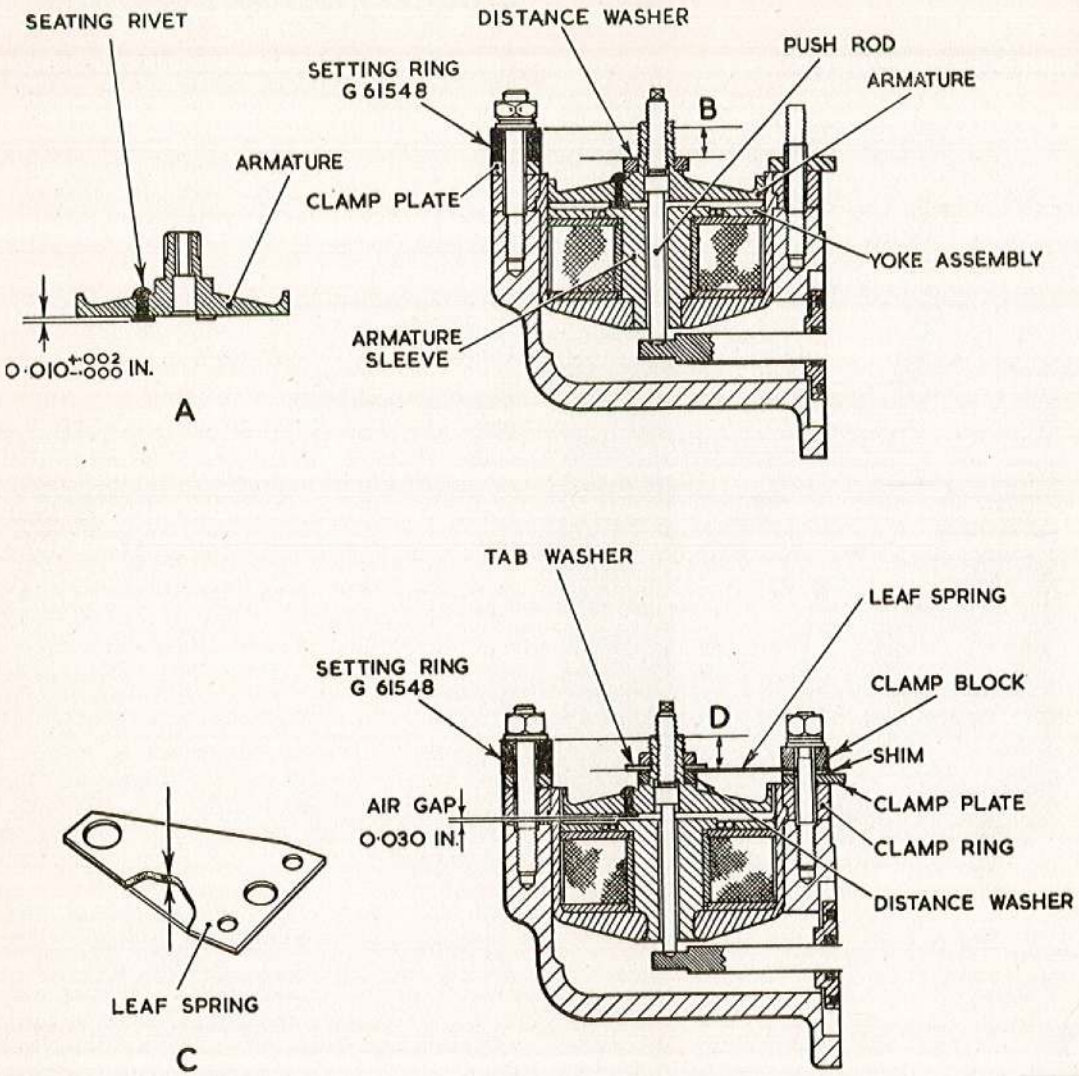

Fig. 11. Setting the solenoid air gap

accordance with its relevant calibration code in the appendices to this chapter. Adjustments to the solenoid armature assembly are to be made with the box spanner T.201777 and to the valve spring adjusting screw with T.201778.

