# Chapter 4

# COMBINED CONTROL UNITS, TYPE RTC. 24

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## LIST OF ILLUSTRATIONS

### Introduction

1. The combined control unit includes an acceleration control, an altitude control, maximum temperature control, shut-off cock and manifold dump valves. These various sub-assemblies are bolted together to form the complete unit.

2. Variations of the basic type of unit are made to meet differing engine installations. These differences are usually in the installation fittings and the calibration codes.

3. To identify a specific type of unit, and using the R.T.C. 24/24AT as an example, the first figure (24) indicates the basic type, the second figure (/24) shows the engine installation for which the unit is intended and the letters (AT) are the calibration code to be used when testing.

4. This chapter applies to all variations of the basic type, and the different calibration codes are given in appendices to the chapter.

5. In these instructions the control unit is first broken down into the following four groups or sub-assemblies and each group is then treated separately.

(1) Acceleration control unit (a.c.u.)
(2) Altitude sensing unit (a.s.u.)
(3) Throttle valve (t.v.)
(4) Governor (gov.)

6. During dismantling, all joint washers, sealing rings, split pins, tabwashers and locking wires must be removed and discarded.

### Cleaning

7. After dismantling, components should be pressure washed in a kerosine bath fitted with a spray gun, and then dried with compressed air. Hard brushes or abrasives must not be used. Particular care is necessary when cleaning components which have micro-finish sealing faces; these should be cleaned with methylated or white spirit and a nylon brush.

### Inspection

8. The following instructions are of a general nature and apply to the procedure which is common to the control unit as a whole. Specific inspection details are given later in the chapter as each sub-assembly is dismantled.

9. Consumable items such as rubber seals, bonded seals, gaskets, split pins and tab-washers must be renewed unless stated otherwise.

10. The cast bodies of the unit must be examined for damage, internal passages for obstruction, and dowels for looseness.

11. Springs should be examined for distortion, cracks and corrosion. In some instances the rates must be checked.

12. Nuts, bolts and studs must be examined for damage to threads and hexagons.

13. Defective plating or enamel on any component will necessitate its being stripped and then replated or enamelled.

14. Some components have micro-inch finished surfaces, these should be carefully examined for scores. Light scores may be polished out but only when it is possible to do so without altering the dimensions of the part.

15. Throughout the inspection operations, reference should be made to the Schedule of Fits, Clearances and Repair Tolerances (Vol. 2, Part 2) when dimensional checks are required.

## DISMANTLING THE COMBINED CONTROL UNIT

### Dismantling to sub-assemblies (*fig.* 1 *and* 2)

16. Unlock and remove the nuts from the pinch bolts on the throttle valve lever and the governor lever. Slacken the two locknuts on the connecting rod, unscrew the two pinch bolts and detach the linkage. In addition to being used to clamp the levers, the pinch bolts are also worm drive bolts which move the levers round the hubs for adjustment purposes; the bolts therefore cannot be driven out, but must be unscrewed for their entire lengths.

17. Extract the split pins from the two ball-joint pins, unlock and unscrew the nuts of the ball-joint bodies and dismantle the linkage.

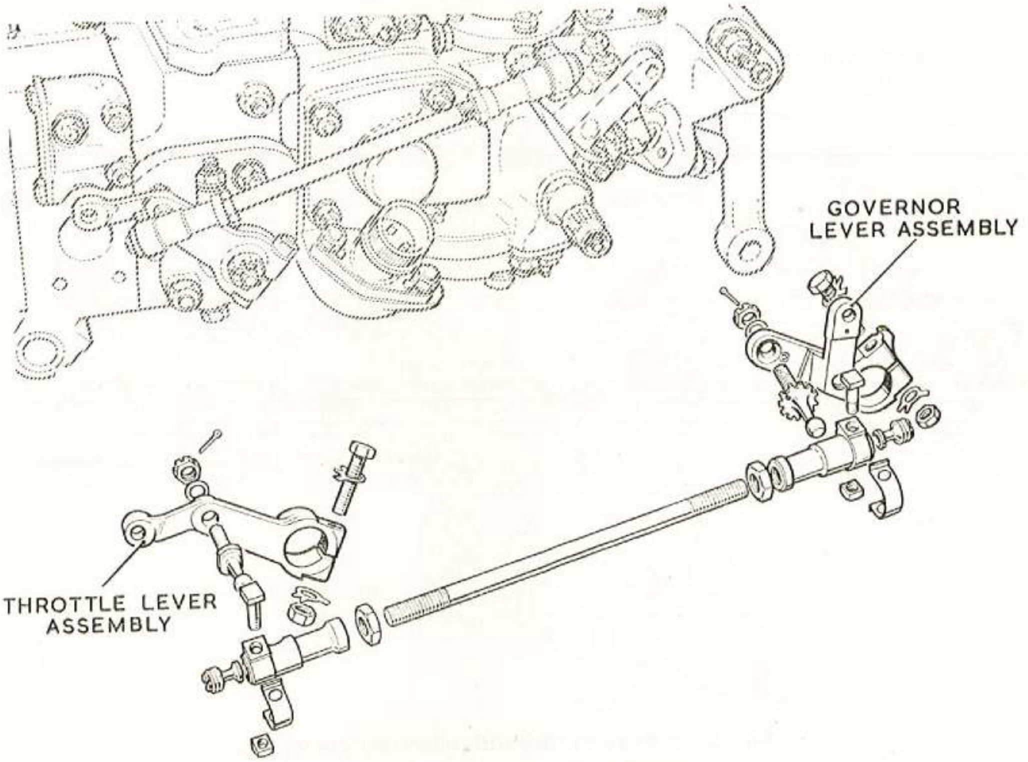


**Fig. 1. Throttle valve linkage**

**18.** Remove the split pin, nut and retaining plate from the mounting link pin on the end of the governor housing, then detach the link.

**19.** Separate the throttle valve and governor units from the altitude sensing and acceleration control units by removing the five nuts from the throttle valve unit and then tapping lightly with a hide-faced hammer.

**20.** Detach the large sealing ring and the small strainer bobbin and sealing rings from the fuel delivery facing on the a.c.u. Extract the sealing ring from the proportional flow connection on the governor housing.

**21.** To separate the a.s.u. from the a.c.u., remove two nuts from the flange of the a.s.u. and then unscrew the third securing nut from the a.c.u. sandwich plate flange as the two units are being eased apart.

**22.** Remove the two bobbins, sealing rings and pressure-raising valve, using extractor T.247868 and T.247869 if necessary. To dismantle the pressure-raising valve, turn the valve sleeve one quarter turn to release it and allow the guide, spring and valve to be withdrawn from the valve body.

**23.** To separate the throttle valve unit from the governor unit, first remove the a.s.u. proportional flow connection from the temperature orifice housing on the governor, then remove the four securing nuts and part the two units by tapping lightly with a hide hammer. The two upper nuts must be released with spanner T.310182 due to the close proximity of the governor spring housing.

**24.** Using extractors T.287987 and T.224320, remove the two interconnecting bobbins and sealing rings.

**Cleaning and inspecting**

**25.** Clean the linkage and other interconnecting parts as detailed in para. 7.

**26.** Examine the link-rods for damage or distortion, and the throttle lever and the governor lever for cracks or corrosion. Ensure that the governor-lever rivets and dowels are secure.

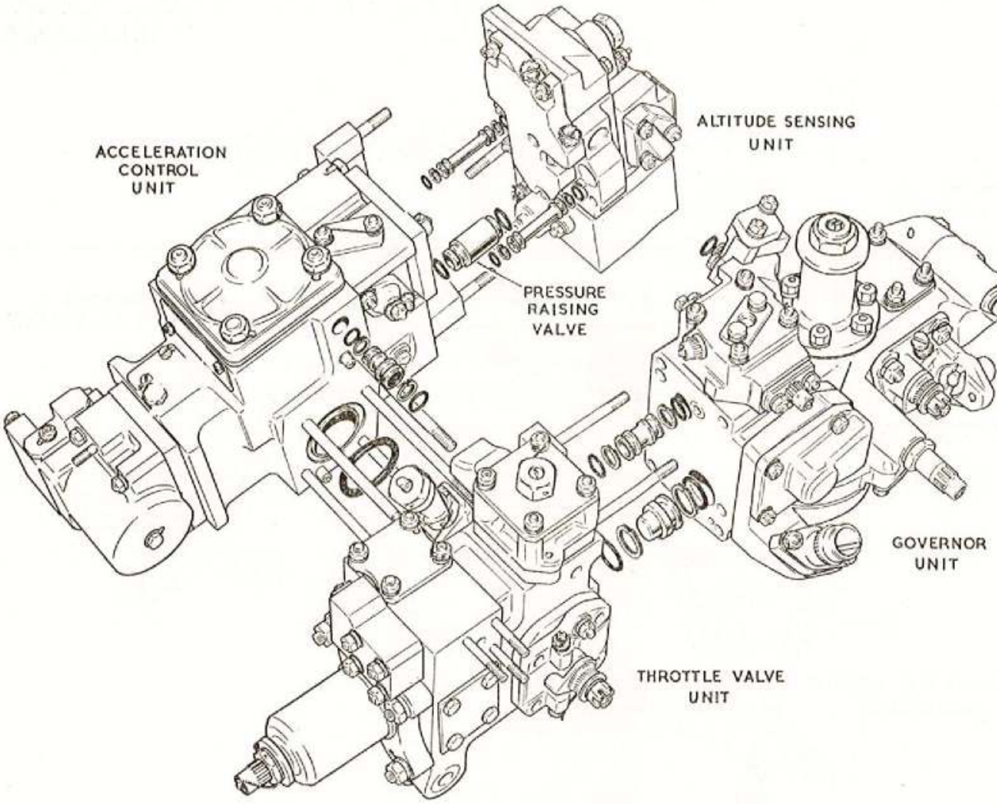


**Fig. 2. Sub-assemblies with interconnecting parts**

**27.** Check the pinch bolts and nuts for serviceability.

**28.** Examine the transfer bobbins for distortion or corrosion and check the seal surface for scores.

**29.** Inspect the pressure-raising valve housing for damage and its seal surfaces for scores. Ensure that the conical face of the valve has no indentations and that the valve stem is a good fit in its sleeve.

**30.** Check that the valve sleeve is not corroded or scored or its locking area damaged. Inspect the spring for cracks.

## ASSEMBLING THE COMBINED CONTROL UNIT

### General

**31.** These instructions cover the building of the complete control unit from the four major sub-assemblies, and the fitting of the control linkage.

**32.** It is emphasized that scrupulous cleanliness is necessary during the assembling operations. Before fitting fuel seals brush each seal and land with OM-58.

**Note. . .**

*On units which embody Mod. CP.*1198 *but not Mod. CP.*1477, *the pressure-ratio switch fitted to the acceleration control contains silicone seals. These are identified by their light red colour and it is important that the seals are not allowed to come into contact with kerosine, gasoline, or any other mineral-based fluids, oils or greases. Before fitting the seals, they and their lands should be smeared with O X*-38.

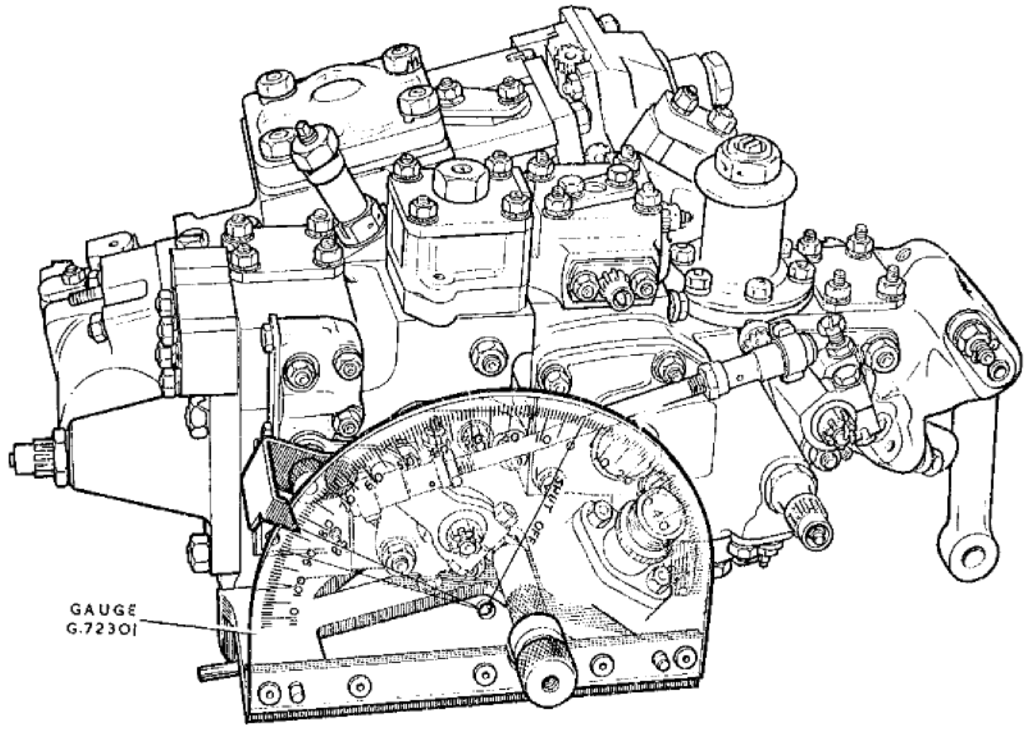


**Fig. 3. Setting the throttle valve lever**

**33.** Before commencing the main operations wirelock the three blanking plugs on the a.s.u. and one on the kinetic block of the acceleration control unit; these will be inaccessible at a later stage.

#### Governor unit to t.v.

**34.** Remove the masking tape from the interconnecting bores of both units. Ease the seals on to the two interconnecting bobbins and insert the bobbins into their bores in the t.v. joint face of the governor unit.

**35.** Fit the t.v. unit partway to the governor and check that the bobbins and backing rings are correctly positioned.

**36.** Before fitting the two units closely together, fit the one tabwasher on one stud the plain and grover washers on the other two studs. Fit the nuts and screw them down whilst easing the units together; the nuts cannot be fitted if the joint faces are touching. The two upper nuts must be tightened with spanner T.310182, due to the close proximity of the governor spring housing.

**37.** Fit plain and grover washers to the remaining two studs, fit the nuts and tighten all five evenly. Lock the tabwasher on the first nut.

#### Pressure-raising valve

**38.** Assemble the valve and spring to the valve guide, with the spring fitting over the spigot of the guide. Insert the assembly, valve head first, into the valve body. Using tool T.260327, press in and turn the valve guide through 90 degrees, then release it and check that the lugs on the guide engage in the slots in the valve body.

**39.** Pressure test the valve as detailed in para. 503.

#### A.S.U. to a.c.u.

**40.** Remove the masking tape from the interconnecting bores of both units.

**41.** Fit the two seals on to the pressure raising valve and also the two seals on to each of the two bobbins. Position the pressure raising valve and the shorter of the two bobbins in their bores in the a.c.u. body and the longer bobbin in its bore in the a.s.u. body, using tools T.247868 and T.247869 if necessary.

**42.** Assemble the a.s.u. partway to the a.c.u., check that the bobbins are positioned correctly, then fit plain and grover washers and nut on the one stud of the a.s.u. and screw the nut down whilst easing the a.s.u. and a.c.u. together.

**43.** Fit plain and grover washers and nuts to the remaining two studs and tighten all three evenly.

**T.v./governor to the a.s.u./a.c.u.**

**44.** It is first necessary to align the constant flow valve housing with the acceleration control to ensure correct alignment of the interconnecting bobbins. Insert alignment plug T.231684 into the constant flow valve housing, slacken the constant flow valve retaining nuts and assemble the a.s.u./a.c.u. to the t.v./gov., so that the small end of T.231684 enters the a.c.u. housing, then tighten the constant flow valve retaining nuts.

**45.** Whilst the unit is complete, if a new a.s.u. body or governor body or a new proportional flow connection has been fitted, then the following check given in para. 46 must be made and the appropriate proportional flow connection selected accordingly.

**Note. . .**

*The proportional flow bobbin between the a.s.u. and governor housings transfers the proportional flow from the linking valve and trim orifices in the governor assembly to the proportional flow senser in the a.s.u. If the a.s.u. has not been pre-calibrated as a sub-assembly it will be necessary to measure and set this flow during calibration of the control unit. In this case a special test rig adapter, R.S.K.203/205 is to be fitted at this stage in place of the proportional flow bobbin to enable a flowmeter to be connected; after calibrating the proportional flow, the adapter is to be removed and the bobbin, fitted. The procedure for fitting the adapters is identical with that for fitting the bobbin.*

**46.** Check the gap between the governor and a.s.u. with slip gauge G.100426. This measurement is made between the faces to be connected by the proportional flow connection.

**47.** The proportional flow connection is available in two lengths. Use the shorter connection when the gap measured with G.100426 is between 0·486 and 0·531 in. inclusive and fit the longer one if the gap is 0·531 in. to 0·576 in.; either may be used if the gap is 0·531 in.

**48.** Separate the t.v./governor from the a.c.u./a.s.u. and remove the alignment plug T.231684 from the constant flow valve. Fit the sealing sleeve into the proportional flow connection bore in the governor body, followed by the seal fitted around the sleeve.

**49.** Ease the seal into the annular groove in the proportional flow connection cover, fit the cover to the connection and secure it with plain and grover washers and nuts on the two studs.

**50.** Fit the seal into the groove at the a.s.u. end of the selected connection.

**51.** Assemble the proportional flow connection to the governor unit and fit plain and grover washers and nuts but do not tighten the nuts.

**52.** Assemble the t.v./gov. to the a.s.u./a.c.u. and position the proportional flow connection. Using spanner T.310812, tighten one nut to secure the connection, separate the two assemblies and tighten both nuts fully.

**53.** Fit the two seals on the constant flow valve strainer bobbin and insert the bobbin into the bore in the constant flow by-pass valve of the t.v. unit.

**54.** Ease the large seal into the annular groove in the joint face of the a.c.u. (main flow delivery from a.c.u. to throttle inlet).

**55.** Assemble the t.v./gov. to the a.s.u./a.c.u. and secure them with plain and grover washers and nuts on the five studs.

**56.** Using gauge G.100426, check that the gap between the proportional flow connection and the face of the a.s.u. is 0·011 to 0·061 in. This is to ensure that the correct connection has been selected and is properly fitted.

**57.** Fit one seal into the groove around the pump delivery bore in the a.s.u. and another seal into the groove around the P.1 bore in the a.s.u.

**58.** Ease the seal into the annular groove in the joint face of the elbow connection for the primary manifold pipe. Fit the connection to the three studs on the t.v. unit and secure it with plain and grover washers and nuts.

**59.** Fit the dummy bracket to the reference resistor platform on the governor unit and secure it with plain and grover washers and nuts.

**60.** Fit all necessary blanking plates whilst the unit is awaiting test.

**Fitting the mounting link**

**61.** Assemble the link and the pin to the unit, lubricating the pin with white petroleum jelly. Fit the retaining plate, washer, grover washer and nut. Tighten the nut and lock it with a split pin.

**Testing**

**62.** The complete control unit must now be tested and calibrated as detailed in Appendix 1.

**Control linkage**

**63.** Fit a locknut to each end of the connecting rod, screw it well down the thread and fit a ball joint body to each end. Assemble a ball pin to each ball joint body, lubricating each ball with white petroleum jelly before fitting it to the body. Fit the adjusting screw into the end of each body and tighten it until any play on the ball joint is just eliminated. Assemble the clamping plates to the ball joint bodies and secure them with the square headed bolts and square nuts. Tighten them by using spanner T.264069 and then turn up the ends of the clamping plates to lock the nuts.

**64.** Set the governor lever hub in a position where its stop lug is adjacent to the detent ball and fit the governor lever on to the hub so that the clamping slot is directly over the upper edge of the stop lug; this is to avoid the governor lever stop interfering with the full range of throttle movement.

**65.** Fit a tabwasher under the head of the worm drive pinch bolt and screw in the bolt. Fit a second tabwasher and then the retaining nut but do not tighten the nut.

**66.** Set the throttle valve lever hub in a position where its stop lug is against the maximum flow stop, then fit the lever over the hub so that the upper edge of the lever arm will be roughly in line with the lower nut on the pilot flow elbow. Fit a tabwasher to the worm drive pinch bolt and screw in the bolt. Fit a second tabwasher and then the retaining nut but do not tighten it.

Note . . .
*The stop screws have been set and locked on the test rig and must not be disturbed, otherwise the throttle calibration will be affected.*

**67.** Fit the protractor G.72301 (*fig.* 3) to the unit and the pointer to the throttle valve lever.

**68.** Move the throttle lever clockwise to the shut-off stop and rotate the lever drive pinch bolt to move the lever relative to its hub until the zero degrees reading is obtained when hard against the shut off stop.

**69.** Fit one ball pin of the assembled linkage to the hole nearest to the hub in the throttle lever, fit a washer and slotted nut. Tighten but do not split pin the nut. Move the throttle lever from the closed stop to a position of 22½ degrees indicated on the quadrant. Move the governor lever until the striker cam is just touching the detent ball and insert the ball pin at this end of the linkage in the hole in the shorter arm of the governor lever; to achieve this it may be necessary to vary the effective length between the ball pins by rotating the ball joint body. One turn of the body represents a change of angle approximately 1½ degrees on the quadrant. If a finer adjustment is required, the ball is eccentric to the shank and provides an angular adjustment of approximately 1½ degrees.

**70.** Through the sighting hole in the shank of each ball joint body check that the linkage rod is visible then fit a plain washer and slotted nut to the governor lever ball pin and tighten the nut.

**71.** Move the lever to the open position and check that the governor lever is not touching its stop and preventing the throttle lever from moving to the 83 degree position. Move it back until the governor lever cam is felt to contact the detent ball and check that the throttle lever pointer is registering 22½ degrees on the quadrant, then move the lever fully clockwise to check that the governor stop is not preventing the throttle lever from travelling to the closed, or zero degrees, position.

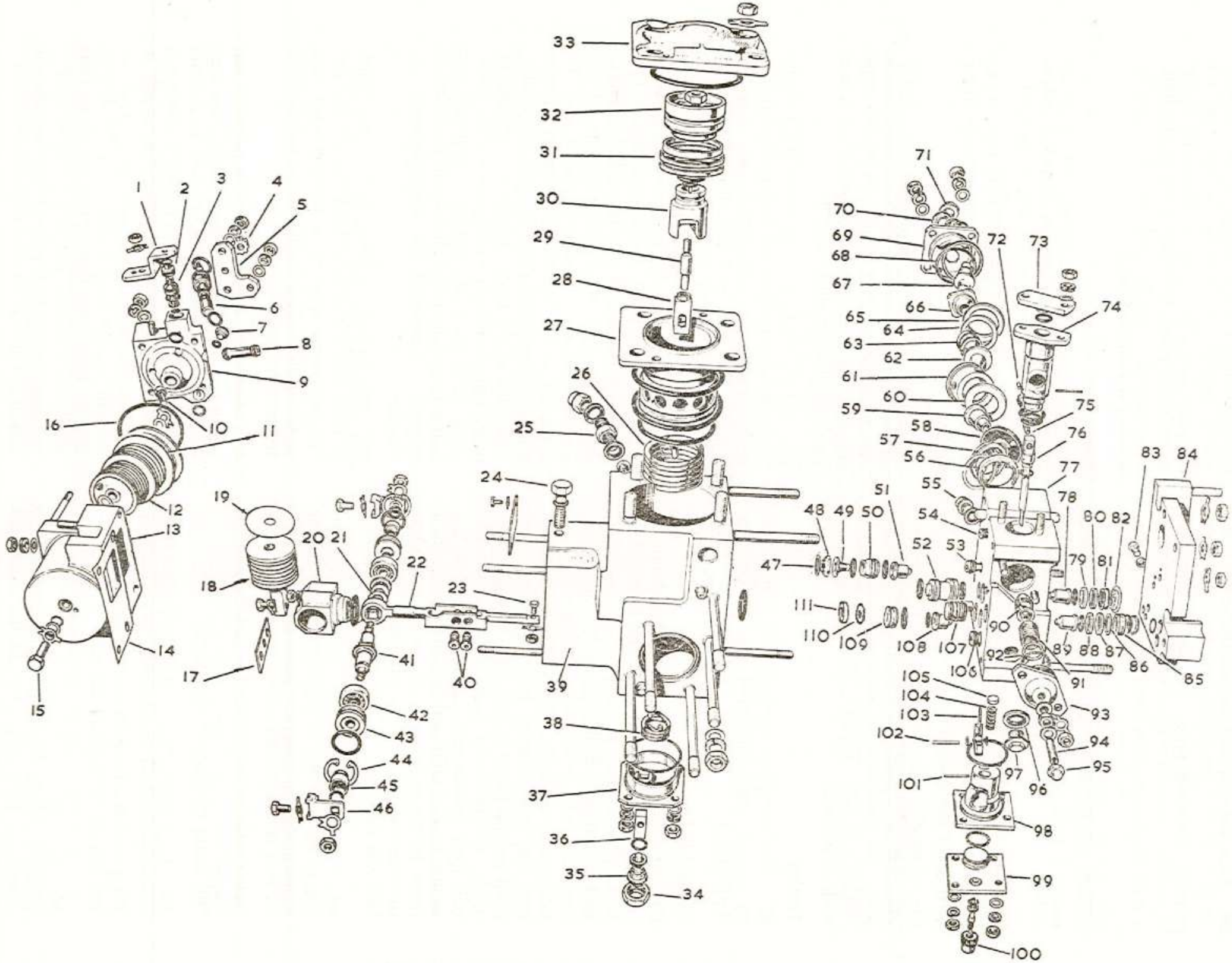


Fig. 4. Exploded view of acceleration control unit

## KEY TO FIG. 4

### PRESSURE RATIO SWITCH

1 Potentiometer bobbin securing bracket
2 Potentiometer bobbin securing plug
3 Potentiometer bobbin
4 Orifice holder locknut
5 Orifice holder cover plate
6 Assembled orifice
7 Blanking plug
8 Transfer bobbin
9 Pressure ratio switch cover
10 Pressure ratio switch valve screw
11 Shims
12 Pressure ratio switch bellows and capsule
13 Pressure ratio switch body
14 Gasket
15 Capsule and bellows retaining bolt
16 Capsule and bellows seal

### ACCELERATION CONTROL

17 Leaf spring, KP2 capsule
18 Kp2 capsule assembly
19 Shims
20 Ball race hinge housing
21 Shims
22 Sensing lever
23 Tappet screw
24 Capsule retaining bolt
25 Pressure tapping union
26 Sensing spring
27 Orifice and servo cylinder
28 Sensing spring anchor
29 Spring anchor securing stud
30 Metering plunger
31 Piston rings
32 Servo piston
33 Servo cylinder end cover
34 Locknut
35 Trimming spring adjusting screw
36 Spring anchor
37 Cover plate
38 Trimming spring
39 Acceleration control body
40 Spring securing pegs
41 Ball race hinge shaft
42 Ball bearing (two off)
43 Retaining collar (two off)
44 Circlip (two off)
45 Distance piece (two off)
46 Leaf spring support arms (two off)

### KINETIC BLOCK

47 Shims
48 Distance piece
49 Conical strainer
50 Bobbin
51 Kinetic insert

(47–51: Internal servo input)

52 Servo blanking plug
53 Transfer bobbin—pressure drop downstream
54 Transfer bobbin—pressure drop upstream
55 Blanking plug
56 Distance piece
57 Seal support spring ring
58 Seal
59 Piston—P.D. control
60 Piston sleeve
61 Stop plate
62 Spring cap
63 Spring
64 Shims
65 Spacing ring
66 Spring seat
67 Adjusting screw
68 Seal
69 Cover plate—P.D. control
70 Seal retainer
71 Locknut
72 Pump servo kinetic lever push rod
73 Cover plate
74 Kinetic lever holder
75 Kinetic lever adjusting screw
76 Kinetic lever
77 Kinetic block
78 Internal servo kinetic insert—recovery
79 Seal abutment ring
80 Strainer
81 Shims
82 Plug
83 Blanking plug
84 Sandwich plate
85 Bobbin—pump servo
86 Shims
87 Strainer
88 Seal abutment ring
89 Pump servo kinetic insert—recovery
90 Pressure drop return spring seat
91 Pressure drop return spring
92 Shims
93 Pressure drop return spring cover
94 Pressure drop lever stop screw
95 Capnut
96 Bonded seal
97 Blanking plug
98 Internal servo kinetic lever holder
99 Lever holder plug
100 Locknut for stopscrew
101 Lever return spring seat retaining pin
102 Lever hinge pin
103 Internal servo kinetic lever
104 Return spring
105 Return spring seat
106 Transfer bobbin—pump pressure to A.S.U.
107 Transfer bobbin—return to pump inlet
108 Kinetic insert—pump servo input
109 Transfer bobbin—pump servo input
110 Shims
111 Strainer

**72.** Fit the split pins to the ball pin slotted nuts, then remove the protractor and pointer G.72310. Using a torque spanner, check that not more than 12 lb. in. is needed to move the throttle valve from idling to full throttle position.

**73.** Complete all wirelocking.

**74.** If modifications have been embodied the modification standard must be shown on the appropriate plate. If a modification involving a type number change has been incorporated then the type number shown on the name plate must be amended accordingly.

**Inhibiting**

**75.** Instructions for the inhibiting of the unit are given in A.P.4471A.

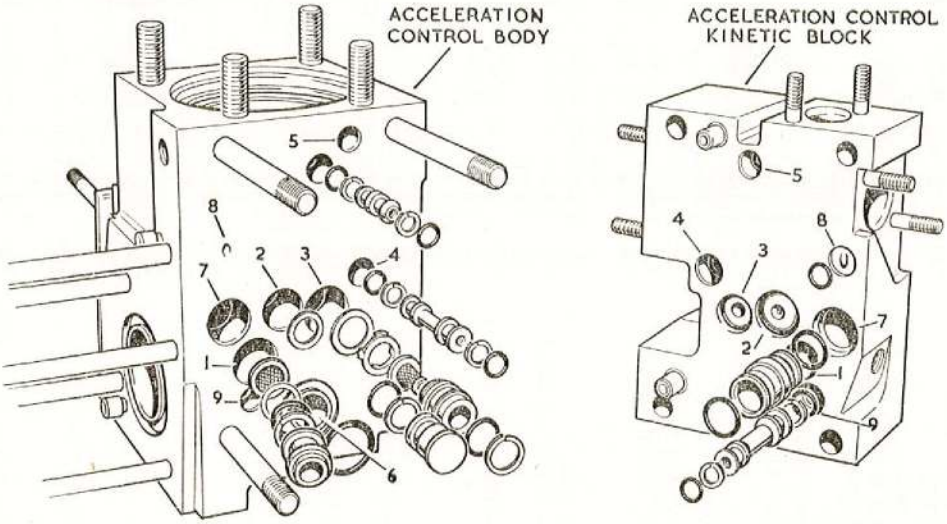


**Fig. 5. Interconnecting parts of acceleration control and kinetic block**

## ACCELERATION CONTROL UNIT (*fig. 4*)

**General**

**76.** The acceleration control unit comprises the following items :-

(1) The pressure-ratio switch, which is an air-operated switch and provides a means of changing the effective compressor delivery pressure applied to the main control capsule.

(2) The acceleration control body, containing the main control capsule, sensing lever and servo-operated fuel metering plunger.

(3) The kinetic block, containing the pressure-drop control and kinetic orifice system controlling pump delivery in accordance with the pressure-drop across the metering plunger orifice, also a second kinetic orifice system which controls the position of the metering plunger according to P2 pressure, this system being operated by the sensing lever.

**77.** The breakdown of the unit (*fig.* 4), commences with the removal and dismantling of the kinetic block, then the pressure ratio switch, and finally the control body.

### DISMANTLING

**Kinetic block**

**78.** Remove the nuts and tabwashers securing the sandwich plate to the kinetic block, then remove the plug and washer from the side of the plate. Unscrew the two $\frac{1}{4}$ in. BSF nuts and one 2BA nut and remove the sandwich plate from the kinetic block.

**79.** Remove the securing nuts and tabwashers and then separate the kinetic block from the acceleration control body. It may be necessary to tap lightly with a hide-faced hammer to overcome the tightness of the joint sealing rings.

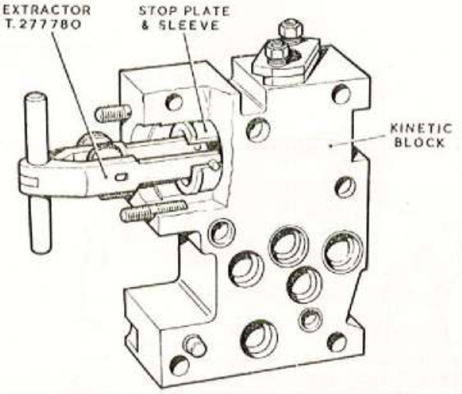


**Fig. 6. Removing the pressure drop control combined stop plate and sleeve**

*Transfer bobbins and jet inserts*

**80.** (1) With extractor T.222026 remove the bobbin from the input orifice bore of the internal servo kinetics and remove the bobbin from the restricting orifice bore (bores No. 3 and No. 2 respectively in fig. 5).

(2) With extractor T.222027 remove the bobbin from the input orifice bore of the pressure drop kinetics and with T.221296 remove the bobbin from the return to pump inlet bore (bores No. 1 and No. 7 respectively in fig. 5).

(3) Remove the plug from the recovery orifice bore of the internal servo kinetics and the bobbin from the recovery orifice bore of the pressure drop kinetics by using T.234702.

(4) Remove the remaining bobbins and strainers by hand.

(5) Using extractor T.238072 withdraw the input and recovery orifices of the pressure drop kinetics and those of the internal servo kinetics.

*Pressure drop control*

**81.** (1) Slacken the capnut and the locknut of the adjusting screw. Remove the two securing nuts and tabwashers and detach the p.d. return spring cover plate; if necessary, use extractor T.200603.

(2) Remove the return spring from the bore and the adjusting screw, capnut, locknut, washers and shims from the cover plate.

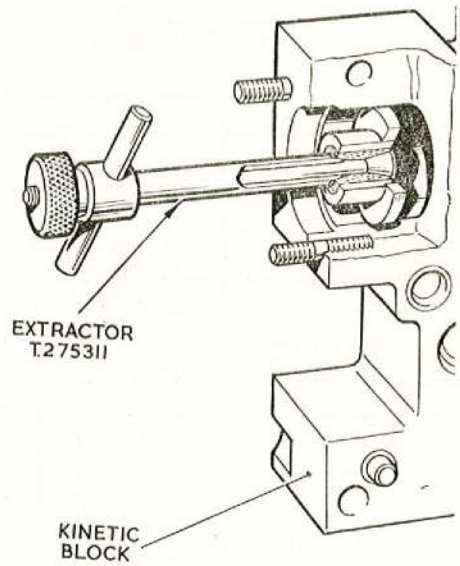


**Fig. 7. Removing the pressure drop control piston sleeve**

(3) Remove the four securing nuts and washers of the p.d. control cover plate.

(4) Using spanner T.169309, remove the adjusting screw and then the spring plate, seals, backing rings, seal retaining ring and locknut from the cover plate.

(5) Remove the spring from the bore and, using the extractor T.277780, (fig. 6) remove the combined stop plate and sleeve and the spacing ring.

(6) Remove the spring seat, shims, piston and push rod from the bore.

(7) Use extractor T.275311 to withdraw the piston sleeve above (fig. 7).

(8) Remove the U-section sealing ring, seal support ring and the distance piece.

(9) Using spanner T.204212 remove the locknut and tabwasher on the p.d. return end of the adjusting screw on the lever. Remove the spring seat from the adjusting screw.

(10) Unscrew the adjusting screw by first using the spanner T.265774 from the p.d. return side and turning the screw through the lever until the cup end is clear of the smallest deeper part of the p.d. control bore. Use the spanner T.265775 to remove the screw.

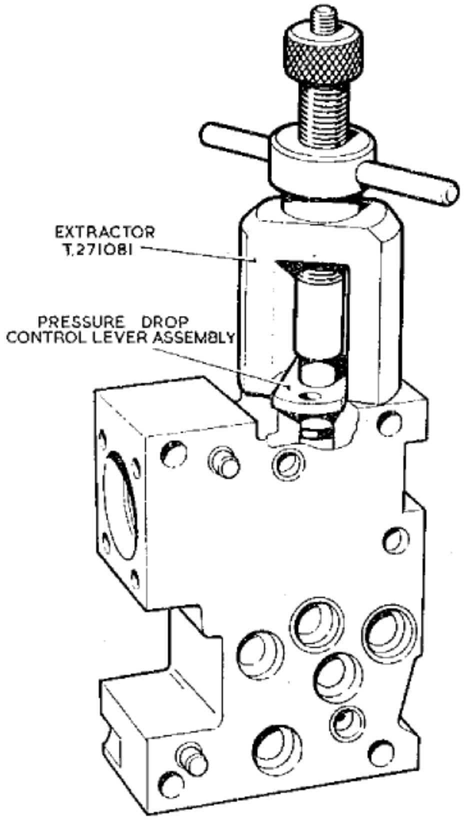


**Fig. 8. Removing the pressure drop lever assembly**

**82.** Remove the cover plate and, using extractor T.271081, withdraw the p.d. kinetic lever as shown in fig. 8. Remove the seal from the lever housing in the kinetic block. Do not separate the lever, pin and housing.

**83.** Remove the two kinetic knife inspection plugs and their bonded seals.

**84.** To remove the internal servo kinetic knife, slacken the serrated locknut by using spanner T.209306. Remove the four securing nuts and washers, detach the cover plate and remove the adjusting screw and seals.

**85.** Using extractor T.215797, withdraw the plug from the lever holder, then, using extractor T.272400 (fig. 9), withdraw the kinetic knife holder.

**86.** Remove the pin, spring seat and spring. This completes the dismantling of the kinetic block.

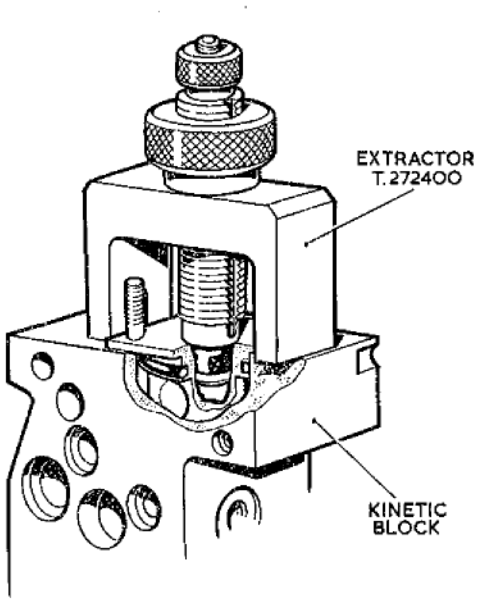


**Fig. 9. Removing the internal servo kinetic knife holder**

**Pressure ratio switch**

**87.** Unscrew the four securing nuts and remove the pressure ratio switch from the a.c.u. Detach the gasket.

**88.** Remove the securing nut and tabwasher and remove the cranked bracket. Use tool T.259624 to withdraw the bobbin retainer, and tool T.209310 (fig. 10) to remove the potentiometer bobbin.

