Chapter 3

CONTROL BOX

This chapter applies to the Goblin Mk. 2 aero-engine

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

GENERAL

1. This chapter details the reconditioning of the control box as fitted to the Goblin Mk. 2 engines (*fig.* 1).

2. The importance of taking particular care during reconditioning cannot be too highly stressed. The control boxes are of precision manufacture and irreparable damage can be done by dropping or by haphazard or incorrect use of tools. It is advisable to have clean metal or wooden trays available in which to place the component parts of each control box.

3. Upon receipt at a Repair Base the group, or individual unit as the case may be, should be suitably recorded, and a route or repair job card issued. The documentary procedure may vary according to the arrangement already in force, but it is recommended that this should cover all stages of stripping and reassembly, and that definite inspectional checks should be included.

4. When dismantling, all parts such as joint washers, tab-washers, and split pins must be scrapped, and it is advisable to ensure that supplies of these are available or that provisioning action has been taken.

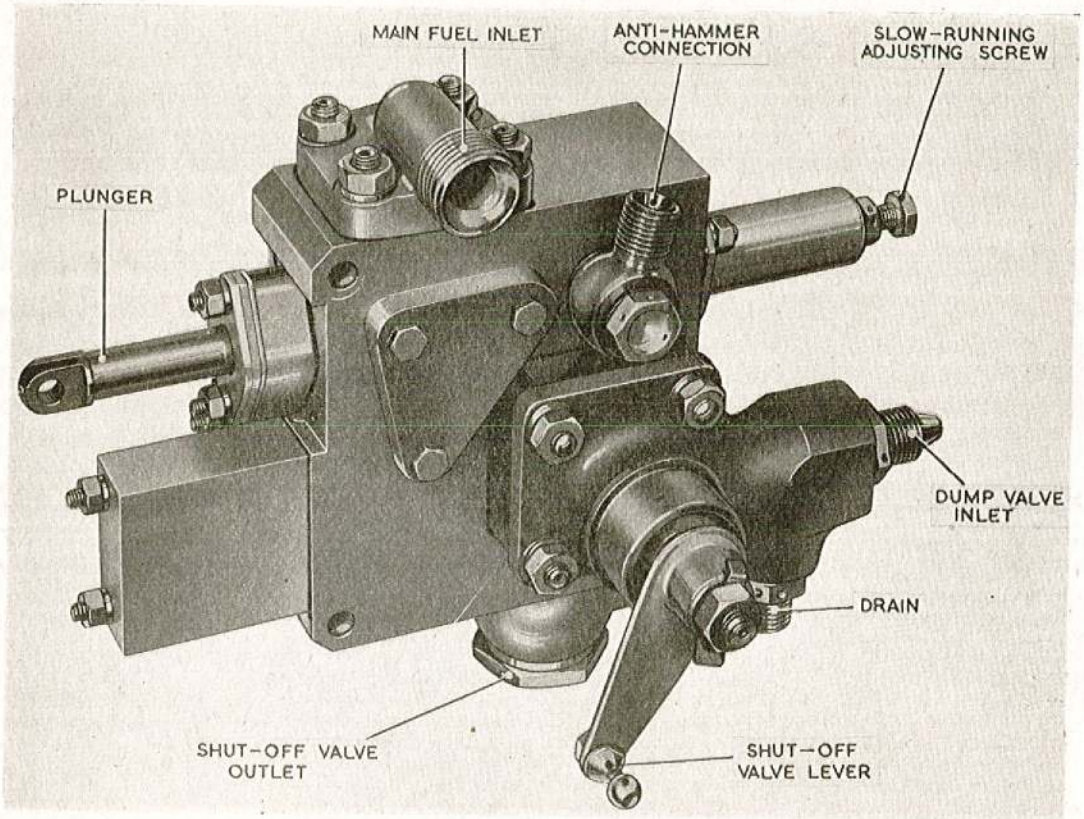


Fig. 1. Control box and dump valve unit

5. After preliminary cleaning and flushing to remove all external dirt and grease, a close visual examination of each control box must be made for external damage or deficiencies. Any damage or deficiency found must be recorded on the job card.

SPECIAL TOOLS

6. The following is a list of special tools required for reconditioning the control box:—

T70264	Shut-off valve lever extractor.
T21503	Spanner for removal of cap-nut from the base of the shut-off valve housing
T72368	Plug gauge for spindle gear
T72369	Plug gauge for bore forming guide for stem of dump valve.
T70038	Gland inserter
T70063	Guide plug
T70053	Inserter for Gaco spindle gland in dump valve assembly
T70041	Dump valve seal inserter

DISMANTLING

7. The following instructions for dismantling the control box are listed in the recommended sequence of operations. Before commencing these operations it is essential that the fuel control valve plunger is pushed fully home in its housing, otherwise it is liable to become bent or damaged and a replacement will be necessary.