Fuel

113. The fuel specifications, temperature limits and pressure are given in the appendix.

Leakage tests

114. Test the orifice valve by connecting the servo connection to a source of high pressure fuel preferably on the test-rig. Ensure that the valve is closed by loading the spring by means of the adjusting screw.

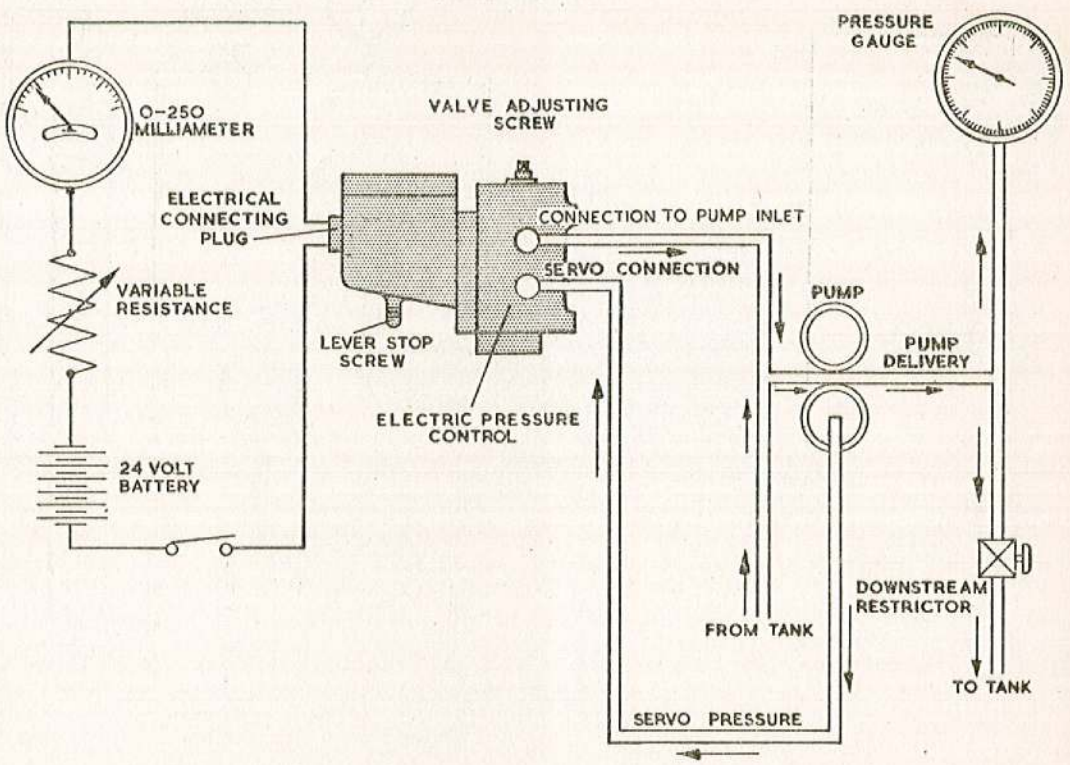

Fig. 12. Diagrammatic layout of test-rig (calibration on pressure differences)

115. The valve body is to be checked for leakage by connecting the return to pump inlet connection to a source of air pressure and then immersing the unit in kerosine. The solenoid must not be assembled for this test (*para.* 89).

Preliminary calibration and endurance test

116. With the unit fully assembled, calibrate it as stated in the appendix after running for 10 minutes at maximum solenoid current.

117. Endurance test the unit over the range and at the conditions stated in the appendix.

118. The unit is to be checked to ensure that there is no excessive calibration change.

119. Bend up the tabwasher on the solenoid armature and lock all adjusting screws. Remove the setting ring G.61548, fit the solenoid chamber cover and secure it with plain washers, grover washers and nuts.