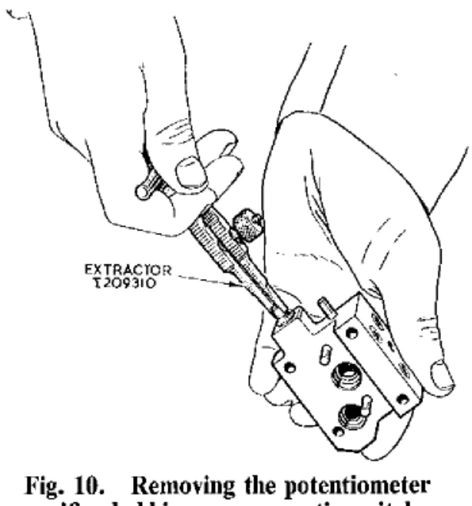


**Fig. 10. Removing the potentiometer orifice bobbin, pressure ratio switch**

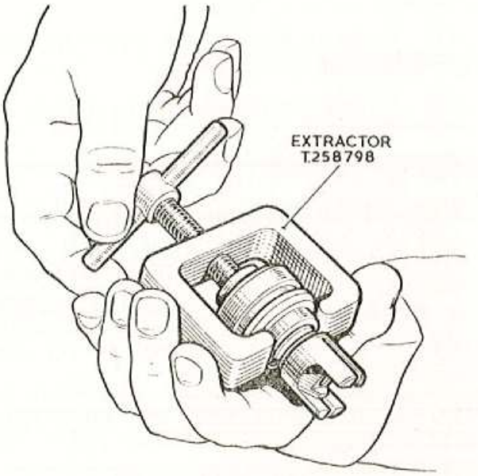


**Fig. 11. Separating the a.c.u. metering plunger and piston**

**89.** Remove the serrated locknut with spanner T.209306. Remove the three cover plate securing nuts and washers, and remove the cover plate together with the splitter orifice and holder by using extractor T.234049. Unscrew the orifice and holder from the cover plate.

**90.** Remove the securing nuts and washers and detach the pressure ratio switch cover. Push out the blanking plug in the external face of the cover and withdraw the bobbin from the side of the cover.

**91.** Using an indelible pencil, mark the bellows flange and adjacent housing to enable the bellows and capsule to be assembled in the same radial position.

**92.** It is recommended that the valve screw inside the bellows should not be disturbed, unless a preliminary rig test has been carried out and the pressure ratio switch has failed to meet the calibration requirements. In this instance, remove the valve screw to enable the capsule and bellows assembly to be rate checked (para. 103).

**93.** Unlock and remove the capsule retaining bolt and tabwasher. Remove the bellows and capsule assembly and if fitted, remove the large diameter shim from beneath the bellows flange. Remove the seal and spacing collar.

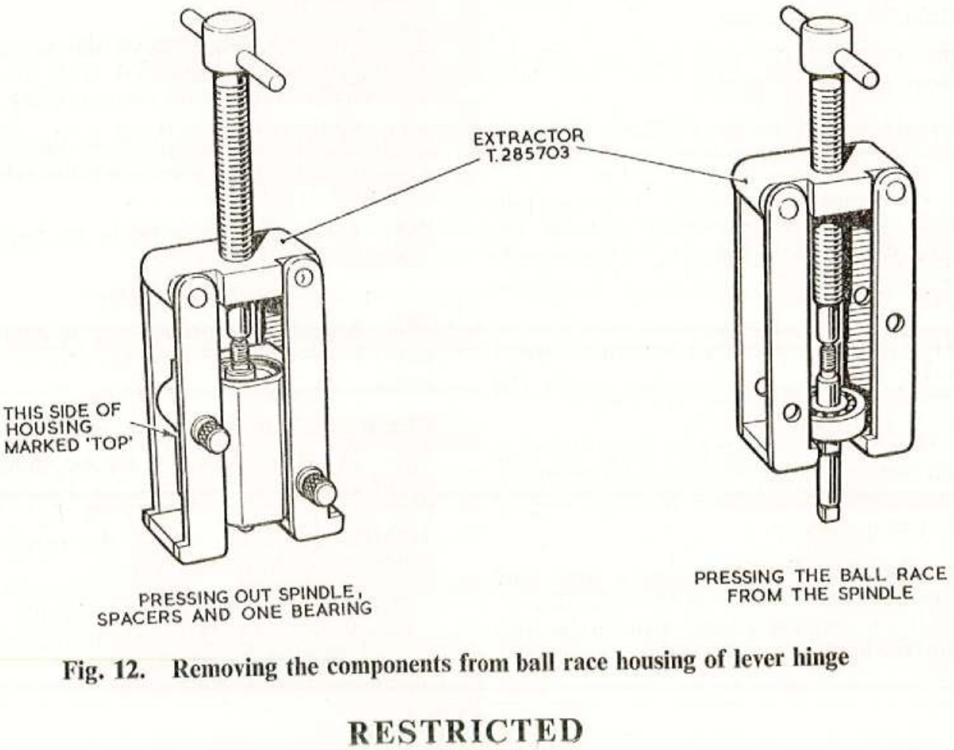


**Fig. 12. Removing the components from ball race housing of lever hinge**

### Metering control

**94.** Remove the trimming spring locknut with a box spanner and unscrew the adjusting screw with key spanner T.160988. Unscrew and remove the four securing nuts and washers and remove the cover plate using extractor T.221285 (*fig.* 27).

**95.** Using tool T.287998, remove the spring retaining peg in the lever and lift out the trimming spring and the spring anchor. Place the trimming spring in the keeper T.287955, and clamp to a length of 1·004 in. This length is measured from the extremity of the long loop to the spring anchor contact point of the upper loop.

**96.** (1) Remove the sensing spring retaining peg in the lever by using the tool T.287998.

(2) Unlock and remove the four securing nuts and washers and detach the cover plate.

(3) Detach the sensing spring from the spring anchor and place it immediately in the spring keeper T.287956. Clamp it to a length of $1{\cdot}931 \pm 0{\cdot}003$ in.; this length is measured between the extremity of the long loop and the spring anchor contact point of the upper loop.

(4) Using two extractors T.271082, withdraw the piston and orifice sleeve.

(5) Draw out the piston and plunger from the orifice sleeve.

(6) Unscrew the retaining nut and remove the spring anchor.

(7) Using extract or T.258798, withdraw the plunger from the piston (*fig.* 11).

**97.** (1) Remove the capsule retaining bolt and unscrew the securing nut of the flanged plug from the base of the capsule chamber. Remove the plug and detach the seal.

(2) Unscrew the three securing screws and remove the leaf spring. Lift the capsule and shims from the body.

**98.** (1) Remove the tappet screw locknut and tabwasher and, using spanner T.221291 remove the tappet screw from the end of the sensing lever.

(2) Remove the two securing nuts and tabwashers and withdraw the lever assembly from the body, then remove the seal from the lever bore.

(3) Unlock and remove the nuts and tabwashers securing the support arms to the lever spindle and remove the support arms.

(4) Remove the circlips from the ball race housing.

(5) With the lever pointing away from the operator and the face of the ball race housing marked TOP uppermost, locate the assembly in the extractor T.285703 (*fig.* 12) and press out the spindle, spacers and one bearing from right to left. It is important that the assembly is located correctly as one bearing is located against a flange on the spindle which permits the spindle to be removed in the one direction only.

(6) Withdraw the lever and shims from the housing.

(7) Reverse the position of the housing endwise in the fixture T.285703 and, using a piece of $\frac{3}{8}$ in. diam. brass rod as a drift, press out the second ball race and spacers.

(8) Reverse the position of the arms of the fixture and of the threaded push rod and press the first ball race from the spindle as shown in fig. 12. This race is an interference fit.

(9) Remove the seals from the spacers and sealing collars.

### Final operations

**99.** Unscrew and remove the capnut, rig testing union and bonded seals from the side of the acceleration control body.

**100.** If the mounting bush in the acceleration control body needs renewing, remove it with tool T.297621.

**101.** Clean the components as detailed in para. 7.

## INSPECTION

**102.** Inspect the components as detailed in para. 8 to 15, then examine the following items.

### Pressure ratio switch

**103.** Remove the valve screw, shims and tabwasher from the base of the bellows, then using adapter T.303909 and fixture T.299105 (*fig.* 13), check the rate of the bellows and capsule as follows.

(1) Place the bellows and capsule in the fixture and add a 2 lb. weight to the weight carrier to stabilize the fixture.

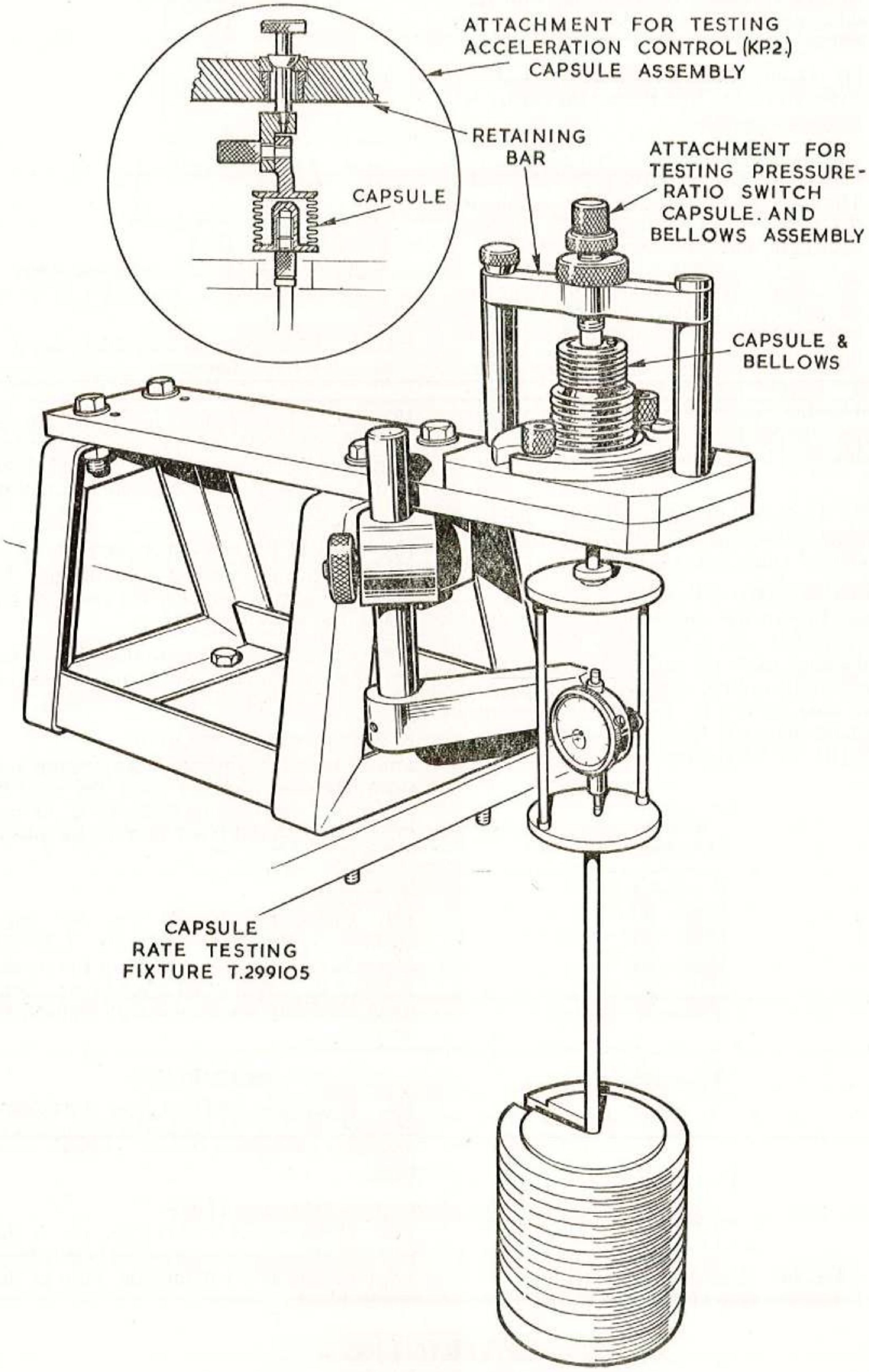


Fig. 13. Capsule rate checking fixture

(2) Adjust the dial test indicator bracket to give a reading of 0·050 in., with the d.t.i. stylus resting on the weight carrier centre.

(3) Gently lift and then lower the d.t.i. stylus to ensure that the weight carrier is hanging vertically.

(4) Set the d.t.i. to zero, then add weights until a reading of 0·036 in. is obtained. The total weight including the weight of the carrier, which is 1 lb., must be not less than 12 lb. and not more than 18 lb.

(5) Before being assembled it may be necessary to re-grind the valve screw to ensure correct alignment with the splitter orifice end face.

**104.** Inspect both orifices in the splitter bobbin for erosion and for crumbling of their edges. If this has occurred, renew both the bobbin and holder; they must not be separated.

**105.** Examine the potentiometer bobbin orifices for erosion and crumbling; renew the bobbin if either has occurred.

**Metering plunger and orifice**

**106.** Inspect the plunger metering slots for erosion and the orifice edge for erosion, crumbling and wear due to plunger contact. Renew either of the components if the defective area cannot be polished satisfactorily without departing from the requirements of the Fits and Clearances.


**Fig. 14. Assembling the seals to the pressure drop kinetic lever assembly**

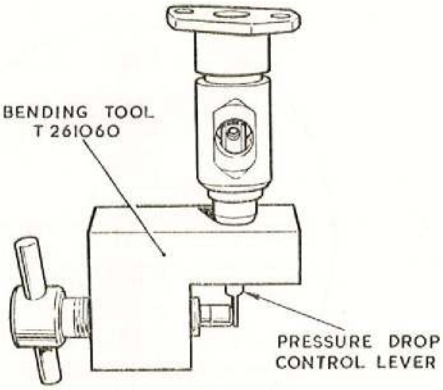


**Fig. 15. Bending the pressure drop control lever**

**107.** Inspect the piston rings for fractures and chipped edges. Check them for flatness by placing them on a surface plate and check their gaps as stated in the Fits and Clearances.

**Kinetic levers**

**108.** Inspect the knife blade of both levers for eroded edges; slight erosion may be polished out provided that the shape of the edge is not altered.

**109.** Check that there is no side play on the lever hinges and that the hinge pins are not proud of the bush surface on both sides.

**Pressure drop piston and sleeve**

**110.** Examine the pressure drop piston and sleeve for corrosion and check for wear in accordance with Fits and Clearances. Ensure the piston push rod is not worn on its spherical ends.

**KP2 capsule**

**111.** Check the capsule rate by using adapter T.303911 and fixture T.299105 (*fig.* 13). The weight carrier on the fixture weighs 1 lb. and must be taken into account when recording the total weight applied to the capsule.

## ASSEMBLING

**112.** It is emphasised that scrupulous cleanliness of components, tools and equipment is necessary throughout the assembling operations.

**Pressure drop control lever**

**113.** Using tool T.224393 (*fig.* 14) fit the two seals on to the pressure-drop kinetic lever assembly and insert it into the bore in the kinetic block.

**114.** Place the seal on to the spigot of the cover plate and fit the cover plate to the end of the lever assembly. Secure it with a plain and grover washer and a wirelocked nut on each stud.

**115.** Using tool T.238072, insert the pressure-drop control input orifice into the kinetic block (bore No. 1 in fig. 5).

**116.** Insert a wood, plastic or light alloy plug into the bore of the input orifice and tap it lightly to seat the orifice, then pass a rubber band round the housing and over the plug to retain the orifice in position.

**117.** Using a toolmakers microscope, check that the distance between the kinetic knife and the input orifice is 0·010 to 0·016 in. Experience has shown it advisable to set the lever between 0·011 and 0·014 in. If necessary, use the lever bending tool T.261060 (*fig.* 15) to attain this position.

**Internal servo kinetic knife**

**118.** (1) Remove the rubber band and temporary plug then fit the sealing ring to retain the pressure-drop control input orifice.

(2) Using pin gauges G.69705—G.69715, determine the size of the hinge pin hole in the kinetic lever and select a slave hinge pin of the same size, or up to 0·001 in. smaller in diameter.

(3) Check the lever holder with the pin gauges and determine that the hinge pin holes in the holder will allow the slave hinge pin a clearance of 0·0005 to 0·0009 in.

(4) Lay the pin aside and measure with a micrometer the width of lever at the pin hole; note the measurement as A. Insert the slip gauge G.112897 into the lever location in the holder and, using feeler gauges in conjunction with the gauge, determine the width of the slot in the holder; note this measurement as B.

(5) Subtract measurement A from B and then subtract a further 0·002 in.; the resultant dimension is the total thickness of shims required either side of the lever to give it a side float of 0·002 in. in the holder.

(6) Select shims of the total thickness determined and assemble the lever shims, holder and pins so that the shims are equally disposed on either side of the lever, i.e. the lever will be located centrally within the holder slot.

(7) Fit the spring into the bore in the kinetic knife lever holder assembly. Insert the plug into this bore, press it into position and secure it with the pin.

(8) Place the seal on to the base of the lever holder assembly and insert the assembly into the bore in the kinetic block.

(9) Fit the seal on to the plug, insert the plug into the bore in the lever holder assembly and press it fully home.

(10) Ease the backing ring and seal on to the lever stop screw and fit the adjusting screw into the cover plate.

(11) Assemble the cover plate to the kinetic lever holder, carefully inserting the lever stop screw into the bore. Fit plain and grover washers on each of the four studs, with plain nuts on three studs and a wirelocked nut on the offset stud.

**119.** Insert the internal servo kinetic input orifice into its bore (No. 3 in fig. 5). Again, fit a temporary plug and rubber band to retain the orifice.

**120.** Adjust the stop screw until the edge of the kinetic knife is just fully across the input orifice. This is seen through the recovery orifice location bore and is a preliminary setting only, final setting will be achieved during testing. Fit the serrated locknut finger tight.

**121.** Check with a toolmakers microscope that the kinetic knife is laterally within 0·010 to 0·016 in. from the face of the input orifice. If the clearance is not within these limits, adjust the lever in the required direction by changing some or all of the lever shims from one side to the other.

**122.** When the position of the kinetic knife relative to the orifice is satisfactory, dismantle the holder lever, pin and shims, and note the thickness of the shims on each side for re-assembling.

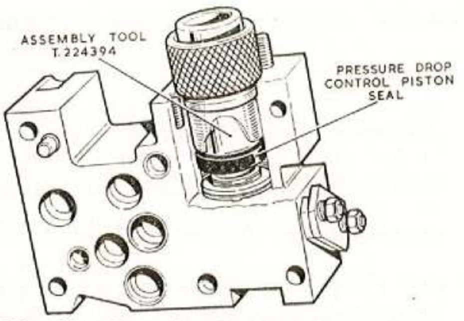


**Fig. 16. Inserting the U-section seal into the pressure drop bore**

**123.** It is necessary now to fit the correct size hinge pin. Using the pin gauges G.69705 G.69715, determine the hole size in the lever and select a hinge pin 0·0001 to 0·0002 in. larger, to provide an interference fit in the lever. Again using the gauges check that the selected pin will have 0·0005 to 0·0009 in. clearance in the lever holder.

**124.** Locate the lever holder in fixture T.314003 and assemble the lever and the shims. Using the locating pin attached to the fixture, make sure that the shims are fitted correctly, as noted when dismantled, then insert the hinge pin so that it is flush with or below the surface of the holder on both sides.

**125.** Ensure that the lever moves freely in the holder under its own weight then fit it to the kinetic block. Remove the rubber band and plug retaining the input orifice and fit the orifice sealing ring.

**Pressure-drop control**

**126.** Using tool T.265775, screw the lever adjusting screw into the pressure-drop lever (pump servo kinetic lever) from the pressure-drop control side, and then using tool T.265774 from the return spring side to avoid scoring the smaller, deepest section of the pressure-drop control bore.

**127.** Insert the distance piece, projections downwards, into the bottom of the pressure-drop bore in the kinetic block, followed by shims 0·005 in. thick. Next insert the seal support, flange first, followed by the U-section sealing ring into the bore, using tool T.224394 as shown in fig. 16.

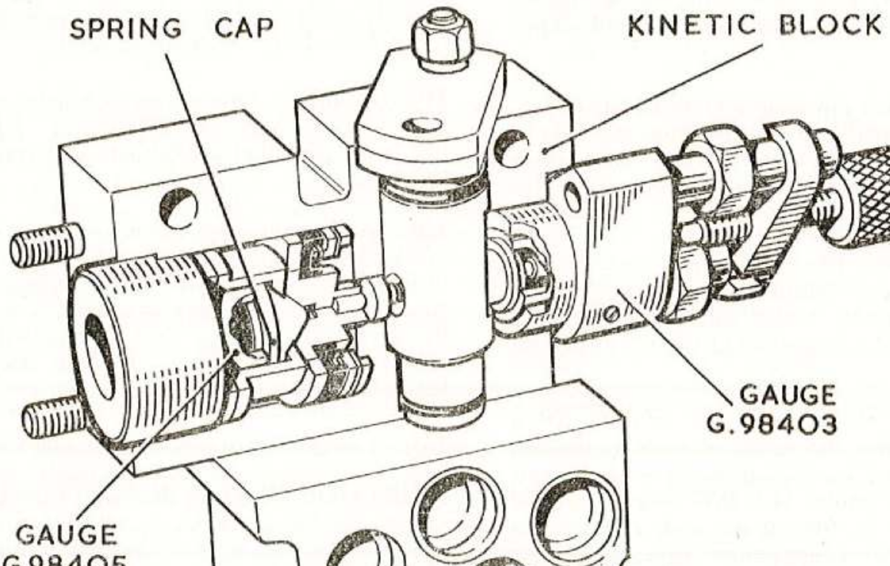


**Fig. 17. Setting the pressure drop control adjustment**

**128.** Position the stop plate, piston and sleeve on an assembly block of brass three inches long and one inch in diameter, with flat and parallel ends. Fill the cup in the spigot of the piston with white petroleum jelly, then insert the push rod into the cup so that it stands vertically.

**129.** Lower the kinetic block over the assembly and then invert the whole to transfer the stop plate, piston, piston sleeve and push rod to the pressure-drop bore; remove the assembly block.

(1) With a finger pressed against the pressure-drop piston and, using the tool T.265774, turn the lever adjusting screw clockwise until contact is just made with the push rod.

(2) Insert shims 0·015 in. thick, and insert the spacing ring. Fit the cover plate, without seals, to the bore.

(3) Check that a gap of 0·005 to 0·010 in. exists between the flange of the cover plate and the body, with the cover plate in the free position. Remove the cover plate.

(4) Measure the height from the flange of the cover plate to the face of its spigot. Note this as measurement A.

(5) Place the setting piece G.93140 in the bore and measure the depth from the face of the body to the setting piece.

(6) Add the thickness of the setting piece (0·100) to this depth to give the depth to the spacing ring. Note this depth as measurement B.

(7) Subtracting A from B shows the amount of compression upon the U-section sealing ring; this must be 0·005 to 0·010 in. If necessary, alter the thickness of the shims between the stop plate and spacing ring to provide this amount of compression.

(8) Fit the cover plate and secure it temporarily with two slave washers and nuts.

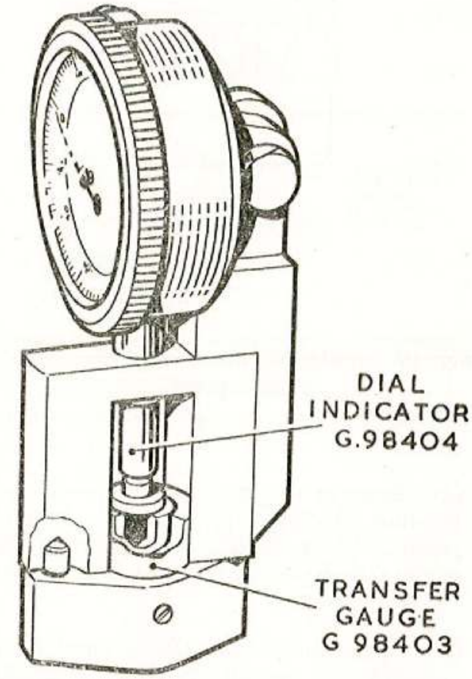


**Fig. 18. Shimming the pressure-drop lever return spring**

**130.** From the pressure-drop lever return spring side, fit the spring seat, saddle side first, tabwasher and locknut to the end of the adjusting screw in the pressure-drop kinetic lever; do not tighten the locknut.

**131.** Using tool T.265774, turn the lever adjusting screw clockwise until maximum resistance is felt, indicating that the lever is at maximum angle and the piston is against its stop plate. Maintain pressure on the tool to hold the piston against the stop and at the same time turn the adjusting screw anti-clockwise until the edge of the knife is 0·001 to 0·003 in. of the edge of the orifice, viewed through the recovery orifice housing bore. Using spanner T.204212, tighten the adjusting screw locknut and lock the tab-washer.

*Pressure-drop control adjustment (fig. 17)*

**132.** (1) Assemble the transfer gauge G.98403 to the return spring side of the kinetic block.

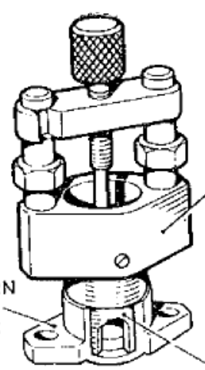


**Fig. 19. Shimming the pressure-drop lever return spring**

(2) Remove the p.d. control cover and position the conical spring cap in the p.d. piston. Insert the distance piece G.98405 in the p.d. bore and locate it correctly on the spring cap.

(3) Apply pressure to the distance piece G.98405 and simultaneously adjust the screw in the transfer gauge until the knife blade is just beginning to cut across the edge of the input orifice.

(4) With a depth micrometer, measure the height from the face of the kinetic block to the face of the distance piece G.89405. Subtract this figure from the nominal length of the distance piece (1·000) to obtain the depth from the face of the kinetic block to the spring cap flange face. Record the dimensions.

(5) Subtract the length of the cover spigot ascertained in the previous paragraph from the depth from the kinetic block face to the spring cap. This will give the distance available for the spring, and must be at least 0·005 in. greater than the fully compressed length of the spring. If necessary, transfer the shims from beneath the piston seal support ring to beneath the cover spacing ring to attain this amount of clearance.

(6) If the shims have to be re-positioned then the whole p.d. piston assembly must be dismantled. The total thickness of the shims must not be altered, otherwise the seal compression check must be repeated.

(7) Fit the adjusting screw into the spring seat and insert them into the cover.

(8) Find the number of turns of the p.d. control adjusting screw needed to move the spring location face on the spring seat from a position level with a face of the spigot of the cover, to the position when the spring seat is hard back in its recess in the cover. The maximum allowable adjustment is one half turn less than this and must be recorded, as any later adjustment on the test rig must not exceed this number of turns, otherwise the spring may be coilbound and not allow the piston to travel to its stop plate.

(9) Leave the seat in its hard back position, remove the spring cap from the bore. Fit the assembled p.d. cover without its seal and backing ring and secure it temporarily with slave washers and nuts.

*Setting the pressure drop lever return spring*

**133.** Lower the inner sleeve of the transfer gauge G.98403 on to the flange of the return spring seat and lock it in position. Remove the transfer gauge G.98403 from the kinetic block.

**134.** Position the dial test indicator G.98404 (fig. 18) on the transfer gauge with the flange resting on the inner sleeve and set the indicator to zero.

**135.** Remove the d.t.i. G.98404 from the transfer gauge G.98403 and position the transfer gauge on the spigot of the cover. Release the inner sleeve of the gauge, press it to the bottom of the spring recess in the cover and lock the inner sleeve, as shown in fig. 19.

**136.** Remove the gauge G.98403 from the cover and take a reading with the dial indicator. Add this reading to the length of the gauge G.98403 (0·400 in.) and subtract the rated length of the return spring. The result will be the thickness of shims to be fitted in the p.d. return spring cover, and must not exceed 0·090 in. Record the readings and the shim thickness, as adjustment may be required during test.

**137.** Fit the p.d. return spring to its seat in the bore. Ease the seal into the groove on the shoulder of the cover. Place the selected shims in the cover and fit the cover to the kinetic block.

**138.** Screw the lever stop screw into the return spring cover until it contacts the end of the lever adjusting screw, then screw in further until the kinetic knife edge is just clear of the delivery orifice, i.e. 0·001 to 0·003 in. from the edge, as viewed with a toolmakers microscope through the recovery orifice location bore.

**139.** Fit a sealing washer and locknut to the adjusting screw and then a second sealing washer and the capnut, tighten the nuts.

**140.** Remove the pressure-drop control cover and fit the seal and backing ring on the spigot of the cover. Using tool T.287958, ease the seal and backing ring into the recess on the adjusting screw and fit the seal retainer. Fit the locknut to the adjusting screw and tighten it. Place the spring and spring cap into the bore, fit the cover and secure it with plain and grover washers and nuts.

**Kinetic recovery orifices**

**141.** Using tool T.238072, insert the internal servo recovery orifice and the pressure-drop recovery orifice into the kinetic block. Fit a seal into each of the two bores, followed by a seal abutment ring and a disc type strainer in each bore.

**142.** Insert the plug into the internal servo recovery orifice bore. Using a depth micrometer and micro-parallel blocks measure the height of the plug above the face of the kinetic block. Insert shims between the plug and the strainer, to bring the plug 0·018 to 0·023 in. above the face of the kinetic block; this will provide compression on the seal when assembled. Fit the seal into the counterbore around the plug.

**143.** Insert the bobbin into the bore of the pressure-drop recovery orifice and measure the height of the bobbin above the face of the kinetic block. Insert shims between the strainer and the seal abutment ring, to bring the bobbin 0·018 to 0·023 in. above the face of the kinetic block; this will compress the seal when assembled.

**144.** Remove the bobbin with tool T.234702, fit the seal and re-insert the bobbin.

**145.** Fit the bonded seals to the inspection plugs and screw one plug into the oblique bore and the other into the bore in the recess of the block.

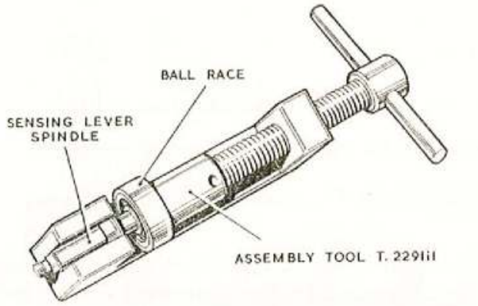


**Fig. 20. Fitting the ball race to the sensing lever spindle**

**146.** Flow test the orifices as instructed in Appendix 1, para 4, 5 and 6. After testing, remove the test plates and lock the tabwashers on the cover-plate of the pump servo kinetic return spring. Temporarily cover both recovery orifices with a short length of adhesive tape.

**Sensing lever hinge**

**147.** If the two ball bearings are to be renewed, select the new ones in accordance with the dimensions specified in Fits and Clearances.

**148.** Using tool T.229111 (fig. 20) press the selected bearing on to the larger diameter of the shaft and against the shoulder.

**149.** If new parts are being used in this assembly, the following check is recommended.

(1) Assemble the lever, second ball bearing, shim, retaining collars, distance pieces (without seals) and support arms on the shaft. Secure the assembly with slave nuts and washers and check with a feeler gauge that a gap of 0·006 to 0·008 in. exists between each retaining collar and its adjacent outer ball race. Dismantle the assembly.

(2) Stand the bearing housing upon its left-hand end as fitted to the body; the housing is inscribed TOP on one surface. Insert the push-fit ball bearing into the housing, followed by the retaining collar, thickest shoulder outermost and without seals at this stage, and then fit the circlip.

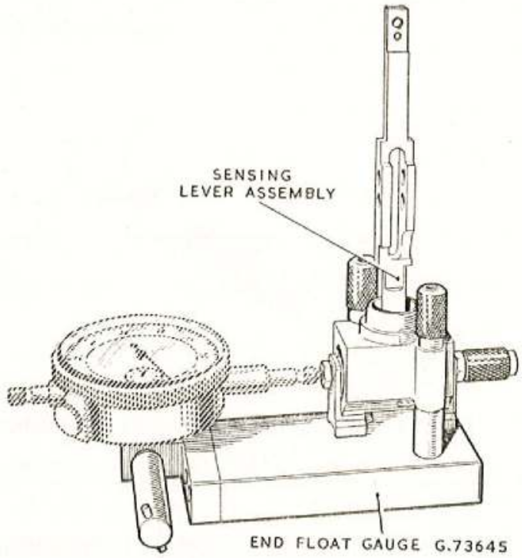


**Fig. 21. Checking the end float of the lever hinge assembly**

(3) Reverse the housing so that it stands upon its right-hand end. Place the 0·020 in. shims in the housing on top of the ball race.

(4) Insert the lever into the housing, with the recess of the lever hub facing upwards so that the recess will face the shoulder of the shaft.

(5) Feed in the shaft, ball race uppermost, and fit the second retaining collar, with its thickest shoulder outermost and without seals, then fit the circlip.

(6) Assemble the two distance pieces, one to each end of the shaft, fit the two leaf spring support arms and secure them with slave nuts and washers.

(7) Position the complete assembly in the end-float gauge G.73645 (fig. 21). Pull the end of the shaft and set the gauge to zero. Push the end of the shaft and note the gauge reading. The end float must be 0·002 to 0·005 in. If necessary, the assembly must be removed from the gauge, the right-hand side of the bearing dismantled, and the 0·020 in. shim replaced by one of appropriate thickness. After which, the bearing must be assembled and checked again in gauge G.73645.

(8) Remove the gauge, and strip the assembly completely except for the shaft and fitted ball race.

**150.** Fit the inner and outer seals to each of the two retaining collars, using tool T.280596 for the outer seals. Assemble the retaining collars, into the ball race housing, fit the circlips and rotate them slightly to ensure that they are fully engaged in their grooves.

**151.** Fit the two distance pieces to the shaft, and using tool T.241679, ease the seal into position in the annular recess of each distance piece.

**152.** Assemble the leaf spring support arms to the squared shaft so that they are pointing in a diametrically opposite direction to the lever. Fit the tabwashers and nuts but do not lock them.

**153.** Assemble the alignment plate T.257466 and position the assembly in the pre-loading fixture T.227460 as shown in fig. 22.

**154.** To pre-load the lever assembly, move the fixture handle to the vertical position, and tighten the support arms securing nuts whilst the load is applied, then lock the tabwashers. Remove the assembly from the fixture.

**155.** Pressure test as instructed in para. 490.

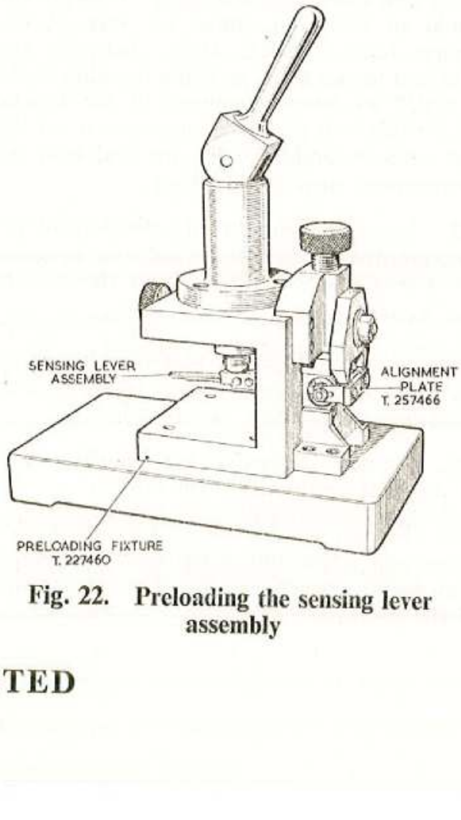


**Fig. 22. Preloading the sensing lever assembly**

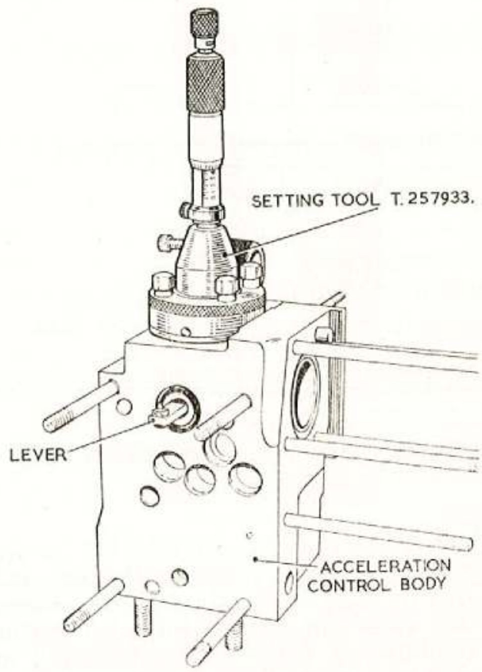


**Fig. 23. Setting the sensing lever in its neutral plane**

**156.** Assemble the acceleration control body to the hydraulic fixture adapter plate T.212176

**157.** Fit the lever housing seal to the body, locating it in the counter-bore in the capsule end of the lever bore.

**158.** Insert the assembled lever into the acceleration control body from the capsule chamber end, the spigot of the lever ballrace housing entering the bore and the holes in the housing fitting over the two studs in the recess in the body, with the surface marked TOP uppermost. Secure the lever assembly with tabwashers and nuts.

**Fitting the capsules**

**159.** Fit the seal to the capsule retaining bolt, insert the bolt through the bottom of the capsule housing and screw it partway into the capsule to centralize it.

**160.** Assemble the leaf spring to the lever assembly locating it in the recesses in the lever arms, with its centre portion in the slot in the stem of the capsule, fit the three retaining screws and tabwashers and tighten but do not lock them at this stage.

**161.** Fit the setting tool T.257933 to the acceleration control body as shown in fig. 23. With the lever held in its highest position take a reading. Repeat with the lever in its lowest position. Halve the difference between the two readings and add the result to the lesser of the readings to obtain the neutral plane of the lever. Record the position of the neutral plane as dimension A; this figure will be used later.

**162.** Adjust the micrometer to set the lever in this neutral position. Take the 0·020 in. setting disc. T.265773 and add shims to this until the total thickness of the shims and disc just occupies the space between the capsule and the body. Remove the setting disc and measure and record the total thickness of the shims.

**163.** Remove the capsule retaining bolt and insert the selected shims between the capsule and the body. When assembled this will put a 0·020 in. pre-load upon the capsule.

