Chapter 1

BAROSTATS, TYPE A.C.U./M15 SERIES

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LIST OF ILLUSTRATIONS

RESTRICTED

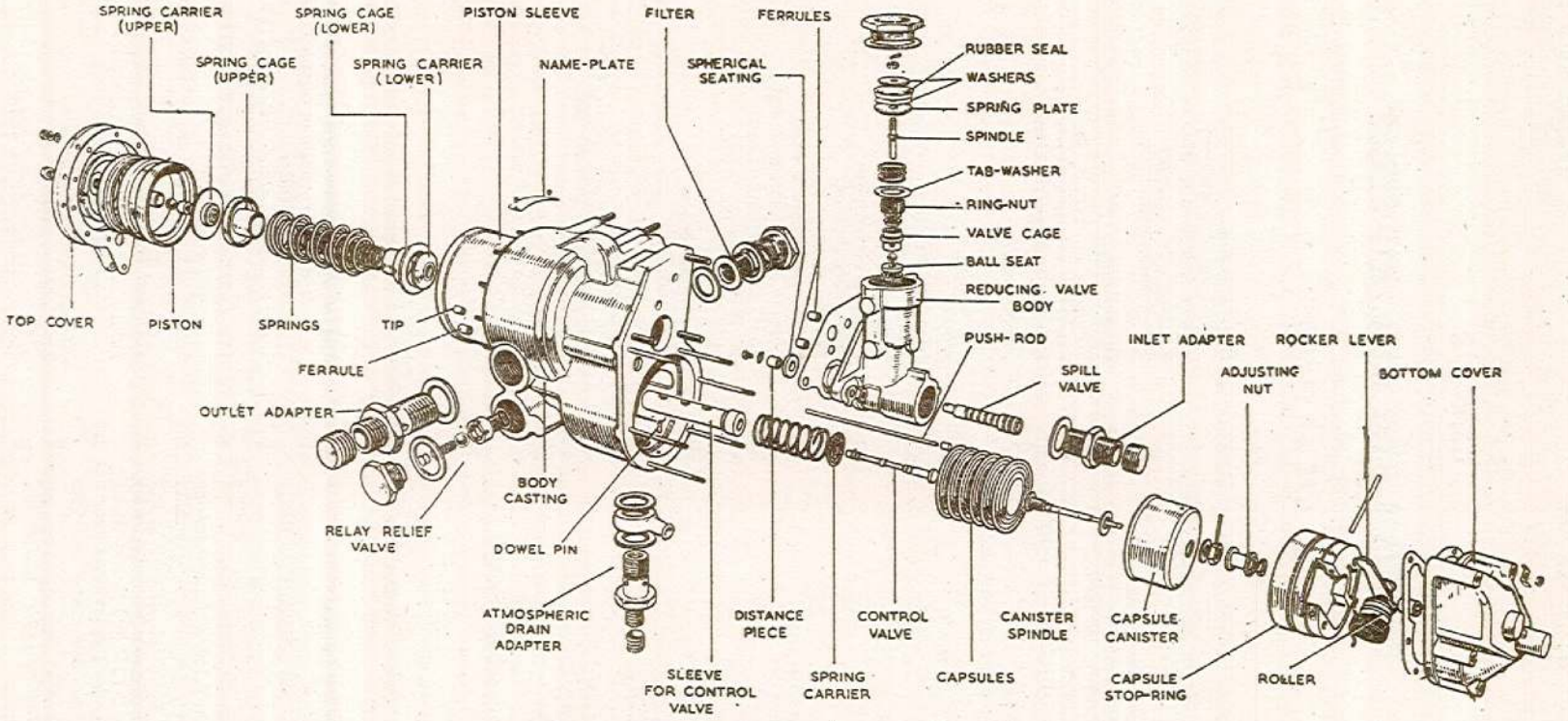


Fig. 1. Dismantled view of typical barostat

GENERAL

1. The barostat is a variable relief valve which is controlled by the variation of atmospheric pressure with altitude.

2. There is one basic type of barostat known as the A.C.U. (altitude control unit), the differences that exist between types being in the installation fittings and calibration settings, which are arranged to suit the requirements of the engine concerned.

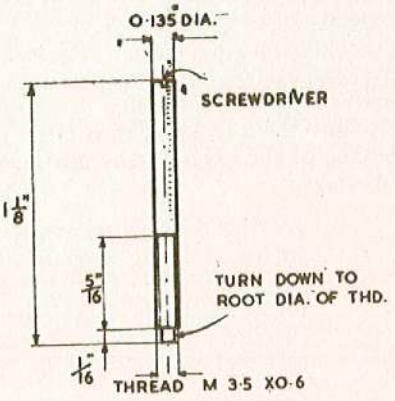
3. The letter following A.C.U. represents the user's code letter, the figure indicates the curve number and the last letter the modification standard, e.g., A.C.U./M15C.

A typical barostat unit is shown dismantled in fig. 1.

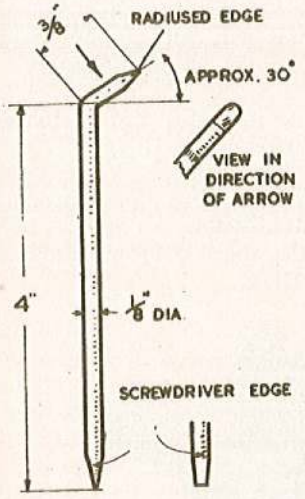
Note . . .

It is most important at all times to ensure that the unit is handled with care and not subjected to excessive shock, otherwise the capsule canister assembly may become damaged by deformation of the canister or misalignment of its spindle.

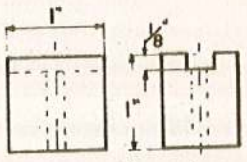
4. During the repair of the barostat unit it is essential that all parts are kept clean. Components must be stored in suitable containers, thus reducing the possibility of loss, damage and corrosion. To prevent damage to nuts and bolts during dismantling

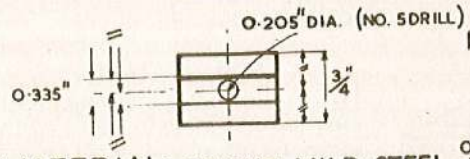


MATERIAL: MILD STEEL.
PLUG, BLANKING FOR REDUCING VALVE BODY.

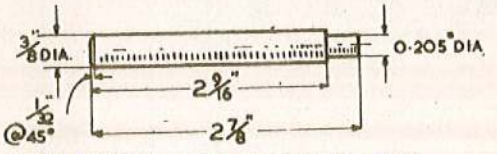


MATERIAL: SILVER STEEL.
SPECIAL UTILITY TOOL.

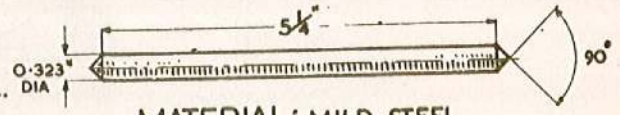




MATERIAL: BRIGHT MILD STEEL.
BLOCK, ASSEMBLY FOR REDUCING VALVE.



MATERIAL: BRIGHT MILD STEEL.
PUNCH, SPECIAL FOR ASSEMBLING FERRULES



MATERIAL: MILD STEEL.
LAP, FOR BALL SEAT.

Fig. 2. Locally made tools

and reassembly, box and ring spanners should be used wherever possible.

5. Whenever a joint or seal is broken, the gasket, joint washer or seal must be renewed. New split pins, tab-washers and lock-wire must always be fitted during reassembly. A list of parts which are separately interchangeable is given under Replacements (*para.* 95).

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

SPECIAL TOOLS

7. Special tools and a test rig are required for the reconditioning of the barostat unit. The special tools required are listed below, fully dimensioned drawings are given for tools to be manufactured locally (*fig.* 2), while the remaining tools will be provisioned.

Manufactured locally — *Nomenclature*

- Block, assembly for reducing valve.
- Lap, for ball seat.
- Plug, blanking for reducing valve body.
- Punch, special, for assembling ferrules.

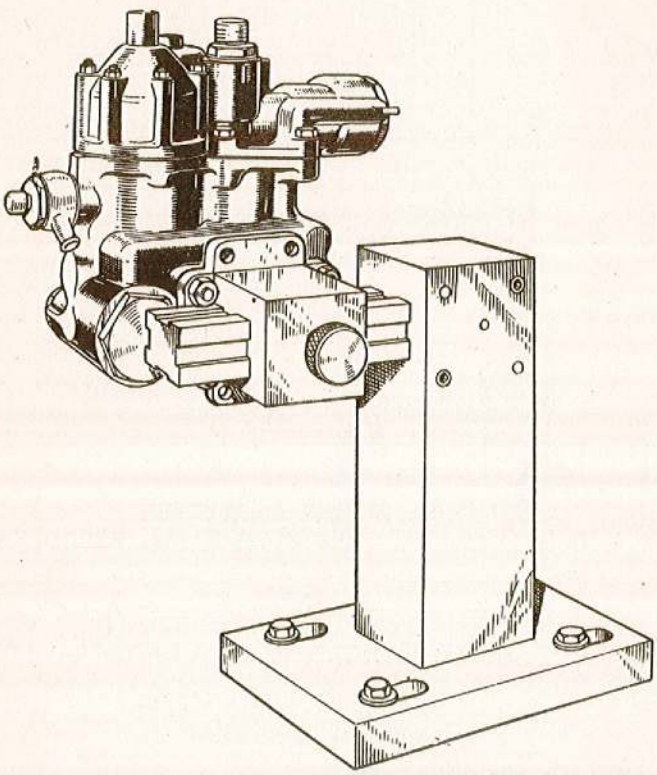


Fig. 3. Use of assembling and dismantling fixture T.127066

Provisioned

Part No.	*Nomenclature*
T.166362	Spanner for removing relay relief valve seating.
G.37700	Gauge, concentricity, for capsule canister assembly.
T.127066	Fixture, assembly.
OT.130250	Cutter, for casting face, reducing valve and filter plug.
OT.130251	Cutter, for casting face, relief valve, outlet adapter and spill valve.
OT.142857	Spanner, for removing reducing valve ring nut.
T.152779	Extractor.
T.157877	Extractor, for valve cage.
T.164247	Tool, for assembling push rod tip.
	Rig, test.