Final calibration test

120. All the results of this calibration are to be recorded and are to meet the calibration requirements.

Insulation test

121. The solenoid is to be megger tested to ensure adequate electrical insulation.

Inhibiting

122. Inhibit the unit as detailed in A.P. 4471A, Vol. 1. Fit the installation connections and blank off all open connections. Complete the wire-locking on the unit.

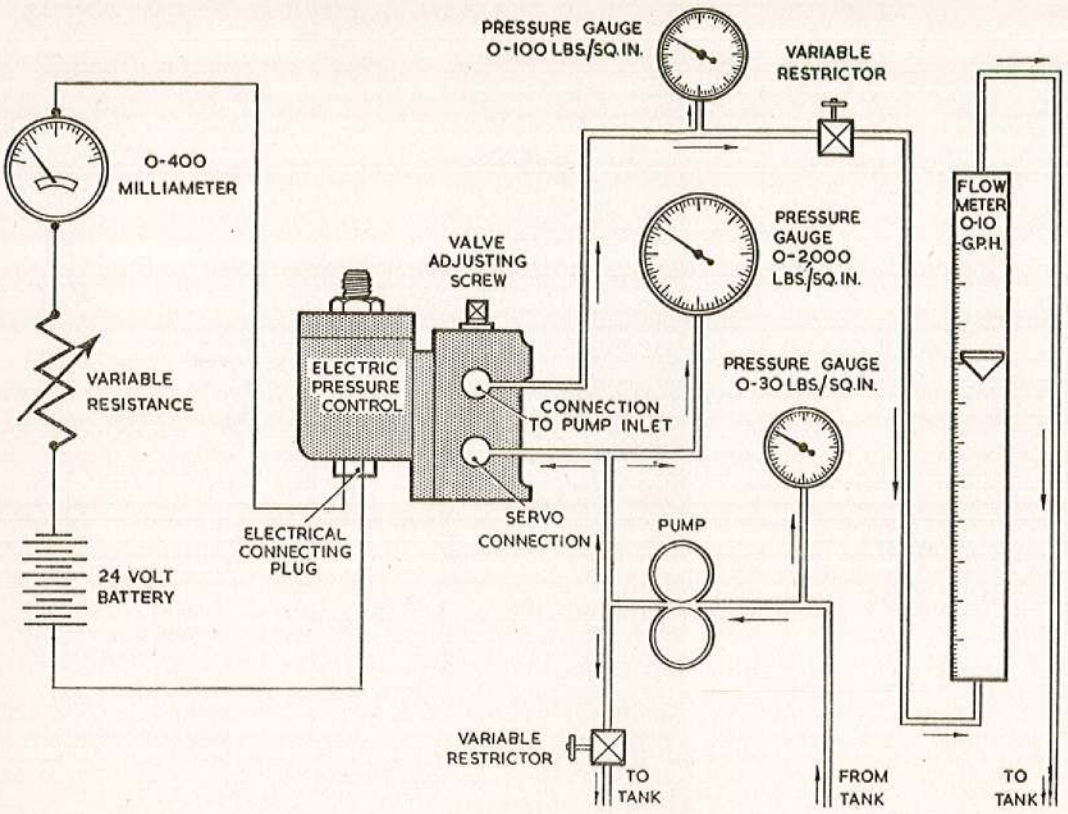

Fig. 13. Diagrammatic layout of test rig (calibration on flow differences)

Appendix 1

CALIBRATION CODE H

Fuel

1. (1) Specification—AVTUR.

(2) Temperature—20 to 40 deg. C.

(3) Inlet pressure—15 to 20 lb. per sq. in.

Leakage tests (*para. 114*)

2. (1) 2,000 lb. per sq. in. static pressure for 5 minutes. No leakage allowed.

(2) Air pressure 40 lb. per sq. in. for 5 minutes. No leakage allowed.