**164.** Fit the capsule retaining bolt and bonded seal. Using a suitable tool on the capsule stem to prevent it turning, check that the capsule is centralized relative to the leaf spring, then tighten the capsule retaining bolt, lock the three leaf-spring retaining screws.

**165.** Fit the tappet screw to the free end of the lever, using tool T.2219291, and screw in until the underside of the lead contacts the lever. Fit the tabwasher and nut but do not lock it.

**166.** Remove the internal servo recovery orifice from the kinetic block, relieve the pressure from the setting tool T.257933 and assemble the kinetic block to the acceleration control body. Secure it with two slave washers and nuts.

**167.** Adjust the lever position again with tool T.257933 until the kinetic knife is just starting to cover the internal servo input orifice. Note this reading as dimension B.

**168.** Subtract B from A (*para.* 161), multiply the remainder by 1·80, which is a constant, and record the result.

**169.** Remove the kinetic block from the acceleration control body and adjust the tappet screw until the gap *under* the tappet head is of the same dimension as that obtained in the preceding paragraph, when checked with feeler gauges.

**170.** Replace the kinetic block on the main body and set the lever in its neutral plane with tool T.257933. Check visually that the kinetic knife is just on the edge of the orifice.

**171.** Remove the kinetic block from the body and, using the key T.320679, tighten the tappet screw lock nut to a loading of 15 in. lb. Remove tool T257933 and lock the tabwasher.

**172.** Fit the seal into the groove on the plunger by using tool T.222031.

**173.** Assemble the spring attachment to the plunger and fit the seal into the annular space in the end of the plunger.

**174.** Assemble the spring attachment and plunger to the piston and using the key T.265750 to hold the attachment, secure them with a tabwasher and nut. Check the plunger and piston assembly for concentricity. Insert the assembly in the outer sleeve of gauge G.115437, then with the metering plunger uppermost in the sleeve and resting on a flat surface, insert the smaller sleeve of the gauge and check that it will slide down over the plunger when using only light finger pressure. If the small sleeve will not slide fully over the plunger, remove the assembly, release the piston securing nut and move the plunger relative to the piston as much as possible, then retighten the nut. Should it be impossible to reduce the eccentricity sufficiently to pass the gauge, select another piston until satisfactory.

**175.** If the plunger is defective, it will be necessary to fit a new plunger and also its matched orifice.

**Metering plunger, piston and rings**

**176.** Before fitting the piston rings, check the gap of each ring as follows:—

(1) Slide the two outer rings, one at a time, into the servo cylinder.

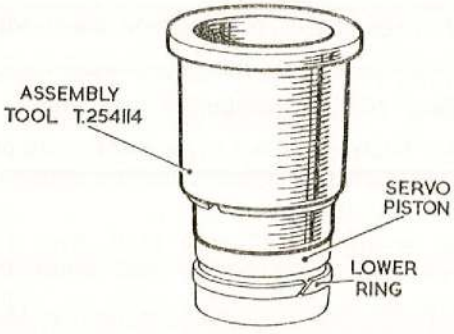


**Fig. 24. Fitting the piston rings**

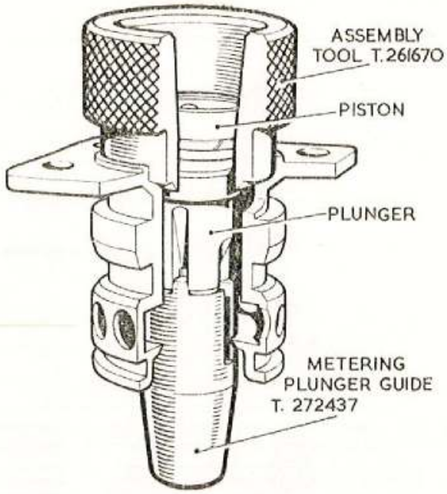


**Fig. 25. Fitting the piston assembly into the servo cylinder**

(2) Using aligning tool T.272438, ensure that the rings are square in the bore and that the ends at the gap are truly in line. The outer rings are slotted either left or right-handed, one of each makes a pair so that when assembled the slots form a V.

(3) Using feeler gauges check that the gaps are not less than 0·005 in. and not more than 0·008 in.

(4) If new rings are fitted the ends of the rings may be filed, using tool T.282114, to attain the stated gap clearances.

(5) With the outer rings located in cylinder and their gaps correct, fit the inner ring into the bores of the outer rings, then using feeler gauges, check that the gap in this ring is not less than 0·005 in.

(6) Remove the inner ring and then the two outer rings from the bore and with tool T.254114 (*fig.* 24) assemble them to the piston. They can be lapped if necessary by using tool T.277750 to attain free movement.

(7) The rings must be free to rotate in the groove without binding but the total clearance between the rings and the groove must not exceed 0·0015 in.

(8) Position the three rings so that the gaps are approximately 120 degrees apart.

(9) The outer rings must not be renewed singly; if one requires renewal then a new pair must be fitted.

**177.** Using tools T.261670 and T.272437 as shown in fig. 25, assemble the piston assembly into the servo cylinder bore; check that it will slide smoothly.

**178.** Test the plunger and orifice as instructed in para. 491 to 494.

**Metering control**

**179.** Fit the seal into the groove at the internal end of the piston and orifice assembly and also the two seals into the housing bores, one in the annular groove midway along the bore, the other in the counterbore.

**180.** Fit the non-protruding end of the large spring to the plunger slot. Insert the assembled piston and orifice sleeve and the spring into the body and secure the projecting spring loop to the lever by inserting the peg in the lever, using tool T.287998.

**181.** Fit the seal on to the trimming adjusting screw. Fit the adjusting screw into the spring anchor and insert it into the cover plate, with the hole in the spring anchor positioned opposite the slot in the inside spigot of the cover. Fit the seal on to the spigot of the cover plate.

**182.** Hook the trimming spring into the spring-anchor slot and insert the whole assembly into the trimming spring bore in the acceleration control body. The cover plate assembly must be inserted so that the adjustment screw boss lies nearest to the kinetic block.

**183.** Using tool T.287998, secure the trimming spring to the main lever with the securing peg.

**184.** Using tool T.160988, turn the trimming spring adjusting screw to apply a slight tension on the spring. This will retain it in position pending adjustments.

**185.** Secure the trimming spring cover plate with plain washers and grover washers on all four studs, plain nuts on three studs and a wirelocking nut on the fourth stud. Fit the adjusting screw locknut finger tight.

**186.** Fit the seal into the recess of the internal servo cylinder end cover and secure the cover to the acceleration control body with four tabwashers and nuts.

**Kinetic block**

**187.** Fit the combination washer to the pressure union and screw the union into the bore in the side of the main body. Fit the second combination washer and capnut and tighten it.

**188.** Ensure that the two input orifice sealing rings are seating on the chamfered face of each orifice. Refer to fig. 5 and insert the following parts:—

*Pump servo input orifice* (*No.* 1 *in a.c.u. body*)

(1) Using a depth micrometer measure the depth to the strainer seating face of the bore in the body.

(2) Insert the bobbin temporarily into the bore in the kinetic block on top of the seal. Place the disc strainer on top of the bobbin and using a depth micrometer and micro-parallel blocks measure the height of the strainer above the face of the kinetic block.

(3) Insert shims between strainer and the bobbin, to make the height of the strainer, 0·015 to 0·020 in. more than the depth of the counterbore in the main body. This will provide 0·015 to 0·020 in. compression on the seal when assembled. Remove the bobbin from the kinetic block.

(4) Insert the strainer followed by the shim into the bore in the body. Fit the seal and then the backing ring on to the bobbin and insert the bobbin on top of the shim.

*Restricting orifice* (*No.* 2 *in a.c.u. body*)

(1) Measure the depth of the bore in the body. Insert the blank bobbin on to the seal in the bore in the kinetic block.

(2) With the depth micrometer and micro-parallel blocks measure the height of the assembly above the face of the kinetic block. This must be 0·015 to 0·020 in. more than the depth of the bore in the body.

(3) Add shims on top of the distance piece to attain the height and to compress the seal when assembled. Remove the shims, and bobbin from the kinetic block.

(4) Fit the seal on to the bobbin, and insert the shims and the bobbin, chamfered end first, into the bore.

*Internal servo input (No. 3 a.c.u. body)*

(1) Measure the depth of the bore in the body. Insert the bobbin on to the seal in the bore in the kinetic block. Position the conical strainer on the bobbin, the cone lying inside the bobbin, and insert the distance piece.

(2) Measure the height of the assembly above the face of the kinetic block. This height must be 0·015 to 0·020 in. more than the depth of the bore in the body. Add shims on top of the distance piece to attain the height and thus compress the seal.

(3) Remove the shims, distance pieces, strainer and bobbin from the kinetic block.

(4) Insert the shims followed by the distance piece, projections downwards, and the conical strainer. Fit the seal on to the bobbin, and insert the bobbin, chamfered end first, over the strainer.

*Pressure drop, downstream (No. 4 a.c.u. body)*

Fit the backing rings and seals on to the bobbin and insert the bobbin into the body.

*Pressure drop, upstream (No. 5 in a.c.u. body)*

Fit the backing rings and seals on to the bobbin and insert it into the body.

*Kinetic lever (No. 6 in a.c.u. body)*

Fit the seal into position in the groove around the bore.

*Return to pump inlet (No. 7 in a.c.u. body)*

Fit the two seals on to the bobbin and insert the bobbin into the body.

*Internal servo (No. 8 in kinetic block)*

Fit the seal into the recess of this transverse drilling.

*Pump pressure to a.s.u. (No. 9 in kinetic block)*

Fit the seals on to the bobbin and insert the bobbin into the body.

**189.** Assemble the kinetic block to the acceleration control body, pressing down on the kinetic knife to ease the lever into the kinetic block. Fit tabwashers and nuts on the two shorter studs in diagonally opposite corners, tighten and lock the nuts.

**190.** Fit the combination washer to the small blanking plug and screw the plug into the side of the sandwich plate.

**191.** Fit the seal into the recess of the bore in the face of the sandwich plate (pump servo kinetic recovery orifice).

**192.** Remove the adhesive tape from the recovery orifices, assemble the sandwich plate to the kinetic block and secure it with tabwashers and nuts.

**Pressure ratio switch**

**193.** The valve plate facing and the splitter orifice face must be both flat and parallel to each other. If the valve screw has not been removed, ensure that the capsule radial position, according to the correlation marking made during dismantling, is correct. The splitter orifice face may be lapped if necessary, using lapping tool T.272436 and a surface plate.

**194.** To attain the necessary compression on the seal of the bellows flange, insert the bellows and capsule assembly into the housing, fit the large seal on to the bevelled flange of the bellows, and assemble the pressure ratio switch cover. Obtain a gap of 0·030 in. to 0·035 in. between the housing and the cover by inserting shims between the bellows flange and the flange of the housing. Check with feeler gauges in at least three places.

**195.** To provide a 0·020 in. tension preload upon the bellows and capsule when assembled, the following measurements of the bellows and capsule and of the housing must be made.

(1) To measure the thickness of the housing, place the spigoted post of T.299383 in its base block, invert the housing and position it centrally over the post.

(2) Measure the depth from the outside face of the housing, through the bolt hole, to the face of the post; note the measurement.

(3) Lift off the housing and remove the spigoted post from the base block of T.299383.

(4) Take the large diameter shim previously selected (para. 194) and fit it to the bellows flange. Position the bellows on the base block of T.299383. Place the 0·020 in. setting disc T.265773 centrally on top of the capsule and lower the housing over the capsule and bellows, making sure it seats correctly on the shim on the bellows flange.

(5) Measure the distance from the outside face of the housing, through the bolt hole, to the setting disc. T.265773 and note the reading.

(6) The difference between the two readings will be the thickness of the spacing collar required to give the 0·020 in. preload upon the bellows and capsule.

(7) Remove the housing from the bellows, remove the setting disc T.265774 and replace it with the selected collar.

**196.** Ensure that the large shim is in position on the bellows flange. Position the selected spacing collar on the top of the bellows and assemble the pressure ratio switch housing over the bellows. Fit the seal on to the securing bolt, fit the tabwasher and plain washer to the bolt, insert it through the housing into the capsule and make it finger tight. Remove the assembly from the base block, tighten and lock the bolt.

**197.** If the valve screw has been removed, fit the screw with a 0·030 in. shim and tabwasher into the base of the bellows and tighten it.

**198.** Check that the face of the valve is in parallel with the housing face by using a depth micrometer and the gauge ring G.96453.

(1) Measure the depth from the face of the switch housing to the face of the valve screw.

(2) Screw the splitter bobbin fully in, then unscrew it one and a half turns. Measure the distance from the end of the splitter orifice to the face of the switch cover. The difference between the two must be set by adjusting the valve screw shim thickness, to zero gap but the shim thickness must not exceed 0·050 in.

**199.** Fit the large seal on to the end of the bellows assembly in the body counter-bore, and the small seal into the recess of the small bore in the end face of the housing.

*Cover and orifice holder*

**200.** Fit the seal into the groove at the innermost end of the orifice bore in the cover. Also fit the seal to the small plug and insert the plug into the face of the cover.

**201.** Using T.234048 ease the two seals on to the orifice and holder and screw the orifice holder into the cover plate. Fit the locknut to the end of the holder but do not tighten it.

**202.** Insert the orifice and holder into the switch cover and press it into position so that the cover plate covers the small blanking plug previously fitted. Secure the cover plate with plain and grover washers on each of the two studs, a plain nut on one stud and a wirelocked nut on the other.

**203.** Fit the two seals on to the potentiometer bobbin and, using tool T.209310 (*fig*. 10) insert the bobbin into the side of the pressure ratio switch cover. Place the seal on to the bobbin retainer and insert the retainer into the top of the bobbin.

**204.** Assemble the cranked securing bracket to the cover. Fit a tabwasher and plain nut on the single stud but do not lock it.

**205.** Fit the small seal into the recess of the tangenital drilling in the inner face of the cover. Fit the cover to the pressure ratio switch body and secure it with a plain washer, grover washer and plain nut on each of the four studs.

**206.** Fit the two seals to the transfer bobbin and insert the bobbin into the side of the pressure ratio switch cover. This bobbin connects a drilling from the orifice holder to the P2 drilling in the acceleration control body.

**207.** Test the pressure ratio switch assembly for leakage as instructed in para. 489.

**208.** Also, carry out the test and setting detailed in Appendix 1, para. 11 to 15.

**209.** Assemble the gasket to the acceleration control body, fit the pressure ratio switch assembly and secure it with plain and grover washers and a nut on each side of the four studs.

**Mounting bush**

**210.** If a new mounting bush is being fitted the tool T.297621 should be used.

RESTRICTED

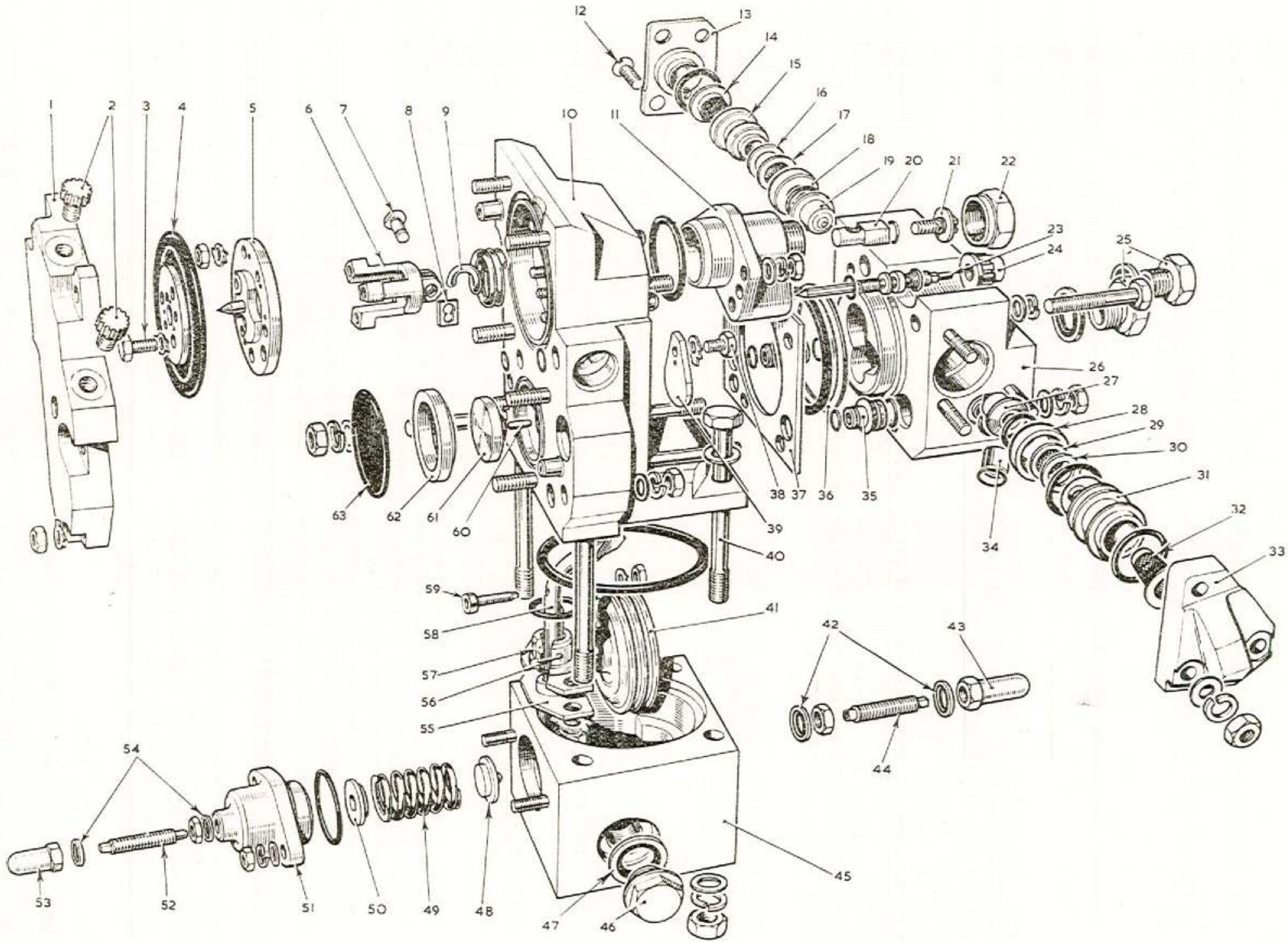


**Fig. 26. Exploded view of altitude sensing unit**

## KEY TO FIG. 26

1 Metering valve cover plate
2 Blanking plugs
3 Diaphragm retaining screws (3 off)
4 Diaphragm assembly
5 Metering valve plate with valve screw
6 Metering valve support ring
7 Clevis pin
8 Clevis pin securing clip
9 Metering valve spring
10 A.S.U. main body
11 Metering valve spring housing
12 Countersunk securing screw (1 off)
13 End plate
14 Recovery orifice conical strainer
15 Strainer sleeve
16 Shim
17 Recovery orifice disc strainer
18 Recovery orifice seal abutment ring
19 Kinetic recovery orifice
20 Metering valve spring anchor
21 Spring adjusting screw
22 Locknut
23 Fixed orifice adjusting screw
24 Locknut
25 Blanking plugs (2 off)
26 Kinetic block
27 Kinetic input orifice
28 Input orifice seal abutment ring
29 Input orifice disc strainer
30 Shim
31 Strainer sleeve
32 Strainer
33 End cover of input orifice bore
34 Seal support sleeve
35 Transfer bobbin
36 Circular shim
37 Square laminated shim
38 Lever stop plate securing screw
39 Lever stop plate
40 Capsule housing retaining bolts (2 off)
41 Capsule assembly
42 Combination sealing washers (2 off)
43 Locknut
44 Capsule adjusting screw
45 Capsule housing
46 Blanking plug
47 Combination sealing washer
48 Spring cap
49 Capsule spring
50 Spring seat
51 Spring housing
52 Adjusting screw
53 Capnut
54 Combination sealing washers (2 off)
55 Seal retaining plate
56 Kinetic lever hinge pin
57 Lever bush
58 Kinetic lever
59 Adjusting screw
60 Actuator piston push rod
61 Actuator piston
62 Piston sleeve
63 Piston diaphragm

# ALTITUDE SENSING UNIT

### General

**211.** This unit contains an evacuated capsule which senses $P_1$ pressure and, through a rocker lever and kinetic orifice connected with the pump servo system, regulates pump delivery in accordance with air-intake under steady running conditions.

**212.** The unit also contains a metering valve which maintains the secondary flow pressure at a constant value to counter the effect of reduced pump delivery at altitude.

## DISMANTLING (*fig.* 26)

### Capsule housing

**213.** Remove the two capnuts, locknuts and washers from the capsule and capsule spring adjusting screws.

**214.** Using tool T.201778, remove the capsule adjusting screw and, with tool T.154353, unscrew the spring adjusting screw.

**215.** Unscrew the two securing nuts and washers and remove the spring housing, spring and spring seats. Place the spring in the spring keeper T.287980.

**216.** Remove the capsule housing from the a.s.u. body, taking care to avoid damaging the capsule.

**217.** Withdraw the capsule from the housing and place it in the capsule keeper T.290960. Turn the clamping screw until the capsule is compressed on to its internal mechanical stops, then unscrew it one-third to one-half of a turn; this permits the capsule to expand 0·010 to 0·015 in. and it must remain so until it is fitted to the control unit.

**218.** Remove the blanking plug and combination washer

### Actuator piston

**219.** Unlock and remove the securing nuts and tabwashers and remove the cover plate. Lift out the actuator and withdraw the piston, piston sleeve and push rod.

### Metering valve

**220.** Remove the three securing screws and tabwashers and remove the diaphragm and orifice assembly.

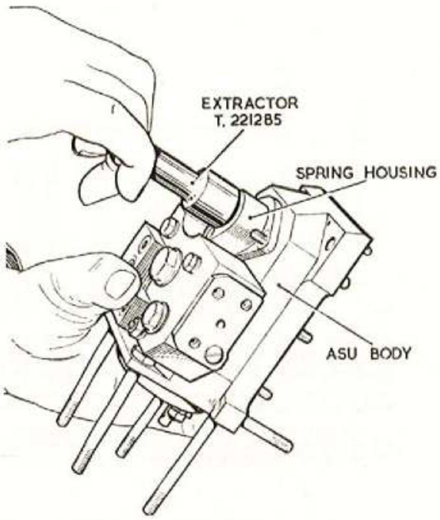


**Fig. 27. Removing the metering valve spring housing**

**221.** Unlock and remove the six screws securing the valve plate to the support ring. Remove the valve plate by using the extractors T.303025 in the two 4BA tapped holes. If no extraction holes are provided, dismantle the valve spring housing and spring assembly as described in subsequent paragraphs, then insert a soft metal drift on to the head of the support ring, through the spring housing location bore, and tap lightly to eject the valve plate assembly and support ring.

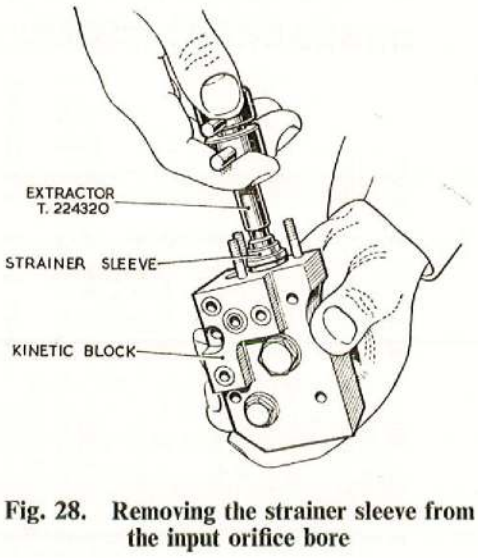


**Fig. 28. Removing the strainer sleeve from the input orifice bore**

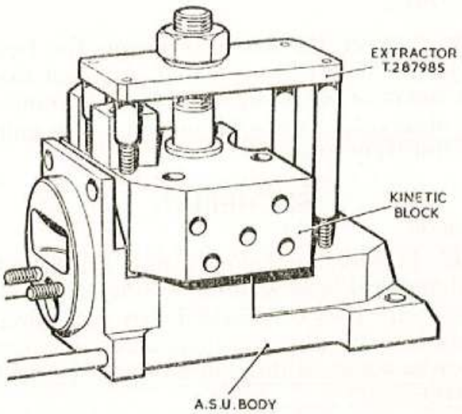


**Fig. 29. Removing the kinetic block from the a.s.u. body**

**222.** The valve screw is taper-ground for concentricity after being fitted and locked in the valve plate; it should not be disturbed except during final calibration, when it may be necessary to adjust the shim thickness beneath the screw head.

**223.** Use spanner T.209306 to release the locknut of the fixed orifice adjusting screw, and spanner T.171611 to remove the adjusting screw.

**224.** Unscrew the locknut of the metering valve spring adjusting screw and, using key spanner T.160988, remove the adjusting screw.

**225.** Remove the two securing nuts and remove the spring housing by using extractor T.221285 as shown in fig. 27.

**226.** Withdraw the spring anchor, spring and support ring. Disengage the spring anchor from the spring. Straighten the clevis pin retaining plate, slide it across to disengage the smaller diameter hole from the clevis pin groove, remove the plate, then withdraw the clevis pin from the lugs of the support ring.

**227.** Remove the spring from the support ring and place it in the spring keeper T.318530.

**Kinetic block**

**228.** (1) Remove the one securing screw and detach the end plate from the recovery orifice bore (marked pump servo on the housing).

(2) Unscrew the three securing nuts and washers and remove the end cover from the input orifice bore (marked pump delivery on the housing).

(3) Remove the seal and small plain sleeve from the bore alongside the pump delivery bore.

(4) From the pump delivery bore, remove the conical strainer and, using extractor T.224320 (*fig.* 28), withdraw the strainer sleeve. Remove the shim.

(5) Remove the disc strainer and seat, shims, seal abutment ring and seal. Using extractor T.238072, withdraw the kinetic input orifice and shims.

(6) Extract the conical strainer, strainer sleeve and shim from the pump servo bore.

(7) Remove the disc strainer and seat, shims, seal abutment ring and, using T.238072, extract the kinetic servo orifice.

(8) Remove the inspection and blanking plugs and their combination washers.

(9) Remove the securing nuts and screws and, using extractor T.287985 (*fig.* 29), remove the kinetic block from the a.s.u. body. Remove the shims.

(10) Withdraw the smaller bobbin from the kinetic block with extractor T.268389 and then remove the second, larger bobbin. Remove the two bolts from the a.s.u. body.

(11) Unlock and remove the locknut, tabwasher and adjusting screw from the lever by using the combination spanner T.268388.

(12) Unlock and remove the nuts and tabwashers securing the seal retaining plate of the lever and withdraw the lever assembly from the a.s.u. body.

(13) Remove the seal retaining plate from the lever bush and the seal from the annular recess in the bush by using extractor T.261059.

(14) Unlock and remove the screw and tabwasher and remove the stop plate.

**229.** Clean the parts as described in para. 7.

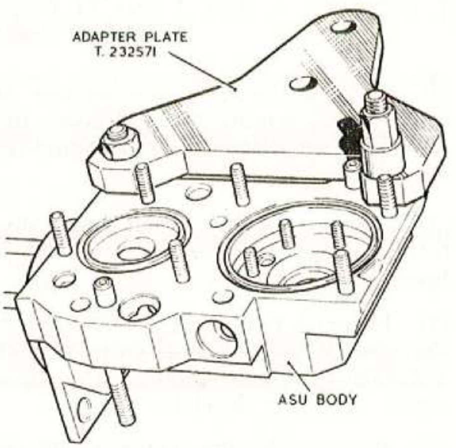


**Fig. 30. Adapter for mounting a.s.u. body on hydraulic fixture**

## INSPECTION

**230.** In addition to the instructions contained in para. 8 to 15, attention should be given to the following items.

**231.** Check that the kinetic lever pivot pin is secure and is not protruding above the surface of the bush.

**232.** Examine the capsule pivots. If they show uneven wear, renew the pivots by using extractor T.305213 and assembly tool T.297618.

**233.** Inspect the actuator piston for fretting; this may be stoned out provided that the limits given in the Fits and Clearances are observed. Renew the push rod if its ends are not truly spherical.

## ASSEMBLING

### General

**234.** Immediately before fitting, brush each seal and seal land with OM-58, refer also to para. 33. It is emphasised that scrupulous cleanliness of all parts, tools and equipment must be observed throughout the assembling operations.

**235.** On completion of assembly the unit must be stored in a lidded box to exclude dust, or all exposed ports must be sealed with blanking plates or suitable tape whilst waiting assembly to the rest of the control unit.

### Kinetic lever

**236,** Bolt the lever housing to the assembly fixture adapter plate T.232571 (*fig.* 30). Using tool T.224299, fit the lever sealing ring into the annular recess in the lever bush, then ease the bush sealing ring on to the bush.

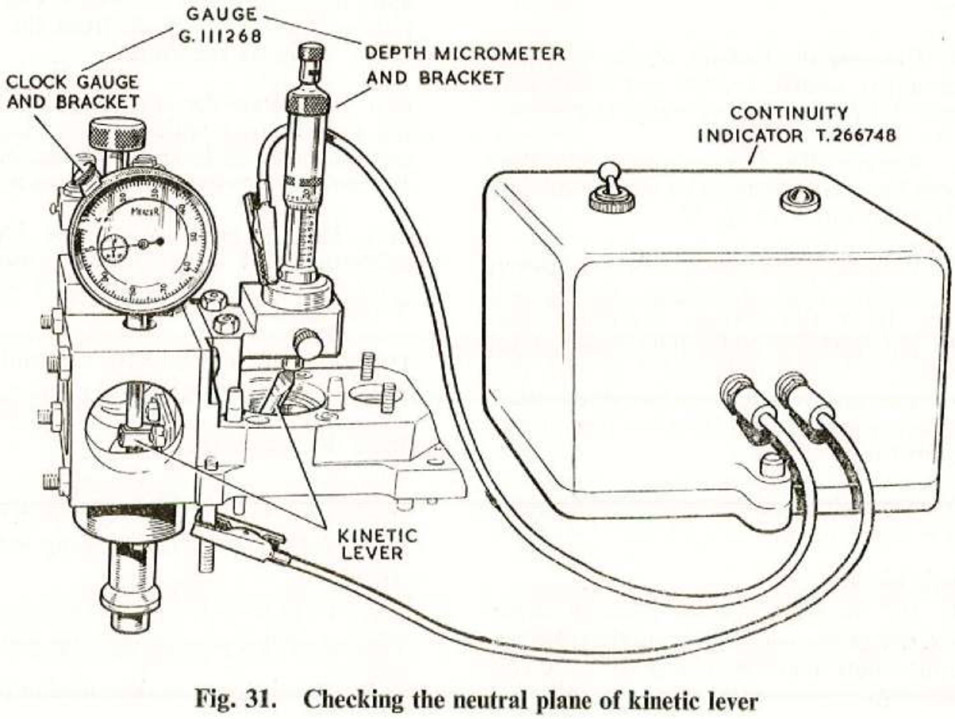


**Fig. 31. Checking the neutral plane of kinetic lever**

**237.** Insert the assembled lever into the housing, fit the seal retaining plate and retain the assembly loosely with tabwashers and nuts.

**238.** Insert the centre piece of aligning tool T.303023 through the actuator piston housing bore and screw the end of the tool into the tappet hole in the lever; screw in fully then back two or three turns. Secure the centre piece with a nut on the end protruding through the lever.

**239.** Position the centralising block of the tool over the centre piece, slide the block down, and locate it in the actuator piston housing bore. Hold the block firmly in position and tighten the two nuts retaining the lever assembly, checking whilst tightening that the centralizing block is free to rotate; this will align the lever correctly in the housing and locate it in its central plane.

**240.** Select a lever stop plate from the range available, measure and note its thickness. Assemble the stop plate to the stud in the housing, fit a tabwasher and nut and tighten but do not lock it.

**241.** Mount the gauge G.111268 (*fig.* 31) on the a.s.u. housing, above the kinetic knife and secure with slave nuts. Connect the continuity indicator T.266748 as shown.

**242.** Switch on the continuity indicator, then holding the centralizing block of T.303023 firmly, screw in the micrometer on gauge G.111268 until it just contacts the kinetic knife, (indicator lamp will be illuminated); then note the micrometer reading as measurement A. The micrometer must make a touch contact only; it must not cause any deflection of the lever.

**243.** Remove the centralizing block of tool T.303023 and apply sufficient upward pressure with the fingers on the tail of the lever, to deflect the lever until it is in firm contact with the stop plate. Holding the lever in this position, screw in the micrometer until it contacts the kinetic knife again (indicator lamp illuminated) and note the micrometer reading at this point as measurement B.

**244.** The difference between measurement A and B, which should be noted as C, should be 0·003 to 0·005 in. If the difference is not within these limits, select a new stop plate thicker or thinner than that already fitted, by an amount equal to the difference between C and the nominal 0·004 in. required, i.e. If, for example, measurement C is 0·006 in. select a new stop plate 0·002 in. thicker than that fitted initially. Remove the original stop plate and fit the new one, then re-check the assembly.

**245.** When correct, remove the gauge G.111268, switch off and disconnect the continuity indicator and remove the aligning tool T.303023. Lock the stop plate tabwasher and the lever retaining nuts and tabwashers.

### Kinetic block

**246.** The kinetic block is assembled at this stage to enable the orifices/kinetic knife clearance to be established and flow tests to be carried out, after which the assembled block is removed from the housing to enable the actuator piston details to be assembled.

**247.** Insert a nominal shim, 0·030 in. thick into the input orifice bore in the kinetic block and ensure that the shim seats correctly in the inner counterbore. Using tool T.238072 insert the input orifice into the housing and seat it firmly on the shim; a light tap on the end of the tool will facilitate correct seating. Remove the tool and fit the temporary retaining plate T.290964 to retain the orifice and shims firmly in the housing.

**248.** Locate a large square laminated shim on the kinetic block seating face on the housing; if the thickness of the original shims is not known, fit shims to a nominal thickness of 0·050 in. Assemble the kinetic block to the housing and secure it with slave nuts and washers.

**249.** Sighting with a toolmakers microscope through the recovery orifice location bore in the kinetic block, deflect the kinetic knife firmly against its stop plate and measure the position of the knife edge relative to the nearest edge of the orifice i.e. the knife edge is to be positioned so that it is just clear of the orifice edge.

**250.** By removing the kinetic block and varying the shim thickness, adjust the height of the block, and therefore the orifice until the edge of the orifice is within 0·001 and 0·003 in. from the edge of the knife when the lever is firmly on the stop plate. The final thickness of the square shim however must not be more than 0·075 in. nor less than 0·020 in.; if these limits are exceeded a new kinetic lever, block or housing must be selectively assembled to obtain an assembly within these limits.

**251.** Using the toolmakers microscope through the top of the kinetic block, measure the gap between the input orifice face and the kinetic knife. This gap must be between 0·012 and 0·018 in. and it is recommended that a gap of 0·015 in. will be most suitable.

**252.** Insert a 0·030 in. thick shim in the recovery orifice location bore in the kinetic block, and using tool T.238072, insert the recovery orifice. Tap the end of the tool lightly to ensure that the orifice and shim are seated. Retain the orifice with plate T.290965.

**253.** Again using the microscope, measure the gap between the faces of the two orifices; this must be 0·054 to 0·057 in. and must be adjusted to within these limits by altering the shim thickness beneath the recovery orifice.

**254.** Remove the input orifice retainer T.290964. Insert a sealing ring into the kinetic block input bore until the ring seats on the orifice flange, then fit the seal abutment washer.

**255.** Fit the transfer gauge G.104280 into the kinetic block input bore so that the small end of the gauge rests on the face of the counterbore, slacken the knurled screw and depress the central plunger lightly to seat its other end squarely on the input orifice seal abutment washer. Tighten the knurled locking screw, then remove the gauge. Using a depth micrometer, measure the depth from the gauge flange face to the adjacent end of the plunger; this measurement, plus 0·018 in., is the thickness of shims to be fitted above the seal abutment washer to ensure that there will be 0·018 in. minimum compression on the seal when finally assembled.

**256.** Fit shims of the required thickness into the input bore and ensure that they are located centrally on the seal abutment washer. Fit the disc strainer seat, recessed side outermost, and ensure that the small spigot on the other face locates the seal shims. Insert the disc strainer, ease two sealing rings on to the conical strainer sleeve and insert the sleeve into the bore (small end first) then insert the conical strainer.

**257.** Using parallel blocks T.261706 (0·500 in. square) and a depth micrometer, measure the height of the conical strainer flange end face above the surface of the kinetic block; this height must be 0·354 to 0·359 in. Select shims equal to the difference between the measured height and the stated height, and insert these shims between the conical strainer sleeve face and the disc strainer. When satisfactory fit a sealing ring to the rig test adapter RSK.203/5 and assemble this adapter to the input facing to retain the input orifice details and prepare for testing.

**258.** Remove the retainer T.290965 from the recovery orifice bore and assemble the strainer details, using the same procedure as for the input orifice; the only difference is that this assembly, the measurement with parallel blocks T.261706 and depth micrometer of the height of the conical strainer flange, is to be 0·235 to 0·240 in. When satisfactory, retain the recovery orifice details with test rig adapter RSK.203/1, in readiness for the orifice flow tests, then fit combination washers to the two kinetic block blanking plugs, fit the plugs and tighten them.

**Setting the tappet screw.**

**259.** Remove the kinetic block assembly and place aside. Insert the lever tappet screw through the actuator piston locating bore in the lever housing and screw it into the lever then fit the tabwasher and locknut above the lever.

**260.** Measure the thickness of the actuator piston and of the piston sleeve and note the difference (e.g. 0·007 in.).

**261.** Using petroleum jelly to retain it, locate the push rod in the cup in the head of the tappet screw, then fit the actuator piston sleeve and piston; ensure that the cup in the face of the piston engages with the push rod.

**262.** Set the dial test indicator of gauge G.75688 to zero on a flat surface and locate the gauge over the piston and sleeve, as shown in fig. 32. Engage the combination spanner T.268388 with the end of the tappet screw and its locknut, depress the lever firmly on to its stop plate and adjust the tappet screw to give a reading on the gauge, which added to the difference between the piston and sleeve, will give a total measurement of 0·010 to 0·011 in., i.e. if the difference (para. 260) is 0·007 in., adjust the tappet until the gauge reading is 0·003 to 0·004 in.