CHECKS AND PRECAUTIONS BEFORE DISMANTLING

8. Study any complaints reported with the unit and carefully examine its exterior for any visible signs of interference or damage, e.g., broken locking wire. Ascertain that all exposed connections have been securely covered to prevent the entry of any foreign matter into the interior of the unit. Ensure that none of the exposed threads and studs are damaged.

9. If the condition of the unit is such that it can be tested, remove the installation fittings from the unit and mount on the test rig as for final calibration (*para.* 146), and make the following tests.

Note . . .

If the unit is reported to be leaking, a leak test must first be made (*para.* 157).

(a) Calibration
(b) Flick test
(c) Leakage from atmospheric drain
(d) Setting of minimum pressure stop.

10. These tests are fully covered in para.113, 132, 140 and 155 respectively.

DISMANTLING

11. A suitably partitioned tray must be available for holding the component parts of each barostat unit. To prevent the accidental interchange of parts during reconditioning, only the parts of one barostat unit must be on the bench at one time. Parts of one

barostat unit must not under any circumstances be stored in the same tray as parts from other units. It is advisable to have close at hand small receptacles or boxes, preferably containing paraffin, in which such small items as nuts, washers, bolts, springs, screws, etc., may be stored for safety until required for inspection and subsequently for re-build.

12. Cut and remove all locking wire. Secure the barostat to the sliding attachment block of the special stripping fixture T.127066 and mount the unit, with the top cover uppermost, on to the fixture (*fig.* 3).

Removing the installation connections

13. Installation connections are fitted to the barostat body at the ports for inlet, spill return to tank and atmospheric drain. These connections comprise adapters and joint washers which have, on certain engine installations, banjo connections.

14. Unscrew and remove the adapters, with joint washers, dust caps, banjo connections and joint washers.

Removing the relay relief valve

15. Unscrew the relay relief valve plug and remove, together with adjustment shims and plain washer. Slacken the knurled locking wheel of the fixture (*fig.* 3), and slide the unit with block off the fixture. Shake the spring and ball out of the relief valve bore of the barostat body into the hand. Again secure the unit on the fixture as before. Using the special spanner (T.166362) unscrew the ball seat from the barostat body and withdraw, together with washer (*fig.* 4).

Removing the piston, sleeve, and springs

16. Invert the unit on the fixture, unscrew the eleven nuts securing the top cover and lift off the cover; if its central stop screw is damaged, unscrew and remove, together with shims.

17. Screw a 2BA slave screw into the tapped centre of the piston and withdraw the piston from its sleeve in the barostat body; remove the slave screw.

18. The piston assembly is not normally dismantled unless damage to any of its parts is evident or suspected. If dismantling is necessary, spring open and remove the circlip from its groove in the piston, using a pair of circlip pliers, lift off the seal retaining ring, and remove the rubber seal.

19. Lift the upper spring cage, together with spring carrier, ball housing and ball; from the piston sleeve of the barostat body. Invert the upper spring cage and carefully tap out the spring carrier assembly using a hammer and drift of convenient size. If it is necessary to dismantle the spring carrier, proceed as follows:—invert the carrier assembly and stand on a hollow base; using a drift of suitable size inserted through the hole in the centre of the carrier, tap out the ball housing together with ball

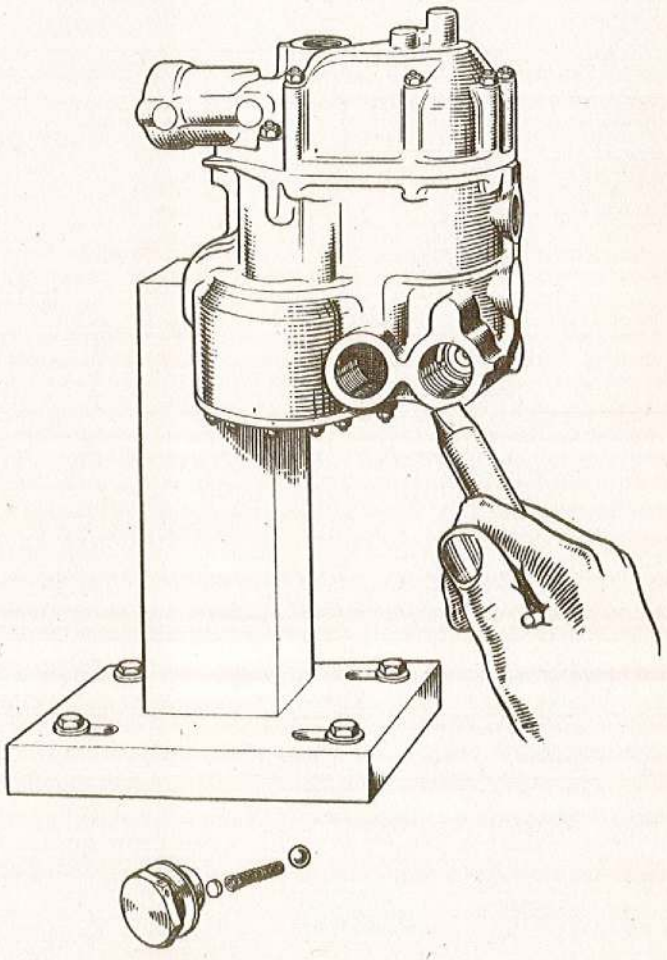


Fig. 4. Use of special spanner T.166362 for removing and fitting relay relief valve seat

and shims. Take note of the thickness of shims. Then carefully tap the ball out of its housing.

20. Remove the large shims from the springs, and lift out the helical springs. Lift off the lower spring cage together with the spring carrier.

21. Carefully lift off the joint from the studs in the barostat body, remove the piston sleeve, and if necessary, remove the ferrule. Remove the unit from the stripping fixture.

Removing the bottom cover

22. Invert the unit on the stripping fixture, with the bottom cover uppermost as in fig. 3. Knock back the tabs of the six tab-washers from the nuts securing the bottom cover to the barostat body, and unscrew and remove the nuts and tab-washers.

23. Lift off the bottom cover and carefully remove the joint. If it is necessary to remove the push rod, insert a suitable split block between the underside of the tip and the main body and inserting a suitable drift through the small hole in the top of the tip, tap the push rod clear. Withdraw the push rod from the other end of the body.

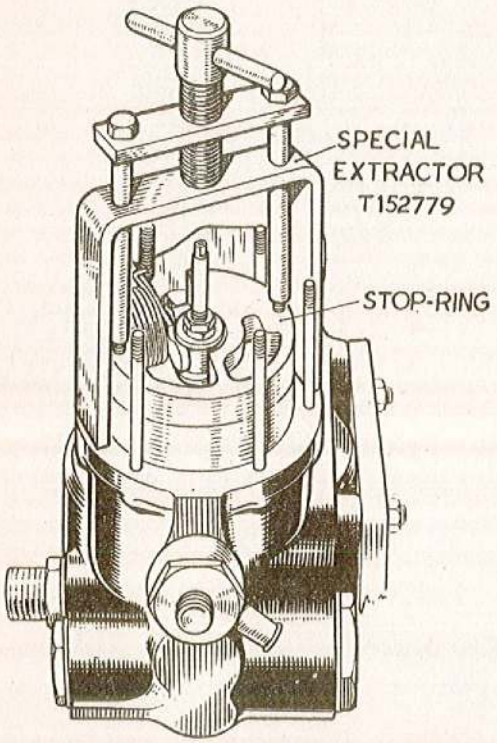


Fig. 5. Use of special extractor T.152779 for withdrawing capsule stop-ring and canister assemblies

Removing the capsule stop-ring and canister assembly

24. Lower the special extractor (T.152779) into position (*fig.* 5) on the capsule stop-ring and tighten the screws of the extractor into the tapped holes in the stop-ring. Tighten the central locating screw with a tommy bar and withdraw the stop-ring, together with the capsule canister assembly, from the barostat body. Spring back the rocker lever to enable the capsule canister assembly to be released from the capsule stop-ring.

Note . . .

The capsule canister assembly need not be dismantled unless damage is evident or suspected or the spindle is not concentric (*para.* 61).

25. If dismantling is necessary proceed as follows :—

OP. 1. Unscrew the lock-nut off the canister spindle, and unscrew the adjusting nut. Flats are provided on the spindle to facilitate removal of nuts.