Preliminary calibration and endurance test (*para. 116*)

3. (1) With the solenoid current set at 100 milliamps set the half-ball to open at an inlet pressure of between 400 to 500 lb. per sq. in. Maximum leakage below 400 lb. per sq. in. is 2 cc per minute. Calibrate the unit to the following figures with increasing and decreasing solenoid current.

Solenoid current (milliamps)	Pressure drop across unit at a constant flow of 10 g.p.h. Min.	Max.
150	Record	
200	340	450
250	100	200
300	Record	
350	—	25

Hysteresis must not exceed the following values.

Milliamps	Pressure drop lb. per sq. in.
150	30
200	70
250	80
300	30
350	5

The lever stop screw is to be adjusted so that it is half a turn out from the point at which the flow begins to be restricted at maximum current.

(2) With the rig restrictor set to give a maximum of 200 lb. per sq. in. upstream pressure, the unit is to be endurance tested by varying the solenoid current from 100 to 350 milliamps for 30 minutes at 3 cycles per minute.

(3) Check the performance after the endurance test to ensure that there is no excessive calibration change and that it is still within the limits given in 3 (1).

Final calibration (*para. 120*)

4. Calibrate as in 3 (1).

Insulation (*para. 121*)

5. 1 megohm minimum resistance at 500 volts.

APPENDIX 2

CALIBRATION CODE K

Fuel

1. During these tests AVTUR is to be used. Fuel temperature to be 20 to 26 deg.C and inlet pressure 15 Lb/in².

Leakage tests (*para.* 114)

2. (1) Servo connection pressure 1500 Lb/in² static pressure; no leakage is allowed.

(2) With an air pressure of 40 Lb/in² maintained for 5 minutes there must be no leakage.

Preliminary calibration and endurance test (*para.* 116)

3. Calibration table

Current (milliamps)	Servo pressure (Lb/in²) 500	750	1000
	Spill flow (gall/hr)		
0	0	0	0–1
50	0	0–1	0–2
100	0–1	0–25	0–4
150	0–2·5	2–7	5–12
200	2·5–7·5	6–15	10–21
250	7·5–13	14–22·5	21–30
300	12·5–18	22–30	32–39
350	24–35	34–48	40–60
400	33–45	42–58	48–71
450	38–50	45–61	50–72
500	38–50	45–61	50–72

4. Hysteresis must not exceed 20 per cent of the maximum limit up to and including the 300 milliamp reading, and 10 per cent at readings above 300 milliamps. The lever stop screw is to be adjusted at 450 milliamps current to just touch the stop on the lever, i.e., adjusted until the flowmeter bobbin falls to $\frac{1}{2}$ gal/hr. There should be no increase in spill between 450 and 500 milliamps when the stop is set.

5. For the endurance test, set the downstream needle as for the preliminary calibration then vary the solenoid current from 0 to 300 milliamps for 60 cycles or 30 minutes whichever is the greater.

Final calibration

6. Repeat the preliminary calibration.

Insulation test (*para.* 121)

7. Minimum resistance 1 megohm at 500 volts.

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Appendix 3

CALIBRATION CODE N

1. When calibrating the electric pressure control to Code N it is necessary, owing to the oritical matching of the associated units, that the tests are made in conjunction with a total downstream simulator and a servo throttle valve. The former simulates the combined performance of a flow distributor, type FD.29/31R and the burner, type CSH.71.

2. Throughout the tests the fuel to be used is AVTUR. Unless otherwise stated the fuel temperature must be maintained at 20° to 26° C and inlet pressure at 15 to 20 lb/in².

3. Before the electric pressure control is tested, the total downstream simulator and the servo throttle valve must first be separately calibrated.

Testing the downstream simulator

4. Check the simulator at four calibration flow points of 100, 300, 500 and 700 gal/h. (*fig.* 1) to ensure that the unit conforms to the requirements.

Testing the servo throttle valve

5. In addition to the servo throttle valve STV.2/2C, a slave servo throttle valve is also required for the tests. These two items must each be checked as follows.