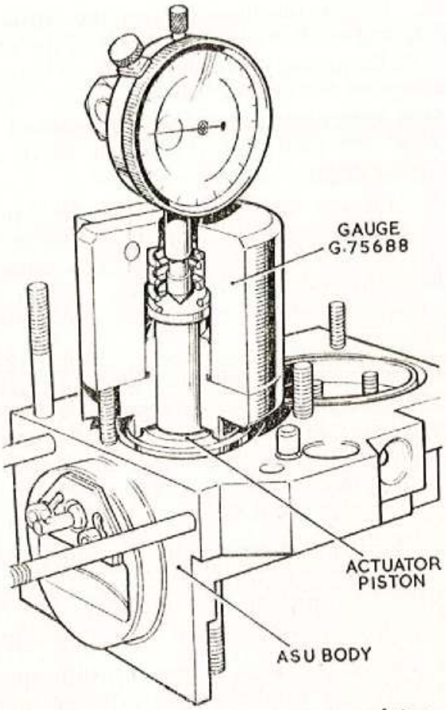


**Fig. 32. Setting the actuator piston**

**263.** Tighten the tappet locknut, check that the gauge reading is still correct with the lever against its stop plate, remove the spanner and depress the d.t.i. plunger to move the actuator against its stop. The total travel of the piston must be 0·010 to 0·011 in.

**264.** Check that the tappet locknut is tightened, re-check the piston travel to ensure that it has not been disturbed, then remove the d.t.i. Remove the actuator piston, sleeve and push rod and place them aside to await final assembly. Secure the tappet locknut tabwasher.

**265.** Measure the thickness of the square shims selected for the kinetic block and select a large ring shim 0·005 in. thicker; this will ensure that there is a required 0·005 in. compression on the kinetic block sealing ring. Locate the selected ring shim on the kinetic block spigot then ease the sealing ring on to the spigot until it abuts the shim.

**266.** Fit the square shims on the lever housing face, then a plain washer to each of the two long capsule housing bolts and insert the bolts through the lever housing flange; these bolts cannot be fitted once the kinetic block is in position.

**267.** Fit sealing rings to the two kinetic block transfer bobbins and insert the bobbins into their respective bores in the lever housing. Assemble the kinetic block to the lever housing, make sure that it engages with the transfer bobbins, push the block firmly on to the housing, then fit plain washers, spring washers and nuts to the two studs and insert the two setscrews complete with plain washers and spring washers. Tighten the nuts evenly.

**268.** Flow test the orifices and lever as specified in Appendix 1.

**Fitting the capsule**

**269.** Ease a large sealing ring into the joint face counterbore in the capsule housing.

**270.** Assemble the capsule pivot screw, together with its locknut and a combination sealing washer, into the insert in the top of the capsule housing and screw in about six turns,

**271.** Locate the capsule in its housing so that the short (concave-ended) pivot engages with the pivot screw, offer the assembly to the lever housing and engage the capsule male pivot with the dimple in the kinetic lever. Push the two housings firmly together and secure with plain washers, spring washers and nut. Check through the capsule spring locating bore that both pivots are engaged and adjust the capsule pivot screw until the capsule is just nipped. i,e. will rotate but has no side play. Screw in a further 1½ turns and make the locknut finger tight to prevent the disengagement of either pivot whilst the spring is being fitted. Fit another combination washer and fit the capnut.

**272.** Assemble the spring seat, cap and spring together, insert them into the capsule chamber and engage the conical pivot on the face of the seat with the dimple in the lever.

**273.** Ease a seal on to the spring housing, assemble the spring housing over the spring. Fit a plain washer and grover washer to the studs then secure with a plain nut on one stud and wirelocked nut on the other.

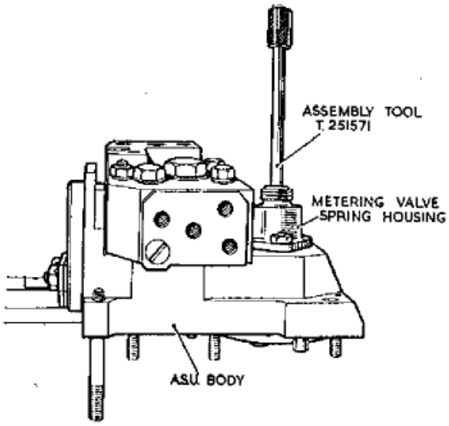


**Fig. 33. Assembling the metering valve spring**

**274.** Fit the locknut and a combination washer to the spring adjusting screw, insert the screw into the spring housing until resistance is felt, indicating contact with the spring seat, then screw in a further three turns. Lightly tighten the locknut, fit a second combination washer and fit the cap nut.

**Metering valve**

**275.** Fit the clevis pin and spring to the diaphragm supporting lugs. The radius is machined away at the foot of one lug and the clevis pin retaining plate must be fitted on this side. After fitting the clevis pin through the lugs and spring loop, fit the retaining plate so that the edge to be turned over will be adjacent to the back of the spring loop.

**276.** Insert the support ring into the metering valve bore. Fit the valve plate with screw into the bore, locating it on the dowel and six studs. The valve screw is taper-ground for concentricity in the plate and should be fitted as a complete assembly. When fitted, the support ring must be positioned radially so that the clevis pin will lie along the axis of the a.s.u. body when the legs of the support ring have passed through the valve plate. Secure the valve plate with tabwashers and nuts.

**277.** Assemble the diaphragm to the legs of the support ring and secure it with three screws and tabwashers.

**278.** Ease the small seal into position in the recess of the series orifice adjusting screw bore and fit the seal into the groove in the metering valve bore.

**279.** Insert the spring anchor guide tool T.251571 into and through the spring housing and screw it into the spring anchor as shown in fig. 33.

**280.** Locate the flush end of the spring in the spring anchor and fit the loop at the other end of the spring on to the clevis pin between the lugs of the support ring; the back of the spring loop must be on the same side of the lugs as the bent-over tab of the clevis pin securing plate.

**281.** Fit the spring anchor in the square bore of the spring housing then remove the guide tool T.251571. Secure the housing with plain and grover washers, a plain nut on one stud and a wirelocked nut on the other.

**282.** Ease the seal into the recess in the top of the spring housing. Using tool T.160988 screw the adjusting screw into the spring anchor in the housing until the spring is loaded lightly. Fit the locknut to the spring housing and make it finger tight.

**283.** Fit the seal and the backing ring on to the series orifice adjusting screw. The backing ring must be outermost of the seal when the adjusting screw is assembled in the housing.

**284.** Screw the series orifice adjusting screw into the bore in the spring housing using tool T.171611 and fit the washer and the serrated locknut, using the combination spanner T.228556 if necessary.

**285.** Assemble the actuator piston sleeve to the a.s.u. body. Position the push rod in the cup head of the adjusting screw and assemble the actuator piston and diaphragm.

**286.** Fit the two small seals into the recesses in the joint face of the cover plate.

**287.** Before assembling the cover plate to the body ensure that the metering valve diaphragm is so positioned radially that the diaphragm support ring does not foul the valve plate during operation.

**288.** Assemble the cover plate to the a.s.u. body and secure it with tabwashers and plain nuts on five studs and a tabwasher and wire-locked nut on the stud between the two serrated blanking plugs.

**289.** Fit the combination washer to the blanking plug and screw the plug into the capsule housing.

**Testing**

**290.** The assembled a.s.u. must now be preliminarily calibrated and tested as specified in para. 548 to 564.

# THROTTLE VALVE

### General

**291.** This unit (*fig.* 34) comprises the following three main sub-assemblies:—

(1) The throttle valve assembly, contains the rotary throttle valve, which sets the flow datum and also combines the functions of a shut-off cock, the idling by-pass, which provides an adjustable flow for ground idling, and the proportional flow strainer which filters the flow to the secondary orifices and linking valve in the governor unit.

(2) The constant flow valve, which counters the effect of reduced pump delivery at altitude and, in conjunction with the idling by-pass, provides the required idling characteristic rising slightly with altitude.

(3) The pressurizing valve assembly, containing the pressurizing valve, which controls the main burner flow according to pilot burner pressure, and the main and pilot manifold dump valves, which drain the manifolds when the engine is stopped.

**292.** When dismantling the unit, take care to avoid damage to the throttle valve plug, which is a rotary shutter with sharp metering edges, and the pressurizing valve plunger, which is carbon-surfaced; the throttle valve plug and the pressurizing valve plunger are each matched with their respective sleeves during manufacture and neither may be changed independently of its mated component.

## DISMANTLING

### Pressurizing valve

**293.** Unscrew the serrated locknut from the p.v. spring adjusting screw by using combination spanner T.231439, then remove the adapter, tabwasher and adjusting screw.

**294.** Unscrew the four nuts and detach the p.v. cover. Remove the spring seat and springs and then the spring housing.

**295.** Using tool T.215797, remove the assembled pressurizing valve damping restrictor bobbin from the spring housing; remove the bush, sleeve and seals from the bobbin.

**296.** Withdraw the p.v. plunger, remove the circlip from the plunger by using tool T.272429 (*fig.* 35) then remove the stop plate. Place the plunger in a clean box to avoid damage to the carbon surface.

**297.** Separate the pressurizing valve housing from the throttle valve, tapping lightly with a hide-faced hammer if necessary to free the seals, remove the seals and withdraw the p.v. sleeve from the housing. Insert the plunger carefully into the sleeve and replace in the box.

### Dump valves

**298.** Unscrew the four nuts and washers and remove the main dump valve cover plate.

**299.** From the valve bore remove the seal support ring, the U-section seal, piston, piston sleeve and the spring, Using extractor T.229102 (*fig.* 36) withdraw the valve orifice plate and remove the seal from the bottom of the bore.

**300.** Slacken the central dome nut, unscrew the four nuts and remove the pilot dump valve connection from the p.v. housing. Remove the spring seat retaining dome nut, screw out the seat from the other side of the housing, then remove the seat retaining plate.

**301.** Withdraw the valve seal retainer, spring and piston from the p.v. housing, then extract the valve sleeve with extractor T.210954 as shown in fig. 37.

### Pilot flow orifice

**302.** Remove the seal from the diffuser plate and detach the plate, then using extractor T.261057, extract the orifice bobbin and the strainer.

### Mounting bush

**303.** If this bush needs renewing it should be removed with the tool T.297621.

### Constant flow valve

**304.** Slacken the adjustment locknut, unscrew the four securing nuts and remove the constant flow by-pass from the t.v. body.

**305.** Unscrew the locknut and remove the adjusting screw from the cover plate.

RESTRICTED

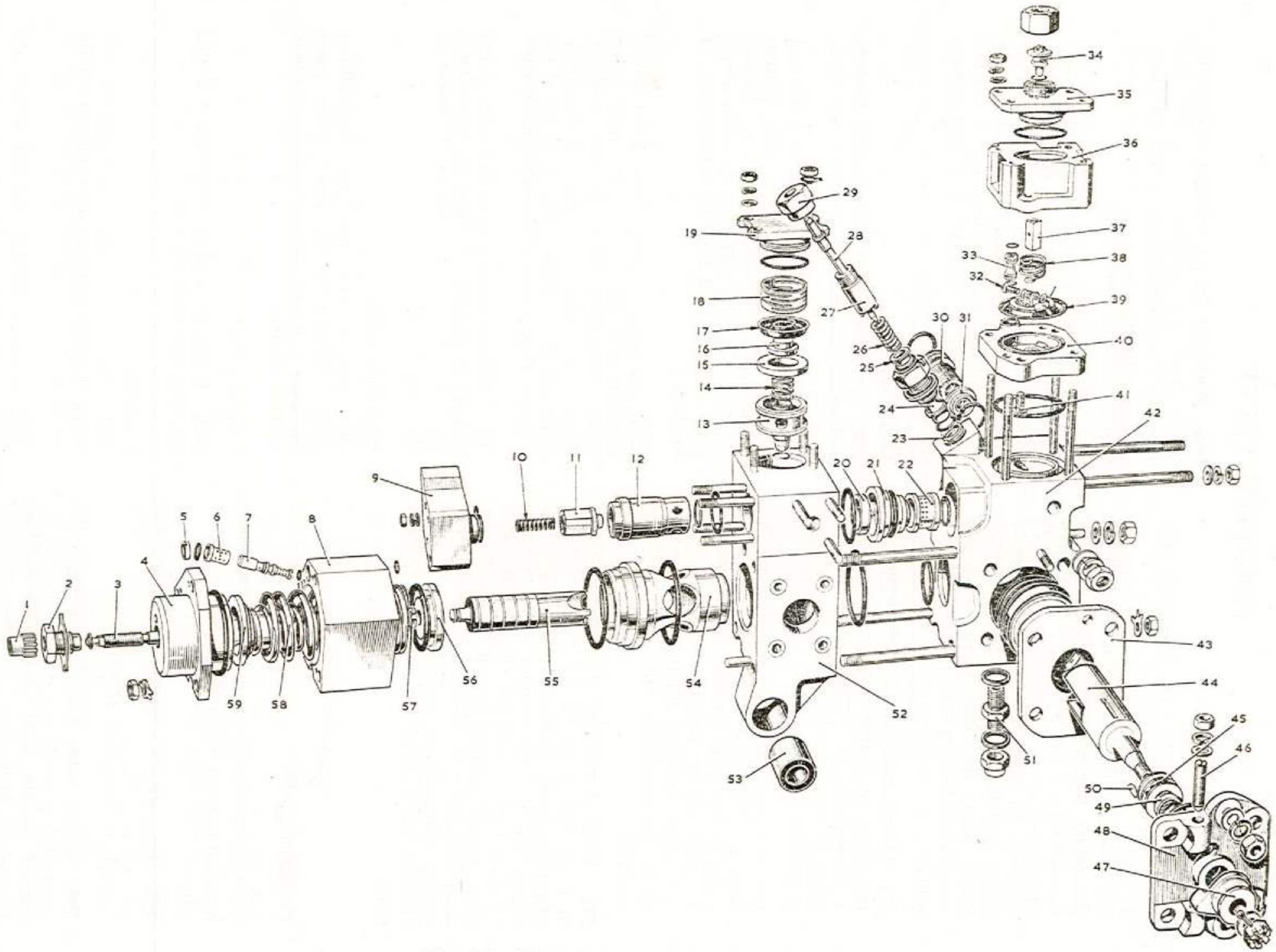


**Fig. 34. Exploded view of throttle valve unit**

## KEY TO FIG. 34

1 Pressurizing valve adjustment locknut
2 Adjusting screw adapter
3 Adjusting screw
4 Valve cover
5 Damping orifice collar
6 Orifice sleeve
7 Orifice bobbin
8 Pressurizing valve spring housing
9 Pilot dump valve connection
10 Valve spring
11 Pilot dump valve piston
12 Valve sleeve
13 Main dump valve orifice plate
14 Valve spring
15 Valve sleeve
16 Main dump valve
17 Valve seal
18 Seal support
19 Cover plate
20 Pilot flow diffuser
21 Pilot flow orifice
22 Strainer
23 Idling valve collar
24 Idling valve body
25 Valve insert
26 Valve spring
27 Valve spring housing
28 Valve plunger
29 Locknut
30 Proportional flow strainer
31 Strainer end plug
32 Clevis pin
33 Constant flow valve restrictor bobbin
34 Adjusting screw
35 Constant flow valve cover
36 Valve spring housing
37 Spring anchor
38 Valve spring
39 Constant flow valve diaphragm
40 Constant flow valve orifice plate
41 Securing screws (2 off)
42 Throttle valve body
43 Valve sleeve
44 Plug
45 Thrust bearing
46 Throttle valve stop screws (2 off)
47 Throttle valve lever hub
48 Throttle valve control stop plate
49 Seal retainer
50 Woodruff key
51 Union
52 Pressurizing valve body
53 Mounting bush
54 Pressurizing valve sleeve
55 Valve plunger
56 Circlip
57 Circlip Pressurizing valve stop plate
58 Valve springs
59 Valve spring seat

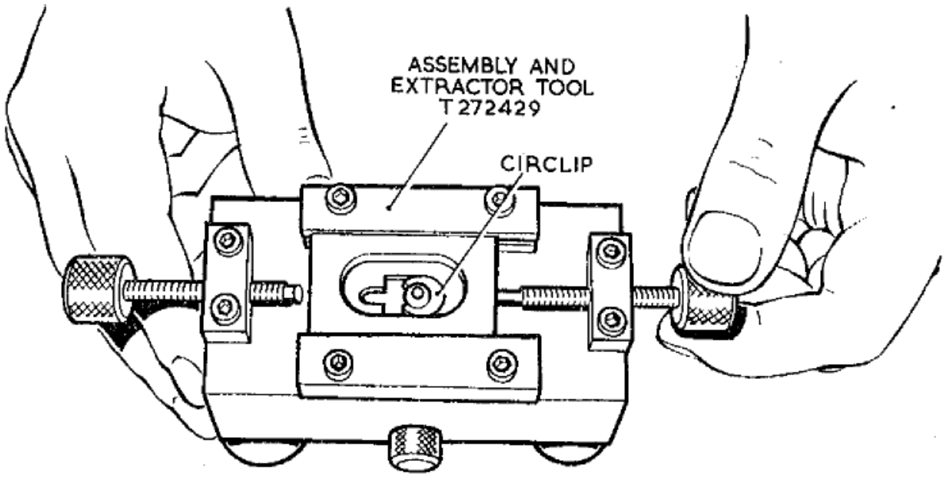


**Fig. 35. Removing the circlip from the pressurizing valve plunger**

**306.** Unscrew the two retaining screws and remove the orifice plate from the spring housing.

**307.** Remove the diaphragm and spring assembly from the spring housing and remove the restrictor bobbin. Disengage the spring anchor from the spring. Extract the split pin and remove the clevis pin, washer and the spring from the diaphragm assembly. Place the spring in the clamp T.293158 and clamp it to a length of 0·437 in.

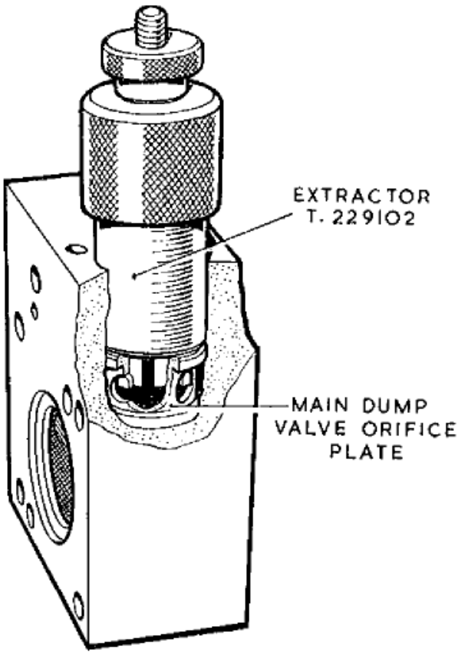


**Fig. 36. Removing the main dump valve orifice plate**

**Idling by-pass valve**

**308.** Unscrew and remove the idling valve assembly from the t.v. body, applying the spanner to the lower hexagon adjacent to the body.

**309.** Remove the seal from the idling valve bore in the body and using extractor T.261055 withdraw the collar from the bore.

**310.** Position the valve assembly in the fixture T.268361 and remove the capnut. Unscrew the plunger by using key spanner T.280558. Remove the assembly from the fixture and dismantle the locking sleeve, spring, insert, seal and valve body.

**Proportional flow strainer**

**311.** Using extractor T.200603, withdraw the cylindrical strainer from the t.v. body and, using extractor T.303021, remove the strainer sealing plug from the bottom of the bore in the t.v. body.

**Throttle valve**

**312.** Unscrew the two stop screws from the control stop plate. Remove the lever hub retaining nut and, using extractor T.280575 (*fig.* 38), withdraw the control lever hub from the throttle valve spindle. Remove the key from the spindle.

**313.** Unscrew the securing nuts and withdraw the control stop plate. Withdraw the throttle valve plug, remove the thrust bearing from the plug; take care to avoid damaging the plug. Remove the seal retainer and seals from the control stop plate bore.

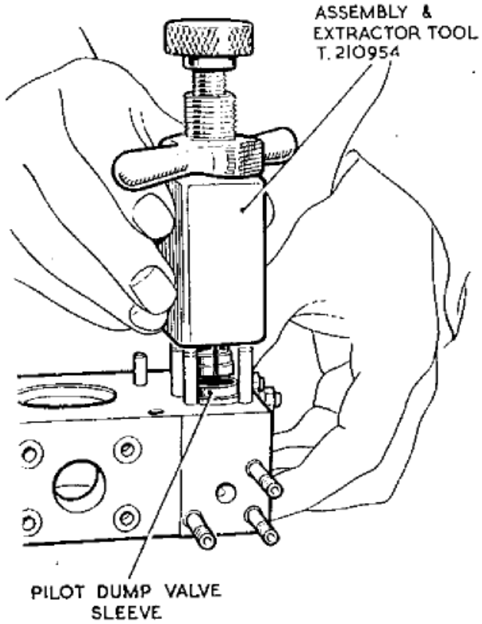


**Fig. 37. Removing the pilot dump valve sleeve**

**314.** Using extractor T.262982, withdraw the t.v. sleeve from the body, then insert the plug carefully into the sleeve and place in a clean box for safe storage.

**315.** Clean the components as instructed in para. 7.

## INSPECTION

**316.** In addition to the instructions given in para. 8 to 15, inspect the following items.

**317.** Ensure that the throttle valve and sleeve are not scored or damaged, that the metering edges are sharp and that their dimensions are within the limits shown in the Fits and Clearances. Examine the throttle valve thrust bearing in accordance with workshop practice.

**318.** Check that the diaphragm of the constant flow valve has been renewed.

**319.** Examine the pressurizing valve plunger for scoring or breakdown of its carbon surface and ensure that the metering edges are sharp. Check the dimensions of the plunger and sleeve with those given in the Fits and Clearances.

**320.** Inspect the pilot flow fixed orifice for crumbling of the edges. Check the dimensions of the pistons and sleeves in the dump valves.

## ASSEMBLING

### Throttle valve

**321.** Using adapter plate T.212175, secure the throttle valve body to the hydraulic fixture so that the joint face which will abut the governor unit is seated against the adapter plate.

**322.** Turn the throttle valve body to a position where the larger end of the t.v. bore is uppermost.

**323.** Ensure that the throttle valve plug is a smooth sliding fit in its sleeve then remove the plug and place aside. Fit the three seals on to the throttle valve sleeve.

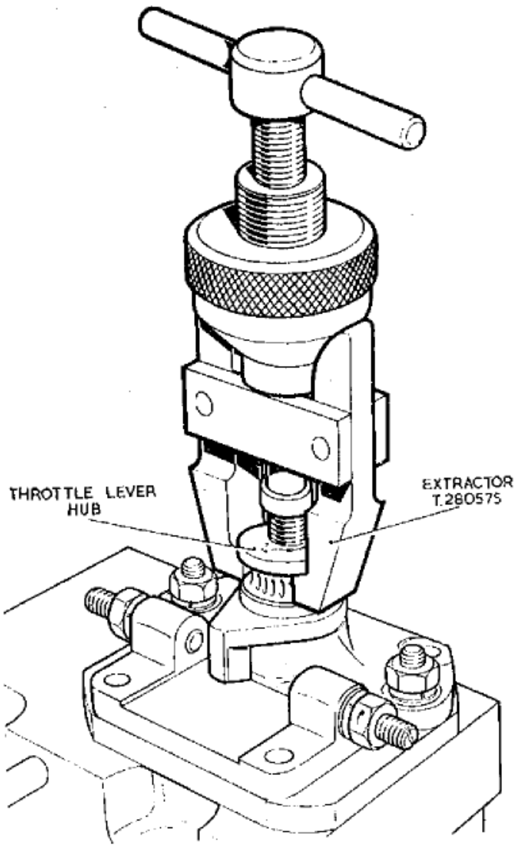


**Fig. 38. Removing the throttle lever hub**

**324.** Using the tool T.271086, ease the throttle valve sleeve into the housing. To avoid damage to the seals the sleeve must be truly in alignment with the housing bore when being fitted.

**325.** Insert the spigot of the locating bush of T.271086 into the smaller end of the throttle sleeve bore, locate the throttle sleeve, flange first, on the tool central bolt, and enter the assembly into the housing, so that the end of the bolt protrudes through the locating bush. Fit the T-handled nut and screw down to draw the throttle sleeve fully into the housing. Remove the tool carefully from the throttle sleeve bore.

**326.** Screw the two stop screws into the control stop plate and fit plain washers, grover washers and locknuts.

**327.** Ease the square section seal, followed by the softer, quad-ring seal, into the control stop plate bore, then fit the seal retainer. Place a seal in the groove in the face of the control stop plate.

**328.** Fit one thrust bearing race into the bore of the control stop plate and the other race on to the throttle valve spindle followed by the ball cage. Check for free running and assemble the control stop plate to the housing.

**329.** Fit the key to the throttle valve spindle. Fit the lever hub on to the spindle, secure it with a plain washer, slotted nut and split pin.

**330.** Insert the throttle valve plug into the sleeve and secure the control stop plate with plain washers, and nuts; tighten the nuts gradually and evenly.

**331.** Fit a bonded seal on to the union and screw it into the side connection to throttle valve. Fit.a second bonded seal and cap nut.

**332.** At this stage the torque test given in para. 497 to 499 must be applied.

**Constant flow valve**

**333.** Take the spring from the keeper, position the long projecting end of the spring between the lugs of the diaphragm assembly and secure it with the clevis pin, washer and split pin. Attach the spring anchor to the opposite end of the spring, using pliers if necessary.

**334.** Place a seal inside the spring housing and fit the cover to housing. Fit the diaphragm assembly to the spring housing.

**335.** Place a seal on adjusting screw and screw it through the cover plate into the spring anchor. Screw it in fully then slacken off two complete turns. Fit the clamp nut to the cover and make it finger tight.

**336.** Fit the seals, on the restrictor bobbin then press the bobbin into the orifice plate, with the restrictor orifice (smallest bore) uppermost. Secure the orifice plate with two screws.

**337.** Test the valve in accordance with instructions given in para. 500 and 501.

**338.** Turn the t.v. body to a position where the constant flow valve is uppermost. Ease the large seal into the groove on the face of the t.v. body.

**339.** Fit the constant flow valve to the t.v. body, fit the plain washers and grover washers to all studs, plain nuts to three studs and a wirelocked nut to the fourth; tighten these lightly, as the valve is to be aligned with the acceleration control body at a later stage.

**Idling by-pass valve**

**340.** Place the seal into the valve body, followed by the insert, plain side uppermost. Place the spring in the valve sleeve and fit the sleeve to the valve body.

**341.** Position the assembly in tool T.268361 (*fig.* 39) and turn the handle of the tool to clamp the assembly solid, with the projecting lugs of the sleeve engaged in the slots in the body.

**342.** Insert the valve plunger into the valve spring housing as far as possible, then screw the valve plunger into the valve by using spanner T.280558. Continue screwing gently until further resistance is felt, indicating that the second thread is about to engage; do not apply any further force as it may not engage immediately. Rotate the handle of the assembly tool anti-clockwise slightly to reduce the spring load, at the same time apply slight pressure on the spanner until the second thread is felt to engage easily, indicated by less resistance to the spanner.

**343.** When this position has been achieved, screw in the plunger until the collar is approximately one eighth of an inch from the end face of the spring housing.

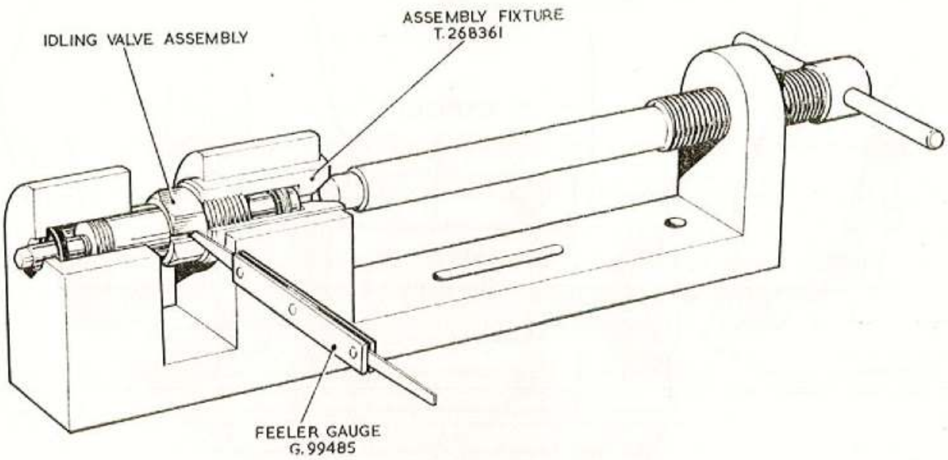


**Fig. 39. Assembling the idling valve**

**344.** Check with the feeler gauge G.99485 that the gap between the lugs of the valve sleeve and the bottom of the slots in which they engage is not more than 0·030 or less than 0·005 in. (*fig.* 39). Remove the assembled valve from tool T.268361.

**345.** Fit the locknut and tighten it to a torque loading of 50 lb. in.

**346.** With a torque limiting screwdriver and adapter T.280565 check that the torque on the valve plunger is not less than 1·5 lb. in.

**347.** Fit the collar into the idling valve bore in the throttle valve body and fit the seal on top of the collar.

**348.** Fit the combination washer to the idling valve body and screw the idling valve body into the throttle valve body. Tighten it with spanner T.215524.

**Proportional flow strainer**

**349.** Place the seal in the bottom of the bore in the throttle valve body and fit the seal on to the strainer. Using tool T.303021, insert the strainer end plate into position in the bore on top of the seal. Fit the strainer into the bore.

**Pilot flow orifice**

**350.** Fit a seal into the annular groove at the end of the strainer and one on the central shoulder on the orifice body.

**351.** Fit the orifice body to the strainer and, using tool T.261057, insert the assembly into the bore in the p.v. joint face of the t.v. body.

**352.** Insert the diffuser plate, cone first, into the bore and seat it in the recess in the orifice body. Fit the seal into place around the diffuser plate.

**Pressurizing valve**

**353.** The pressurizing valve sleeve and plunger are supplied as a matched pair.

**354.** Fit one seal into the groove in the t.v. joint face of the pressurizing valve body and one into the p.v. bore of the throttle valve body.

**355.** Fit the pressurizing valve body to the throttle valve body and secure it with a tab-washer and nut on each stud.

**356.** Check the fit of the p.v. sleeve in the body. Fit the seal against the flange of the sleeve and insert the sleeve into the body.

**357.** Fit the stop plate to p.v. plunger. Secure the spring clip to the plunger by using tool T.272429 as shown in fig. 40; ensure that no burr has been set up by the fitting. Insert the plunger into position in the p.v. sleeve.

**358.** Fit one seal at the end of the small bore in the face of the p.v. body and one on the projecting shoulder of the p.v. sleeve. Assemble the spring housing to the p.v. body.

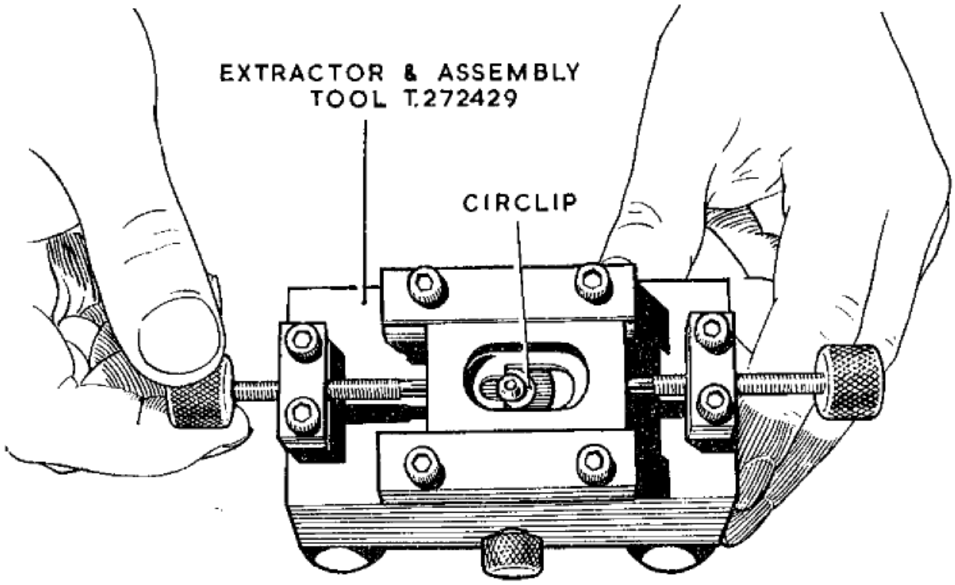


**Fig. 40. Fitting the circlip to the pressurizing valve plunger**

**359.** Place the seal in the groove around the damping orifice bobbin, assemble the sleeve to the bobbin, and fit the seal on the sleeve. Fit the seal bush and then insert the bobbin into the bore in the spring housing.

**360.** Insert the larger and then the smaller of the two p.v. springs into the spring housing. Ensure that both springs are correctly seated on the stop plate, then fit the spring seat.

**361.** Place one seal in the bottom of the adjusting screw bore in the cover plate and another on the spigot of the cover plate.

**362.** Fit the cover plate to the spring housing and secure it with four slave washers and nuts; these nuts will be replaced later.

**363.** Screw the adjusting screw into the adapter, fit the tabwasher and screw the adapter into the cover. Tighten the adapter and lock the tabwasher.

**364.** Fit the serrated locknut finger tight ; this will be adjusted later.

**Dump valves**

**365.** Fit a sealing ring in the groove midway down the pilot dump valve location bore in the p.v. housing. Insert the dump valve piston into the sleeve, fit a seal into the annular groove in the face of the sleeve and insert the assembly into the p.v. housing.

**366.** Fit a sealing ring to the pilot dump valve spring seat locating spigot on the spring housing inner face and fit a sealing ring in the corresponding annular groove in the outer face.

**367.** Fit a sealing ring over the spring seat stem and locate the ring under the spring seating flange. Insert the spring seat stem through the pilot dump valve connection block and screw it into the retaining plate; screw in fully then fit a combination washer and the dome nut to the screw and tighten finger tight.

**368.** Assemble the pilot dump valve spring to the spring seating and, making sure that the spring enters the dump valve piston, fit the connecting block assembly to the p.v. housing. Align the pilot dump valve spring seating retaining plate with the four studs, slackening the dome nut if necessary. Fit plain washers, spring washers and nuts to the retaining studs and tighten these fully. Tighten the pilot dump valve spring seating dome nut.

**369.** Fit a seal into the bottom of the main dump valve bore in the p.v. body. Insert the valve orifice plate into the bore by using tool T.229102 as shown in fig. 36. Fit the valve sleeve in to the bore, then insert the spring through the valve sleeve into the annular recess of the orifice plate. Check that the valve moves freely in the valve sleeve.

**370.** Fit the valve seal to the valve, position the valve in the bore and place the seal support on the valve seal.

**371.** Fit the seal on to the spigot of the cover plate. Position the cover plate on the body so that one tabwasher hole is adjacent to the short stud.

**372.** Fit plain washers, grover washers, and plain nuts to the two studs adjacent to the dump connection, a tabwasher and plain nut to the short stud and a plain washer, grover washer, and wirelocked nut to remaining stud.

# GOVERNOR

## DISMANTLING

**373.** Remove the large lobe-shaped cover plate from the side of the housing, the smaller square plate adjacent to the governor spring housing and the access plug from the inclined end face.

**374.** Remove the governor adjustment locknut from the top of the spring housing and remove the adjusting screw.

**375.** Remove the retaining nuts from the spring housing flange and lift off the housing. Remove the clevis pin to separate the governor spring from the diaphragm centre piece and disengage the spring anchor from the spring, using tool T.257456 to expand the spring.

**376.** Lift out the diaphragm stop plate and ease the diaphragm assembly out of the governor housing. Using tool T.218949 remove the governor rocker lever spring and spring plate.

### Swivel link and lever

**377.** Unlock and remove the two retaining nuts from the swivel link hinge plate, exposed when the diaphragm has been removed. Lift out the diaphragm centre piece and swivel assembly.

**378.** Remove the pin retaining the swivel link to the hinge plate, detach the hinge plate and remove the clevis pin retaining the swivel link to the diaphragm centre piece. Remove the tappet screw and locknut from the centre piece.

**379.** Remove the governor lever hub retaining nut and withdraw the hub, using extractor T.280575 (fig. 43) if necessary. Remove the nuts securing the stop bracket to the housing and withdraw the stop bracket and yoke from the housing. Remove the key from the yokeshaft and draw the yoke from the bracket bush.

### Temperature trim housing

**380.** Remove the temperature trim housing from the unit by removing the four securing nuts and two securing bolts. Remove the seals from the lever bore in the governor body and joint face. To dismantle the temperature trim housing:—

(1) Unscrew the serrated locknut of the spring adjusting screw by using combination spanner T.228556. Remove the two securing nuts and remove the retaining plate and sleeve together with the adjusting screw.

(2) Withdraw the spring, spring seat and spring cap, and remove the adjusting screw from the sleeve.

(3) Unscrew the serrated locknut of the temperature trim control orifice by using combination spanner T.228556, unlock and remove the two securing nuts and remove the retaining plate with the orifice, using tool T.224367 (*fig.* 42) if necessary. Unscrew the orifice body from the retaining plate and remove the seals from the orifice body and the bore of housing.

(4) Remove the two serrated locknuts from the lever stop screws, using combination spanner T.228556, and remove the stop screws.

(5) Remove the cover plate.

(6) Remove the two securing screws and withdraw the temperature-trim lever from the housing.