2. Extract the split pin securing the canister nut and spindle, unscrew the nut and remove, with the washer.

3. Lift out the spindle and washer from the capsule canister.

26. Using a drift of suitable size, tap out the spindle securing the rocker lever, roller and spring from the stop-ring assembly, and remove the spring, rocker lever and roller.

27. Lift out the six separate capsules from the capsule chamber.

Removing the control valve

28. Remove the control valve with the spring and spring carrier from the sleeve in the barostat body.

Removing the reducing valve body and associated details

29. Mount the unit on the stripping fixture so that the reducing valve bore is vertical. Unscrew and remove reducing valve body plug and plain washer. Carefully withdraw the plunger assembly; if necessary this can be withdrawn by pliers applied to the castellated nut. Lift out the reducing valve spring.

Note . . .

The reducing valve assembly is not normally dismantled unless damage to any of its parts is evident or suspected.

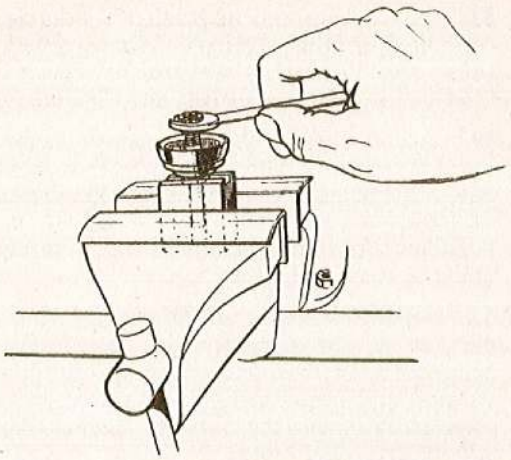


Fig. 6. Use of locally made block for dismantling and assembling reducing valve plunger assembly

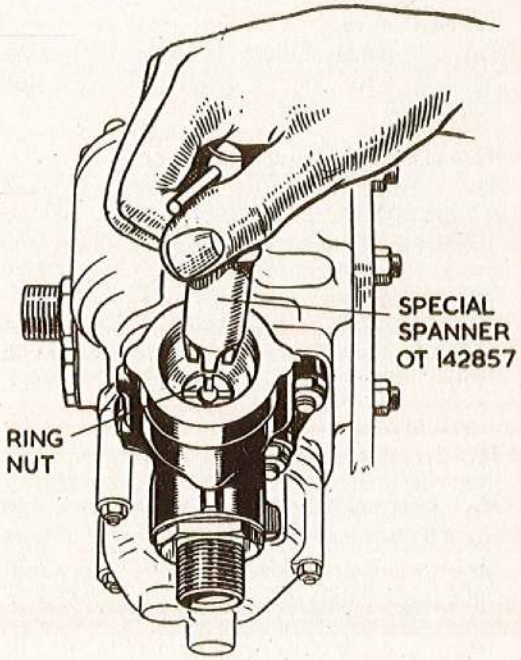


Fig. 7. Use of special spanner O.T. 142857 for unscrewing slotted ring nut in reducing valve body

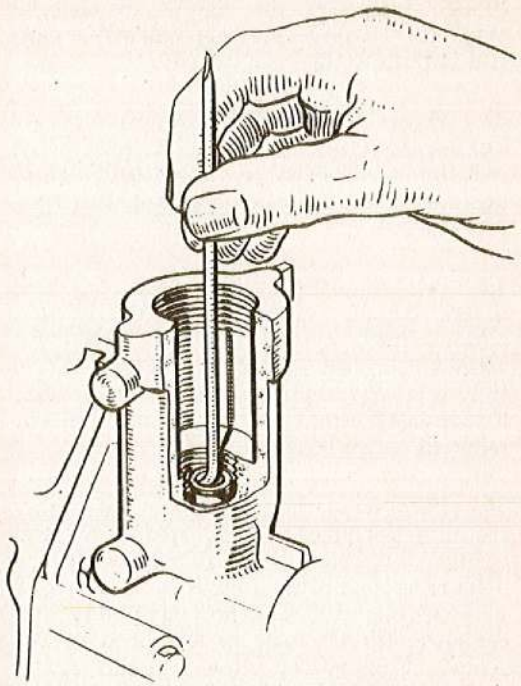


Fig. 8. Tool for lifting out shim and rubber seal from reducing valve body

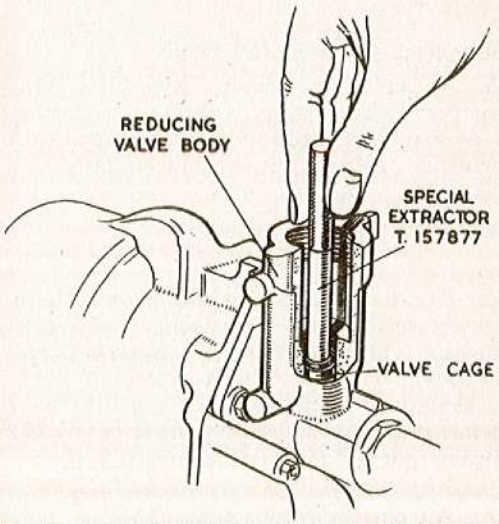


Fig. 9. Use of special extractor T.157877 for removing and fitting cage

30. If dismantling is necessary, lower the assembly into the special block (*fig.* 2 *and* 6) and proceed as follows :—

OP. 1. Extract the split pin securing the castellated nut to the spindle of the reducing valve and unscrew the nut.

2. Lift off the upper washer, rubber seal, lower washer and spring plate.

3. Lift the spindle out of the block.

31. Knock back the lips of the tab-washer locking the ring nut in the base of the reducing valve body and remove. Unscrew the ring nut, using the special spanner

OT.142857 (*fig.* 7) and lift out the shim and rubber seal (*fig.* 8). Screw the special extractor T.157877 into the ball valve cage and withdraw the cage (*fig.* 9).

32. Knock back the lips of the tab-washers locking the three nuts which secure the reducing valve body to the barostat body, unscrew the nuts and remove, together with tab-washers.

33. Lift off the reducing valve body and invert, to allow the ball to fall into the hand. Remove the ball seat and joint washer using the special tool (*fig.* 2). Carefully remove the joint and the two ferrules, if damaged, from the joint face of the reducing valve body.

34. Prise back the lip of the tab-washer securing the screw to the spill valve and remove this screw, using two screw drivers —locating one with the slots in the spill valve through the reducing valve body, and the other in the slot in the head of the screw. Remove the screw and tab-washer and lift off the distance piece and spherical seating; withdraw the spill valve from the reducing valve body.

Filter plug and associated details

35. Unscrew and remove the filter plug together with washer from the barostat body using a standard $\frac{7}{8}$ in. Whitworth ring spanner. Lift out the wire-wound filter and the sealing washer.

CLEANING

36. The bench upon which the work is to be effected should be covered with zinc sheeting or linoleum which must be kept scrupulously clean. Clean containers must be available for storing all dismantled parts. Before cleaning the barostat body or covers, ensure that all gaskets are removed.

37. All parts must be thoroughly cleaned and washed before reassembly. For this purpose a washing plant having a paraffin bath and spray gun must be available, and the plant must have adequate filtering facilities for removal of foreign matter from the paraffin. Hard brushes or abrasives must not be used for cleaning, or rag for drying. After cleaning, all parts must be dried by compressed air; when all parts have been dried and cleaned they are to be laid out for inspection.

INSPECTION

General

38. All viewing and inspection checks are contained in this section. Where dimensions and clearances are to be checked refer to the Schedule of Fits and Clearances.

39. Each detail should receive close scrutiny for any signs of damage or wear and, if necessary, renewed. The detail components are grouped as nearly as possible into sub-assemblies, each group under a main heading.

40. Separate details which do not form part of a sub-assembly are dealt with nearest to their associated group, and the viewing and inspection checks are listed to correspond with the normal dismantling sequence of operations.

Distortion checks

41. Distortion checks are not normally necessary.

Permissible wear

42. All parts subject to wear should be checked with the Schedule of Fits and Clearances.

Redundant and consumable parts

43. During inspection all parts rendered redundant by the embodiment of essential modifications must be rejected. Inspectors must therefore have complete information concerning relevant modifications. Tab-washers, split pins, gaskets and other consumable parts must be rejected during dismantling.

Scores and surface damage

44. In general, scores on moving parts or joint faces may cause leakage and impair the operational efficiency of the unit all parts so affected must be replaced. Where spares are not readily available, very slight surface scoring, insufficient to seriously affect the efficiency or safety of the unit, may be acceptable. Slight scoring of the servo piston skirt and sleeve is permissible In all instances the acceptance of such parts is at the discretion of the inspector-in-charge.

Installation connections

45. Carefully examine all adapters for cleanliness and for general condition. Ensure that the threads are undamaged. Inspect all banjos for cleanliness and damage. Ascertain that the joint faces are smooth, otherwise leakage may result when re-assembled.

Relay relief valve

46. Examine the ball valve for cleanliness and damage, and ensure that the helical spring is free from distortion, fracture and sharp edges. Check that the shims are not cracked or damaged, and that the spring bore is clean, that its threads are undamaged, and that the hexagon flats also are undamaged. Examine the relief valve plug for condition.

Top cover

47. Examine the top cover, especially the joint face, for damage; leakage may result when reassembled.

48. If the piston stop screw has been removed for any reason, ensure that its threads are clean and undamaged; also that its hexagon flats are not worn.