Leakage test

6. With the diapragm assembled in the unit, the outlet restrictor removed, the blank internal bobbin fitted, and the valve chamber open to atmosphere, apply a pressure of 2000 lb/in² at the spill flow connection for five minutes. There must be no leakage either internally or externally.

Preliminary calibration

7. (1) With the known flow No. bobbin and the outlet restrictor union fitted, assemble the unit to the rig (*fig.* 2). For the servo throttle valve test, the burner simulator is to have a flow No. 20 restrictor, i.e., a nominal orifice diameter of 0·131 in and inlet/outlet pipe sizes of $\frac{3}{8}/\frac{3}{4}$ in BSP, giving a flow of $500\ ^{+0\cdot0}_{-4\cdot0}$ gal/h at an inlet pressure of 625 lb/in².

(2) In place of the LPC, the spill flow is regulated with a variable restrictor (a needle valve having fine adjustment) boost supply being from an air boost tank.

(3) A pump delivery pressure setting of 1400 lb/in² is achieved by adjusting the slave barometric pressure control.

(4) Increase the spill flow from zero to a maximum as shown in the following table and then decrease in a similar manner. Record the main flow, pump delivery pressure, spill pressure and burner pressure at each stage.

(5) The main flow must be within the stated limits; if necessary, the internal orifice is to be lapped to achieve these readings.

Servo throttle valve calibration table

Spill flow (gal/h)	Main flow (gal/h)
0	750
2	746—750
4	742—750
6	730—750
8	720—740
10	702—722
12	681—701
14	654—674
16	624—644
18	594—614
20	558—578
22	523—537
24	475—505
26	431—465