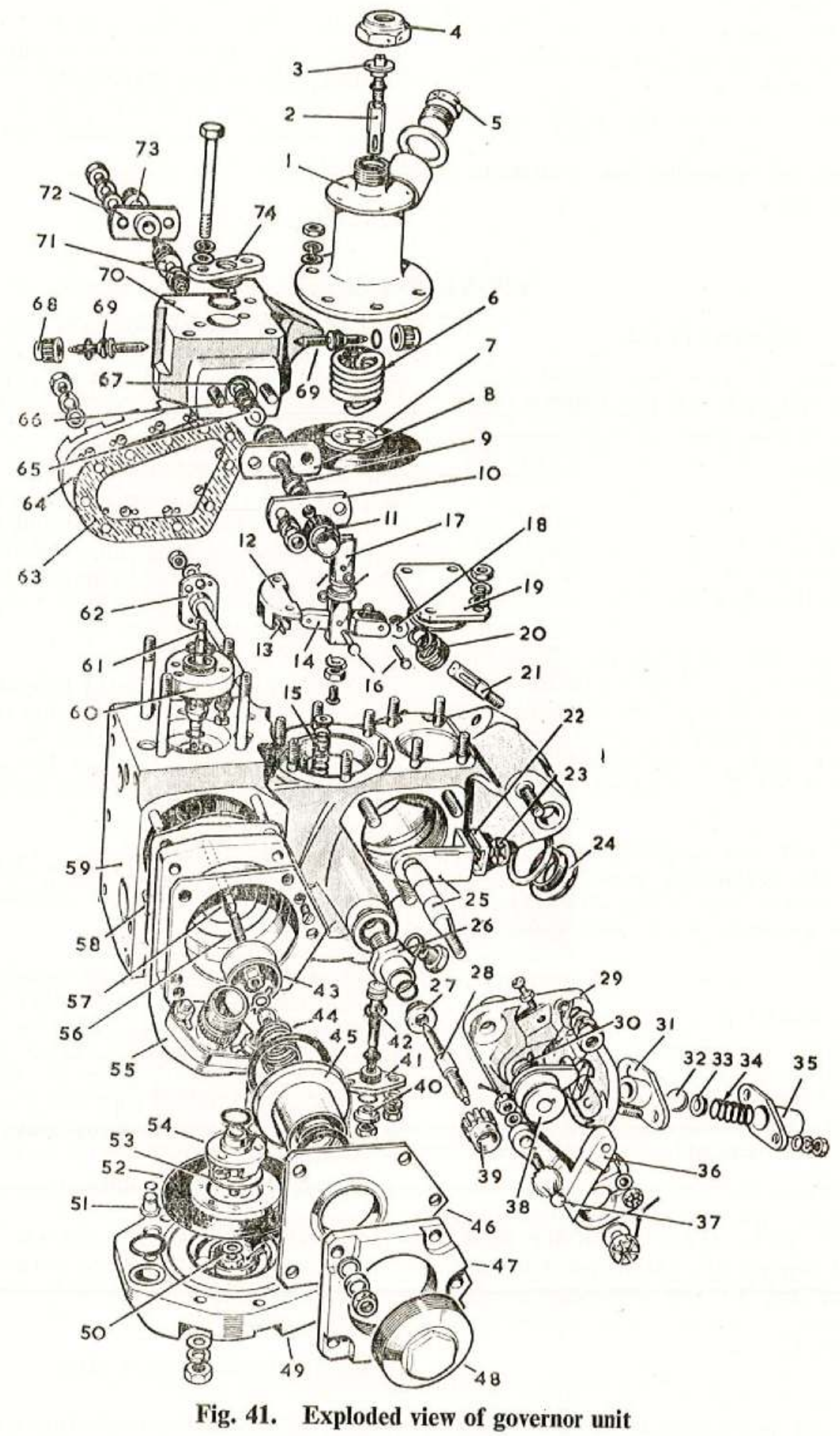


**Fig. 41. Exploded view of governor unit**

## KEY TO FIG. 41

1 Governor spring housing
2 Governor spring anchor
3 Governor adjusting screw
4 Locknut
5 Blanking plug
6 Governor spring
7 Governor diagram
8 Adjusting screw sleeve
9 Temperature trim adjusting screw
10 Retaining plate
11 Locknut
12 Swivel link hinge plate
13 Hinge pin
14 Swivel spring link
15 Governor lever return spring
16 Clevis pins
17 Diaphragm centre
18 Swivel spring bearing
19 Cover plate
20 Swivel spring
21 Swivel anchor
22 Adjusting plate
23 Swivel spring adjusting nut
24 Blanking plug
25 Yoke and spindle
26 Governor lever stop screw sleeve
27 Seal retainer
28 Stop screw
29 Control lever stop bracket
30 Idling detent
31 Detent ball housing
32 Detent ball
33 Spring seat
34 Detent spring
35 Spring housing
36 Control lever
37 Control rod ball pin
38 Control lever hub
39 Governor stop screw locknut
40 Seal retainer
41 Orisice retaining plate
42 Governor secondary orisice
43 Temperature trim solenoid armature
44 Armature spring
45 Armature housing
46 Clamping plate
47 Cover plate
48 Armature adjustment access plug
49 Linking valve cover plate
50 Linking valve plate shim
51 Blanking plug
52 Linking valve diaphragm
53 Linking valve plate
54 Linking valve orifice
55 Breeze plug retaining plate
56 Armature adjusting screw
57 Armature push rod
58 Shim plate
59 Governor housing (TV joint face)
60 Temperature trim lever bush
61 Temperature trim lever
62 Governor lever
63 Cover plate gasket
64 Side cover plate
65 Spring seating
66 Temperature trim lever spring
67 Spring cap
68 Locknut
69 Temperature trim lever stop screw (2)
70 Temperature trim orifice housing
71 Temperature trim orifice
72 Orifice retaining plate
73 Locknut
74 Cover plate

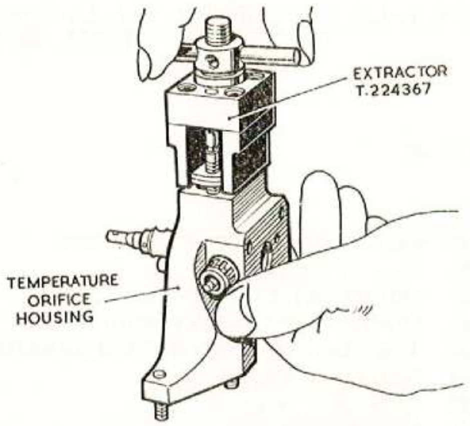


**Fig. 42. Removing the temperature trim orifice and retaining plate**

**Governor orifice**

**381.** Release the governor orifice locknut, remove the two retaining nuts from the orifice body flange and withdraw the orifice assembly, using extractor T.287988. Remove the locknut and unscrew the orifice from the body, using T.171611 if necessary.

**Linking valve**

**382.** As it is necessary to remove the linking valve cover before the governor lever lower stop pin can be extracted, dismantle the valve as follows:

(1) Remove the linking valve cover retaining nuts and lift off the cover. Lift out the linking valve assembly, remove the split pin and retaining nut and separate the diaphragm and valve plate. Discard the diaphragm.

(2) Lift out the bias spring and place it in spring keeper T.287975.

(3) Remove the three nuts retaining the linking valve orifice plate in the housing and extract the plate.

(4) Using extractor T.205226 withdraw the governor lever stop pin spacing bush from the linking valve cover facing in the housing.

**Governor lever**

**383.** Release the locknut on the lever upper stop screw, remove the stop screw assembly, then separate the stop screw locknut, screw, seal retainer and body.

**384.** Unlock and remove the two nuts retaining the governor lever bush flange and withdraw the lever assembly from the housing. Remove the seal abutment ring from the housing counterbore. Push out the lower stop pin and extract it from the linking valve cover seating face of the housing.

**Note. . .**

*It is not permissible to dismantle the lever and bush, as special equipment is required to assemble these details, due to the very close tolerances involved.*

**Detent ball.**

**385.** Remove the two nuts retaining the detent ball spring housing and lift off the spring housing. Separate the housing, spring and spring cap, lift out the ball and withdraw the ball housing.

**Mounting link**

**386.** Remove the retaining nut from the mounting link pin retaining plate, remove the plate, then withdraw the link pin with extractor T.303927.

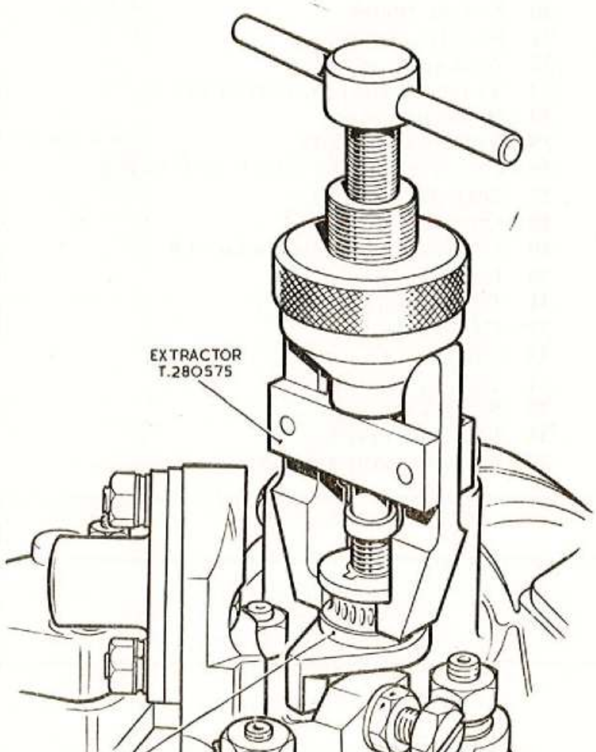


**Fig. 43. Removing the governor lever hub**

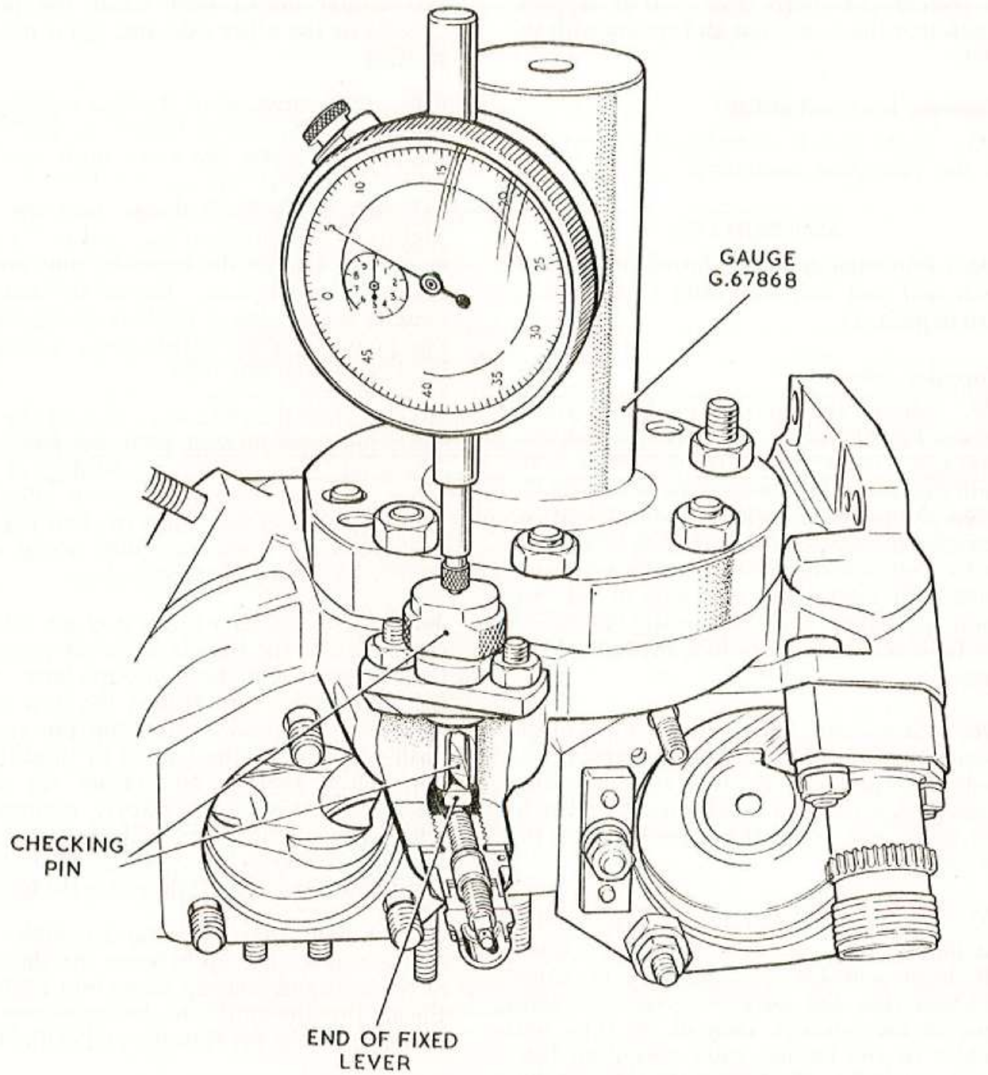


**Fig. 44. Setting the radial plane of the governor fixed lever**

**387.** Clean the components as described in para. 7.

## INSPECTION

**388.** In addition to the instructions contained in para. 9-15, inspect the following items.

### Linking valve

**389.** The riveted diaphragm assembly must be renewed. The valve plate must be checked for flatness with an optical flat and inspected for scoring. Light scoring or staining may be polished out provided that the plate will then pass the optical test.

**390.** Inspect the orifice edge for crumbling; if not severe, the face may be lapped to restore a sharp edge to the orifice; in this case, the orifice legs must be lapped also until they are between 0·00005 in. and 0·001 in. below the orifice face.

### Temperature trim lever and orifice

**391.** Check that there is no side play between the lever and its bush and that the hinge pin is not proud of the bush surface.

**392.** Inspect the orifice edge for crumbling; if this is slight the orifice face may be lapped to restore the sharp edge. After lapping, check that the face is flat and square with the body.

**Governor lever and orifice**

**393.** Inspect the lever and orifice as detailed in the preceding paragraph.

## ASSEMBLING

**394.** Immediately before fitting seals, brush each seal and seal land with OM-58, refer also to para. 33.

**Governor lever**

**395.** Mount the housing on the assembly fixture T.212177, ease the lever seal and seal abutment ring over the long end of the lever until the seal abuts the lever bush. Insert the assembly into the housing and check that the lever is positioned so that the flat face at the end is towards the governor orifice locating bore. Fit tabwashers and nuts to the two studs and tighten them sufficiently to position the bush seal but do not lock the nuts at this stage.

**396.** Fit a sealing ring on to the waist of the lever adjusting screw, insert the screw in the body, fit the seal retainer and adjusting screw locknut. Fit a combination washer to the body and screw the assembly into the governor housing.

**397.** Position the governor housing so that the linking valve facing is uppermost. Insert the bush and the checking pin of gauge G.67868 into the governor orifice locating bore in the housing, then fit the d.t.i. and holder to the linking valve mounting face, as shown in fig. 44. Clamp the d.t.i. so that its stylus is resting on the checking pin, the other end of which must be in contact with the flat on the lever, adjust the stop screw out of contact with the lever.

**398.** Deflect the lever through its full range of travel and note the readings, then depress the lever and screw in the stop screw to raise the end of the lever until it is positioned, in contact with the stop screw, at the mid-way point of the total travel noted previously.

**399.** With the lever still held against the stop screw, set the checking pin of the gauge G.67868 so that the engraved indicator line registers with the engraved line on its bush, then rotate the checking pin about 30 degrees to one side and note the reading. Re-align the register marks then rotate the pin 30 degrees to the other side and again note the reading.

**400.** Any variation in the two readings indicates that the lever is incorrectly positioned radially. Slacken the lever bush retaining nuts slightly and using tool T.272413 on the flat sides of the bush flange, turn the bush slightly in the direction required to level the lever face, tighten the retaining nuts and re-check the radial plane. Repeat this until the reading is the same at the two 30 deg. checking points. When satisfactory, secure the lever bush retaining nuts.

**401.** Rotate the checking pin until the indicator lines are aligned with the lever axis. Again take two readings at 60 deg. to each other. If there is any discrepancy, adjust the stop screw either way until the two readings are identical. Lock the stop screw when satisfactory and remove the gauge.

**402.** Insert the lever lower stop pin into the small bore in the linking valve cover seating face, fit the spacing bush into the bore. With the lever held firmly against the stop screw, check that the end of the stop pin spacing bush is flush with the face of the housing; if not, select another bush from the range available. When satisfactory, remove the selected bush and place aside to await final assembly, remove the stop pin, fit a sealing ring to the pin and re-fit the pin in the housing.

**403.** Finally, assemble the governor lever spring and spring cap between the short end of the lever and housing, using tool T.218949. Ensure that the dimple in the spring cap seats correctly on the pivot in the end of the lever.

**Temperature trim lever housing**

**404.** Fit a seal to the lever bush short end, insert the lever assembly into the temperature trim lever housing so that the flat machined face of the lever faces the orifice location bore. Secure the assembly with two cheese-head screws.

**405.** Fit a seal to each of the two stop screws, insert the screws into the lever housing, a few turns each, and fit their locknuts.

**406.** Insert the bush and checking pin of gauge G.102460 (*fig.* 45) into the orifice location bore in the housing and bolt the d.t.i. fixture of the gauge to the linking valve cover facing on the housing.

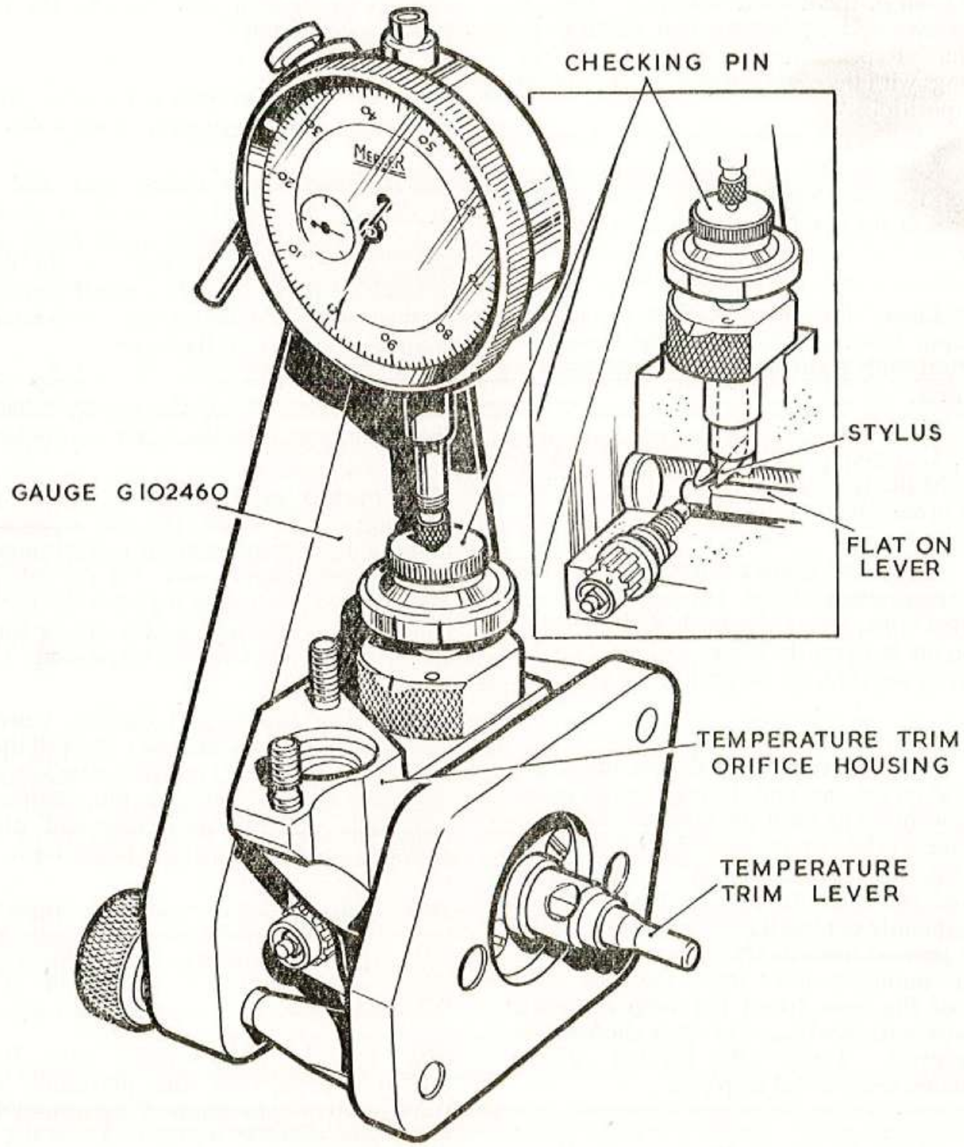


**Fig. 45. Setting the plane of the temperature trim lever**

**407.** Check that the stop screws do not interfere with the movement of the lever to its maximum in each direction. Move the lever to maximum deflection one way and set the d.t.i. to zero. Move the lever fully in the opposite direction and note the reading. Screw in the stop pins until the lever is located by both pins in a position where the d.t.i. indicates half of the reading noted previously.

**408.** There are two sets of three engraved lines on the checking pin flange, the centre of each set being marked with a cross. Align one of the cross markings with the engraved line on the pin bush, then rotate the pin to one side and align the one engraved adjacent line with the line on the bush. Note the d.t.i. reading. Rotate the pin in the opposite direction to align the third mark with the bush line and again note the reading.

**409.** If the two readings are not the same, slacken off the two screws securing the lever bush to the housing, and slightly rotate the lever bush in the desired direction. Tighten the screws and again take two readings as before. Repeat this procedure until the readings with the checking pin are the same at both positions.

**410.** Remove the gauge G.102460. Fit a seal on the lever bush and two seals into the recesses of the two bores in the lever housing face.

**411.** Lower the lever housing on to the governor housing, locate it on the studs and secure it with plain washers, grover washers and nuts.

**412.** Using combination spanner T.228556 unscrew the two stop pins until they are well clear of the lever.

**413.** Secure the gauge G.102460 (*fig.* 45) to the temperature lever housing with the knurled nuts, insert the bush and checking pin in the bore for the orifice and position the stylus of the d.t.i. on the end of the checking pin.

**414.** Note the reading, and then move the lever at its external end through its full range of movement in both directions. Note the readings at the extreme positions of the lever. The total travel must not be less than 0·060 in. and the travel from the central position consequently not less than 0·030 in. With the lever pressed towards the orifice bore, screw in the minimum lever travel stop pin until half of the lever travel has been traversed according to the d.t.i. The lever should now be central. Tighten the locknut of the minimum lever travel stop pin.

**415.** Screw in the maximum lever travel stop pin until it just contacts the lever.

**416.** Using the checking gauge G.102460 again check the radial position of the lever as described in para. 397 to 399.

**417.** To check that the lever will be longitudinally parallel to the orifice face rotate the checking pin until the indicating line lies along the line of the lever. Note the gauge reading and then rotate the pin through 180 degrees and again note the reading.

**418.** If these two readings are not the same then adjust the two stop pins until the readings are the same at both positions. When satisfactory, tighten and wirelock the minimum flow stop pin.

**419.** Unscrew the maximum lever travel stop pin until it is well clear of the lever.

**420.** Assemble the spring seat and cap to the spring and retain them in position with a smear of white petroleum jelly. Insert the assembled spring into the recess in the housing so that the conical projection of the spring seat fits in the corresponding conical depression in the lever.

**421.** Fit the seal on the spring adjusting screw and assemble the screw to the sleeve.

**422.** Fit the seal into the groove around the sleeve and insert the sleeve into the housing making sure that the end of the screw locates in the spring cap. Fit the retaining plate and secure it with a grover washer and plain nut on one stud and a grover washer and wirelocked nut on the other stud.

**423.** Using the tool T.228556, screw in the adjusting screw to apply the full spring load upon the lever, pressing it against the minimum lever travel stop pin. Screw the locknut on to the projecting end of the adjusting screw and make it finger tight.

**424.** Note the d.t.i. reading. Press the lever away from the orifice bore, against the spring, as far as possible and again note the reading.

**425.** This lever movement must be at least 0·030 in. Set the maximum lever travel stop pin to allow a maximum lever movement of 0·045 in. then tighten the stop pin locknut. Remove gauge G.102460.

**426.** Finally, secure the temperature orifice housing to the unit with plain and grover washers on all four studs, wirelocked nuts on the spring adjustment side and plain nuts on the other two studs.

**Temperature trim orifice**

**427.** Fit a seal into the orifice bore in the orifice housing and one in to the groove on the orifice body.

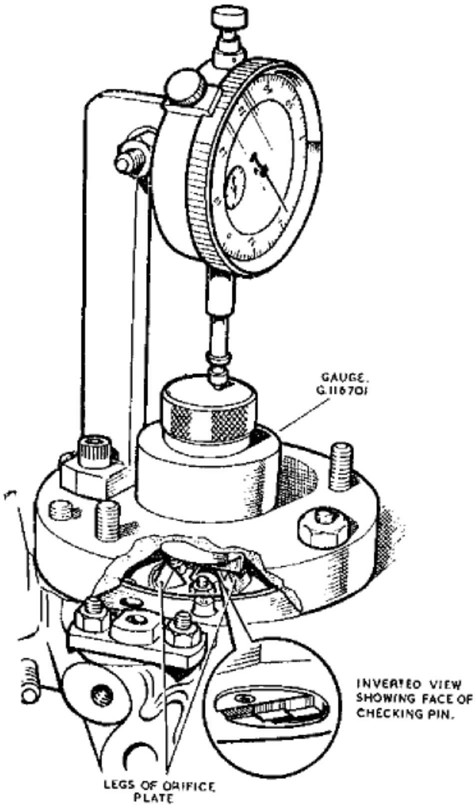


**Fig. 46. Checking the height of the linking valve orifice plate**

**428.** Using tool T.228556, screw the orifice fully into the retaining plate and make the locknut finger tight. Insert the orifice into the bore in the temperature orifice housing so that the orifice faces the flat upon the lever.

**429.** Secure it with a grover washer and plain nut on one stud and a grover washer and wirelocked nut on the other stud.

**430.** Fit a seal into the groove on the spigot of the cover plate and assemble the cover plate to the unit. Fit the two set-screws with plain and grover washers and tighten them.

**431.** Fit the blanking plug RSK.203/207 to the governor orifice location bore, assemble the test plates and connect the housing assembly to the flow rig. Adjust the temperature trim orifice either way until a flow of between 11 and 12 g/hr. is established at an input pressure of 100 lb/in $^2$.

**Linking valve**

**432.** Insert the linking valve plate into the diaphragm assembly, fit the adjusting washer and slotted nut. Place the centralizing ring T.231861 over the valve plate so that the reduced diameter of the ring fits in the annular recess between the plate and the diaphragm ring.

**433.** Tighten the slotted nut with a torque spanner set to 15 lb. in. then check that the split pin can be inserted. If not, select another adjusting washer which will allow the split pin to be inserted with the nut tightened to the stated loading.

**434.** Remove the split pin as it is to be fitted after the assembly has been pressure tested. Remove the centralizing ring T.231861

**435.** Make the test as detailed in para. 505 to 508.

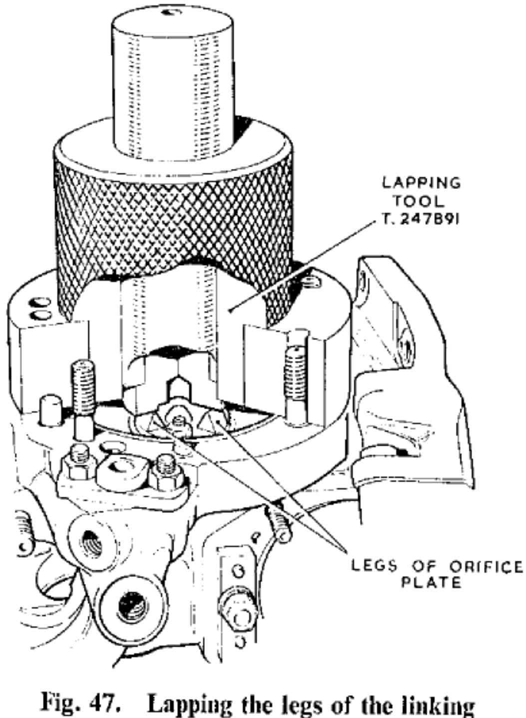


**Fig. 47. Lapping the legs of the linking valve orifice plate**

436. Fit the seal into the orifice bore in the governor body. Insert the orifice plate into the bore and on to the three projecting studs at the bottom of the recess so that the marks made during dismantling are aligned. Fit a tabwasher and nut on each stud and tighten but do not lock them.

437. Position the depth gauge G116701 on the diaphragm face of the body and check that the lands of the three legs of the orifice plate are 0·0005 to 0·001 in. below the orifice centre as shown in fig. 46.

438. If the lands are not within these limits, remove the nuts and tabwashers and try the orifice plate in the two alternative positions, tightening the nuts each time. Select the position which provides the best setting and only then, if necessary, use the tool T.247891 (fig. 47) to lap the legs or the orifice face to within the stated limits.

439. If the orifice face has to be lapped, afterwards check the annular width of the face; this may have increased due to its intersection with the conical position. If the face land width exceeds 0·012 in. the diameter must be reduced by re-coning the outer surface. Also the legs must not exceed 0·019 in. width of land.

440. Carefully remove all trace of the lapping paste and lock the securing nuts.

441. Using a depth micrometer and the parallel bars T.261706, measure the distance from the diaphragm face of the body to the face of the orifice, and note the reading.

442. Assemble the diaphragm assembly to the cover and again using the depth micrometer and parallel bars, measure the distance from the face of the linking valve plate to the joint face of the cover, and note the reading.

443. Subtract the second reading from the first. The difference is the amount of diaphragm lift and should be 0·015 in. minimum. If it is not, then select alternative diaphragm assemblies until the required gap is achieved.

444. Fit the square section seal into the recess of the bore alongside the linking valve recess.

445. Insert the previously selected spacing bush in the bore in the joint face of the body on the top of the governor lever stop pin.

446. Fit the diaphragm assembly with its beaded rim located in the annular groove, then fit the cover to the body, locating it on the nine studs. Secure it with six plain washers, grover washers and nuts and three tabwashers and nuts. Tighten and lock all nine nuts.

**Solenoid**

447. Insert the solenoid core with its BREEZE plug and plate into the housing, without fitting the seal into the recess in the bottom of the cavity in the housing. Using suitable distance pieces and slave nuts on the studs, make them finger tight to secure the solenoid.

448. Using feeler gauges, check the gap between the flange of the solenoid casing and the joint face of the housing. Select a laminated shim 0·001 to 0·002 in. less in thickness than the gap.

449. Remove the solenoid core, fit the seal into the groove at the bottom of the cavity in the housing fit the previously selected shim and replace the solenoid. Insert the push rod into the bore in the solenoid to engage the bore in the lever.

450. Fit the adjusting screw to the armature and the tabwasher and locknut to the adjusting screw. Leave the locknut finger tight, with the adjusting screw showing approximately three threads out of the nut; this is a convenient setting for calibration during rig testing.

451. Position the assembled armature on the solenoid, with the end of the push rod engaging in the end of the adjusting screw. Fit the spring into the annular recess in the armature.

452. Fit a seal into each end groove of the armature housing and assemble the housing over the armature. Fit the spigoted clamp plate over the armature housing and then fit the cover plate.

453. Secure the cover plate with plain and grover washers and nuts and, using adapter T.320695, tighten evenly to a torque of 15 lb. in. on each nut.

454. Fit the large access plug to the cover but do not tighten it as it will be later removed for calibration purposes.

455. Pressure test the assembly as described in para. 502.

**Detent ball**

**456.** Insert the ball and the spring seat into the ball housing. Assemble the housing with the ball and carrier to the stop bracket.

**457.** Insert the spring into its housing and assemble it to the ball housing on the stop bracket. Secure it with two plain washers, grover washers and nuts.

**Swivel link**

**458.** Fit the stop screw, washer and nut to the stop bracket assembly and make it finger tight.

**459.** Fit the seal into the groove on the shoulder of the stop bracket, and then two seals, square-section seal outermost, into the groove in the outer end of the stop bracket bore.

**460.** Ease the spindle into the stop bracket. Fit the key, and then the lever hub to the spindle. Secure it with a washer and a slotted nut.

**461.** Using feeler gauges, check that there is an end float of 0·002 to 0·005 in. between the bush face and the yoke face.

**462.** Assemble the stop bracket to the unit and secure it with plain washers, spring washers and nuts on two studs and a tab-washer and wire-locked nut on the third stud.

**463.** Fit a slave lever to the yoke hub and check that a pull of not more than 2 lb. is required to move the lever. Remove the lever and secure the hub nut with a split pin. Lock the tabwasher on the stop bracket retaining nut.

**464.** Assemble the face end of the swivel spring link to the hinge plate and insert the retaining pin. Fit a locknut and tabwasher to the tappet screw and assemble the screw to the diaphragm so that there is a gap of 0·3125 in. between the underside of the screw head and the locknut, with the locknut tightened against the tabwasher. Do not lock the tabwasher.

**465.** Using the tool T.223794, ease a seal into the groove in the upper end of the diaphragm centre. Position the swivel spring, link and diaphragm centre assembly in the housing, locate the link hinge plate on the two studs, and secure it with two tabwashers and nuts. Lock the tabwashers.

**466.** Position the end of the yoke arm adjacent to the access hole in the housing. Locate the adjusting plate on the yoke, and insert the spring anchor through the yoke and adjusting plate. Manipulate the spring anchor to engage the swivel spring in the slot, then fit the adjusting nut to retain the spring and anchor in position; the nut is slotted on its inner face to engage with two projections on the adjusting plate and provide a self-locking adjustment.

**Diaphragm and control spring**

**467.** Fit a sealing ring to the groove in the diaphragm assembly spigot and another similar seal to the annular groove in the diaphragm top plate. Assemble the diaphragm on to the diaphragm centre and push it down until the assembly is located in the housing.

**468.** Engage the spring anchor with the spring then, using tool T.257456 to expand the spring, attach the lower end of the spring to the diaphragm centre. Fit the clevis pin, then a washer, and secure it with a split pin.

**469.** Fit a sealing ring to the annular groove in the face of the control spring housing and assemble the spring housing over the spring and anchor so that the anchor engages in the square-section hole. Secure the housing and diaphragm assembly to the governor housing with plain washers, spring washers and nuts.

**470.** Place a sealing ring in the counterbore in the outer end of the spring housing, insert the governor adjusting screw then fit and tighten the locknut.

**471.** Check with a feeler gauge that there is a gap of at least 0·030 in. between the diaphragm tappet and the governor lever. Adjust the tappet if necessary, tighten the locknut and lock the tabwasher.

**Blanking plug and cover plates**

**472.** Fit the washer to the large hexagonal headed blanking plug and screw the plug into the hole in the inclined face of the governor body.

**473.** Assemble the rectangular cover plate to the governor body, locating it on the four studs immediately adjacent to the spring housing and secure it with a plain washer, grover washer and plain nut on each of the four studs.

**474.** Fit a gasket to the side facing on the governor housing, fit the large, lobe-shaped cover plate and secure it with tabwashers and nuts on the eleven studs.

## TESTING

**475.** The testing procedure comprises the preliminary testing and calibrating of various sub-assemblies. This is followed by the calibration of the throttle valve assembly, altitude sensing unit and temperature control interconnected. Finally, a test is carried out on the complete unit, including the acceleration control.

**476. Test rigs and adapters**

| | |
|---|---|
| R.71A | General purpose flushing rig |
| R.124 | Flowmeter |
| R.125 | Test unit and stand |
| R.133 | Air test tank |
| R.157 | Sub-assembly rig |
| R.159A | High-pressure kerosine wash unit |
| R.169 | Calibration rig |
| R.193 | Static pressure tests |
| RSK.203 | General fittings and test adapters |
| — | Refrigerator for cold testing (–40 deg. C.) |

**477.** Each sub-assembly and main assembly requires certain blanking plates, connections and adapters to enable it to be connected to the test rig; this equipment is supplied with the test rig under part numbers which are prefixed RSK.203. Additional pressure test equipment is included in the List of Special Tools.

### SUB-ASSEMBLY TESTS

**Pressure drop kinetic lever seal, leakage test**

**478.** (1) Assemble the p.d. control lever into the fixture T.262317 (*fig.* 48). Connect a static fuel pressure line to the union and apply a pressure of 2000 lb./in $^2$ for 10 minutes; there must be no leakage from the open end of the fixture.

(2) Disconnect the fuel line and drain all fuel from the fixture union. Connect an air-line and immerse the fixture in fuel with the open end uppermost. Apply an air pressure of 5 lb/in $^2$ for 10 minutes; there must be no leakage.

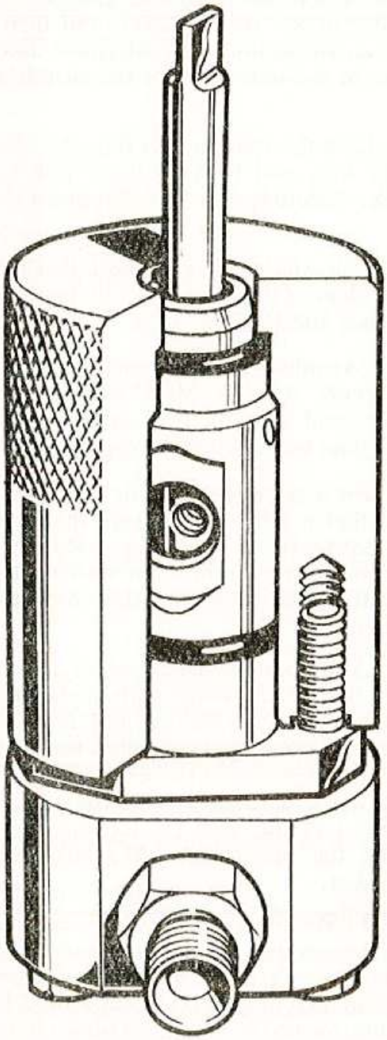

**Fig. 48. Pressure testing the pressure drop lever hinge seal (fixture T.262317)**

**Pressure drop control lever, pressure consciousness test**

**479.** Assemble the test rig adapters end plate RSK.203/69, RSK.203/71 and RSK. 203/82 to the kinetic block assembly and connect to the test rig. The two needle valves in the adapter RSK.203/82 enable a differential pressure to be applied across the control piston. With both needle valves open, start the rig and fill the assembly with fuel.

**480.** Close the downstream valve and apply maximum pump delivery pressure to stabilize the control lever seal, then adjust the pressure to 1600 $lb/in^2$. As this pressure is applied equally to both sides of the p.d. control piston, the piston will be displaced by its control spring to move the kinetic knife clear of the kinetic orifices.

Apply a pressure of 100 $lb/in^2$ to the input orifice and note the recovery pressure; this should be at least 98 $lb/in^2$.

**481.** Open the downstream needle valve to reduce the pressure on the control spring side of the piston; this will move the piston against its control spring and away from the lever, which under the influence of the return spring, should follow the piston and cause the kinetic knife to interrupt the orifice flow, this being denoted by a change in the kinetic recovery pressure.

**482.** Reduce the pressure to 800 $lb/in^2$ and repeat the check.

**483.** If in either case the lever does not interrupt the flow instantly, i.e. no drop in recovery pressure, the lever seal is excessively pressure conscious. Adjust this by increasing the shims under the lever return spring.

**484.** If an excessive thickness of shims is required then a new lever assembly must be fitted; this will necessitate repeating the entire p.d. assembling procedure, followed by the pressure consciousness check.

**Pressure drop control kinetic flow tests**

**485.** These tests are to be made with the kinetics 'drowned', i.e. with the space between the orifices totally enclosed and filled with fuel at rig pump pressure. A test should also be made with the space between the orifices open to atmosphere, when the recovery pressure must not vary from the drowned recovery pressure by more than 1%.