49. Check that the duct in the cover connecting the main piston cylinder with the control valve bore is quite clean and unobstructed. Ensure that the ferrule is clean, undamaged and not distorted.

Piston and associated details

50. Examine the piston carefully for damage and excessive scores, and the circlip groove for rags of metal and sharp edges.

51. Check that the circlip is not distorted or broken. Examine the seal retaining ring for cleanliness and damage, and the oil seal itself for distortion and swelling.

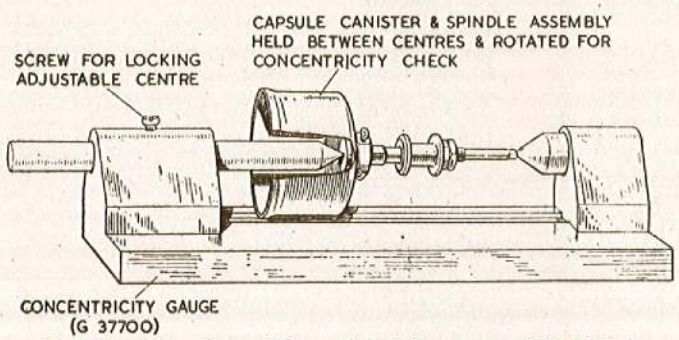


Fig. 10. Use of special concentricity gauge G.37700 for checking alignment of capsule canister and spindle assembly

52. Examine the piston sleeve for cleanliness, excessive scores and other damage.

Note . . .

Although slight scoring on piston and sleeve will not normally affect performance of the unit, bad scores are likely to produce hysteresis or excessive back leakage.

53. Inspect the upper spring carrier for damage, and ensure that the spring cage is clean and undamaged, also that the ball and housing are sound and clean. Check that the helical springs are free from corrosion, fractures and sharp edges. Inspect the shims for distortion and cracks. Examine the lower spring carrier and spring cage for damage.

Bottom cover

54. Examine for condition and cleanliness, and ensure that the sealing face is free from damage.

Capsule stop-ring assembly

55. Examine the spring for fractures and sharp edges.

56. Carefully inspect the polished contact faces of the rocker lever for cracks and the spindle bore for cleanliness.

57. Inspect the distance piece for cleanliness and damage, and check that the spindle is clean and free from corrosion, distortion and other damage.

58. Examine the stop-ring generally for cleanliness and damage. Ensure that the holes for the rocker lever spindle are clean and free from obstruction and that the tapped holes, used for withdrawal purposes, are clean and serviceable.

59. Ensure that the push rod is a good sliding fit in its bore in the main casting. Examine the rod for corrosion and distortion and inspect the detachable tips of the push rods for damage.

Capsule canister assembly

60. Normally, it is not necessary to dismantle this assembly unless damage is noticed or suspected, therefore examine generally for damage, and ensure that the lock-nut is securely fastened.

61. Check the alignment of canister and spindle by means of the special concentricity gauge G.37700 (*fig.* 10). This gauge has two centres, one of which is adjustable laterally. For this check the canister spindle is held between the centres and rotated.

Capsules

62. To ensure that the capsules have not collapsed, hold the six capsules together in pairs, the soldered pips of each pair facing inwards, the three pairs being held together, one above the other. Should any capsule have collapsed, it will be readily noticeable as the distance between the capsules will vary.

Control valve

63. Examine the control valve thoroughly for damage of any kind. Ascertain that the bearing surfaces are clean and show no signs of corrosion. At the same time, check that the control valve moves freely in the main casting bore without binding. Ensure that the two ports in the valve are clean and free from obstruction.

Reducing valve body, details

64. Inspect the spill valve for cleanliness and damage, and ensure that the valve ports are clean and the oil relief grooves free from obstruction. Check that the valve moves freely in the bore of the valve body without binding.

65. Ensure that the reducing valve plug is clean and undamaged. Examine the reducing valve plunger assembly very carefully for general condition. Ensure that the rubber seal is free from distortion, swelling or breakage. Examine the threads of the spindle for cleanliness and damage, and ensure that the plain lower portion of the spindle is clean and unworn.

66. Check that both washer and spring plate are clean and free from cracks or other damage, and that the helical spring is not chipped or fractured and has no sharp edges. Ensure that the ring nut is clean, that its threads and slots are undamaged, and check that the shim is not cracked or broken. Examine the small rubber seal for distortion, swelling and damage.

67. Inspect the valve cage generally for cleanliness and damage, and the ball for signs of wear. Ensure that the ball seat is clean and free from damage, and that the ball seating face in particular is not worn or damaged. Slight marking of the face may be removed by very light lapping with fine lapping paste, using the lapping tool (*fig.* 2) held in a power-driven check. Ensure that the ball seat is thoroughly washed in paraffin after lapping to ensure that all paste is removed. Check that the copper washer is not cracked or distorted.

68. Inspect the reducing valve body for general condition. Ensure that all internal tappings and drillings are clean, unobstructed and undamaged.

Note . . .

*It is most important that the machined faces of both reducing valve body and main casting are true with their tapped inner bores. In the event of damage to either of these faces they may be trued up by skimming with the special cutters OT.*130250 *or OT.*130251 (*fig.* 10); *only the minimum of metal must be removed to re-establish alignment* (*para.* 79).

69. Check that the sealing face is clean and undamaged. Ensure that the spherical seating of the spill valve is sound, also that the distance piece is undamaged. Examine the screw generally for condition and ensure that the ferrules are serviceable and clean.

Filter plug and filter

70. Examine the plug, particularly on the threads, for cleanliness and damage, also the internal bore which houses the filter and the drilled passages which connect to it. Examine the filter itself for cleanliness and for damage to the wire-winding or soldering.

Body casting

71. Examine the body casting generally for cleanliness and damage (*para.* 68). Ensure that all studs are free from distortion and damaged threads, and check that all joint faces are free from damage, and that all internal tappings are clean and undamaged. Ensure that all internal drillings are clean and unobstructed, and remove any sharp edges.

REBUILDING THE UNIT SUB-ASSEMBLIES

General

72. Again ensure that all details are thoroughly clean before commencing to assemble. It is advisable when fitting joints to apply a thin coating of petroleum jelly to facilitate location.

73. Before actually commencing to rebuild the unit it is advisable to prepare various sub-assemblies in order that rebuilding may become a straightforward procedure. The various sub-assemblies are first completed as follows.

Piston assembly

74. Place the piston on the bench, open end downwards, and lower the piston seal into position, the open end of the "U" section uppermost. Locate the seal retaining ring into position in the seal with its smaller diameter facing downwards and, using standard circlip pliers, lock the circlip into position in its groove in the piston.

Capsule stop-ring assembly

75. Locate the straight portion of the spring arm with the internal drilling in the wall of the stop-ring, and with the distance piece and holes for the spindle in the stop-ring. Tap the spindle through its locating holes, in the capsule stop-ring, spring, distanee piece and rocker lever, using a hammer and suitable drift. Ensure that the spindle is positioned correctly in the stop-ring, i.e., centrally, with no projection of the spindle ends beyond the circumference of the stop-ring. Lift the free arm of the helical spring on to the top of the rocker lever.

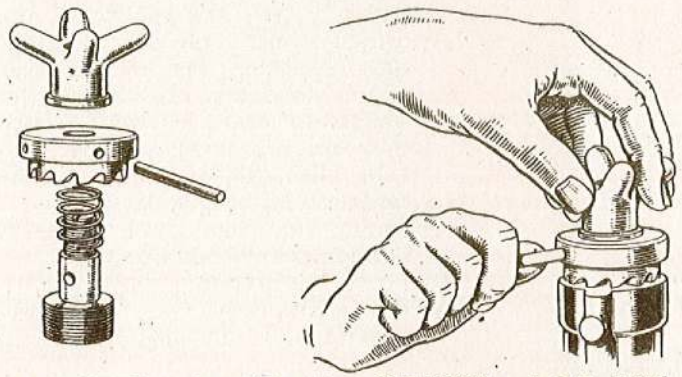


Fig. 11. Use of special cutters O.T. 130250 and O.T. 130251 for truing casting faces

Capsule canister assembly

76. Position the washer inside the canister, over the hole in its base. Lower the canister spindle (small-end first) into the canister and pass it through the washer and through the hole in the base of the capsule canister. Locate a washer on the spindle under the canister and screw on the securing nut. Tighten this nut securely, holding the spindle by means of the flats provided.

77. Drill the spindle through the hole in the nut to take a $\frac{1}{16}$ in. dia. split pin and pass the pin through both nut and spindle and secure (*para.* 99). Screw the adjusting nut on to the spindle, plain end inwards, and secure temporarily with the lock-nut —this is locked finally when calibrating the unit.

78. This assembly must then be tested for concentricity using the gauge G37700 shown in use in fig. 10. By rotating the canister any misalignment or deformation will be readily seen. Slight misalignment can be corrected by gently setting the spindle in the desired direction.

Reducing valve assembly

79. If it is found necessary to true up the casting face of the reducing valve or filter plug (*para.* 68), the following procedure should be adopted:—screw the centre spindle of the cutter assembly No. O.T.130250 into the threads which locate the plug, lower the spring and cutter on to the spindle and retain with the wing nut (*fig.* 11). Insert a tommy bar into one of the holes in the cutter and turn gently, tightening the wing nut until just sufficient metal has been removed to true up the face. The same procedure is adopted if it is found necessary to true up the casting face for the spill valve adapter and relay relief valve except that cutter assembly O.T.130251 is used in place of assembly O.T.130250.