Hysteresis must not exceed 5 gal/h

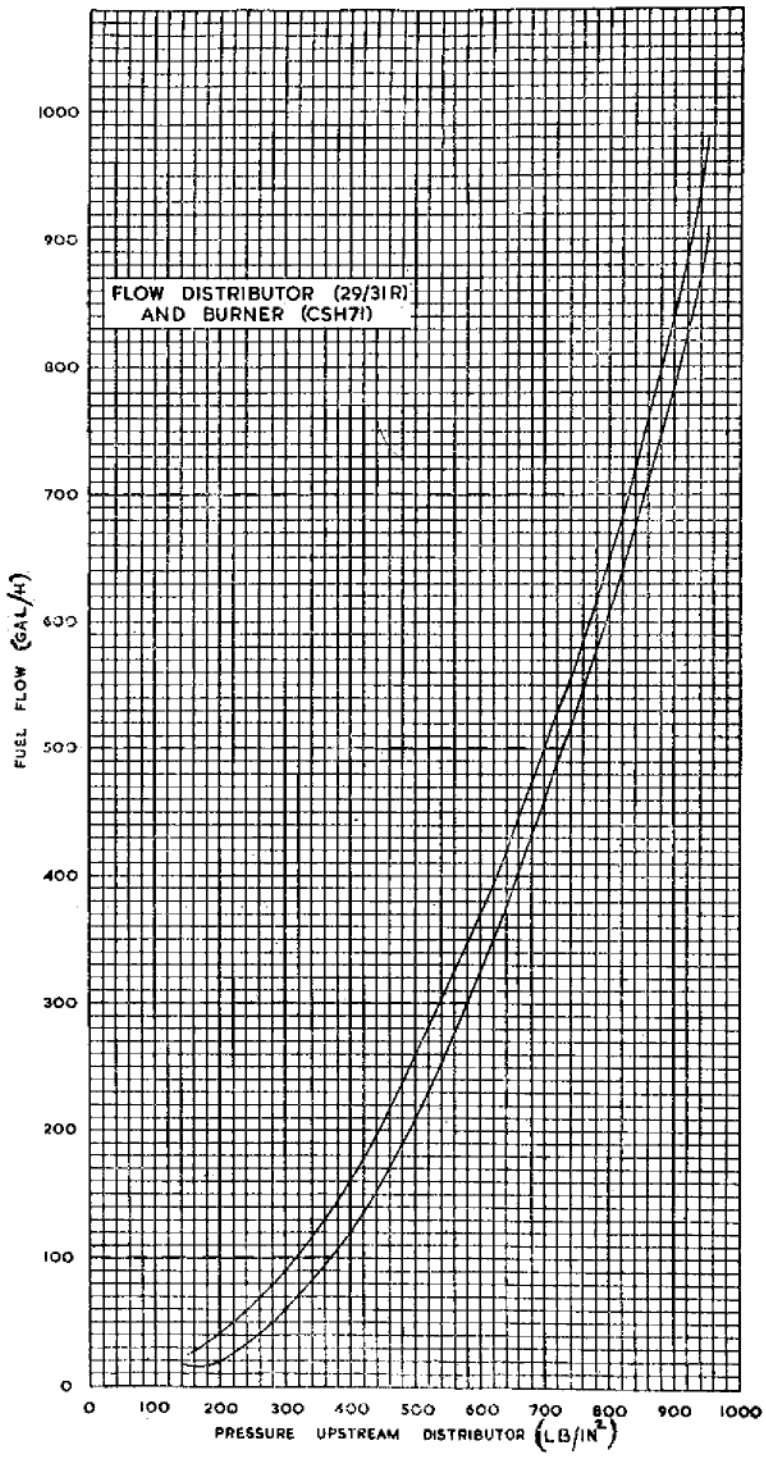

Fig. 1. Simulator calibration limits curve

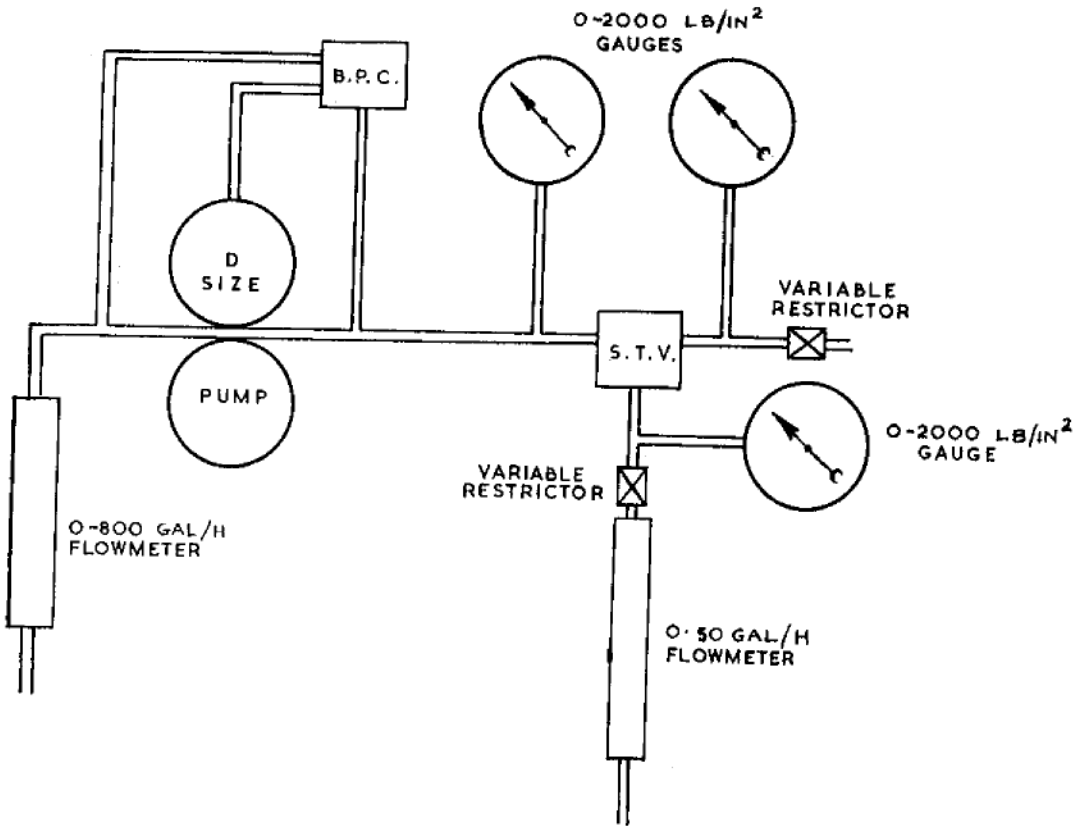

Fig. 2. Slave servo throttle valve calibration

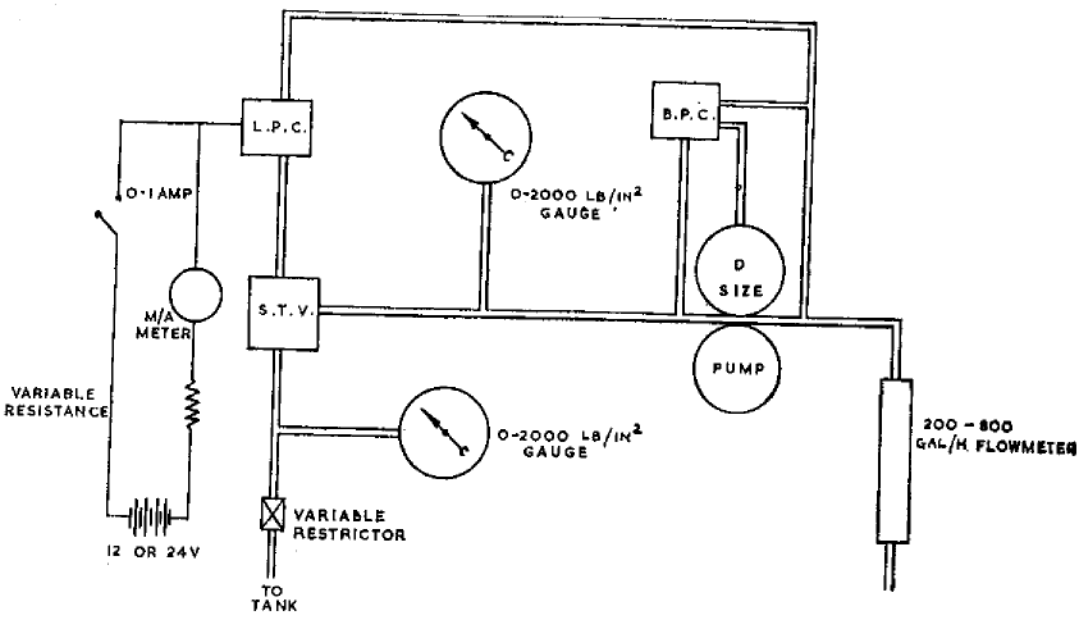

Fig. 3. Servo throttle valve (final calibration)

Leakage test and final calibration

8. (1) Pressure test at 2000 lb/in² pump delivery pressure. There must be no internal or external leakage.

(2) Repeat the calibration as in para. 7, but with the LPC included as in fig. 3, and refer to the table in para. 11.

Testing the combined servo throttle valve and electric pressure control

9. Where it is necessary to calibrate flowmeters for fuel temperatures in excess of 30 deg. C for normal working, the fuel temperature limits for calibration must be within ± 5 deg. C of the temperature at which the flowmeters were calibrated. Boost pressure to be at a constant 15 lb/in².

Leakage tests

10. (1) With a pressure 1500 lb/in² at the servo connection, there must be no leakage.

(2) With an air pressure of 5 lb/in², then 80 lb/in², each for five minutes there must be no leakage.

Preliminary calibration and endurance test

11. (1) Set the barometric pressure control to 1400 lb/in² pump delivery pressure at all readings.

(2) Connect the unit as shown in fig. 4, using the slave STV and also the flow distributor and burner simulator.