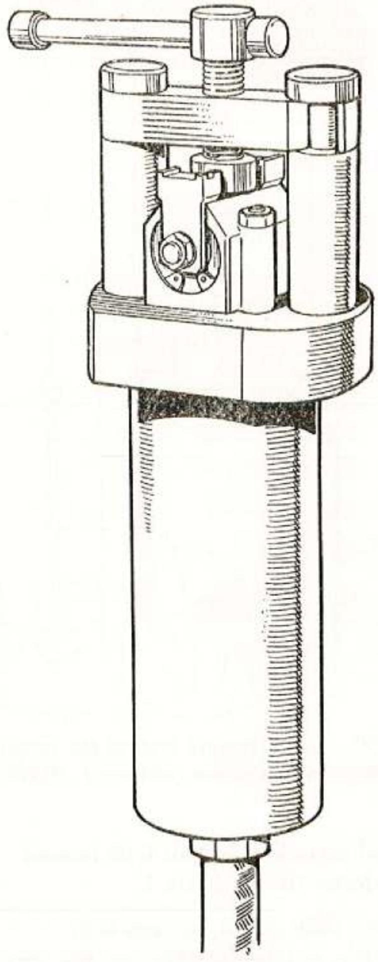

**Fig. 49. Pressure testing the sensing lever hinge (fixture T.231686)**

**486.** Assemble the test rig adapters RSK. 203/69 and RSK.203/71 to the kinetic housing, with the pressure drop control cylinder lever and kinetic orifices assembled, and connect to the test rig, then refer to Appendix 1.

**Setting the pressure drop control lever stop screw**

**487.** Apply a pressure of 100 $lb/in^2$ to the input kinetic orifice and note the recovery pressure. Turn the lever stop screw slowly clockwise until there is a change in recovery pressure, indicating that the kinetic knife is interrupting the flow. Turn the screw anticlockwise until the recovery pressure is fully restored. Locate the knife interruption point carefully, turn the stop-screw very slightly anticlockwise, tighten the locknut.

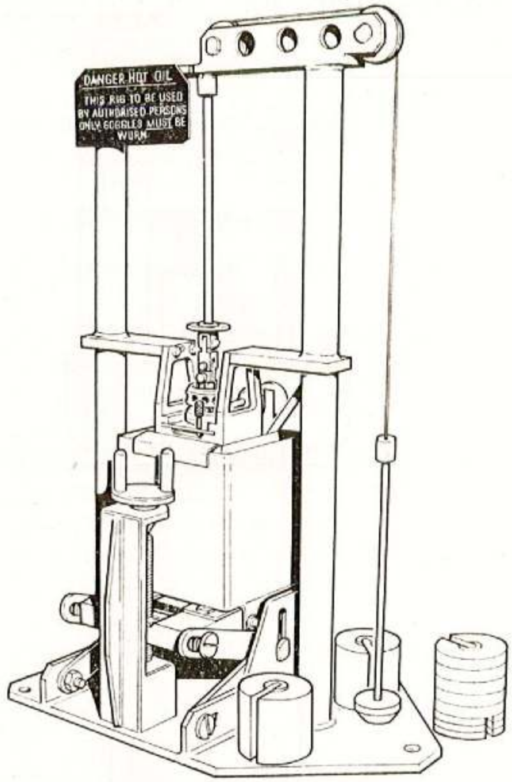


**Fig. 50. Temperature testing the metering plunger servo piston (fixture T.303903)**

**Internal servo kinetic flow tests (a.c.u.)**

**488.** Refer to Appendix 1.

**Pressure-ratio switch, leakage test.**

**489.** Fit a joint washer to the pressure-ratio switch joint face then fit test plate T.228580 and secure it to the switch with washers and nuts. Connect an air-line to the union in the test plate, blank off the P1 connection and apply an air pressure of 150 lb/in $^2$ (gauge). Close the air supply cock and leave for 5 minutes; during this time any fall in pressure must not exceed 3 lb/in $^2$.

**Sensing lever hinge, pressure test (a.c.u.)**

**490.** Fit the sensing lever assembly into the pressure test fixture T.231686 (*fig.* 49). Connect the fixture union to the fuel pressure rig and apply a pressure of 3000 lb/in $^2$ for 5 minutes; there must be no loss of pressure and no visible leakage from the ball races.

**Internal servo piston, temperature test (a.c.u.)**

**491.** Fit the assembled servo piston, metering plunger and orifice sleeve to test fixture T.303903 (*fig.* 50) with the oil tank in its lowest position. Apply weights to the weight platform of the fixture and record the total weight at which the piston moves; it must not exceed 10 lb. Record this weight and also the room temperature. Remove the the weights.

**492.** Rotate the fixture handle to raise the tank until the assembly on test is submerged in the tank fluid (Tellus 27 or similar high flash point fluid) which must be at a temperature of 120 deg. C. Leave the assembly to soak for 10 minutes, then apply weights again until the piston moves. The weight must be within 6 lb. of the figure previously recorded at room temperature.

**Internal servo piston, leakage test (a.c.u.)**

**493.** Fit the assembled orifice, piston and plunger in the test fixture T.258797 (*fig.* 51) to test for leakage past the piston rings. A stop screw on the fixture permits the piston position to be altered so as to check leakage at various positions. Connect the fixture to the test rig and check at four positions of the piston namely, out, one third in, two thirds in, and fully in.

**494.** Apply a pressure of 100 lb/in $^2$ at each position and check that the leakage at each point does not exceed 100 cc per minute.

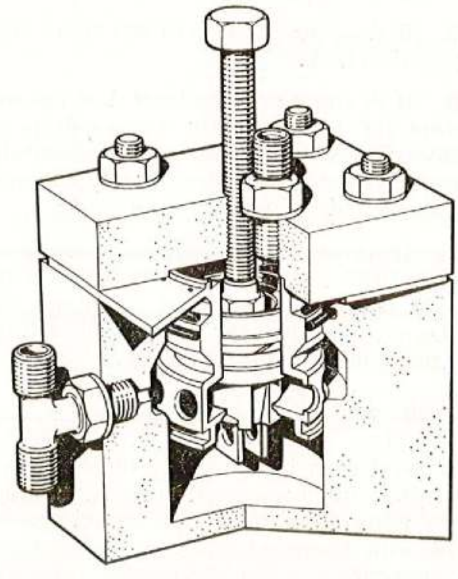

**Fig. 51. Testing the servo piston rings for leakage (fixture 258797)**

**Kinetic orifice flow tests (a.s.u.)**

**495.** Refer to Appendix 1, para. 4, 5 and 6.

**Kinetic lever seal leakage test (a.s.u.)**

**496.** Before assembling the capsule and housing details, blank off all connections except the proportional flow inlet. Connect an air-line to the proportional flow inlet and apply an air pressure of 80 lb/in $^2$ with the assembly totally immersed in kerosine. There must be no leakage from the lever hinge seal.

**Pressure-raising valve flow test**

**497.** Insert the assembled valve into the fixture T.237421 (*fig.* 52), apply a fuel flow of 20 gal/hr. and check that the pressure is between 20 and 29 lb/in $^2$. Increase the flow to 100 gal/hr. and check that the pressure is between 27 and 36 lb/in $^2$.

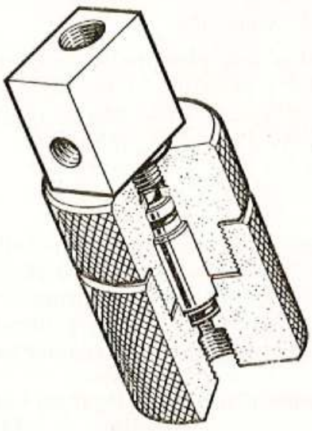

**Fig. 52. Pressure testing the pressure-raising valve (fixture T.237421)**

**Throttle valve cold torque test**

**498.** With the throttle valve and sleeve assembled into the housing, fit a blanking plate to the a.c.u. attachment face, with four long bolts passing through the housing, sleeve flange and control stop plate, fit washers and nuts. Immerse the assembly in fuel and cool in a refrigerator for one hour at a temperature of —40 deg. C, then remove the assembly from the refrigerator and check the torque required to move the lever and then the torque to keep it moving.

**499.** The check may be made with a torquemeter wrench, and a suitable adapter engaging the lever retaining nut, or by using a spring balance attached to the outer hole of the throttle lever.

**500.** When using a torquemeter, the torque must be 33 lb/in to move the lever, and 22 lb/in to keep it moving. When using a spring balance the pull required to move the lever must be 12 lb., and 8 lb. to keep it moving. If the torque required is excessive, remove the t.v. plug and examine it for high spots, burrs or dirt. High spots may be polished out but the sharp metering edges must be maintained.

**Constant flow valve, calibration**

**501.** The only adjustments required are to the spring adjustment and the restrictor orifice size. Connect the valve to the flow rig and rotate the spring adjusting screw clockwise until it is tight, i.e. the spring anchor has reached its full limit of travel and the spring therefore is at its maximum tension. If the flow is now less than that stated in Appendix 1, remove the restrictor bobbin and open out the orifice, not more than 0·0005 in. at a time and preferably by lapping, then re-checking until the required flow is established. If the flow is more than that stated, fit a new bobbin then enlarge the orifice until the required flow is established.

**502.** To check the valve for pressure consciousness, with the valve providing a constant flow of between 40 and 42 g/hr. at 25 lb/in $^2$ input pressure, increase the pressure to 150 lb/in $^2$; any increase in flow must not exceed 6 g/hr.

**Solenoid pressure test**

**503.** Fit the two blanking plates T.218828 and T.244153 to the unit, with connections assembled immerse the unit in kerosine and apply an air pressure of 80 lb/in $^2$. There must be no leakage past the lever seals and no external leakage.

**Pressurizing valve temperature test**

**504.** Immerse the sleeve and plunger assembly in Tellus oil 27 and allow to soak for 5 minutes in a controlled temperature of 100 deg. C, after which the plunger should be free to move in the sleeve.

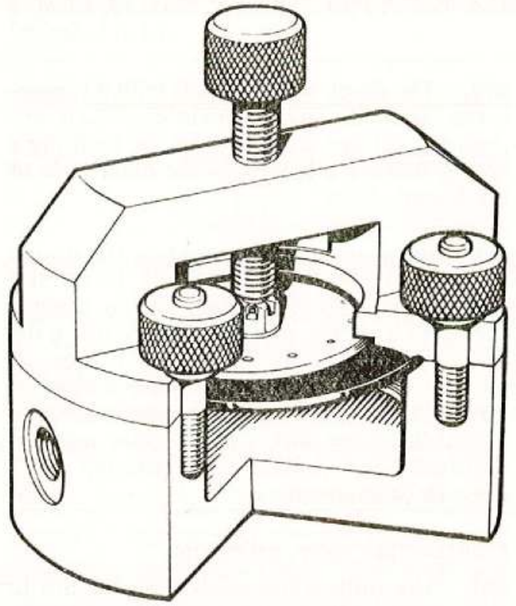

**Fig. 53. Pressure testing the linking valve diaphragm (fixture T.222022)**

**Linking valve diaphragm leakage test**

**505.** Fit the assembled linking valve plate and diaphragm into the test fixture T.222022 (*fig.* 53) with the valve plate facing downwards i.e. toward the pressure chamber. Locate the diaphragm beading in the annular groove in the fixture, locate the fixture top plate and secure it with the four knurled nuts; the top plate is designed to simulate the actual operating conditions of the valve assembly.

**506.** Connect the fixture to the pressure test rig and raise the pressure slowly and steadily to 400 lb/in$^2$. Hold the pressure for 5 minutes, then release it. Remove the fixture top plate and examine the valve assembly and diaphragm surface for leakage; there must be no leakage past the rivets or the valve plate.

**507.** An earlier type of test fixture had a bridged top plate fitted with a central screw. In this instance, locate the valve plate and diaphragm assembly in the fixture T.22202 and then continue as instructed in the following paragraph.

**508.** Connect the fixture to the pressure test rig and, with the central screw clear of the valve centre, apply a pressure of 5 lb/in$^2$ to seat the rim of the diaphragm plate against the shoulder in the fixture top plate, then screw the central screw in until it just contacts the end of the linking valve screw; this ensures that the diaphragm plates are fully supported at the rear and at the centre. Increase the fuel pressure slowly and steadily to 400 lb/in$^2$, hold this pressure for 5 minutes, then release it. There must be no leakage past the rivets or valve plate.

**Air pressure test of combined control unit.**

**509.** Prior to final calibration, the unit without the pressure ratio switch is to be pressure tested. Attach the air supply to the pump delivery connection. Blank off all connections except P1 and P2. Immerse the unit in S.B.P.6 fluid and increase air pressure slowly to 80 lb/in$^2$. There must be no external leakage from the unit nor from the P1 and P2 connections.

**Calibrating the pressure-ratio switch**

*Split-ratio calibration*

**510.** Fit a test plate to the switch unit to enable $KP_2$ pressure to be registered on a suitable gauge. Also gauge tappings are required for $P_1$ and $P_2$ readings.

**511.** Screw the switch bobbin fully out to clear the switch pad, then fit a blank potentiometer bobbin. The following are typical requirements for split-ratio calibration; for the specific calibration figures refer to Appx. 1.

| $P_2$ (lb/in$^2$ abs.) | ($KP_2$ lb/in$^2$ abs.) Min. | Max. |
|---|---|---|
| 40 | 27·5 | 29·5 |
| 70 | 48·5 | 51·5 |

**512.** Set the $P_2$ pressure to 40 lb./in$^2$ (abs). The $KP_2$ pressure will most likely be higher than the stipulated 27·5 to 29·5 lb/in$^2$ abs., which would mean that the end orifice in the splitter bobbin must be opened up, until the $KP_2$ reading is within the limits. Opening up the orifice should be done in stages of 0·0001 to 0·0002 in. to maintain uniformity.

**513.** Next, increase $P_2$ pressure to 70 lb/in$^2$ (abs) and check that $KP_2$ is within the limits.

**514.** It may be necessary to effect the slight re-adjustment on orifice size to obtain the ratio to satisfy both $P_2$ increments, depending on the individual characteristics of the splitter bobbin. For instance, in order to obtain the bottom $KP_2$ limit at 70 lb/in $^2$ $P_2$, it is possible that the splitter valve would have to be calibrated to give a top limit $KP_2$ reading at 40 lb/in $^2$ $P_2$ setting. It is however desirable to aim at the mid-limit requirements of $KP_2$.

*$P_2/P_1$ changeover calibration*

**515.** Remove the blank potentiometer bobbin and fit the correct bobbin. The following table is a typical example of calibration requirements.

| $P_1$ (lb/in $^2$ abs) | $P_1$ (in Hg. abs) | $P_2$ (lb/in $^2$ abs) Min. | Max. |
|---|---|---|---|
| 5·1 | 2·5 | 20·5 | 21·5 |
| 10·15 | 5 | 35 | 37 |
| 20·35 | 10 | 59·5 | 62 |

**516.** Set $P_1$ manometer reading to 2·5 lb/in $^2$ abs and screw in the splitter valve slowly until the air switch operates, this is indicated by a sudden rapid rise in $P_2$ and $KP_2$ pressures. $KP_2$ and $P_2$ pressures should be equal when the switch is fully closed.

**517.** When this is achieved, tighten the splitter valve locknut and check that the setting is correct by reducing then increasing $P_2$.

**518.** Next, set $P_1$ to 10 lb/in $^2$ abs. and increase $P_2$ slowly until the changeover occurs, which should be between 59·5 and 62 lb/in $^2$ abs.

**519.** If the changeover is early, i.e. lower than 59·5 lb/in $^2$ abs. $P_2$, open the exit (side) orifice in the potentiometer bobbin. Conversely if the changeover is late, i.e. occurs at a higher $P_2$ pressure than 62 lb/in $^2$ abs, open out the entry (end) orifice in the potentiometer bobbin. Open the orifices by reaming not more than 0·0001 to 0·0002 in. each time, otherwise the increase may be too great, necessitating a new bobbin.

**520.** When the changeover is satisfactory at 10 lb/in $^2$ abs $P_1$, check at 2·5 lb/in $^2$ abs $P_1$. If this is now outside the limits of 20·5 to 21·5 lb/in $^2$ abs $P_2$, re-set the splitter adjustment to bring the changeover within the required limits, then check at 10 lb/in $^2$ abs $P_1$ and re-adjust the potentiometer orifice sizes as necessary. Continue to check and set the splitter at 2·5 lb/in $^2$ abs $P_1$, followed by the re-checking and opening either of the potentiometer bobbin orifices at 10 lb/in $^2$ abs $P_1$ as required, until the change-over is correct at both points.

**Note . . .**

> *The potentiometer bobbin orifice must not be opened out beyond the sizes specified in the test schedule, otherwise, the air mass flow limits will be exceeded.*

**521.** If the unit is calibrated correctly at $P_1$ values of 2·5 and 10 lb/in $^2$ abs. then is should also be within the $P_2$ switch limits at 5 lb/in $^2$ abs $P_1$ conditions; if it is not, a compromise should be possible by use of the $P_2$ pressure limits at the other two setting points.

**522.** If difficulty is experienced in achieving the switch calibration, make the following checks:

(1) When the correct switch ratio at all $P_1$ increments cannot be obtained, examine the unit for damaged seals.

(2) If there is sluggish switch action, check the preload on the P2/P1 bellows and examine the unit for damaged seals.

(3) If $KP_2$ does not equal $P_2$ after switching, examine the switch pad for foreign matter, the switch contact face of splitter valve for damage, and ensure that the switch pad is square to the flange of $P_2/P_1$ bellows.

(4) When the correct split ratio at both $P_2$ settings cannot be obtained, examine the unit for damaged seals and ensure that the splitter orifice maximum size has not been exceeded.

**Acceleration control unit**

*Pressure tests*

**523.** Connect a suitable fuel supply to the pump delivery connection on the a.c.u. and blank off all apertures except the KP2 capsule chamber. Apply fuel pressure and check for leakage in accordance with Appendix 1.

**524.** Remove the blanks, disconnect the fuel supply and connect an air supply to the KP2 chamber; immerse the unit completely in fuel and test as stated in Appendix 1.

*Preliminary calibration*

**525.** Connect the unit to the test rig, with the calibrated pressurising valve, throttle valve, constant flow avlve and burner simulators connected.

**526.** Fit a blank to the P1 connection and calibrate to the requirements of Appendix 1, by means of (a) the main lever trimming spring adjustment, to set the main flow datum, and (b) the pressure-drop preload adjustment, to set the curve slope.

**527.** When the correct curve has been obtained, check the plunger mechanical cut-out point. This can be varied only slightly by moving the curve datum-wise within the flow limits by means of the trimming spring adjustment. Raising the curve will effect an earlier cut-out, and lowering it will effect a later cut-out.

**528.** If the correct cut-out cannot be achieved by these means, then the unit must be fitted with another main flow control plunger of different cut-out dimensions which can be selected from a range supplied. A close approximation of the new plunger cut-out size required, can be obtained by the following method.

*Plunger cut-out early*

(1) Assume that the flow cut-out occurs at the $P_2$ value of 68 lb/in $^2$ and the required cut-out is at 72 lb/in $^2$. Remove the control plunger from the unit and measure the distance from the start of the flow control slot to the start of the cut-out flats. Multiply this distance by 72 lb/in $^2$ and divide by 68 lb/in $^2$. The result is the required dimension on the plunger. Select the nearest size to this from the range supplied.

*Plunger cut-out late*

(2) Assume that the cut-out occurs at a $P_2$ value of 76 lb/in $^2$, and the required cut-out is 72 lb/in $^2$ then follow the same procedure as for (1) but this time multiply the measured distance on the plunger by 76 lb/in $^2$ and divide by 72 lb/in $^2$.

(3) Any variation between the required size of plunger cut out and the actual size available should be overcome by the flow tolerances of the cut-out requirements.

*Split calibration*

**529.** Remove the blank from the connection and connect the $P_1$ supply. Record a curve of $P_2$ v flow at 14·7 lb/in $^2$ abs. $P_1$ conditions, which, if the split ratio has been correctly calibrated, should fall within or very near to the required flow limits. The plunger cut-out position should occur at precisely the same flow reading as already obtained on the unsplit curve.

**530.** If the curve is outside the flow limits it must be corrected by adjusting the splitter bobbin orifice to alter the split ratio. The slope must not at this stage be adjusted on the pressure-drop mechanism.

**531.** Only very small corrections to the splitter orifice size should be necessary to obtain the desired correction, and it is recommended that lapping is employed to achieve this, otherwise the orifice may be opened beyond the required amount.

**532.** Set $P_1$ at 2·5 lb/in $^2$ abs and $P_2$ at 10 lb/in $^2$ abs. Check that the flow is in the centre of the limits, if it is not, make an adjustment on the trimmer spring. This adjustment should be small enough not to materially affect previous setting made to the unsplit curve and may not immediately be apparent on the flow meter until the $P_2$ pressure has been reduced, then reset to 10 lb/in $^2$ abs. Careful rechecking after the trimmer spring adjustment is therefore necessary.

**533.** Next, check the flow reading at a P2 value approximately 5 lb/in $^2$ abs. before the plunger cut-out, with P1 set at 14·7 lb/in $^2$ abs. If the flow is away from the nominal requirements line, make a correction on the pressure-drop adjustment; it is emphasized that only a very small correction should be made in this way, or the previously set unsplit curve may be adversely affected.

**534.** Repeat paragraph 532 and 533 until the desired flow setting is achieved at both points. If there is doubt about the extent of the adjustments made, then check the unsplit calibration to ensure that it is still within limits.

*Flow sweep settings*

**535.** Where accurate flow sweeps are required, it is necessary to record flow readings during the switch operation of the $P_2/P_1$ control, and to this end, fine control diaphragm type valves are used to hold the $P_2$ pressure at any desired point and so prevent a rapid switch action. The preliminary switch settings previously made on the air-switch bench, therefore, will most likely require some re-adjustment in order to meet the more fastidious flow requirements.

**536.** Commence by setting the $P_1$ to 2·5 lb/in² abs and $P_2$ to 20 lb/in² abs. This point corresponds to a condition where the switch is almost closed, with the flow somewhere between the split and unsplit calibration lines. At this condition, set the flow to mid limits of the schedule requirements by means of the splitter valve adjustment. Screw in to raise the flow, or screw out to lower the flow.

**537.** Now set $P_1$ to 10 lb/in² abs and $P_2$ to 60 lb/in² abs, then check that the flow is in mid limit of calibration. If it is not, it will be necessary to open the exit (side) orifice in the potentiometer bobbin by a small amount to reduce the flow, or to open the entry (end) orifice to increase the flow. Lapping of the orifices is advocated at this stage.

**538.** Repeat para. 536 and 537 until the required flow is obtained at each point.

**539.** Check the flow sweep at 5 lb/in² abs $P_1$ conditions, this should now also be within the limits. If this is not so, it is possible that the plunger cut-out is overriding the switch control on the 10 lb/in² abs $P_1$ curve, so that the true ratio of the potentiometer orifice sizes is falsely represented by the flow readings. In this case the flow should be brought within the limits on the 5 lb/in² abs $P_1$ curve by further adjustment of the potentiometer orifice sizes to effect a compromise between the 5 and 10 lb/in² $P_1$ curves.

**540.** Record a complete calibration at all $P_1$ settings.

**541.** Should difficulty be experienced in calibrating the switch, check the following:—

(1) If there is excessive downstream pressure consciousness, check the pressure-drop knife hinge seal for leakage.

(2) Where there are irregular shaped curves at low $P_1$ settings, check for excessive control plunger to orifice clearance or damage.

(3) If there is excessive hysteresis, check that main lever is free to move without fouling the servo knife housing. Ensure that the control plunger to orifice clearance is not below limits and that the plunger and piston are concentric to one another within the limits specified in the Fits and Clearances.

(4) When the curve is high at 2·5 or 5 lb/in² abs $P_1$ settings, check the $P_2/P_1$ switch operation and inspect for dirt on the switch pad, for a misaligned switch pad, or for damaged seals on the switch bobbin.

**Pilot dump valve**

**542.** The opening and closing points for the operation of this valve are ascertained by applying a pressure upstream of the throttle valve assembly with the t.v. fully open.

**543.** Increase the pressure slowly from zero. Fuel will emerge from the dump valve drain connection and the point at which this fuel flow ceases will signify the opening point; this must be between 40 and 50 lb/in² input pressure. Reduce the pressure slowly until fuel again emerges from the dump outlet to denote the closing point, which should be between 15 and 25 lb/in².

**544.** If there is any variation from the requirements, check the components for foreign matter, seal defects and if these are satisfactory, fit a new spring.

**Pressurising valve**

**545.** The pressurising valve, which is combined with the throttle valve, constant flow valve and dump valves is to be calibrated as a fully assembled unit. The throttle valve must be fully open at all times.

**546.** The calibration of fuel flow versus pilot burner pressure is attained by the use of two adjustments, namely, the p.v. spring preload adjusting screw to change the curve datum, and the pilot flow orifice size to effect a slope change. Proceed as follows:—

(1) Record a curve of pilot pressure and fuel flow in order to establish what action is required to bring the unit within the requirement limits.

(2) If the general slope is correct the curve can be moved datum wise by means of the p.v. spring preload only, to achieve the calibration.

(3) If the slope is incorrect then the pilot flow orifice must be changed, i.e. to steepen the curve, fit a smaller orifice and conversely a larger orifice to flatten the curve, bearing in mind that the pressure is plotted as the base line on the graph with the flow variant plotted vertically.

(4) In some cases the orifice size change may only need to be in the order of 0·0005 in. in which case the desired result can be achieved by lapping the original hole size. After changing the orifice size it will be necessary each time to re-adjust the datum setting. Conditions for recording the pressurizing valve curve, such as burner simulator sizes, are given in Appendix 1.

(5) If it is necessary to open the pilot flow orifice a comparatively large amount, and drills or reamers are used, allowance should be made to finish off by lapping. This is important as the edges of a ragged hole will eventually crumble and increase the flow number of the orifice with a resultant change in calibration.

(6) If the curve is unobtainable due to excessively high pressures, check that the pilot flow orifice seal is intact or that the movement of the p.v. plunger is not impeded by any foreign matter.

**Throttle valve**

**547.** The throttle valve is now to be calibrated when assembled to the a.s.u. and governor unit (Appendix 1, para. 31 to 39 and 56 to 58).

**Altitude sensing unit**

**548.** Connect the unit to the test rig, using the throttle valve, linking valve, constant flow valve and pressurising valve with which it will be finally assembled (see Appendix 1 para. 40 to 48). A kinetic block in parallel with the a.s.u. kinetic pressure tappings is to be used to simulate the servo conditions created by the acceleration control.

**549.** Set the throttle curve to the approximate flow requirements by the same procedure as detailed in para. 565.

**550.** When setting the a.s.u. capsule pressure ($P_1$) during calibration always bring the mercury down from a higher level in order to keep the unit hysteresis one way.

**551.** Set the $P_1$ capsule to become inactive at between 65 and 68 in. Hg. abs. by means of the capsule preload screw, unless otherwise stated in the Appendix 1. This is done with the test rig running and the throttle lever at approximately 40 deg. angle.

**552.** Set the $P_1$ manometer at 60 to 70 in, Hg. abs, first ensuring that there is some preload already applied on the capsule, otherwise, when the capsule collapses with increasing $P_1$ pressure, it can fall out of its conical location.

**553.** Screw in the capsule preload screw until the fuel flow reading on the rotameter starts to fall; if the flow commences to fall immediately, reduce the preload until the flow stops rising. The latter will be the case if too much initial preload had been applied to the capsule.

**554.** Lock the adjusting screw nut and fit the cap nut to prevent $P_1$ leakage. Check the setting by operating the manometer to ensure that the flow ceases to increase at the correct manometer reading. Slight re-adjustment may be necessary due to the effect of tightening the lock nut.

*Setting the proportional pressure-drop*

**555.** A differential pressure gauge must be connected to the a.s.u. to record the pressure difference across the kinetic lever actuating piston. With the manometer reading 5 in. Hg abs, adjust on the control spring preload until the pressure reading on the differential gauge is between 6 and 16 lb/in$^2$. The control spring is that which co-axially opposes the $P_1$ capsule. Operate the manometer to a higher level and decrease once more to 5 in. Hg. abs and check that the pressure reading is still 6 to 16 lb/in$^2$.

**556.** Re-check that the capsule still becomes inoperative as previously set; if it is necessary to re-adjust, then the proportional pressure-drop setting must also be re-checked. Repeat the procedure until both capsule and proportional pressure-drop setting are correct.

**557.** Reset the throttle valve calibration to within the limits by means of the governor trimming adjustment.

**558.** Set the fuel flow to within the required cruise limits at 30 in. Hg. abs with the t.v. lever. The lever must be locked at this position throughout the remainder of the calibration. The calibration can then be affected by means of three adjustments, namely, the metering valve preload screw for datum flow changes, the governor trim adjustment to alter the slope setting between 5 and 10 in. Hg. abs, and the metering valve series orifice adjustment to obtain curve settings between 10 and 30 in. Hg. abs.

**559.** Having set the flow at 30 in. Hg. abs, ascertain the flow readings at 5 and 10 in. Hg. abs. Set the flow at 5 in. Hg. abs by means of the metering valve adjustment, check the 10 in. reading and set to required flow by means of the governor trim adjustment; continue the last two sequences until the correct flow readings are obtained at 5 and 10 in. Hg. abs.

**560.** Next, set $P_1$ to 30 in .Hg. abs; the flow at this point will now be outside the limits due to adjustments having been made at the lower $P_1$ values. Adjust the metering valve series orifice to bring the flow within the limits. Re-check the 5 and 10 in. settings, where slight re-adjustment may again be necessary.

**561.** Repeat the procedures as already stated as often as is necessary in order to bring the main flow within required limits at all three $P_1$ increments.

**562.** Next, record a complete curve at all $P_1$ increments. If the flows are outside the limits at one or more points, then the allowed setting tolerances at 5, 10 and 30 in. Hg. abs should enable the curve to be manipulated further at these points to effect a compromise which will meet requirements at all $P_1$ increments.

**563.** The following information should be of use when the curve shape is difficult to obtain.

(1) The steeper the curve setting between 5 and 10 in. Hg. abs, the higher the flow readings at 20 and 25 in. Hg. abs and the lower the readings from 35 in. onwards; that is assuming that the 30 in. Hg. abs $P_1$ flow is reset to the same value after adjusting the slope.

(2) From this it can be seen that if the flows are below the limits at 15, 20 and 25 in. Hg. abs they can be lifted by steepening the curve between 5 and 10 in. and re-adjusting the flow at 30 in. by means of the series orifice.

**564.** If the calibration is not straightforward, then the following notes may assist in locating possible discrepancies.

(1) If the unit does not control when $P_1$ is varied, it is possible that the actuator push pin was dislodged during the assembling operations.

(2) When the required curve cannot be obtained, ensure that the $P_1$ capsule is located correctly in its conical seatings.

(3) If the hysteresis is excessive, ensure that the $P_1$ capsule is located correctly. Check the actuator push pin for uniform hemispherical ends.

(4) If the curve levels off at altitude, the metering valve may not be completely closing or the clearance between orifice and valve plunger may be too great.

(5) If the curve shape is not uniform, replace the governor trim orifice with a new one and if no improvement is shown, exchange also the temperature trim orifice.

## FINAL CALIBRATION

**Throttle valve.**

**565.** The t.v. calibration is achieved by the use of two adjustments, namely, the governor trim orifice to alter the pressure drop across the throttle valve, and so effect the slope of the requirement curve, (t.v. angle v fuel flow), and the idling by-pass valve to establish the datum setting of the curve.

(1) Set the $P_1$ manometer to ground level conditions and with the test rig running, ascertain the angular position of the idling dwell. This is between 15 and 25 degrees, during which no flow change is experienced.

(2) Locate the upper end of the dwell, where the flow just commences to rise. Find the exact position, set the protractor pointer to 25 deg. on the quadrant and lock the pointer to the throttle spindle; the pointer is now directly to the position of the throttle plug metering edge.

(3) Close the throttle to zero deg. angle and set the minimum stop screw at this position; set the maximum stop similarly at 83 deg. and lock both.

(4) If the dwell is angularly incorrect a compromise may be effected at the slight expense of the idling dwell by moving the quadrant datum the necessary small amount.

(5) The flow limits at the dwell position should be adequate to achieve this compromise. If not it will be apparent after the the next stage of calibration has been undertaken.

(6) Move the throttle lever to its maximum stop and at this position set the main fuel flow to within the required limits by means of the governor trim adjustment.

(7) Position the throttle angle to 20 deg. and set the idling fuel flow to requirements by means of the idling by-pass valve.

(8) Check the flow readings at maximum throttle angle and correct with the governor trim adjustment. Repeat sub-para. 6 and 7 as often as is necessary to achieve the flow requirements at both positions.

(9) Record the flow readings at all angular increments. If the recordings are only slightly outside the requirements at one or more points, it may be possible by full use of the limits imposed on the two setting points to move or swing the curve sufficiently to obtain correct readings at all increments.

(10) If, after obtaining the correct flow readings at the two setting points, the flows at other angular increments are well outside the limits, then the only possible recourse is to remove the throttle assembly from the unit and ascertain that the holes in the throttle sleeve are free from obstructions.

**Altitude sensing unit**

**566.** The final a.s.u. calibration should be straightforward as the calibration will already have proved on the preliminary test. It is most likely, however, that the unit will need some re-adjustment. The calibration should readily be obtained by use of the metering valve, series orifice and governor trim adjustment only.

**567.** The same procedure as outlined in paragraph 545 to 554 can then be followed to achieve the final results. The throttle valve calibration must of course, be completed prior to starting the a.s.u. calibration.

*Consistency checks*

**568.** To ensure consistency of the unit prior to recording the final results, a check should be made to determine whether the a.s.u. will satisfy the following conditions.

(1) Open the throttle to 83 deg. and reduce the rig pump pressure to 10 lb/in $^2$.

(2) Close the throttle slowly to the required cruise setting at 30 ins. Hg. (abs) and note the flow. As the same time increase the pump pressure slowly to 20 lb/in $^2$. and check that flow remains constant. If necessary, repeat this procedure until the flow is as noted at these two conditions. To approach this condition the throttle must always be closing and the pump pressure must always be increasing.

(3) Having obtained this condition, lock the throttle lever. Reduce $P_1$ to 2·5 in. Hg. abs. then increase to 40 in. and finally decrease to 30 in. If the flow now recorded is outside the flow noted in sub-para 2. by more than $\pm 5$ gal/hr then the unit must be reset and cycled. Record the final curve when these conditions are met.

**Temperature control**

**569.** The following instructions are intended as a general approach to the calibration of the temperature control unit; until experience has been gained, however, some units may appear difficult to calibrate within a reasonable time.

**570.** Commence by setting the main fuel to 1000 gal/h by means of the throttle valve. Screw in the temperature trim lever spring adjustment a small amount to ascertain that preload is present. Lack of preload will be indicated by the flow rising. Screw in until the flow stops rising then re-adjust the flow to 1000 gal/h with the throttle lever.

**571.** The calibration can now be obtained by means of the three following adjustments:—

(1) Temperature trim lever spring preload adjustment to effect datum trim changes.

(2) Armature push rod to effect combined slope and datum trim changes.

(3) Shim under armature leaf spring to alter the air gap between armature and solenoid coil. This adjustment assists the other two adjustments in obtaining the correct curve characteristic.

**572.** The three adjustments have to be constantly manipulated in conjunction with one another by trial and error methods rather than as individual means of influencing the curve by predetermined amounts, since re-adjustment on either one can offset the effect of the other two.

**573.** Ascertain that the flow is set to 1000 gal/hr and screw out the lever spring adjustment until the flow just starts to fall, then screw in one half turn.

**574.** Next, screw in the armature push rod until the flow just starts to fall and then screw out one half turn. The two screw adjustments are now in a known position and if at a later stage difficulty is experienced in obtaining the requirements, it is deemed advisable to reset as stated above and make a new start.

**575.** Ascertain that a full percentage trim is possible by manually depressing the armature to its full extent; if insufficient flow reduction is obtained, then the armature push rod must be screwed in a small amount until the required trim is obtained at the fully depressed position.

**576.** Without further adjustment, apply the current to the solenoid and record a curve of flow v milliamps in order to determine the next move.

**577.** The temperature calibration requires a standing current of 100 milliamps before affecting a trim on the flow and 46 to 50 per cent flow reduction with 350 m/s applied from the 1000 gal/hr setting.

**578.** If the cut-in point is too early, that is when the flow commences to fall at too low a current reading, then the lever spring is to be further preloaded so that a standing current of 100 m/a is applied before flow trimming commences; this may in turn prevent the full percentage trim at 350 m/a, in which case the leaf spring shims must be decreased or the armature push rod screwed in, or a combination of both.

**579.** It is difficult to state any specific move to obtain a set condition, as an adjustment at one point will probably necessitate readjustment at one or both other points until the correct combination is arrived at.

**580.** In some difficult calibration cases it may be found helpful to rotate the armature plate to a new radial position, so that the three brass studs on its underside are more evenly distributed radially in relation to the centre line of the leaf hinge.

**581.** When making an adjustment, tighten the locknuts each time, as any subsequent tightening will affect the calibration particularly with regards to the armature push rod adjustment.

**Acceleration control unit**

**582.** The $P_2/P_1$ switch should need no further calibration adjustments than those already undertaken on the preliminary calibration.

**583.** If the preliminary calibration has been carried out correctly, only minor adjustments should be necessary on the final unit. If difficulty is encountered however, the preliminary procedure can be undertaken on the final unit.

**584.** The major difference between preliminary and final calibration conditions, is that on the final test the altitude sensing unit is inter-connected to the $P_1$ supply and can therefore over-ride the acceleration control $P_1$ settings.

**585.** This occurrs on the 5 lb/in$^2$ abs. $P_1$ curve, when the flow has switched on to the unsplit line. Some slight variation in a.c.u. flow readings at this point may be experienced between different units, depending on the particular setting of the a.s.u. within its limits at 5 lb/in$^2$ abs. $P_1$.

**586.** Only slight re-adjustment to the 5 lb/in$^2$ abs. a.c.u. curve should be necessary to bring the flow within limits, and this can be effected by very fine adjustment of the a.c.u. pressure drop control without materially effecting the rest of the calibration.

**Flow stability check**

**587.** Fuel control units which have to cater for a flow reduction of 50 per cent or more during temperature control at altitude conditions, are fitted with a spring in the proportional flow linking valve to bias the proportionality of the unit when the temperature trim is in operation.

**588.** Owing to the low operating pressure-drop across the throttle valve at altitude conditions, it is necessary to ensure that when the throttle valve is opened at high-altitude full-trim conditions, there is sufficient operating force to overcome the bias spring load plus any initial mechanical resistance in the altitude sensing unit, which may prevent the a.s.u. kinetic knife from responding to the small pressure changes incurred when opening the throttle valve.

**589.** The procedure for the flow recovery check is detailed in Appendix 1 and consists of applying a stipulated altitude setting to the a.s.u. and 350 milliamps to the temperature trim solenoid, then slamming the throttle from fully open to idling. The solenoid current is then switched off and the throttle opened slowly to increase the main fuel flow.

**590.** The flow should return to a minimum stated value, which is not less than 33 gal/h below the bottom limit imposed at the particular altitude condition as set at the start of the test.

**591.** In order that a satisfactory flow recovery can be achieved when opening the throttle valve at the fully trimmed high altitude condition, it is necessary for the a.s.u. metering valve to be so adjusted that it will allow proportional flow to leak past even when the valve is in the closed position.