80. Position the plunger valve spindle in the special block (*fig.* 6), holding it by its hexagon flats, lower the spring plate on to the hexagon, then the large shim, seal (cup uppermost) and washer, and secure with the castellated nut. Drill the spindle through the slots of the castellated nut and secure with the split pin (*para.* 99). Remove the assembly from the block.

Spring carrier assembly

81. Place the ball housing on the bench, insert ball and firmly tap the ball valve seat fully home. Place the spring carrier on the bench, flange uppermost, and place shims in the base of the spring carrier, the maximum shimming allowed being 0·010 in. On units being overhauled it is advisable to shim up to the same thickness

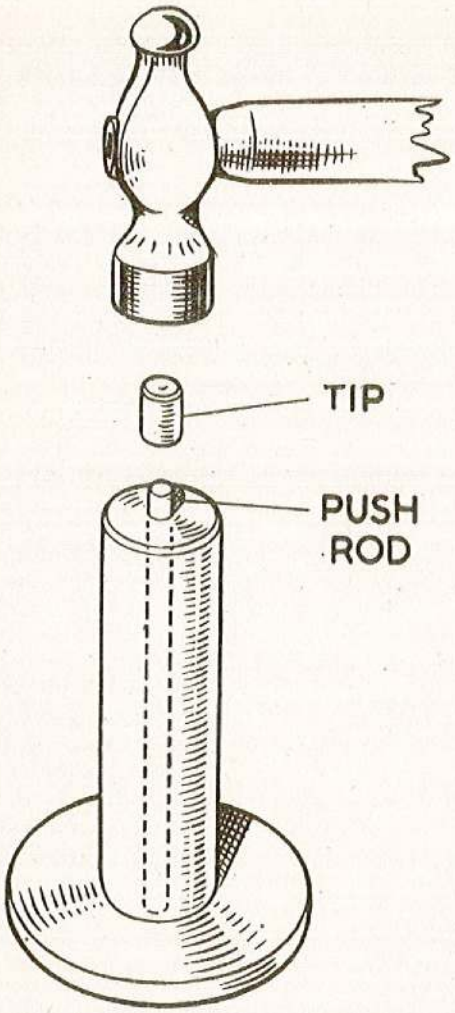


Fig. 12. Use of special assembling tool T.164247 for fitting tip to push rod

as when dismantled (*para.* 19), further adjustment to shimming being effected if necessary during calibration.

82. These complete the sub-assemblies and normal assembling may then proceed.

REASSEMBLY

Rebuilding the barostat body

83. Before proceeding with the rebuilding of the barostat body ensure that the faces of the main casting, against which are fitted the filter plug, the relay relief valve plug and outlet adapter, are undamaged. If it is found necessary to reface these seatings, proceed as described in para. 79, using cutter assembly O.T.130250 for the filter plug face and assembly O.T.130251 for the other two faces. Ensure that all parts are clean and then assemble the unit as follows :—

OP. 1. Gently tap one tip on the push rod, using the special assembling tool T.164247 (*fig.* 12). Lower the rod into the main body from the rocker lever end, untipped end first.
2. Ensure the push rod is quite free in its bore, then tap on the tip at the other end.
3. Position the ferrule (if removed) correctly in the upper face of the main body using the special punch (*fig.* 2 *and* 13).
4. Place the spring plate on the control valve, then the helical spring, over the control valve, on to the spring plate.
5. Lower the control valve into its sleeve in the main body, through the spring plate and helical spring.
6. Ensure that the control valve moves freely in its bore.
7. Position the six separate capsules, in one stack of three pairs, on to the control valve and spring carrier, the soldered pips of each pair of capsules facing inwards.
8. Carefully feed the spindle of the capsule canister through the stop-ring, springing the rocker lever away sufficiently to allow the spindle to pass ; carefully release the rocker lever to allow it to engage with the adjusting nut of the capsule canister spindle.
9. Ensure that the dowel pin is in position in the body casting.
10. Locate the stop-ring correctly with the main body, i.e., with the stop-ring slot in alignment with

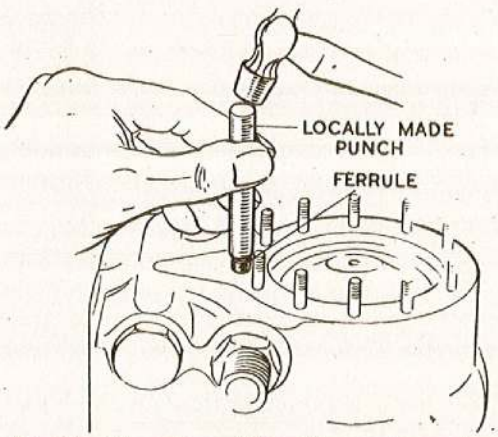


Fig. 13. Use of special locally made punch for fitting ferrule

its dowel pin, lower the stop-ring into position in the main body, and carefully tap the stop-ring fully home.

OP. 11. Ensure that the rocker lever is positioned centrally over the push rod, and that both push rod and rocker lever operate freely.

12. Lower a slave gasket over the studs in the main body around the capsule canister.

13. Ensure that the canister spindle is positioned centrally, so that it will enter its housing in the cover correctly, and lower the bottom cover on to the main studs in the casting. This cover should start easily on the studs, otherwise distortion of the studs is indicated; this must be rectified before proceeding. Should the cover not lower completely against the casting face this may be due to the canister spindle failing to locate with its housing in the cover. On no account should this cover be forced home, otherwise this may collapse the capsule canister.

14. At this stage, the cover should be secured by two nuts and plain washers, diametrically opposite across the body.

Rebuilding the reducing valve

84. Mount a slave barostat body on the assembling jig T.127066 with the reducing valve body bore in the vertical position (*para.* 29).

OP. 1. Insert the two ferrules in the reducing valve body by means of the locally made special punch (*fig.* 2).

2. Push the spill valve through the inlet chamber of the reducing valve body and lower the spherical seating on to the spill valve, at the same time pressing the latter fully home.

3. Position the distance piece over the inner end of the spill valve, then the tab-washer, and insert the slotted hexagon headed screw into the spill valve. Tighten this screw using two screwdrivers, one to hold in the slot at the larger end of the spill valve and the other in the slotted head of the screw.

4. Mount the reducing valve body on the slave barostat and temporarily secure with two slave nuts and washers to the two central securing studs.

OP. 5. Lower the copper washer into the base of the reducing valve bore, then the ball seat on to it, tapping it gently home with a suitable drift.

6. Lower the $\frac{5}{16}$ in. dia. steel ball on to its seat, then the valve cage, using the special extractor T.157877 (*fig.* 9), followed by the rubber seal and shim, and secure by screwing in the ring nut with the special box driver O.T.142857 (*fig.* 7).

7. Temporarily position the tab-washer into the reducing valve bore over the ring nut. Locate the helical spring correctly in the reducing valve bore and engage the spindle of the plunger assembly with the bore of the ring nut.

Reducing valve pressure test

85. Connect the unit up as shown in fig. 16 and subject it to the following pressure test. With the inlet pressure set to 800/900 lb. per sq. in., and a flow of 60/65 gallons per hour registered on the flowmeter, the reducing pressure should maintain a reading of 50/55 lb. per sq. in. When testing for back leak, set at the above readings, then shut off the supply; if satisfactory the flowmeter spinner should fall to zero.

86. If the ball is not seating fully the reducing valve pressure will increase which will necessitate examination of the ball and seat for the presence of foreign matter or for bad seating. Faulty sealing may be due to flats on the ball or to bad seating faces, and should be rectified by fitting a replacement ball or by careful lapping of the ball seat (*para.* 67).

87. Repeat the pressure test. When satisfactory, remove the reducing valve plunger assembly and helical spring and lock over the tabs of the tab-washer into the hole in the body and the slots in the ring nut. It may be necessary to remove the ring nut and to rub its base slightly with fine emery cloth in order that the tab-washer will correctly align with the hole in the body and the slot in the ring nut.

Note . . .

If the ring nut is removed the pressure test described above must be repeated.

88. With the tab-washer locked and the test satisfactorily completed, remove the slave body and reducing valve from the assembling and dismantling fixture and fit the barostat body being reassembled to the fixture so that when the reducing valve body is fitted its bore will be vertical. Then position the gasket correctly and fit the reducing valve body on to its securing studs on the main casting and temporarily secure with three slave nuts and washers. Fit the spill valve inlet adapter to the reducing valve body, with its joint washer.

89. Lower the rubber sealing washer into the port in the casting opposite to the relay relief valve, then the filter (flanged end first) and lastly the end plug and joint washer. Ensure that the filter plug is fully tightened or leakage will result. Move the barostat unit into the position on the fixture shown in fig. 3.

90. Turn the partially assembled unit so that the top cover face is uppermost, and carefully insert and tap the ferrule, if previously removed, into the main casting duct which connects the drilling through the top cover from the piston bore with the spill connection.

91. Lower the piston sleeve correctly in the main body—this should be positioned with the mark on its end in alignment with the ferrule and the drain hole in the sleeve in line with its mating hole in the main body.

92. At this stage ensure that the piston sleeve does not stand proud of the main body. If a new sleeve is fitted one conforming to this requirement must be selected.