(3) Check the LPC over the range shown in the following table. The lapping of the STV orifices may be necessary to achieve the specified calibration values. There should be no reduction in main flow between 450 and 500 milliamps when the stop has been set. The slope of the curve must not exceed 40 gal/h difference between any 20 milliamp increment or decrement of LPC current.

Calibration table for combined slave STV and LPC

Current (milliamps)	Main flow (gal/h) minimum	maximum
0	750	Setting point
40	750	750
80	740	748

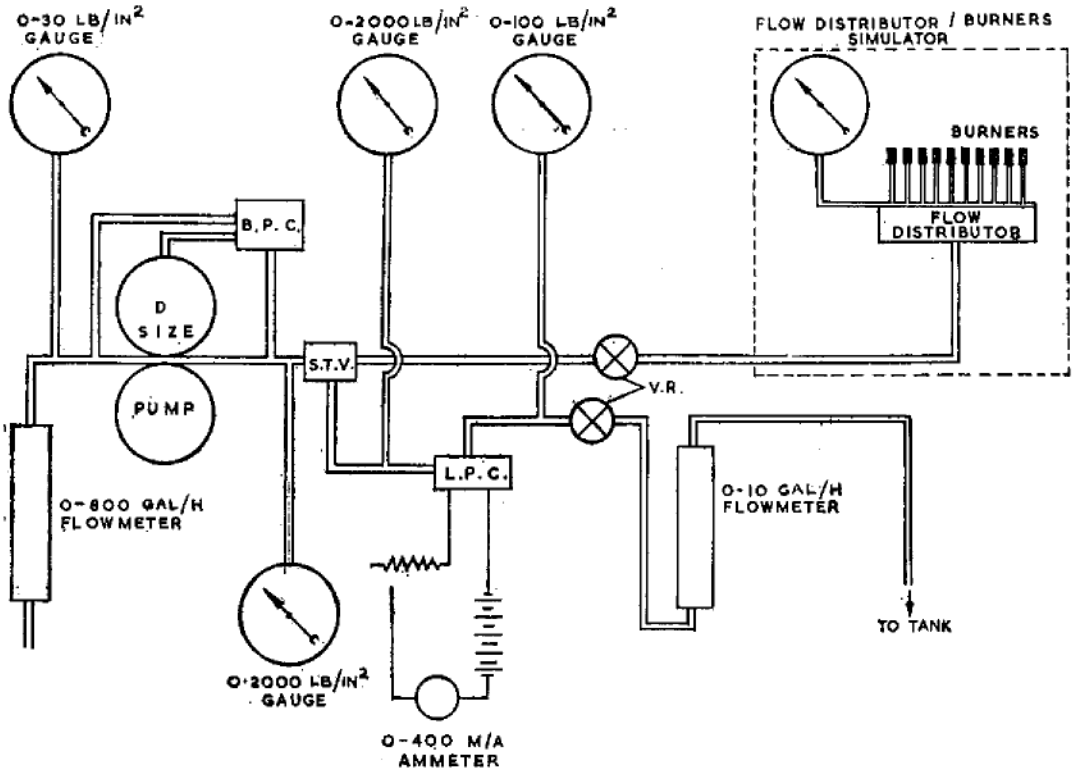

Fig. 4. Calibration (L.P.C. unit)

120	720	737
160	685	710
200	638	670
240	582	618
280	520	560
320	455	495
360	390	420
400	352	365
450		340 Set stop
500		340

Hysteresis must not exceed 40 gal/h.

12. Endurance test the unit by varying the solenoid current 0 to 300 milliamps for 60 cycles or 30 minutes whichever is the greater.

13. Repeat the preliminary calibration to ensure that the unit still meets the specified requirements.

Final calibration

14. Remove the slave servo throttle valve and fit the STV.2/2C, then repeat the calibration test.

Insulation test

15. One megohm minimum resistance at 500 volts.

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