**592.** The higher this leak is, the better will be the flow recovery properties; the leakage, however, must be limited by its effect on the altitude characteristic, which will tail up and out of requirement limits if too much pre-leakage is present, therefore a compromise must be made which enables both the altitude curve and the flow stability requirements to be met.

**593.** The amount of pre-leakage to be set is based on calibration experience of a particular unit type and varies with different linking-valve bias spring loading. The bias spring load is obtained by selecting a spring which will enable the temperature trim pull-down requirements to be met; the metering valve pre-leakage is then set accordingly so that the flow recovery requirements can also be met.

**594.** Metering valve pre-leakage is varied by inserting the required shims under the head of the metering valve needle. The leakage past the valve is measured when fuel is applied upstream at a pressure of 8 lb/in$^2$ (gauge).

**595.** It can be said that the higher the bias spring load on the linking valve, then the higher must be the metering valve-pre-leakage in order to meet the flow stability requirements.

**596.** It is not possible to state a specific pre-leakage figure for a given bias spring load, it has been found by experience that the shape of the altitude requirement curve also has an effect on the flow recovery properties of the unit. Flow recovery is also affected by proportional flow values and component frictional differences which can vary from unit to unit.

**Fault finding during tests**

*Altitude calibration*

**597.** Refer to para. 564 (1) to (5).

*Acceleration control*

**598.** Refer to para. 541 (1) to (4)

*Pressurising valve and throttle valve*

**599.** If excessive pilot burner pressures are experienced when opening the throttle, examine for blockage in the pilot burner simulator, damaged seal on pilot flow orifice, or a sticking p.v. plunger.

**600.** If main burner pressure is high and pilot burner pressure is low, inspect for blockage in the pilot flow orifice.

*Stability check*

**601.** The cause of fuel flow failing to return to the stipulated valve can usually be attributed to the altitude sensing unit. A certain amount of mechanical resistance in the moving parts of the a.s.u. is unavoidable, but it is necessary to reduce friction to a minimum so that the unit will still respond to the very small change in operating force when the throttle is opened at low flow condition (high altitude).

**602.** The major causes of stiction are to be found in the a.s.u. metering valve or actuator piston assembly and can be due to misaligned assemblies, sharp edges or poor finish of moving components. The $P_1$ capsule and spring assembly, also the kinetic lever hinge, can be suspect for similar reasons.

**603.** All the above faults are conducive to hysteresis in the a.s.u. calibration itself, although they may be sufficient to be of detriment at the high altitude low flow condition only, where for instance the metering valve is almost closed and the actuator piston is very close to its mechanical stop.

## 604. Special tools

| *Tool No.* | | *Application* |
|---|---|---|
| G.56967 | ASU | Gauge, seal compression, kinetic block assembly |
| G.58249 | ACU | D.T.I. and stand, kinetic block shimming |
| G.67868 | Gov | Checking pin and bush, governor lever setting |
| G.71351 | TV | Gauge, seal protrusion |
| G.71353 | TV | Gauge, seal protrusion |
| G.72301 | GA | Protractor, throttle lever setting |
| G.73645 | ACU | Gauge, Ball race end float, sensing lever hinge |
| G.75688 | ASU | Gauge, actuator piston height |
| G.87515 | ACU | Setting piece, ball race hinge |
| G.87516 | ACU | Setting piece, ball race hinge |
| G.93140 | ACU | Setting piece, pressure drop control shims |
| G.96453 | ACU | Checking block, P2/P1 capsule and bellows |
| G.98403 | ACU | Transfer gauge, pressure drop lever return spring |
| G.98404 | ACU | D.T.I. and stand, pressure drop lever return spring |
| G.98405 | ACU | Distance piece, pressure drop control adjustment |
| G.99485 | TV | Feeler gauge, idling by-pass assembly |
| G.100426 | GA | Slip gauge, proportional flow bobbin selection |
| G.102460 | Gov | Setting gauge, temperature trim lever |
| G.103312-23 | ACU | Plug gauge, setting P2/P1 orifices |
| G.104280 | ASU | Transfer gauge, kinetic orifice shims |
| G.111268 | ASU | Depth gauge and bracket, lever stop plate selection |
| G.115437 | ACU | Concentricity gauge, metering plunger piston and sleeve |
| G.116701 | Gov | Depth gauge, linking valve |
| T.154353 | ASU | Combination spanner, capsule spring adjusting screw |
| T.160988 | ACU | Key, trimming spring adjustment |
| T.160988 | ASU | Key, metering valve spring adjustment |
| T.160988 | Gov | Key, governor spring adjustment |
| T.169309 | ACU | Key, pressure drop spring adjustment |
| T.171611 | ASU | Key, metering valve series orifice adjustment |
| T.171611 | Gov | Key, governor orifice assembly |
| T.174678 | TV | Key, pressurizing valve spring adjusting screw |
| T.177125 | GA | Box spanner, $\frac{1}{4}$ in. B.S.F. |
| T.177125 | ACU | Box spanner, $\frac{1}{4}$ in. B.S.F. |
| T.177125 | ASU | Box spanner, $\frac{1}{4}$ in. B.S.F. |
| T.177125 | TV | Box spanner, $\frac{1}{4}$ in. B.S.F. |
| T.177125 | Gov | Box spanner, $\frac{1}{4}$ in. B.S.F. |
| T.199126 | GA | Spanner, pressure drop control spring adjustment |
| T.200603 | ACU | Extractor, pressure drop lever return spring cover plate |
| T.200603 | TV | Extractor, proportional flow strainer |
| T.201778 | ASU | Key, capsule pivot adjustment |
| T.204211 | Gov | Spanner, spring yoke assembly |
| T.204212 | ACU | Spanner, pressure drop lever adjusting screw locknut |
| T.205226 | Gov | Extractor, governor lever stop pin spacing bush |
| T.209306 | ACU | Splined spanner, splitter orifice locknut and internal servo lever stop locknut |
| T.209306 | ASU | Splined spanner, metering valve series orifice adjustment locknut |
| T.209310 | ACU | Extractor, potentiometer orifice bobbin |
| T.210954 | TV | Extractor, piston sleeve, pilot dump valve |
| T.212175 | TV | Adapter plate, hydraulic assembly fixture |
| T.212175/H | TV | Adapter plate and assembly fixture complete |
| T.212176 | ACU | Adapter plate, hydraulic assembly fixture |
| T.212176/H | ACU | Adapter plate and assembly fixture complete |
| T.212177 | Gov | Adapter plate, hydraulic assembly fixture |
| T.212177/H | Gov | Adapter plate and assembly fixture complete |
| T.212179 | GA | Spanner, temperature trim lever stop screw |
| T.215524 | TV | Box spanner, idling by-pass valve |

| *Tool No.* | | *Application* |
|---|---|---|
| T.215797 | ACU | Extractor, 4 BA, internal servo kinetic lever holder |
| T.215797 | TV | Extractor, orifice bobbin |
| T.217276 | GA | Combination spanner, ASU capsule/adjustment |
| T.217276 | ASU | Combination spanner, ASU capsule/adjustment |
| T.218514 | ASU | Assembly tool, capsule pivot |
| T.218828 | Gov. | Test plate, air pressure test |
| T.218829 | Gov | Test plate and union |
| T.218949 | Gov | Assembly tool, governor lever spring |
| T.221285 | ACU | Extractor, trimming spring cover plate |
| T.221285 | ASU | Extractor, metering valve spring housing |
| T.221291 | ACU | Key, sensing lever tappet screw |
| T.221296 | ACU | Extractor, pump inlet bobbin |
| T.222022 | Gov | Test fixture, linking valve diaphragm |
| T.222026 | ACU | Extractor, internal servo kinetic input orifice bobbin |
| T.222027 | ACU | Extractor, pressure drop kinetic input orifice bobbin |
| T.222031 | ACU | Assembly tool, metering plunger sealing ring |
| T.223794 | Gov | Assembly tool, seal, diaphragm centre |
| T.224299 | ASU | Assembly tool, kinetic lever seal |
| T.224320 | GA | Extractor, TV/Gov. interconnecting bobbin |
| T.224320 | ASU | Extractor, kinetic orifice strainer sleeve |
| T.224367 | Gov | Extractor, temperature trim orifice assembly |
| T.224393 | ACU | Assembly sheath, seal, kinetic lever |
| T.224394 | ACU | Assembly sheath, seal, pressure drop control |
| T.227460 | ACU | Setting fixture, sensing lever hinge pre-load |
| T.228556 | GA | Combination spanner, metering valve series orifice adjustment |
| T.228556 | ASU | Combination spanner, metering valve series orifice adjustment |
| T.228556 | ACU | Combination spanner, internal kinetic lever stop screw |
| T.228556 | Gov | Combination spanner, temperature trim orifice and lever stop adjustment |
| T.228580 | ACU | Test plate, pressure ratio switch leakage check |
| T.229102 | TV | Extractor, main dump valve orifice plate |
| T.229111 | ACU | Assembly tool, sensing lever shaft and ball race |
| T.230780 | GA | Combination spanner, sensing lever trimming spring adjustment |
| T.231439 | TV | Combination spanner, pressurising valve spring adjustment |
| T.231439 | GA | Combination spanner, pressurising valve spring adjustment |
| T.231439 | Gov | Combination spanner, governor lever stop screw |
| T.231440 | GA | Splined ring spanner, temperature trim lever stop screw and orifice locknuts |
| T.231684 | GA | Alignment plug, constant flow valve |
| T.231686 | ACU | Fixture, sensing lever hinge pressure test |
| T.231861 | Gov | Centralizing tool, linking valve plate and diaphragm |
| T.232571 | ASU | Adapter plate hydraulic assembly fixture |
| T.232571/H | ASU | Adapter plate and assembly fixture complete |
| T.234048 | ACU | Assembly sheath, splitter orifice seal |
| T.234049 | ACU | Extractor, splitter orifice bobbin |
| T.234702 | ACU | Extractor, pressure drop recovery orifice bobbin |
| T.237421 | GA | Fixture, pressure testing pressure-raising valve |
| T.238072 | ACU | Extractor, pressure drop and internal servo kinetic jets |
| T.238072 | ASU | Extractor, kinetic jets |
| T.241679 | ACU | Assembly tool, sensing lever hinge seals |
| T.244153 | Gov | Blanking plate, temperature trim orifice housing air pressure test |
| T.247868 | GA | Extractor, ASU/ACU inter connecting bobbin |
| T.247869 | GA | Extractor, ASU/ADC interconnecting bobbin |
| T.247891 | Gov | Lapping tool, linking valve orifice legs |
| T.251571 | ASU | Assembly tool, metering valve spring anchor |

| *Tool No.* | | *Application* |
|---|---|---|
| T.254114 | ACU | Assembly tool, metering plunger servo piston rings |
| T.257456 | Gov | Spring expander, governor spring anchor assembly |
| T.257466 | ACU | Setting piece, sensing lever support arms |
| T.257933 | ACU | Setting tool, sensing lever and capsule assembly |
| T.258797 | ACU | Test fixture, metering plunger servo piston leakage |
| T.258798 | ACU | Extractor, metering plunger from servo piston |
| T.259624 | ACU | Extractor, potentiometer bobbin retainer |
| T.260327 | GA | Key, pressure raising valve assembly |
| T.261055 | TV | Extractor, idling by-pass valve collar |
| T.261057 | TV | Extractor, bobbin |
| T.261059 | ASU | Extractor, kinetic lever seal |
| T.261060 | ACU | Bending tool, pressure drop kinetic lever |
| T.261670 | ACU | Assembly tool, metering plunger servo piston |
| T.261706 | ASU | Micro-parallel strips, kinetic block shimming |
| T.261706 | Gov | Micro-parallel strips, linking valve setting |
| T.262317 | ACU | Fixture, pressure drop control lever seal leakage test |
| T.262345 | TV | Slave reach nuts, PV housing to TV housing |
| T.262982 | TV | Extractor, throttle valve sleeve |
| T.264069 | GA | Spanner, throttle valve linkage nuts |
| T.265750 | ACU | Key, spring anchor assembly |
| T.265773 | ACU | Setting disc, KP 2 capsule and P2/P1 capsule preload |
| T.265774 | ACU | Spanner, pressure drop lever return spring adjustment |
| T.265775 | ACU | Spanner, pressure drop control spring adjustment |
| T.266748 | ASU | Continuity indicator, kinetic lever setting |
| T.268361 | TV | Fixture, idling by-pass valve assembly |
| T.268371 | TV | Assembly tool, orifice bobbin |
| T.268388 | ASU | Combination spanner, kinetic lever tappet |
| T.268389 | ASU | Extractor, 5 BA, kinetic block transfer bobbin |
| T.271081 | ACU | Extractor, pressure drop kinetic lever |
| T.271082 | ACU | Extractor, metering plunger orifice plate |
| T.271086 | TV | Assembly tool, throttle valve sleeve |
| T.272400 | ACU | Extractor, internal servo kinetic lever assembly |
| T.272413 | Gov | Aligning tool, governor lever |
| T.272429 | TV | Extractor, pressurizing valve stop plate circlip |
| T.272436 | ACU | Lapping tool, splitter orifice end face |
| T.272437 | ACU | Assembly tool, metering plunger servo piston |
| T.272438 | ACU | Aligning tool metering plunger piston ring gap check |
| T.275311 | ACU | Extractor, pressure drop control piston sleeve |
| T.277750 | ACU | Lapping tool, metering plunger piston rings |
| T.277780 | ACU | Extractor, pressure drop control piston stop plate |
| T.280558 | GA | Key, idling by-pass valve adjustment |
| T.280558 | TV | Key, idling by-pass valve assembly |
| T.280565 | TV | Adapter, torque wrench, idling by-pass valve assembly |
| T.280575 | TV | Extractor, throttle lever hub |
| T.280575 | Gov | Extractor, governor lever hub |
| T.280596 | ACU | Assembly tool, sensing lever hinge seals |
| T.282114 | ACU | Filing block, metering plunger piston rings |
| T.282135 | GA | Ring spanner, pressure drop control spring adjustment locknut |
| T.285703 | ACU | Extractor, sensing lever ball race from shaft |
| T.287955 | ACU | Keeper, sensing lever trimming spring |
| T.287956 | ACU | Keeper, sensing spring |
| T.287958 | ACU | Assembly tool, pressure drop control spring adjusting screw seal |
| T.287975 | Gov | Keeper, linking valve bias spring |
| T.287970 | ASU | Keeper, control spring |
| T.287985 | ASU | Extractor, kinetic block |
| T.287987 | GA | Extractor, TV/Gov. interconnecting bobbin |
| T.287988 | Gov | Extractor, governor orifice |
| T.287998 | ACU | Extractor, sensing lever spring pegs |

| *Tool No.* | | *Application* |
|---|---|---|
| T.290960 | ASU | Keeper, capsule |
| T.290964 | ASU | Retaining plate, kinetic input orifice |
| T.290965 | ASU | Retaining plate, kinetic recovery orifice |
| T.293156 | ASU | Keeper, capsule |
| T.293158 | TV | Keeper, constant flow valve spring |
| T.293173 | TV | Fixture, pressurizing valve plunger leakage test |
| T.297621 | ACU | Extractor, control unit mounting bush |
| T.297621 | TV | Extractor, control unit mounting bush |
| T.299105 | ACU | Test fixture, capsule rate check |
| T.299383 | ACU | Setting block, P2/P1 capsule and bellows pre-load |
| T.299396 | TV | Fixture, throttle valve leakage test |
| T.303021 | TV | Extractor, proportional flow strainer end plug |
| T.303023 | ASU | Aligning tool, kinetic lever |
| T.303025 | ASU | Extractor, metering valve plate and screw |
| T.303026 | ASU | Assembly sheath, metering valve series orifice needle seal |
| T.303903 | ACU | Fixture, metering plunger piston hot test |
| T.303909 | ACU | Adapter, P2/P1 capsule and bellows (Use with T.299105) |
| T.303911 | ACU | Adapter, KP2 capsule (use with T.299105) |
| T.303927 | Gov | Extractor, mounting link pin |
| T.303938 | ACU | Keeper, pressure drop control spring |
| T.305213 | ASU | Extractor, capsule pivot |
| T.310182 | GA | Ring spanner, TV/Gov. Assembly retaining nuts |
| T.316009 | ASU | Assembly tool, capsule pivot |
| T.316011 | ASU | Keeper, capsule |
| T.318530 | ASU | Keeper, metering valve spring |
| T.318541 | GA | Combination spanner, solenoid push rod adjustment |
| T.318541 | Gov | Combination spanner, solenoid push rod adjustment |
| T.320679 | ACU | Key, sensing lever tappet screw |
| T.320695 | Gov | Adapter, wrench, solenoid cover |



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# Appendix 1

*(Completely revised)*

# CALIBRATION CODE A.T.

**1.** During the test, the fuel used must be AVTUR, at a temperature of 20 to 40 °C. The inlet pressure must be maintained at 15 to 20 lb/in $^2$

**2.** For the calibration, the rig pump servo flow must be 24·9 to 25·1 gal/h at 1250 lb/in $^2$ delivery pressure, 150 gal/h main flow, and a pump speed of 2600 rev/min.

**3.** Where it is necessary to calibrate flowmeters for temperatures in excess of 30 °C for normal working, the fuel temperatures must be within ± 5 °C of the fuel temperature at which the flowmeters were calibrated.

**4.** Unless otherwise stated, the main and nominal restrictors shown in Table 1 are to be used as burner simulators and should be calibrated at ± 2½ °C of the temperature at which the flowmeters were calibrated.

## TESTING THE SUB-ASSEMBLIES

### Kinetic orifices

**5.** These tests should only be necessary when new kinetic orifices have been fitted, but they can also be applied to prove orifices which are suspected of inaccuracy caused by erosion.

**6.** The tests must be made with the orifice 'drowned', i.e. with the space between the orifices totally enclosed and filled with fuel at rig pump inlet pressure.

### Pump servo control orifice (a.c.u. and a.s.u.)

**7.** (1) With the pressure applied to the input orifice, check the flow

| Pressure (lb/in $^2$) | Flow (gal/h) |
|---|---|
| 100 | 9·5 ± 0·5 |

(2) With the pressure applied to the recovery orifice, check the flow.

| Pressure (lb/in $^2$) | Flow (gal/h) |
|---|---|
| 100 | 20·0 ± 0·5 |

(3) Apply the pressures in stages to the input orifice. At each stage, the recovery pressure must not be less than 98% of the corresponding input pressure.

| Pressure (lb/in $^2$) |
|---|
| 200 |
| 400 |
| 600 |
| 800 |
| 1000 |

(4) With the orifices and kinetic knife assembled, apply the pressure to the recovery orifice. With the knife blade clear, record the flow. Close the knife blade across the orifices and maintain the recorded flow. The input pressure must not increase by more than 3 lb/in $^2$ or alternatively, flow must be at least 19 gal/h with pressure maintained at 100 lb/in $^2$.

**TABLE 1**

| Simulator | Flow No. | Pressure (lb/in $^2$) | Flow (gal/h) |
|---|---|---|---|
| Pilot restrictor nominal ... | 2·88 | 450 | 60·5 to 61·5 |
| —5% ... ... ... ... | 2·74 | 450 | 57·5 to 58·5 |
| +5% ... ... ... ... | 3·02 | 450 | 63·5 to 64·5 |
| Main restrictor ... ... | 72 | 200 | 1005 to 1025 |
| Test restrictor ... ... ... | 34·5 | 1400 | 1280 to 1300 |

**Internal servo control orifices (a.c.u.)**

**8.** (1) Apply the pressure to the input orifice, and check the flow.

| Pressure ($lb/in^2$) | Flow (gal/h) |
|---|---|
| 100 | 16·0 to 16·5 |

(2) Apply the pressure to the recovery orifice and check the flow.

| Pressure ($lb/in^2$) | Flow (gal/h) |
|---|---|
| 100 | 31 to 32 |

(3) Apply the pressure in stages to the input orifice. At each stage the recovery pressure must not be less than 98% of the corresponding input pressure with spill pressure set to 100 $lb/in^2$ below input pressure at each increment.

| Pressure ($lb/in^2$) |
|---|
| 200 |
| 400 |
| 600 |
| 800 |
| 1000 |

(4) With the orifices and kinetic knife assembled, apply the pressure to the recovery orifice. With the knife blade clear, record the flow. Close the knife blade across the orifices and maintain the recorded flow. The input pressure must not increase by more than 3 $lb/in^2$ or alternatively, flow must be at least 29·5 gal/h with pressure maintained at 100 $lb/in^2$.

**Leakage test (a.c.u.)**

**9.** (1) With a pressure of 2200 $lb/in^2$ applied at the inlet for 10 minutes, there must be no leakage into the bellows chamber.

(2) Submerge the unit in fuel, apply a P2 pressure of 150 $lb/in^2$ for five minutes, and check there is no leakage.

**Pressure ratio switch**

**10.** If new bellows are fitted, the unit must be heat soaked. (Refer to paragraph giving details of assembly of pressure ratio switch.)

**11.** During build of the switch, a stability drop test is to be carried out. (Refer to paragraph giving details of assembly of pressure ratio switch.)

**12.** Before being fitted to the switch control, the P2/P1 double orifice splitter valve must be tested as follows.

| P2 pressure ($lb/in^2$ abs.) | K.P2 pressure ($lb/in^2$ abs.) min. | max. |
|---|---|---|
| 35 | 24·5 | 26·5 |
| 55 | 38·0 | 40·0 |

**13.** The splitter bobbin must be calibrated on the downstream orifice, the diameter of which must be 0·0515 to 0·0535 in. The inlet orifice diameter is to be 0·0485 to 0·0495 in.

**14.** Assemble the double orifice valve to the P2/P1 switch control, and with the $\frac{1}{2}$ in. diameter engine pipe fitted, check that it conforms to the following change-over limits.

(1) P1 = 2·5 $lb/in^2$ abs.

| P2 pressure ($lb/in^2$ abs.) | K.P2 pressure ($lb/in^2$ abs.) Min. | Max. |
|---|---|---|
| 16 | 11·5 | 13·25 |
| 20 | 17·5 | 19·25 |
| 22 | 20·5 | 22·0 |

(2) P1 = 5 $lb/in^2$ abs.

| P2 pressure ($lb/in^2$ abs.) | K.P2 pressure ($lb/in^2$ abs.) Min. | Max. |
|---|---|---|
| 30 | 21·75 | 24·0 |
| 35 | 29·5 | 33·25 |
| 40 | 37·75 | 40·0 |

(3) P1 = 10 $lb/in^2$ abs.

| P2 pressure ($lb/in^2$ abs.) | K.P2 pressure ($lb/in^2$ abs.) Min. | Max. |
|---|---|---|
| 55 | 39·0 | 41·0 |
| 60 | 45·0 | 47·0 |

**15.** During calibration, the potentiometer hole diameters must be controlled at 0·045 to 0·0485 in. for the inlet, and 0·045 to 0·052 for the outlet.

**16.** Check that when the switch-over has taken place (P1 = 2·5 $lb/in^2$ abs.), K.P2 pressure is within 0·5 $lb/in^2$ of P2 pressure. The test is to be made at 2 $lb/in^2$ above the P2 pressure at which the switch-over occurs, by blanking off the P1 and noting the rise on the K.P2 pressure gauge.

**Acceleration control unit**

*Calibration*

**17.** The unit must now be tested with the throttle valve, pressurizing valve, constant flow valve and burner simulators connected.

# Appendix 2

# CALIBRATION CODE 118 AND 119

**1.** During the test the fuel used must be AVTUR, at a temperature of 20 to 40 °C. The inlet pressure must be maintained at 15 to 20 lb/in $^2$.

**2.** When it is necessary to calibrate flowmeters for temperatures in excess of 30 °C for normal working purposes, the fuel temperatures for test purposes must be within $\pm$ 5 °C of the temperature at which the flowmeters were calibrated.

**3.** Unless otherwise stated the main and nominal restrictors shown in Table 1 are to be used as burner simulators and should be calibrated at $\pm 2\frac{1}{2}$ °C. of the temperature at which the flowmeters were calibrated.

## TESTING THE SUB-ASSEMBLIES

### Kinetic orifices

**4.** These tests should only be necessary when new kinetic orifices have been fitted, but they can also be applied to prove orifice which are suspected of inaccuracy caused by erosion.

**5.** The tests must be made with the orifice 'drowned', i.e., with the space between the orifice totally enclosed and filled with fuel at rig pump inlet pressure.

### Pump servo control orifices (a.c.u. and a.s.u.)

**6.** (1) With the pressure applied to the input orifice, check the flow

| Pressure (lb/in $^2$) | Flow (gal/h) |
|---|---|
| 100 | 9·5 $\pm$ 0·5 |

(2) With the pressure applied to the recovery orifice, check the flow

| Pressure (lb/in $^2$) | Flow (gal/h) |
|---|---|
| 100 | 20 $\pm$ 0·5 |

(3) Apply the pressure in stages to the input orifice. At each stage the recovery pressure must not be less than 98% of the corresponding input pressure.

| Pressure (lb/in $^2$) |
|---|
| 200 |
| 400 |
| 600 |
| 800 |
| 1000 |
| 1200 |
| 1400 |
| 1600 |

(4) With the orifice and kinetic knife assembled, apply the pressure to the recovery orifice. With the knife blade clear, record the flow. Close the knife blade across the orifices and maintain the recorded flow. The input pressure must not increase by more than 3 lb/in $^2$, or alternatively, flow must be at least 19 gal/h with pressure maintained at 100 lb/in $^2$.

**TABLE 1**

| Simulator | Flow No. | Pressure (lb/in $^2$) | Flow (gal/h) |
|---|---|---|---|
| Pilot restrictor nominal ... | 2·88 | 450 | 60·5 to 61·5 |
| −5% ... ... ... ... | 2·74 | 450 | 57·5 to 58·5 |
| +5% ... ... ... ... | 3·02 | 450 | 63·5 to 64·5 |
| Main restrictor ... ... | 52 | 300 | 890 to 910 |
| Test restrictor ... ... ... | 34·5 | 1400 | 1280 to 1300 |

**Internal servo control orifices (a.c.u.)**

7. (1) Apply the pressure to the input orifice, and check the flow.

| Pressure (lb/in $^2$) | Flow (gal/h) |
|---|---|
| 100 | 16 to 16·5 |

(2) Apply the pressure to the recovery orifice and check the flow.

| Pressure (lb/in $^2$) | Flow (gal/h) |
|---|---|
| 100 | 31 to 32 |

(3) Apply the pressure in stages to the input orifice. At each stage the recovery pressure must be not less than 98% of the corresponding input pressure with spill pressure set to 100 lb/in $^2$ below input pressure at each increment.

| Pressure (lb/in $^2$) |
|---|
| 200 |
| 400 |
| 600 |
| 800 |
| 1000 |

(4) With the orifices and kinetic knife assembled, apply the pressure to the recovery orifice. With the knife blade clear, record the flow. Close the knife blade across the orifices and maintain the recorded flow. The input pressure must not increase by more then 3 lb/in $^2$ or alternatively, flow must be at least 29·5 gal/h with pressure maintained at 100 lb/in $^2$.

**Leakage tests (a.c.u.)**

**8.** With a pressure of 2200 lb/in $^2$ applied at the inlet for 5 minutes, there must be no leakage into the bellows chamber.

**Pressure ratio switch**

**9.** (a) If new bellows are fitted, the unit must be heat soaked. (Refer to paragraph giving details of assembly of pressure ratio switch.)

(b) During build of the switch a stability drop test is to be carried out (Refer to paragraph giving details of assembly of pressure ratio switch.)

**10.** Before being fitted to the switch control the P2/P1 double orifice splitter valve must be tested as follows:—

| Pressure (lb/in $^2$ abs.) | K.P2 (lb/in $^2$ abs.) Min. | Max. |
|---|---|---|
| 35 | 24·75 | 26·75 |
| 55 | 39·0 | 41·0 |

**11.** Assemble the double orifice valve to the P2/P1 switch control, and with the $\frac{1}{2}$ in. diameter engine pipe fitted, check that it conforms to the following change-over limits:—

**12.** P1 = 2·5 lb/in $^2$ abs.

| P2 pressure (lb/in $^2$ abs.) | K.P2 pressure (lb/in $^2$ abs.) Min. | Max. |
|---|---|---|
| 12 | 8·0 | 9·0 |
| 16 | 11·5 | 13·0 |
| 21 | 19·0 | 21·5 |
| 23 | 20·5 | 23·5 |

**13.** P1 = 5 lb/in $^2$ abs.

| P2 pressure (lb/in $^2$ abs.) | K.P2 pressure (lb/in $^2$ abs.) Min. | Max. |
|---|---|---|
| 15 | 10·0 | 11·5 |
| 20 | 13·0 | 14·5 |
| 30 | 21·5 | 23·5 |
| 35 | 29·0 | 31·5 |

**14.** P1 = 10 lb/in $^2$ abs.

| P2 pressure (lb/in $^2$ abs.) | K.P2 pressure (lb/in $^2$ abs.) Min. | Max. |
|---|---|---|
| 55 | 39·5 | |
| 60 | | 47·5 |

**15.** Check that when the switch-over has taken place (P1 = 2·5 lb/in $^2$ abs.) K.P2 pressure is within 0·5 lb/in $^2$ of P2 pressure This test is to be made at 2 lb/in $^2$ above the P2 pressure at which the switch-over occurs by blanking off the P1 and noting the rise on the K.P2 pressure gauge.

**Acceleration control unit**

*Calibration*

**16.** Rig pump speed to be 2600 rev/min, 1250 lb/in $^2$ stall pressure, 150 gal/h main flow and 24·9 to 25·1 gal/h pump servo flow. The unit is to be tested with the throttle valve, pressurising valve, constant flow valve and burner simulators connected. The downstream restrictor on the rig is to be open and the P1 engine pipe fitted. Connect the kinetic simulator block in parallel with the a.c.u. kinetic valves.

The downstream restrictor on the rig is to be open and the P1 engine pipe fitted. Connect the kinetic simulator block in parallel with the a.c.u. kinetic valves.

**18.** Blank off the P1 connection on the P2/P1 switch, and with a pump speed of 3000 rev/min calibrate the unit as follows:—

| P2 pressure (lb/in² abs.) | Flow (gal/h) Min. | Flow (gal/h) Nom. |
|---|---|---|
| 2 | 60 | — |
| 3 | 67 | — |
| 4 | 78 | — |
| 6 | 100 | — |
| 8 | 122 | — |
| 15 | | 247 |
| 20 | | 330 |
| 25 | | 412 |
| 30 | | 495 |
| 35 | | 578 |
| 40 | | 660 |
| 42·5 | | 700 |
| 45 | | 740 |
| 48 | | 1035 |
| 50 | | 1260 |

The curve when plotted must be within 5 gal/h of a straight line.

**19.** Remove the blank from the P1 connection and calibrate the unit as follows:—

**20.** Curve with P1 pressure maintained at 2·5 lb/in² abs.

| P2 pressure (inHg abs.) | P2 pressure (lb/in² abs.) | Flow (gal/h) Min. | Flow (gal/h) Max. |
|---|---|---|---|
| 8·15 | 4 | 72 | 92 |
| 12·2 | 6 | 77 | 97 |
| 16·25 | 8 | 89 | 109 |
| 20·35 | 10 | 107 | 128 |
| 24·45 | 12 | 131 | 152 |
| 28·5 | 14 | 158 | 182 |
| 32·6 | 16 | 190 | 217 |
| 34·6 | 17 | 211 | 238 |
| 36·6 | 18 | 233 | 260 |
| 38·7 | 19 | 258 | 288 |
| 40·7 | 20 | 284 | 318 |
| 42·75 | 21 | 312 | 355 |
| 44·75 | 22 | 345 | 390 |
| 46·8 | 23 | 375 | — |

**21.** Curve with P1 pressure maintained at 5 lb/in² abs.

| P2 pressure (inHg abs.) | P2 pressure (lb/in² abs.) | Flow (gal/h) Min. | Flow (gal/h) Max. |
|---|---|---|---|
| 10·15 | 5 | 74 | 105 |
| 20·35 | 10 | 112 | 138 |
| 30·5 | 15 | 160 | 185 |
| 40·7 | 20 | 215 | 244 |
| 50·8 | 25 | 278 | 305 |
| 61·0 | 30 | 358 | 395 |
| 63·0 | 31 | 378 | 414 |
| 65·0 | 32 | 400 | 437 |
| 67·2 | 33 | 425 | 467 |
| 69·2 | 34 | 450 | 503 |
| 71·25 | 35 | 485 | 545 |
| 73·3 | 36 | 528 | 595 |
| 75·3 | 37 | 585 | 617 |
| 77·4 | 38 | 607 | 645 |
| 81·5 | 40 | 640 | 677 |

**22.** Curve with P1 pressure maintained at 10 lb/in² abs.

| P2 pressure (inHg abs.) | P2 pressure (lb/in² abs. | Flow (gal/h) Min. | Flow (gal/h) Max. |
|---|---|---|---|
| 20·35 | 10 | Record | |
| 29·9 | 14·7 | Record | |
| 40·7 | 20 | Record | |
| — | 25 | Record | |
| — | 30 | Record | |
| — | 35 | Record | |
| — | 40 | Record | |
| — | 45 | Record | |
| — | 50 | Record | |
| — | 55 | Record | |
| — | 58 | — | 760 |
| — | 59 | — | 865 |
| — | 60 | — | 990 |
| — | 61 | Record | |
| — | 62 | 840 | — |

**23.** Curve with P1 pressure maintained at 14·7 lb/in² abs.

| P2 pressure (inHg abs.) | P2 pressure (lb/in² abs.) | Flow (gal/h) Min. | Flow (gal/h) Nom. | Flow (gal/h) Max |
|---|---|---|---|---|
| 29·9 | 14·7 | — | 222 | — |
| 40·7 | 20 | — | 268 | — |
| — | 25 | — | 315 | — |
| — | 30 | — | 365 | — |
| — | 35 | — | 415 | — |
| — | 40 | — | 475 | — |
| — | 45 | — | 535 | — |
| — | 50 | — | 595 | — |
| — | 55 | — | 655 | — |
| — | 60 | — | 715 | — |
| — | 62 | — | — | 845 |
| — | 64 | — | — | 1015 |
| — | 66 | 835 | — | 1185 |
| — | 68 | 925 | — | — |
| — | 70 | 1010 | — | — |
| — | 72 | 1100 | — | — |

**24.** Hysteresis must not exceed 5% of the flow when increasing and decreasing up to the reading before each change-over point.

**25.** At 35 lb/in ² abs. P2 pressure and P1 open to atmosphere, the pressure consciousness of the unit from 750 to 1200 lb/in ² pilot pressure must not exceed 25 gal/h. Inlet pressure conciousness from 5 to 35 lb/in ² must not exceed 10 gal/h throttle valve fully open.

**26.** With P1 open to atmosphere, at 35 lb/in ² abs., record the pressure drop across the unit.

**27.** With P2 pressure set at 90 lb/in ² abs. and throttle fully open, close and then open the rig P2 supply cock. The deceleration time from P2 being shut off, to the collapse to 800 lb/in ² pilot pressure must not exceed 3·5 seconds. The acceleration time from P2 being opened to 1000 lb/in ² pilot pressure must not exceed 3·5 seconds.

*Endurance test*

**28.** Blank off the P1 connection, then test the unit from 0 to 150 lb/in ² P2 pressure at two cycles per minute for one hour and a maximum downstream pressure of 1000 lb/in ²

**29.** Check that the calibration is still within the limits given in para. 20 to 27 of this appendix.

*Leakage test*

**30.** With an inlet pressure of 40 lb/in ², and a downstream pressure of 2200 lb/in ² applied for five minutes, check there is no external leakage.

**31.** Submerge the unit in fuel, apply a P2 pressure of 150 lb/in ² for five minutes, and again check there is no leakage.

**Throttle valve**

**32.** Sub-zero torque test in accordance with testing para. 498.

**Pilot dump valve**

**33.** With the pilot flow discharging through the nominal restrictor F.No. 2·88 and giving a flow of 60·5 to 61·5 gal/h at 450 lb/in ², ensure that the pilot dump valve opens at 40 to 50 lb/in ² and closes at 15 to 25 lb/in ².

**34.** At an input pressure of 1000 lb/in ² check that the leakage to dump does not exceed 2 cm ³/min. Establish a free flow through the main manifold connection and dump valve. The pressure required to give a flow of 30 gal/h must not exceed 5 lb/in ².

**Constant flow by-pass**

**35.** (1) At the required pressure, set the flow by means of the valve adjusting screw.

| Pressure (lb/in ²) | Flow (gal/h) |
|---|---|
| 25 | 40 to 42 |

(2) Check the pressure consciousness by varying the inlet pressure over the range; any alteration in flow must not exceed the figure shown.

| Pressure (lb/in ²) | Flow (gal/h) |
|---|---|
| 25 to 150 | 6 |

**Pressurizing valve**

**36.** Fit the largest pilot burner simulator (+ 5%), i.e. flow No. 3·02, and set the unit near to the bottom limit of the curve 490 lb/in ² at 150 gal/h.

**37.** Take a complete curve of flow versus pressure. Ensure that it is within the limits and that hysteresis is at no point in excess of 75 lb/in ².

**38.** Fit the smallest pilot burner simulator (—5%) flow No. 2·74 and check that the unit, as set is within the top limit of the curve (1070 lb/in ² at 1300 gal/h).

| Flow (gal/h) | Pilot pressure (lb/in ²) | |
|---|---|---|
| | Min. | Max. |
| 150 | 490 | 660 |
| 200 | 500 | 680 |
| 400 | 550 | 750 |
| 600 | 600 | 820 |
| 800 | 650 | 890 |
| 1000 | 700 | 960 |
| 1300 | 770 | 1070 |

**39.** Check that with the pilot simulator (flow No. 2·74) and the main simulator (flow No. 34·5) the pilot pressure does not exceed 1300 lb/in ² at 1300 gal/h.

**40.** The leakage from the main burner connection is to be set between 8 to 17 gal/h at 250 lb/in ² pilot pressure.

**41.** Pressure test the unit at 2200 lb/in ² pump pressure and 40 lb/in ² inlet pressure for five minutes. There must be no external leakage.

**Altitude sensing unit**

**42.** Kinetic flow check, refer to para. 7.

*Leakage tests*

**43.** Kinetic lever pressure hinge seal leakage test; this test to be carried out as stated in para. 496.

*Calibration*

**44.** Pump speed to be 2600 rev/min; pump servo flow 24·9 gal/h; stall pressure 1200 to 1250 lb/in $^2$; and main flow 150 gal/h.

**45.** To test the unit separately, use the linking valve, throttle valve, pressurizing valve and constant flow by-pass valve with which the a.s.u. is to be finally calibrated. Connect the kinetic simulator block in parallel with the a.s.u. kinetic valves.