93. Position the gasket over the studs in the main body around the piston sleeve. Place the lower spring carrier over the spherical seating of the spill valve, at the base of the piston bore. Assemble the lower spring cage and springs on to the carrier. Assemble the upper spring cage to the upper spring carrier assembly and fit them in to position on the springs. Carefully align the ball valve with its location in the inner bore of the piston, and slide the piston into its sleeve, at the same time compressing the springs. Ensure that the piston moves freely, without sticking, in the bore of the sleeve. Locate the top cover with the studs in the main casting and temporarily secure with slave washers and nuts.

94. Drop the copper washer into the relay relief valve port, and lower the insert or ball seat into the casting; tighten with special screwdriver T.166362. Position the ball on the seat, and place a 1 mm. shim into the base of the valve plug which forms the spring housing. Lower the helical spring on to the ball in the casting, place a sealing washer over the plug and screw the latter into the main casting.

95. Insert the adapter together with sealing washer into the adjacent outlet port in the main casting, and remove the unit from the fixture.

REPLACEMENTS

Note . . .
Sliding parts in the unit are fitted individually and are therefore not interchangeable.

96. The control valve is lapped to suit its sleeve on initial assembly and is thus not interchangeable. Damaged sleeves will necessitate a new body complete with sleeve.

97. The main piston and sleeve are interchangeable.

98. The spill valve and reducing valve body are mated on initial assembly and are only replaced together.

99. The main springs for the main servo piston of the barostat are carefully selected during the calibration of the unit and care should be taken to ensure that replacements conform to the same spring rate. For guidance in this process the accompanying table should be referred to. The spring rate is expressed as Kg. per mm. and is calculated from a standard formula in which the

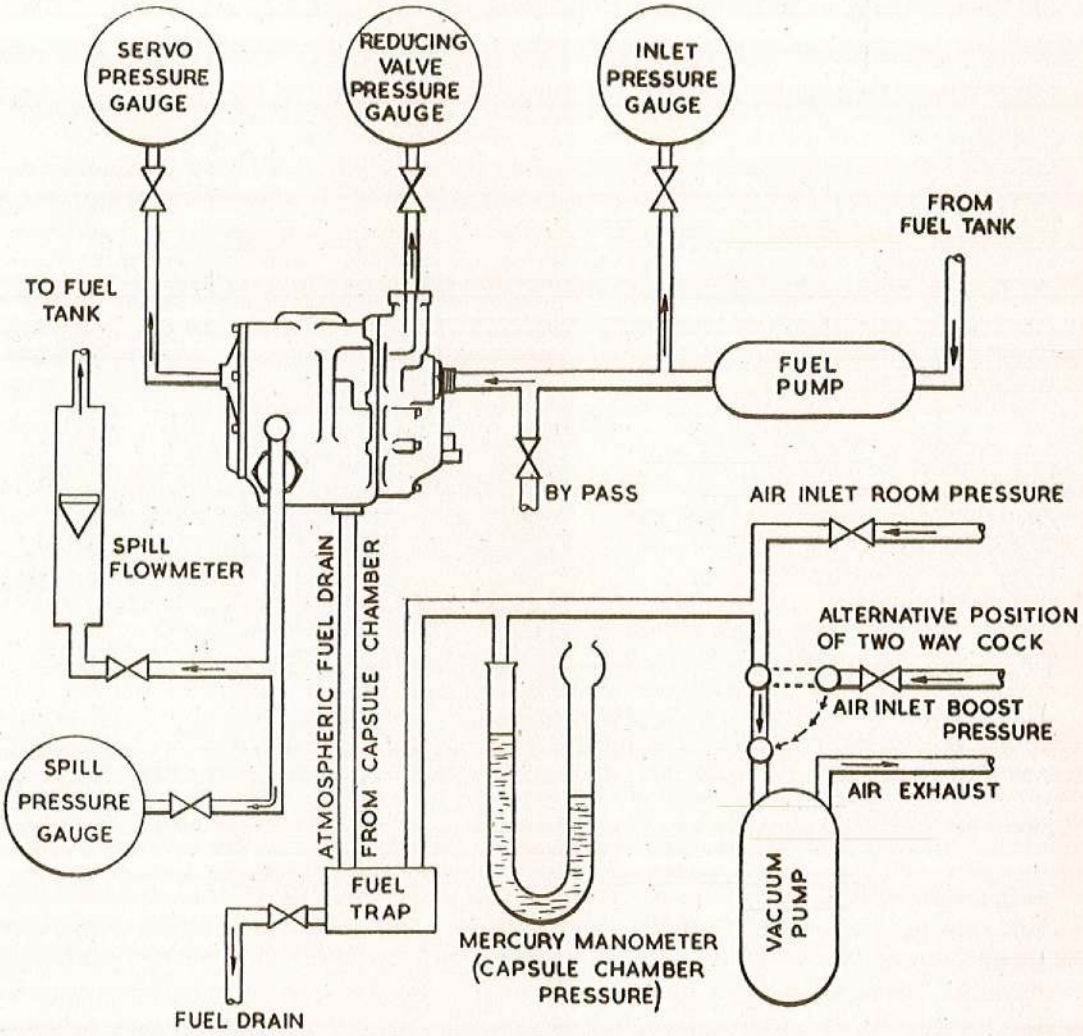
$$\text{rate} = 0{\cdot}179\,\frac{Cd^4}{NR^3}$$

where C=Modulus of transverse elasticity

d=Diameter of wire

N=Number of active coils

R=Mean radius of the coil



THE RANGE OF THE GAUGES AND FLOWMETERS MUST PERMIT ACCURATE OBSERVATIONS OF ALL VALUES DEALT WITH

Fig. 14. Schematic layout of test rig

Type	Installation Code	Springs						Combined Nominal Rate
		Outer		Intermediate		Inner		
		Colour	Rate	Colour	Rate	Colour	Rate	
M	15C	Aluminium	0·99 ±0·03	—	0·80 to 0·87	—	0·45 to 0·58	2·35

Note . . .

When already drilled spindles and nuts are used for either the capsule canister or reducing valve assemblies and the hole through the nut does not align with the hole in the spindle, one further drilling only is permissible and this must be at right angles to the existing hole. Spindles which have already been drilled twice must be renewed.

RIG TESTING

General

100. Carefully record all calibration test results for subsequent entry into the official test record sheet.

101. Unless stated otherwise the fuel used throughout these tests is to be kerosine to specification D. Eng. RD2482, latest issue, the limits of its temperature to be between 20 deg. C minimum and 26 deg. C maximum, and checks should be made at regular intervals to ensure that the fuel used conforms to these standards.

High-pressure test

102. Remove the reducing valve body complete from the barostat unit and fit instead a blanked-off slave body fitted with a dummy relief valve having no spill holes ; this is supplied with the test rig equipment.

103. Mount the barostat unit on the rig as shown in the schematic diagram (*fig.* 14) and connect the inlet and outlet connections as shown, a pressure gauge of suitable capacity being connected to the inlet line. Blank off the other connections with the exception of the atmospheric drain, which may be left open.

104. Start the rig and raise the inlet pressure to 1,500 lb. per sq. in. and maintain the pressure at this value for two minutes. Carefully examine the unit during this period and ensure that there is no leakage other than through the atmospheric drain. In the event of leakage, trace and rectify. On satisfactory completion of the test remove the slave unit and fit instead the normal reducing valve assembly.

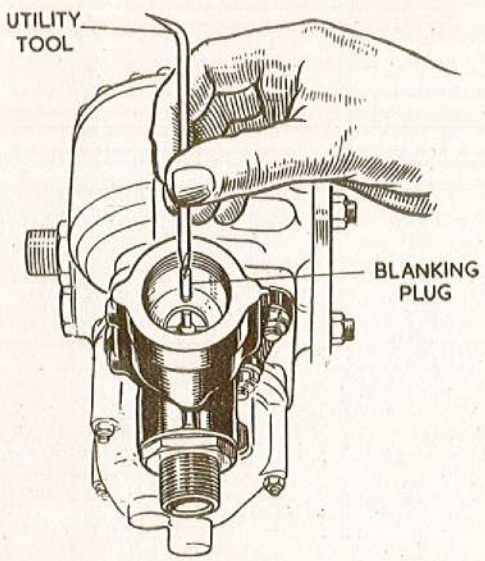


Fig. 15. Locally made tool for tightening blanking plug in reducing valve body

Setting of relay relief valve

105. Unscrew the reducing valve plug and remove with plain washer. Withdraw the reducing valve assembly comprising nut, shim, spindle, split pin, washer and spring plate. Then remove the helical spring and tab-washer. Blank off the drain hole in the base of the reducing valve bore using the special locally made blanking plug and tool (*fig.* 15) taking care not to damage the valve bore.