**46.** Set the throttle valve calibration as in the table, para. 59, before calibrating the a.s.u. to cruise characteristics only at 3000 rev/min.

**47.** The flow from the linking valve to the secondary flow senser (proportional flow) is to be 18 to 35 gal/h at 30 inHg abs.

**48.** At 5 inHg abs., set the pressure across the actuator diaphragm at 6 to 16 lb/in $^2$ by adjustment of the main spring, with the capsule set to become inoperative at 66 to 70 inHg abs.

**49.** The following limits are for decreasing flows with decreasing P1 pressures:—

| Capsule pressure (inHg abs.) | Cruising flow (gal/h) Min. | | Max. |
|---|---|---|---|
| 66 | | Record | |
| 60 | | Record | |
| 55 | | Record | |
| 50 | | Record | |
| 45 | 1500 | | 1585 |
| 40 | 1395 | | 1475 |
| 35 | 1280 | | 1340 |
| 30 | 1170 | | 1180 |
| 25 | 1010 | | 1050 |
| 20 | 855 | | 895 |
| 15 | 685 | | 725 |
| 10 | 490 | | 530 |
| 5 | | Record | |
| 3·5 | | Record | |
| Hysteresis | | | 20 |

**50.** Inlet pressure consciousness from 5 to 25 lb/in $^2$ must not exceed 25 gal/h at ground level conditions and 15 gal/h at 5 inHg abs.

**51.** Delivery pressure consiousness check is to be carried out at 5 inHg abs. by increasing pump pressure by 200 lb/in $^2$. At full throttle conditions the variation must not exceed 25 gal/h.

*Endurance test*

**52.** Test the unit over the capsule pressure range given in the table for 60 cycles or one hour whichever is the greater number of cycles, then check that there is no calibration change and the unit still conforms to the limits given in para. 49.

*Pressure test*

**53.** At 2200 lb/in $^2$ downstream pressure, and 40 lb/in $^2$ inlet pressure maintained for five minutes, check that there is no external leakage.

**Final calibration (without a.c.u.)**

**54.** First pressure test the unit by blanking off all connections except P1 and P2, apply an air pressure to the pump delivery connection and submerge the unit in white spirit (S.B.P.6 fluid). As the air pressure is slowly increased to 80 lb/in $^2$ (gauge), there must be no external leakage from the unit, nor from the P1 or P2 connections.

**55.** For the calibration, the rig pump servo flow must be 24·9 to 25·1 gal/h at 1250 lb/in $^2$ delivery pressure, 150 gal/h main flow, and a pump speed of 2600 rev/min.

**56.** Record the specific gravity of the test fuel at 15 °C.

**57.** The rig pump amplifier valve must be blanked off and the stall pressure controlled by a b.p.c. spilling to atmosphere.

**58.** If a variable speed test rig is not available, a fixed-speed type may be used providing that sufficient speed is available to meet the maximum flow requirements.

**Throttle valve**

**59.** Calibration at 30 in Hg abs. Record the fuel temperature before the test.

| Throttle angle (deg) | Flow (gal/h) Min. | Max. |
|---|---|---|
| 0 | 0 | |
| 5 | 0 | |
| 10 | Record | |
| 15 | 115 | 120 |
| 20 | 115 | 120 |
| 25 | 120 | 140 |
| 30 | 176 | 216 |
| 40 | 455 | 515 |
| 50 | 780 | 830 |
| 60 | 1005 | 1055 |
| 70 | 1270 | 1320 |
| 80 | 1530 | 1590 |
| 83 | 1605 | 1625 |

(1) Record the main, pilot and pump pressures against each throttle setting.

(2) Pilot pressure hysteresis must not exceed 75 $lb/in^2$.

(3) Set the maximum throttle stop to 83°.

(4) With the idling by-pass screwed fully IN, the flow should be 100 gal/h maximum.

(5) With the idling by-pass screwed fully OUT the flow should be 185 (190) gal/h minimum.

**60.** With a rig pump speed of 500 rev/min and the throttle valve shut (0°T.V. angle), the leakage measured at the dump outlet, is not to exceed 100 $cm^3$/min. All the leakage is to issue from the dump and none from the burners.

**T.V. torque test (linkage not fitted)**

**61.** At seal level conditions and a pump speed of 3080 rev/min, from 0 to 83° throttle lever angle, 5 lb in. maximum in each direction.

**Throttle movement test**

**62.** Note the flow at full throttle 30 inHg abs., at cruising 30 inHg abs., and at 10 inHg abs. Oscillate the throttle lever rapidly from idling to full throttle at least ten times the transient pressure, endeavouring to stall the pump. If the flow decreases by more than 20 gal/h of the figures previously noted, the throttle movements must be repeated until stability is achieved.

**Altitude Sensing Unit**

**63.** (1) Note the fuel temperature before checking the curve.

(2) Test the line connecting the P1 capsule chamber to the manometer for leaks.

(3) At full throttle conditions with a capsule pressure of 66 inHg abs., the pump pressure must not exceed 2000 $lb/in^2$.

**64.** The following limits are for decreasing flows at full throttle (3080 rev/min) and at cruising speed, (3000 rev/min)

| P1 (inHg abs) | Gal/h at 3080 rev/min Min. | Max. | Gal/h at 3000 rev/min Min. | Max. |
|---|---|---|---|---|
| 66 | 2545 | 2795 | Record | |
| 60 | 2440 | 2655 | Record | |
| 55 | 2335 | 2525 | Record | |
| 50 | 2215 | 2375 | Record | |
| 45 | 2090 | 2210 | 1500 | 1585 |
| 40 | 1950 | 2030 | 1395 | 1475 |
| 35 | 1775 | 1845 | 1280 | 1340 |
| 30 | 1605 | 1658 | 1170 | 1180 |
| 25 | 1400 | 1470 | 1010 | 1050 |
| 20 | 1190 | 1250 | 855 | 895 |
| 15 | 950 | 1010 | 685 | 725 |
| 10 | 680 | 740 | 490 | 530 |
| 5 | 380 | 450 | Record | |
| 3·5 | 280 | 360 | Record | |
| Hysteresis | 33 gal/h | | 20 gal/h | |

**Windmilling test**

**65.**

| P1 (inHg abs) | Altitude idling flow T.V.=20° Pump speed 2000 rev/min Flow (gal/h) Min. | Max. | Windmilling flow T.V.=20° Pump speed 800 rev/min Flow (gal/h) Min. | Max. |
|---|---|---|---|---|
| 30 | 115 | 125 | — | — |
| 25 | 109 | 119 | — | — |
| 20 | 100 | 111 | — | — |
| 17·5 | 95 | 106·5 | — | — |
| 15 | 89·5 | 101 | 81·5 | 100 |
| 12·5 | 83 | 94 | 73·5 | 93 |
| 10 | 75·5 | 87 | 65 | 84 |
| 7·5 | 67 | 78 | 56 | 75 |
| 5 | 55 | 65 | 45 | 65 |
| 2·5 | Record | | Record | |
| Hysteresis | 6·5 gal/h | | | |

**66.** When checking the windmilling flow, set the throttle valve angle to 20°. After setting to the correct values of P2 and P1, close the throttle valve then re-open it 20° before recording the curves.

**67.** Check the pressure consciousness at 5 inHg abs. by increasing the pump pressure 200 lb/in² by the restrictor in the main manifold line. Any variation in flow must not exceed 25 gal/h.

**68.** Test the inlet pressure consciousness from 5 to 25 lb/in² at cruising conditions; this must not exceed 25 gal/h at ground level conditions and 15 gal/h at 5 inHg abs.

**Temperature control**

*Calibration* (*pre-mod.* 1347)

**69.** Before the test, energise the solenoid at 350 mA for ten minutes, the current must be derived from a full-wave rectified single-phase a.c. supply.

| Solenoid Current mA | Flow (gal/h) Min. | Max. | Flow (gal/h) at 83° T.V. angle Pl=5 inHg abs. Min. | Max. |
|---|---|---|---|---|
| 0 | 1000 | | 380 | 450 |
| 100 | 1000 | | Record | |
| 150 | 955 | 990 | Record | |
| 200 | Record | | Record | |
| 250 | Record | | Record | |
| 300 | Record | | Record | |
| 350 | 500 | 600 | min. 50% of initial flow at zero mA | |
| Hysteresis | | 180 | 120 | |

**70.** The flow must decrease steadily with the increase of current over the 100 to 350 mA range.

*Maximum slope limit*

**71.** For a change in current of 50 mA the flow change must not exceed 200 gal/h (1000 gal/h curve setting) and 100 gal/h (380—450 gal/h curve setting).

*Post-Mod. C.P.1347.*

| Solenoid Current mA | Flow (gal/h) Min. | Flow (gal/h) Max. | Flow (gal/h) at 83° T.V. angle Pl=5 inHg abs. Min. | Flow (gal/h) at 83° T.V. angle Pl=5 inHg abs. Max. |
|---|---|---|---|---|
| 0 | 1000 Set with T.V. | | 380 | 450 |
| 100 | 990 | 1000 | Record | |
| 150 | 955 | 1000 | Record | |
| 200 | Record | | Record | |
| 250 | Record | | Record | |
| 350 | Record | | Record | |
| 400 | 500 | 600 | Min 50% of initial Flow at zero mA | |
| Hysteresis | | 50 | | 25 |

**Note. . .**

*With a current of* 80 *mA applied to the j.p.t. solenoid and* 66 *inHg abs. on the a.s.u., the flow must not be below* 2545 *gal/h.*

**72.** The flow must decrease steadily with the increase of current over the 100 to 400 mA range.

*Maximum slope limit*

**73.** For a change in current of 50 mA, the flow change must not exceed 200 gal/h (1000 gal/h curve setting) and 100 gal/h (380—450 gal/h curve setting).

*Flow recovery test*

**74.** Apply a P1 pressure of 3·5 inHg abs. to the a.s.u. and 350 mA to the solenoid. Slam the throttle from 83° to 20° and reduce the current to the solenoid to zero quickly, then slowly open the throttle to 83°. The fuel flow should return to a minimum of 247 gal/h. Record the actual flow.

*Solenoid tests*

**75.** Connect an ohmmeter between the pins 'A' and 'B' on the electrical plug. The resistance should be 27 to 31 ohms at 20 °C.

**76.** Disconnect the ohmmeter, then join 'A' and 'B' and connect to a 500 V insulation tester. Connect the other lead of the tester to the body of the unit; this connection must penetrate the anodised surface. Rotate the handle of the tester until the clutch operates during which time the needle should indicate an insulation greater than 50 megohms at 20 °C.

**Final calibration (a.c.u.)**

**77.** These tests are to be made with the acceleration control assembled to the unit, and a $\frac{1}{2}$ in. diameter P1 engine pipe and capacity chamber interconnected with the a.s.u.

**78.** P1 = 2·5 lb/in $^2$ abs.

| P2 pressure (in Hg abs.) | P2 pressure (lb/in $^2$ abs.) | Flow (gal/h) Min. | Flow (gal/h) Max. |
|---|---|---|---|
| 8·15 | 4 | 72 | 92 |
| 12·2 | 6 | 77 | 97 |
| 16·25 | 8 | 89 | 109 |
| 20·35 | 10 | 107 | 128 |
| 24·45 | 12 | 131 | 152 |
| 28·5 | 14 | 158 | 182 |
| 32·6 | 16 | 190 | 217 |
| 34·6 | 17 | 211 | 238 |
| 36·6 | 18 | 233 | 260 |
| 38·7 | 19 | 258 | 288 |
| 40·7 | 20 | 284 | 318 |
| 42·75 | 21 | 312 | 355 |
| 44·75 | 22 | 338 | 385 |
| 46·8 | 23 | 360 | — |

**79.** P1 = 5 lb/in ² abs.

| P2 pressure (in Hg abs.) | (lb/in ² abs.) | Flow (gal/h) Min. | Max. |
|---|---|---|---|
| 10·15 | 5 | 74 | 105 |
| 20·35 | 10 | 112 | 138 |
| 30·5 | 15 | 160 | 185 |
| 40·7 | 20 | 215 | 244 |
| 50·8 | 25 | 278 | 305 |
| 61·0 | 30 | 358 | 395 |
| 63·0 | 31 | 378 | 414 |
| 65·0 | 32 | 400 | 437 |
| 67·2 | 33 | 425 | 467 |
| 69·2 | 34 | 450 | 503 |
| 71·25 | 35 | 485 | 545 |
| 73·3 | 36 | 528 | 595 |
| 75·3 | 37 | 580 | 612 |
| 77·4 | 38 | 595 | 628 |
| 81·5 | 40 | 625 | 660 |

**80.** P1 = 10 lb/in ² abs.

| P2 pressure (in Hg abs.) | (lb/in ² abs.) | Flow (gal/h) Min. | | Max. |
|---|---|---|---|---|
| 20·35 | 10 | | Record | |
| 29·9 | 14·7 | | Record | |
| 40·7 | 20 | | Record | |
| — | 25 | | Record | |
| — | 30 | | Record | |
| — | 35 | | Record | |
| — | 40 | | Record | |
| — | 45 | | Record | |
| — | 50 | | Record | |
| — | 55 | | Record | |
| — | 58 | — | | 760 |
| — | 59 | — | | 865 |
| — | 60 | — | | 990 |
| — | 61 | | Record | — |
| — | 62 | 840 | | — |

**81.** P1 = 14·7 lb/in ² abs.

| P2 pressure at constant P1 (in Hg abs.) | 14·7 (lb/in ² abs.) | Flow (gal/h) increasing Min. | Nom. | Max. |
|---|---|---|---|---|
| 29·9 | 14·7 | — | 222 | — |
| 40·7 | 20 | — | 268 | — |
| | 25 | — | 315 | — |
| | 30 | — | 365 | — |
| | 35 | — | 415 | — |
| | 40 | — | 475 | — |
| | 45 | — | 535 | — |
| | 50 | — | 595 | — |
| | 55 | — | 655 | — |
| | 60 | — | 715 | — |
| | 62 | — | — | 845 |
| | 64 | — | — | 1015 |
| | 66 | 835 | — | 1185 |
| | 68 | 925 | — | — |
| | 70 | 1010 | — | — |
| | 72 | 1100 | — | — |

**82.** Hysteresis is not to exceed 5% of the flow with increasing and decreasing P2 up to the reading before the plunger cut-out point.

**83.** At 35 lb/in ² abs. P2 pressure, with P1 open to atmosphere and the throttle valve fully open, the pressure consciousness of the unit from 750 to 1200 lb/in ² pilot pressure must not exceed 25 gal/h.

**84.** With P2 pressure set at 90 lb/in ² abs. and full throttle, close and open the P2 supply cock. The deceleration time from P2 being shut off, to the fall in pilot pressure to 800 lb/in ² must not exceed 3·5 seconds. The acceleration time from P2 being opened to reach 1000 lb/in ² pilot pressure, must not exceed 3·5 seconds.

*Endurance test*

**85.** The unit must be tested at one cycle per minute for one hour at the following conditions.

| A.S.U. P1 (inHg abs.) | A.C.U. P2 (lb/in ² abs.) | L.P.C. Solenoid current (mA) |
|---|---|---|
| 5 to 45 | 15 to 90 | 0 to 350 |

**86.** Check that the calibration is still within the limits; if re-setting is necessary the endurance test must be repeated.

**87.** Record the fuel leakage from the main burner connection at the following pilot burner pressures.

| Pilot burner pressure (lb/in ²) | Leakage from Main burner connection (gal/h) Min. | | Max. |
|---|---|---|---|
| 200 | | Record | |
| 250 | 8 | | 17 |
| 300 | | Record | |

*Leakage test*

**88.** With the P1 pressure at 2·5 inHg abs. and the throttle lever angle at 2° below the idling dwell, there must be no leakage from the dump connection. Close the throttle, and re-open to 2°, and again check there is no leakage.

**89.** Stop the pump, set the throttle to idling, and apply an inlet pressure of 40 lb/in ². No fuel should issue from the pilot burner line with the burner pipe outlet held 30 inches above the control unit sprayer connection.

### Final T.V. torque test

**90.** With the unit on the bench and prior to fitting the linkage, the T.V. torque is to be checked between detent and full throttle and must not exceed $3\frac{1}{2}$ lb in.

**91.** With the linkage assembled and the unit refitted on the test rig, at sea level conditions and a pump speed of 3080 rev/min the T.V. torque must not exceed the following,

(a) 8 lb in. on units fitted with range speed governor

(b) 6 lb in. on units in which the range speed governor is deleted.

### Pressure tests

**92.** After all forms of locking have been completed, test the unit at 2200 lb/in $^2$ delivery pressure with inlet pressures of 5 lb/in $^2$ and then 40 lb/in $^2$. There must be no external leakage.

**93.** With the pump stationery, close the throttle and apply an inlet pressure of 5 lb/in $^2$ for 5 minutes. Increase the pressure slowly to 40 lb/in $^2$ and maintain this for 5 minutes. There must be no leaks throughout the test.

**94.** Make a spot calibration check on the throttle valve and a.s.u. curves.

### Inhibiting

**95.** The unit is to be inhibited with OM-11 or OM-13 oil.

**17.** Blank off the P1 connection on the P2/P1 switch and calibrate as follows:—

| P2 pressure (inHg abs.) | P2 pressure (lb/in² abs.) | Flow (gal/h) Min. | Flow (gal/h) Max. |
|---|---|---|---|
| 10·15 | 5 | 74 | 94 |
| 20·35 | 10 | 142 | 158 |
| — | 25 | 364 | 392 |
| — | 41 | 600 | 642 |
| — | 44 | — | 850 |
| — | 48 | 825 | — |

The curve when plotted must be within 5 gal/h of a straight line.

**18.** Remove the blank from the P1 connection and calibrate the unit as follows:—

**19.** Curve with P1 pressure maintained at 2·5 lb/in² abs.

| P2 pressure (inHg abs.) | P2 pressure (lb/in² abs.) | Flow (gal/h) Min. | Flow (gal/h) Max. |
|---|---|---|---|
| 8·15 | 4 | 62 | 90 |
| 12·2 | 6 | 72 | 92 |
| 20·35 | 10 | 97 | 110 |
| 28·5 | 14 | 144 | 161 |
| 40·7 | 20 | 264 | 288 |
| — | 21 | 300 | 326 |
| — | 22 | 314 | 340 |
| — | 23 | 328 | 355 |

**20.** Curve with P1 pressure maintained at 5 lb/in² abs.

| P2 pressure (inHg abs.) | P2 pressure (lb/in² abs.) | Flow (gal/h) Min. | Flow (gal/h) Max. |
|---|---|---|---|
| 5·1 | 5 | 75 | 95 |
| 10·15 | 10 | 105 | 125 |
| 20·35 | 20 | 200 | 220 |
| — | 30 | 328 | 352 |
| — | 34 | 418 | 455 |
| — | 38 | 563 | 583 |
| — | 40 | 590 | 612 |

**21.** Curve with P1 pressure maintained at 10 lb/in² abs.

| P2 pressure (lb/in² abs.) | Flow (gal/h) Min. | Flow (gal/h) Nom. | Flow (gal/h) Max. |
|---|---|---|---|
| 55 | — | 592 | — |
| 58 | — | — | 700 |
| 59 | — | — | 770 |
| 60 | — | — | 900 |
| 62 | 750 | — | — |
| 63 | 900 | — | — |

**22.** Curve with P1 pressure maintained at 14·7 lb/in² abs.

| P2 pressure (inHg abs.) | P2 pressure (lb/in² abs.) | Flow (gal/h) Min. | Flow (gal/h) Nom. | Flow (gal/h) Max. |
|---|---|---|---|---|
| 29·9 | 14·7 | — | 210 | — |
| | 25 | — | 285 | — |
| | 60 | — | 650 | — |
| | 62 | — | 670 | 770 |
| | 65 | — | 700 | — |
| | 68 | 840 | — | — |

**23.** Hysteresis must not exceed 10 gal/h for flows up to 200 gal/h, and 20 gal/h for flows above 200 gal/h when increasing and decreasing P2 up to the reading before each change-over point or point of cut-out.

**24.** At 35 lb/in² abs. P2 pressure, with P1 open to atmosphere, the pressure consciousness of the unit from 750 to 1200 lb/in² pilot pressure must not exceed 25 gal/h. Inlet pressure consciousness from 5 to 35 lb/in² must not exceed 10 gal/h.

**25.** With P1 open to atmosphere, at 35 lb/in² record the pressure drop across the unit.

**26.** With P2 pressure set at 90 lb/in² abs. and throttle fully open, close and then open the P2 supply cock. The deceleration time from P2 being shut off, to the collapse to 800 lb/in² pilot pressure must not exceed 3·5 seconds. The acceleration time from P2 being opened to 1000 lb/in² pilot pressure is not to exceed 3·5 seconds.

*Endurance test*

**27.** Blank off the P1 connection, then test the unit from 0 to 150 lb/in² P2 pressure for 90 cycles at a maximum downstream pressure of 1000 lb/in².

**28.** Check that the calibration change is within the limits given in para. 19 to 26 of this appendix.

*Leakage test*

**29.** With an inlet pressure of 40 lb/in² and a downstream pressure of 2200 lb/in² for five minutes, check that there is no external leakage.

**Throttle valve**

**30.** Sub-zero torque test in accordance with testing para. 498.

**Pilot dump valve**

**31.** With the pilot flow discharging through a restrictor flow No. 2·88, ensure that the valve opens at 40 to 50 lb/in $^2$ and closes at 15 to 25 lb/in $^2$.

**32.** At an intake pressure of 1000 lb/in $^2$, check that the leakage to dump does not exceed 2 cm $^3$/min. Establish a free flow through the main manifold connection and dump valve. The pressure required to give a flow of 30 gal/h must not exceed 5 lb/in $^2$.

**Constant flow by-pass**

**33.** At the required pressure, set the flow by means of the valve adjusting screw.

| Pressure (lb/in $^2$) | Flow (gal/h) |
|---|---|
| 25 | 33 |

Check the pressure consciousness by varying the inlet pressure over the range; any alteration in flow must not exceed the figures shown.

| Pressure (lb/in $^2$) | Flow (gal/h) |
|---|---|
| 25 to 150 | 4 |

**Pressurising valve**

**34.** Fit the largest pilot burner simulator (+ 5%) i.e. flow No. 3·02 and set the unit near to the bottom limit of the curve, i.e. 490 lb/in $^2$ at 150 gal/h.

**35.** Take a complete curve of flow versus pressure and ensure that it is within the limits, and that hysteresis is at no point in excess of 20 lb/in $^2$.

**36.** Fit the smallest pilot burner simulator (—5%) i.e. flow No. 2·74 and check that the unit, as set, is within the top limit of the curve, i.e. 1070 lb/in $^2$ at 1300 gal/h.

| Flow (gal/h) | Pilot pressure (lb/in $^2$) | |
|---|---|---|
| | Min. | Max. |
| 150 | 490 | 660 |
| 200 | 500 | 680 |
| 400 | 550 | 750 |
| 600 | 600 | 820 |
| 800 | 650 | 890 |
| 1000 | 700 | 960 |
| 1300 | 770 | 1070 |

**37.** Check that with the pilot simulator (flow No. 2·74) and the main simulator (flow No. 34·5) the pilot pressure does not exceed 1300 lb/in $^2$ at 1300 gal/h.

*Leakage test*

**38.** Pressure test the unit at 2200 lb/in $^2$ pump pressure and 40 lb/in $^2$ inlet pressure for five minutes. There must be no external leakage.

**Altitude sensing unit**

**39.** Kinetic lever hinge seal leakage test; this test to be carried out as stated in para. 496.

*Calibration*

**40.** Pump servo flow to be set at 24·9 to 25·1 gal/h; stall pressure 1200 to 1250 lb/in $^2$; and main flow 150 gal/h; and a pump speed of 2600 rev/min.

**41.** To test the unit separately, use the linking valve, throttle valve, pressurising valve and constant flow by-pass valve, with which the a.s.u. is to be finally calibrated. Connect the kinetic simulator block in parallel with the a.s.u. kinetic valves.

**42.** Calibrate to full throttle flow characteristics only (83° T.V. angle), 3080 rev/min. The throttle lever limit stops are to be set prior to calibrating the a.s.u.

**43.** The flow from the linking valve to the secondary flow sensor (proportional flow) must be 18 to 35 gal/h at 30 inHg abs.

**44.** At 5 inHg abs., set the pressure drop across the actuator diaphragm at 6 to 16 lb/in $^2$ by adjustment of the main spring with the capsule inoperative at 65 to 68 inHg abs.

**45.** The following limits are for decreasing flows with decreasing P1 pressure.

| Capsule pressure P1 (inHg abs.) | Full throttle Flow (gal/h) | |
|---|---|---|
| | Min. | Max. |
| 45 | 1660 | 1765 |
| 30 | 1310 | 1380 |
| 10 | 580 | 620 |
| 5 | 350 | 390 |
| 3·5 | 240 | 330 |
| Hysteresis | | 33 |

**46.** Inlet pressure consciousness from 5 to 25 lb/in$^2$ at cruising conditions must not exceed 25 gal/h at ground level conditions and 15 gal/h at 5 inHg abs.

**47.** Delivery pressure consciousness. At 5 inHg abs., increase pump pressure by 200 lb/in$^2$. At full throttle conditions the variation must not exceed 25 gal.

*Endurance test*

**48.** Test the unit over the capsule pressure range given in the table for 30 cycles, then check there is no calibration change and the unit still conforms to the limits given in para. 45.

*Leakage test*

**49.** At 2200 lb/in$^2$ downstream pressure and 40 lb/in$^2$ inlet pressure maintained for five minutes, check that there is no external leakage.

**Overspeed governor and temperature trim**

**50.** Blank off the proportional flow outlet, and apply an air pressure of 80 lb/in$^2$ to both sides of the linking valve diaphragm. Immerse the unit in fuel and check for leaks. No leakage is allowed.

**Final calibration (without a.c.u.)**

*Leakage test*

**51.** Remove the P2/P1 switch, and apply air to the variable datum governor diaphragm and to the pump delivery connection. The remainder of the connections except P1 and P2 are to be blanked off. Immerse the unit in white spirit (S.B.P. 6) and increase air pressure slowly to 80 lb/in$^2$ (gauge). No external leakage from the unit or the P1 and P2 connections is permitted.

**52.** Fit the P2/P1 switch, and blank off the P1 connection. Apply an air pressure of 150 lb/in$^2$ (gauge) to the P2 connection. Close the P2 supply cock and maintain the air pressure for five minutes. Leakage must not exceed 3 lb/in$^2$.

*Calibration*

**53.** For the calibration, the rig pump servo flow must be 24·9 to 25·1 gal/h at 1250 lb/in$^2$ delivery pressure, 150 gal/h main flow and a pump speed of 2600 rev/min.

**54.** Record the specific gravity of the test fuel at 15 °C.

**55.** The rig pump amplifier valve is to be blanked off and stall pressure controlled by a b.p.c. spilling to atmosphere.

**Altitude calibration**

**56.** Note the fuel temperature before checking each curve.

**57.** Test the line connecting the P1 capsule chamber to the manometer for leaks.

**58.** At full throttle conditions with a capsule pressure of 50 inHg abs., the pump pressure must not exceed 1850 lb/in$^2$. Record the actual pressure on the test record.

**59.** The cruise curve from 30 inHg abs. to 10 inHg abs. is to be read from the same flowmeter.

**60,** The following limits are for decreasing flows:

| P1 InHg abs. | Full throttle 3080 rev/min. (gal/h) | | Cruising flow 2935 rev/min. (gal/h) | | Idling flow 1200 rev/min (gal/h) | |
|---|---|---|---|---|---|---|
| | Min. | Max. | Min. | Max. | Min. | Max. |
| 54 | 1840 | 1970 | | | | |
| 45 | 1660 | 1765 | 1300 | 1410 | | |
| 30 | 1310 | 1380 | 1050 gal/h set by T.V. | | 120 gal/h set by T.V. | |
| 20 | 980 | 1035 | | | | |
| 15 | 790 | 840 | | | | |
| 10 | 580 | 620 | 445 | 485 | | |
| 5 | 350 | 390 | | | 36 | — |
| 3·5 | 240 | 330 | | | — | — |
| Hysteresis | | 33 | | 20 | | 6·5 |

**61.** Check the pressure consciousness at 5 inHg abs. by increasing the pump pressure 200 lb/in $^2$ by the restrictor in the main manifold line. Any variation in flow must not exceed 25 gal/h.

**62.** Test the inlet pressure consciousness from 5 to 25 lb/in $^2$ at cruising conditions; this must not exceed 25 gal/h at ground level and 15 gal/h at 5 inHg abs.

**Throttle valve**

**63.** Calibration at 30 inHg abs. Record the fuel temperature before the test.

**64.** Set the throttle lever to 83°, and adjust the main flow by means of P1 pressure until within the table limits (1350 to 1370 gal/h). If adjustment is made to the idling flow (20° throttle angle), the altitude curve is to be checked to ascertain whether it is still within the limits.

| Throttle angle (degrees) | Flow (gal/h) Min. | Max. |
|---|---|---|
| 0 | 0 | (throttle stop) |
| 20 | 115 | 120 |
| 25 | 120 | 140 |
| 30 | 160 | 190 |
| 40 | 380 | 430 |
| 50 | 650 | 700 |
| 60 | 835 | 875 |
| 70 | 1050 | 1100 |
| 80 | 1270 | 1310 |
| 83 | 1350 | 1370 (throttle stop) |

**65.** Check that with 150 gal/h flow, pilot pressure flow is a minimum of 510 lb/in $^2$ and with 1000 gal/h flow, pilot pressure is a maximum of 950 lb/in $^2$.

**66.** Pilot pressure hysteresis at these points must not exceed 20 lb/in $^2$.

**67.** Record the pump pressure against each throttle setting.

**68.** Set the maximum throttle stop to 83°.

**69.** With the idling by-pass valve screwed fully in, the flow should be 90 gal/h maximum.

**70.** With the idling by-pass screwed fully out, the flow should be 140 gal/h minimum.

*Leakage test*

**71.** With a pump speed of 500 rev/min and the throttle valve shut (0° T.V. angle), the leakage measured at the dump outlet, is not to exceed 100 cm $^3$/min. All the leakage is to issue from the dump and none from the burners.

*Torque test*

**72.** At sea level conditions and a pump speed of 3080 rev/min, the torque required to move the lever from 0 to 83° in each direction must not exceed 5 lb in.

*Throttle movement test*

**73.** Note the flow at full throttle 30 inHg abs., cruising 30 inHg abs., and at 10 inHg abs. Oscillate the throttle lever rapidly from idling to full throttle at least ten times the transient pressure, endeavouring to stall the pump. If the flow decreases by more than 20 gal/h of the figures previously noted, the throttle movements must be repeated until stability is achieved.

**Temperature control**

*Calibration*

**74.** Before the test, energise the solenoid at 350 mA for ten minutes. The current must be derived from a full-wave rectified, single phase a.c. supply.

*Pre-mod CP.* 1347

| Solenoid current mA | Flow (gal/h) Min. | Max. | At 83° T.V.5 inHg abs. P1 Min. | Max. |
|---|---|---|---|---|
| 0 | 1000 | T.V. | 350 | 390 |
| 100 | 1000 | | Record | |
| 150 | 955 | 990 | Record | |
| 200 | Record | | Record | |
| 250 | Record | | Record | |
| 300 | Record | | Record | |
| 350 | 500 | 600 | Minimum 50% of flow reading at zero mA | |
| Hysteresis | | 180 | | 120 |

**75.** The flow must decrease steadily with increase of current in the 100 to 350 mA range.

*Maximum slope limit*

**76.** For a change in current of 50 mA the flow change must not exceed 200 gal/h for the 1000 gal/h curve setting and 100 gal/h for the 350 to 390 gal/h curve setting.

*Post-mod CP.* 1347

**77.**

| Solenoid current mA | Flow (gal/h) Min. | Max. | At 83° T.V. 5 in Hg abs. P1 Min. | Max. |
|---|---|---|---|---|
| 0 | 1000 T.V. Set with T.V. | | 350 | 390 |
| 100 | 990 | 1000 | Record | |
| 150 | 955 | 990 | Record | |
| 200 | Record | | Record | |
| 250 | Record | | Record | |
| 300 | Record | | Record | |
| 350 | Record | | Record | |
| 400 | 500 | 600 | Minimum 50% per cent of flow reading at zero mA | |
| Hysteresis | | 50 | | 25 |

**78.** The flow must decrease steadily with increase of current in the 100 to 400 mA range.

*Maximum slope limit*

**79.** For a change in current of 50 mA the flow change must not exceed 200 gal/h for the 1000 gal/h curve setting and 100 gal/h for the 350 to 390 gal/h curve setting.

*Flow recovery test*

**80.** Apply a P1 pressure of 3·5 inHg abs. to the a.s.u. and 350 mA to the solenoid. Slam the throttle from 83 to 22½° and reduce the current to the solenoid to zero quickly, then slowly return the throttle to 83°. The fuel flow should return to a minimum of 207 gal/h. Record the actual flow.

*Solenoid tests*

**81.** Connect an ohmmeter between the pins 'A' and 'B' on the electrical plug. The resistance should be 27 to 31 ohms at 20°C.

**82.** Disconnect the ohmmeter; join 'A' and 'B' and connect to a 500 volt insulation tester. Connect the other lead of the tester to the body of the unit; this connection must penetrate the anodised surface. Rotate the handle of the tester until the clutch operates during which time the needle should indicate an insulation greater than 50 megohms at 20°C.

**Final calibration (a.c.u.)**

**83.** These tests are to be made with the acceleration control assembled to the unit, and with the P1 connection on the P2/P1 switch blanked off calibrate as follows:—

| P2 pressure (inHg abs.) | P2 pressure ($lb/in^2$ abs.) | Flow (gal/h) Min. | Flow (gal/h) Max |
|---|---|---|---|
| 10·15 | 5 | 74 | 94 |
| 20·35 | 10 | 142 | 158 |
| | 25 | 364 | 392 |
| | 41 | 600 | 642 |
| | 44 | — | 850 |
| | 48 | 825 | — |

**84.** With $\frac{1}{2}$ in. diameter P1 engine pipe and capacity chamber interconnected with the a.s.u. calibrate as follows:—

| P2 pressure (inHg abs.) | P2 pressure ($lb/in^2$ abs.) | Flow (gal/h) Min. | Flow (gal/h) Max |
|---|---|---|---|
| 8·15 | 4 | 62 | 90 |
| 12·2 | 6 | 72 | 92 |
| 20·35 | 10 | 97 | 110 |
| 28·5 | 14 | 144 | 161 |
| 40·7 | 20 | 264 | 288 |
| | 21 | 290 | 326 |
| | 22 | 304 | 340 |
| | 23 | 318 | 355 |

**85.** P1 = 5 $lb/in^2$ abs.

| P2 pressure (inHg abs.) | P2 pressure ($lb/in^2$ abs.) | Flow (gal/h) Min. | Flow (gal/h) Max. |
|---|---|---|---|
| 5·1 | 5 | 75 | 95 |
| 10·15 | 10 | 105 | 125 |
| 20·35 | 20 | 200 | 220 |
| | 30 | 328 | 352 |
| | 34 | 418 | 455 |
| | 38 | 538 | 568 |
| | 40 | 565 | 597 |

**86.** P1 = 10 $lb/in^2$ abs.

| P2 pressure ($lb/in^2$ abs.) | Flow (gal/h) Min. | Flow (gal/h) Nom. | Flow (gal/h) Max. |
|---|---|---|---|
| 55 | — | 592 | — |
| 58 | — | — | 700 |
| 59 | — | — | 770 |
| 60 | — | — | 900 |
| 62 | 750 | — | — |
| 63 | 900 | — | — |

**87.** P1 = 14·7 $lb/in^2$ abs.

| P2 pressure at constant P1 (inHg abs.) | P2 pressure at constant P1 ($lb/in^2$ abs.) | Flow (gal/h) Min. | Flow (gal/h) Nom. | Flow (gal/h) Max. |
|---|---|---|---|---|
| 29·9 | 14·7 | — | 210 | — |
| | 25 | — | 285 | — |
| | 60 | — | 650 | — |
| | 62 | — | 670 | 770 |
| | 65 | — | 700 | — |
| | 68 | 840 | — | — |

**88.** Hysteresis is not to exceed 10 gal/h for flows up to 200 gal/h and 20 gal/h for flows above 200 gal/h with increasing and decreasing P2 up to the reading before the plunger cut-out point or each changeover point.

**89.** At 35 $lb/in^2$ abs. P2 pressure, with P1 open to atmosphere, the pressure consciousness of the unit from 75 to 1200 $lb/in^2$ pilot pressure must not exceed 25 gal/h.

**90.** With P2 pressure set at 90 $lb/in^2$ abs. and full throttle, close and open the P2 supply cock. The deceleration time from P2 being shut off, to the fall in pilot pressure to 800 $lb/in^2$ must not exceed 3·5 seconds. The acceleration time from P2 being opened to 1000 $lb/in^2$ pilot pressure must not exceed 3·5 seconds.

**Endurance test**

**91.** The unit must be tested for 25 cycles at the following conditions:—

| A.S.U. P1 (inHg abs.) | A.C.U. P2 ($lb/in^2$ abs.) |
|---|---|
| 5 to 45 | 15 to 90 |

L.P.C.
Solenoid current (mA)
0 to 350

**92.** Check that the calibration is still within the limits; if re-setting is necessary the endurance test must be repeated.

**Leakage tests**

**93.** With the P1 pressure 2·5 inHg abs. and the throttle lever angle at 2° below the idling dwell, check there is no leakage from the dump connection. Close the throttle valve to 0° and re-open to 2° below the idling dwell, again check there is no leakage.

**94.** Stop the pump, set the throttle to idling, and apply an inlet pressure of 40 $lb/in^2$. No fuel should issue from the pilot burner line with the burner pipe outlet held 30 inches above the control unit pilot sprayer connection.

**Torque tests**

**95.** With the unit on the bench and prior to fitting the linkage, the throttle valve torque is not to exceed $3\frac{1}{2}$ lb in. between detent or full throttle.

**96.** With the linkage assembled and the unit refitted on the rig, the torque at sea level conditions and 3080 rev/min is not to exceed the figures stated.

(a) 8 lb in. on units fitted with range speed governor

(b) 6 lb in. on units with range speed governor deleted

**Pressure tests**

**97.** After all forms of locking have been completed, test the unit at 2200 lb/in $^2$ delivery pressure with inlet pressures of 5 lb/in $^2$ and then 40 lb/in $^2$. There must be no external leaks.

**98.** With the pump stationary close the throttle, and apply an inlet pressure of 5 lb/in $^2$ for five minutes. Increase slowly to 40 lb/in $^2$ and maintain this for five minutes. There must be no leaks throughout the test.

**99.** Make a spot calibration check on the throttle valve and a.s.u. curves.

**Inhibiting**

**100.** The unit is to be inhibited with OM-11 or OM-13 oil.



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TIME
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STATE OF SQUADRONS