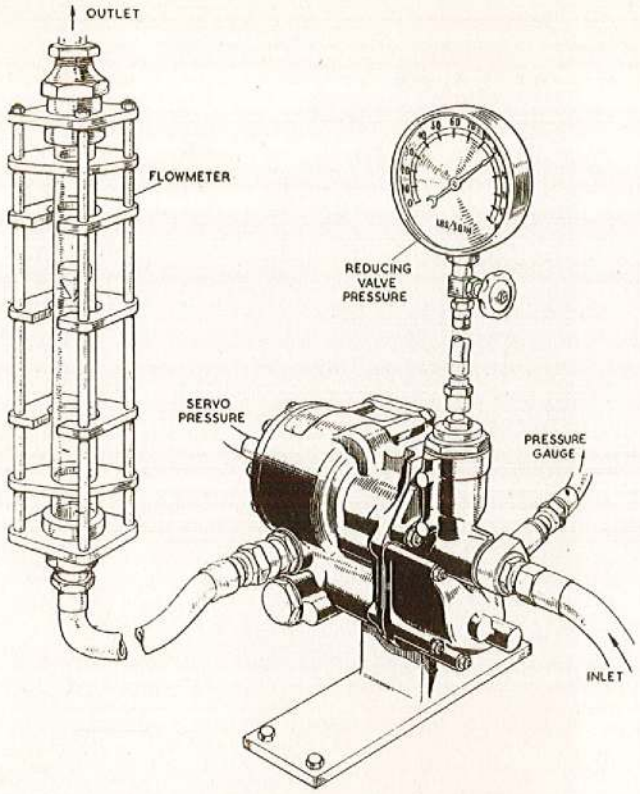


Fig. 16. Setting the relay relief valve

106. Mount the barostat unit on the rig and connect the pipes to the unit as shown in fig. 16, using a specially adapted end plug which has a pressure test connection; this is supplied with the test rig.

107. Start the rig and steadily increase the inlet pressure until the relay relief valve blows off; this will be indicated by a sudden increase in spill flow shown on the flowmeter.

108. Observe the pressure of the gauge connected to the reducing valve body; when the relay relief valve blows off, it should record between 85 and 105 lb. per sq. in.

109. If the valve blows off outside these limits, unscrew the relay relief valve plug and remove together with the plain seating washer, after which the loading of the spring for the relief valve can be altered as desired. Insert additional shims if the valve blows off below the lower limit, and remove shims as necessary if the valve blows off above the upper limit. The maximum thickness of shims allowed is 3 m.m.

110. If the blow off value is still below the lower limit, fit a replacement spring of suitable rate in the relay relief valve plug and re-test.

111. On the satisfactory completion of this test disconnect the pressure gauge connection and special end plug (*para.* 106), from the reducing valve body; remove the special blanking plug (*para.* 105) and refit all items mentioned in para. 105 except the end plug and washer. The special end plug and pressure gauge connection will be required for further tests.

Spill flow test

112. With the barostat unit still mounted on the rig as for the previous setting, proceed as follows:—

OP. 1. Start the rig, set the manometer to 30 in. Hg. absolute corrected, i.e., I.C.A.N. sea-level stationary conditions, and adjust the inlet pressure to 100 lb. per sq. in.

2. Observe the spill flow as indicated by the flowmeter; this must not exceed 5 gallons per hour.

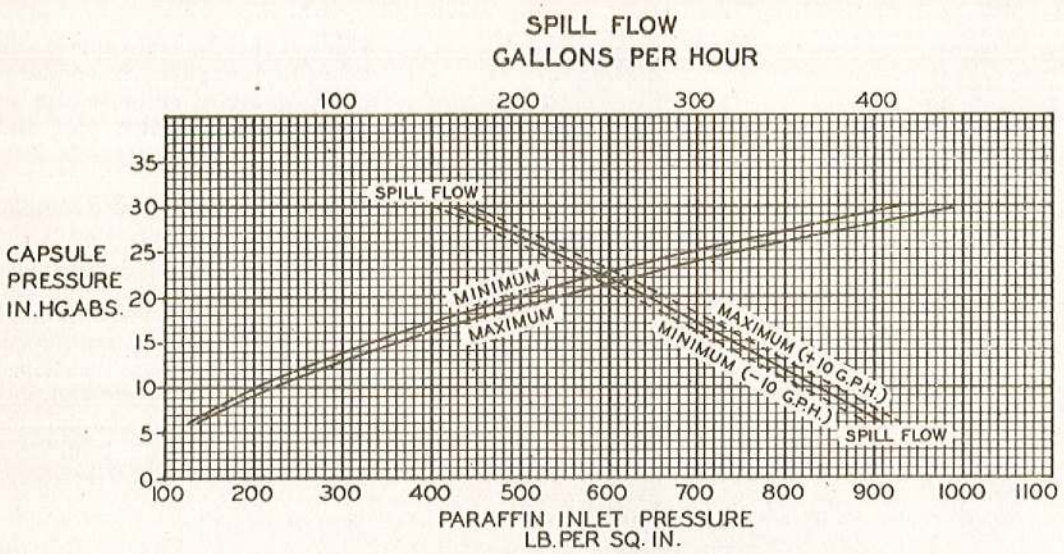
3. If the spill flow is excessive and the reducing valve pressure gauge indicates that the reducing valve is working satisfactorily, a sticking spill valve must be suspected and should be examined and rectified.

4. The actual spill flow obtained, together with the inlet pressure, should be noted and entered on the official test sheet.

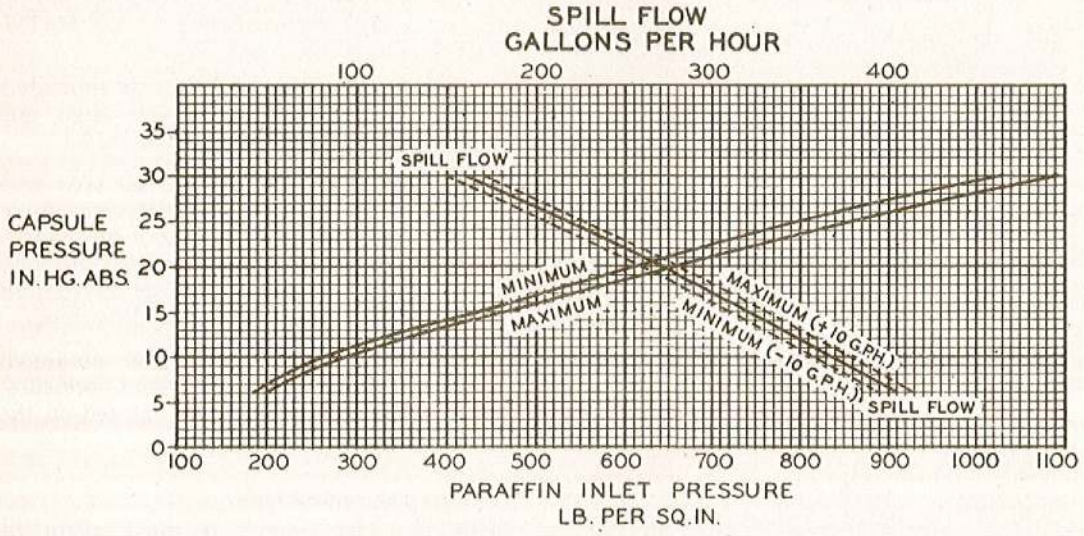
Preliminary calibration

113. The barostat unit must again be connected up on the rig as shown in fig. 14 and the unit calibrated.

114. Start the rig and set the barostat unit to ground level conditions, i.e., a capsule chamber pressure of 30 in. Hg. absolute as recorded on the manometer



PERFORMANCE CURVES FOR BAROSTAT
TYPE ACU/M15 CALIBRATION 'B'



PERFORMANCE CURVES FOR BAROSTAT
TYPE ACU/M15 CALIBRATION 'C'

Fig. 17. Performance curves

(correction being made for the barometric pressure of the day), and the spill flow as tabulated in the following calibration table (*fig.* 17).

CALIBRATION TABLE (*Fig. 17*)

		Calibration "B"						Calibration "C"					
Capsule pressure in. Hg. absolute		30	25	20	15	10	6	30	25	20	15	10	6
Spill flow in G.P.H. (± 10 G.P.H.)		160	215	270	320	367	403	160	215	270	320	367	403
Inlet pressure in lb. per sq. in.	Maximum	990	758	553	370	220	136	1,090	865	655	470	290	200
	Minimum	930	702	513	340	200	124	1,030	805	615	440	265	185

Note . . .
To achieve the necessary vacuum seal after any adjustment to the canister spindle, the bottom cover must be refitted correctly before re-testing the calibration setting.

115. If the inlet pressure does not come within the limits specified, it will be necessary to adjust the setting.

116. If the inlet pressure is above the maximum limit remove the bottom cover from the barostat unit, slacken the lock-nut, and move the adjusting nut of the spindle anti-clockwise to cause a slight inward movement of the canister spindle. By this means the position of the control valve is raised via the push rod to cause a slight upward movement of the main piston. This slightly eases the pressure of the springs against the fuel relief valve, increases the spill flow and reduces the inlet pressure.

117. If the inlet pressure is below the lower limit, remove the bottom cover from the barostat unit, slacken the lock-nut and move the adjusting nut of the spindle clockwise to reverse the operation described above.

118. Set the barostat to altitude conditions, i.e., 6 in. Hg. absolute corrected, set the spill flow to the specified value (as in the appropriate calibration code) and observe the inlet pressure. If different from that specified, again adjust the canister spindle.

119. If all adjustment has been taken up on the canister spindle and the inlet pressure is still below the minimum limit, additional shims in the ball housing of the upper carrier for the main springs may enable the desired setting to be obtained. This will necessitate the removal of the top cover of the barostat unit and withdrawal of the main piston to enable the upper spring cage, complete with the spring carrier, ball, ball housing and shims to be removed.

120. Carefully tap the ball housing, complete with ball and shims, out of the spring carrier using a hammer and drift of convenient size. Insert further shims as necessary in the spring carrier, and refit the ball housing into the carrier, using a hammer and suitable drift.

Note . . .
The total thickness of shims must not exceed 0·010 *in.*

121. Refit the spring cage complete with carrier, shims, ball housing and ball with spring shims on to the main springs. Refit the main piston correctly on the ball seat in the piston sleeve, and secure the top cover on to the barostat with five slave nuts and washers.

122. With the barostat again connected as shown in fig. 14, start the rig and again set the manometer and barostat to sea level stationary conditions corrected (*para.* 114.)

123. If satisfactory under these conditions set the barostat to altitude conditions, i.e.,

6 in. Hg. absolute corrected, adjust the spill flow to the appropriate value as tabulated in the calibration code, and observe the inlet pressure; this should correspond with that listed in the appropriate calibration code.

124. It may be that "bottoming" of the piston occurs at this altitude setting, which means, in this instance, that the piston is hard against the top cover of the barostat body before the full calibration setting is achieved, the inlet pressure becoming stabilised in spite of alteration above or below the 6 in. Hg. absolute pressure.

125. If "bottoming" occurs before the specified altitude conditions are reached the raising or lowering of the curve bodily over the whole range will be necessary. This may be achieved by changing the individual springs in the main spring stack to produce different loadings yet have the same combined spring rate.

126. In addition, further adjustment to calibration settings can be made by changing the main piston springs to give a slight difference in combined spring rate, and will tend to alter the slope of the calibration curve.

127. An increase in rate will reduce the inlet pressure under altitude conditions (i.e., low absolute pressures) relative to any given inlet pressure at sea-level stationary conditions (i.e., 30 in. Hg. absolute pressure).

128. A reduction in spring rate will have the converse effect to that stated above.

129. The calibration curves achieved may be moved bodily towards either higher or lower inlet pressure limits by means of the canister spindle adjustment described in para. 116.

130. By suitably combining this range of adjustments it will be possible to bring the calibration settings of the barostat within the specified range.

131. When the specified inlet pressures are steadily maintained both at the upper and lower ends of the calibration range, without any further adjustment, effect a complete test at the specified altitude pressures as tabulated in the calibration table. Figures should be noted with increasing and decreasing capsule pressures and when satisfactory the bottom cover should again be removed and the canister spindle lock-nut tightened provisionally against the adjusting nut, and the cover again fitted.

Preliminary flick test

132. With the barostat unit mounted as shown in fig. 14, start the rig and set to the figures listed in the calibration table against 30 in. Hg. absolute corrected. Observe the inlet pressure and then stop the rig pump.

133. Restart the pump without altering the controls on the rig and ascertain that the inlet pressure does not exceed that already observed (*para.* 132) by more than 10 lb. per sq. in. If this figure is exceeded, a sticking spill valve should be suspected and the unit dismantled for inspection of this valve and the trouble rectified.

Endurance run

134. The endurance run is to be of 60 minutes duration. With the barostat unit still mounted on the rig and connected as shown in fig. 14, start the rig and set the unit to the settings corresponding to 30 in. Hg. absolute corrected in the calibration table.

135. Approximately every two minutes over a period of one hour, decrease the capsule pressure from 30 in. Hg. absolute to 6 in. Hg. absolute and increase again to 30 in. Hg. absolute; this cycle is effected automatically on the test rig.

Preliminary hysteresis check

136. The endurance run may be deemed satisfactory and the test certificate endorsed to that effect if the unit passes the following hysteresis check.

137. With the barostat unit mounted on the rig and connected as shown in fig. 14, again subject the unit to a calibration test through the complete range from 30 in. Hg. absolute to 6 in. Hg. absolute and back again to 30 in. as specified in the calibration table.

138. Ascertain that the inlet pressure readings for each corresponding point (both down and up the scale) do not differ by more than 5 lb. per sq. in.

139. Excessive hysteresis will be caused by friction of moving parts and if this is suspected the unit must be dismantled as necessary and the parts suspected of sticking inspected and eased or replaced. Any unit which has been corrected for excessive hysteresis must again be subjected to the endurance test as outlined in para. 134 and 135.

Leakage from atmospheric drain

140. With the unit mounted on the rig and connected as shown in fig. 14 start the rig and restrict the flowmeter inlet so that there is a back pressure in the spill line of 5 lb. per sq. in. Ensure that there is no leakage from the joint faces of the barostat.

141. Allow the spill from the atmospheric drain to run into a measuring cylinder and record the leakage. This must not exceed 5 C.C. over a period of 1 minute.

142. Excessive leakage from the atmospheric drain must be traced and rectified, the probable cause being bell-mouthing of the control valve sleeve, or excessive clearance between the push rod and its bore.

FINAL STRIP EXAMINATION

143. When the preliminary testing is completed satisfactorily, the unit must be dismantled sufficiently to enable all moving parts, such as the main piston, relief valve, control valve, canister spindle, push rod and the corresponding sleeves to be examined.

144. The extent to which the unit is to be dismantled will be at the discretion of the inspector-in-charge, and reference should be made to the relevant preceding para. for the dismantling procedure.

145. Should it be found necessary to fit replacement parts the unit should again be tested as previously described.

FINAL CALIBRATION TESTS

146. If the unit is satisfactory after inspection, make a complete final calibration series of tests as follows, all particulars being entered on the approved test sheet.

147. Check the prevailing barometric pressure ; this must be taken into consideration when setting the manometer for obtaining readings at the various absolute pressure settings listed in the calibration table.

High-pressure test

148. Repeat the high-pressure test already described in para. 102.

Relay relief valve test

149. Repeat the relay relief valve test already described in para. 105.

Final endurance test

150. Repeat the endurance test described in para. 134 but for a period of 15 minutes instead of 60 minutes.

Final calibration test

151. Repeat the calibration test over the full range both up and down the scale as described in para. 113.

152. When satisfactory remove the bottom cover and finally tighten the lock-nut on the canister spindle firmly against the adjusting nut.

Final flick test

153. Repeat the flick test already described in para. 132.

Final leakage from atmospheric drain

154. Repeat the leakage test already described in para. 140.

Setting minimum pressure stop

155. With the barostat unit mounted on the rig and connected as shown in fig. 14, disconnect the tapping to the servo pressure gauge at the barostat top cover, and insert the stop screw in the top cover instead.

156. Start the rig and with the spill flow set to 403 $\pm$ 10 gallons per hour and the manometer at 6 in. Hg. absolute corrected (altitude conditions), observe the spill pressure. Decrease the capsule pressure to 5 in. Hg. absolute and check that the inlet pressure has not dropped by more than 10 lb. per sq. in. of that observed above. Insert shims under the stop screw if necessary until this condition is fulfilled.

General leakage test

157. With the barostat unit mounted on the test rig connect up the inlet and spill pipes as shown in fig. 14 and blank off the reducing valve chamber with the normal installation plug and washer.

158. Wipe and blow the barostat unit thoroughly dry. Start the rig and set the barostat at 30 in. Hg. absolute corrected conditions. After a run of 10 minutes, there should be no signs of leakage from the unit except from the atmospheric drain. In the event of leakage, trace and rectify. When satisfactory, temporarily secure dust caps on the exposed connections and remove the unit from the rig.

PREPARATION FOR DESPATCH

159. Complete the installation connections and lock all tab-washers on the bottom cover.

160. Using stainless steel locking wire of 22 S.W.G., wire-lock the following assemblies :—

Filter and relay relief valve plugs to the adjacent webs on the main barostat body.

Reducing valve end plug to the adjacent web on the body.

Piston stop screw in the top cover to the barostat body.

161. Ensure that the name plate is securely fixed to the main body of the barostat, and that the type indicated corresponds with the details of the actual unit.

INHIBITING

162. Remove the dust caps from the inlet adapter and the drain connection and inject flushing oil (specification D.T.D.561) under pressure into the inlet connection; raise the pressure until the spill valve opens to allow fuel to spill; this will indicate that the unit is filled with flushing oil; refit dust caps.

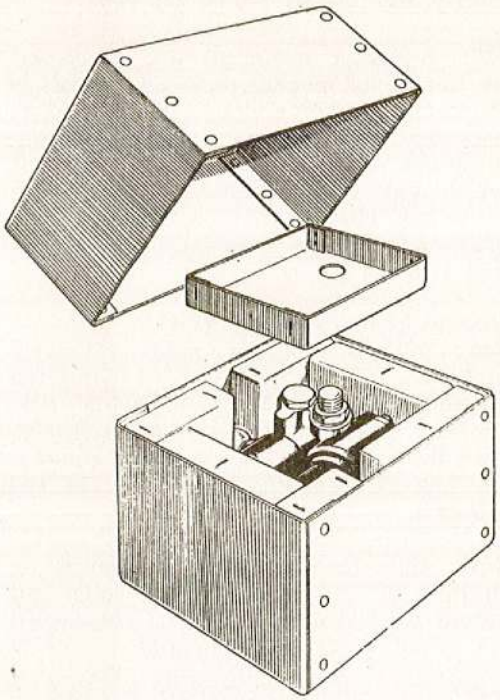


Fig. 18. Special packing box for despatch

PACKING

163. Pack each unit individually in the special container (fig. 18) together with the completed test sheet applicable to the unit.