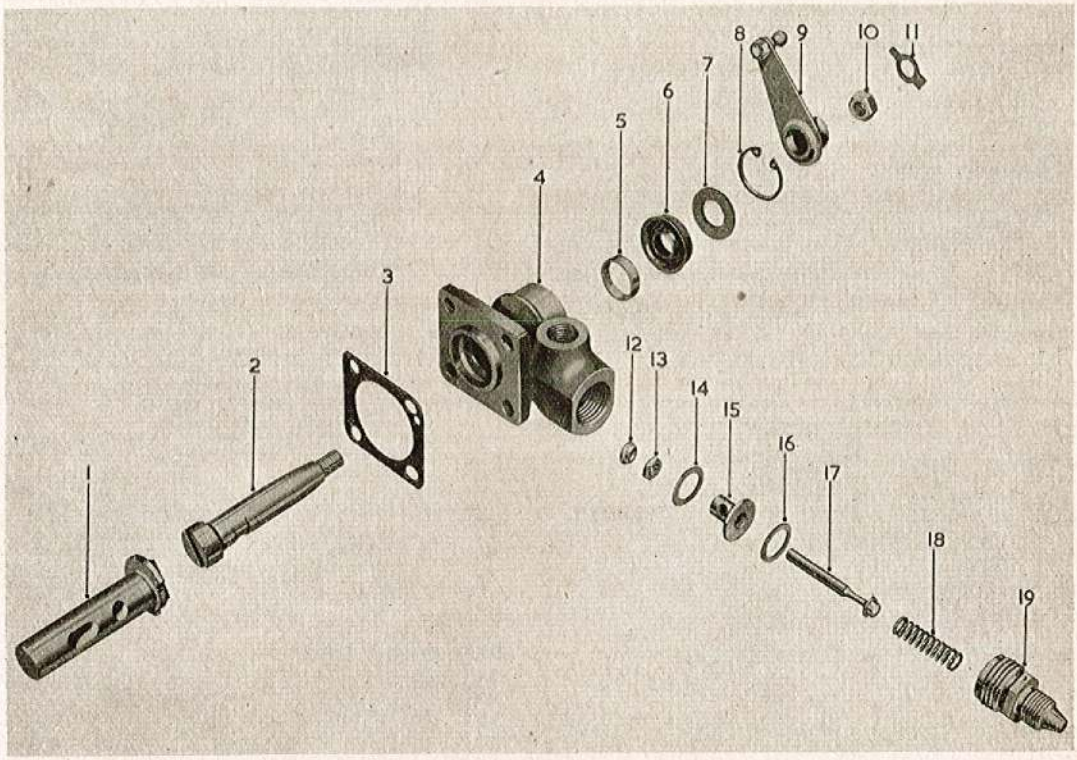
Minimum pressure valve

8. After removal of the minimum pressure valve as described in the following operations, reconditioning should be performed as detailed in Sect. 4, Chap. 2 of this volume.

OP. 1. Unscrew and remove the nuts and spring washers from the four attachment studs.

2. Withdraw the valve.

3. Remove the gauze filter and the small retaining spring from the counterbore in the control box.



1 SHUT-OFF VALVE
2 SHUT-OFF VALVE SPINDLE
3 JOINT WASHER
4 DUMP VALVE HOUSING
5 DISTANCE COLLAR
6 SPINDLE GLAND
7 RETAINING WASHER
8 CIRCLIP
9 SHUT-OFF VALVE LEVER
10 RETAINING NUT
11 LOCKING WASHER
12 WASHER
13 SEAL
14 ALUMINIUM WASHER
15 LOOSE VALVE SEAT
16 ALUMINIUM WASHER
17 DUMP VALVE
18 VALVE SPRING
19 INLET UNION ADAPTER

Fig. 2. Exploded view of dump valve assembly

DUMP VALVE ASSEMBLY (*fig.* 2)

Shut-off valve lever

9. On no account must leverage be used for the removal of the shut-off valve lever from its tapered location on the spindle, as damage to the shoulder of its location will inevitably result.

OP. 1. Bend back the tabs on the washers, and unscrew and remove both the retaining nut and the washer.

2. Insert the horseshoe portion of the extractor T70264 under the flange of the lever, and with the centre pad bearing against the shut-off valve spindle, screw inward the extractor screw and withdraw the lever.

Dump valve

10. It is essential that the dump valve is removed before any attempt is made to withdraw the shut-off valve spindle, as damage by abrasion on the sides of the cam-slot and scores in the bore of the housing will result if removal is attempted with the dump valve stem in position in the cam-slot.

OP. 1. Cut and remove the locking wire.

2. Screw out the inlet union adapter (19) and remove the valve spring (18).

3. Withdraw the dump valve (17), the loose valve seat (15) and the two plain aluminium washers (14 *and* 16) fitted either side of its flange.

OP. 4. Extract the dump valve seal (13). and washer (12) from the bore in the housing.

Fuel dump valve drain

11. Unlock and unscrew the fuel dump valve drain union connection from the side of the dump valve housing.

Dump valve housing

12. Unlock and unscrew the four retaining nuts and withdraw the dump valve housing complete with the shut-off valve spindle from the main assembly. During this removal the coupling dog of the spindle will disengage from the tenon of the shut-off valve which will remain in the control box body.

Shut-off valve spindle

13. It is essential that no attempt must be made to remove the shut-off valve spindle with the dump valve in position.

OP. 1. Withdraw the shut-off valve spindle from the housing.

2. By use of the appropriate circlip pliers remove the circlip from the dump valve housing.

3. Withdraw the gland retaining washer, the Gaco spindle gland, and the distance collar from within the valve bore.

Shut-off valve

14. The rotary type fuel shut-off valve exposed upon removal of the dump valve housing and spindle must now be withdrawn from its bush, which is integral with the control box body. No attempt must be made to extract the bush, as this will be inspected in position.

Control valve plunger assembly

15. Particular care must be taken throughout the following operations to ensure that the control valve plunger is not bent or damaged.

OP. 1. Cut the lockwire and unscrew and remove the two retaining nuts and washers holding the tubular cover over the rear of the plunger.

2. Draw the cover from the two locating studs. Release the lock-nut and remove the slow-running adjustment from the end of the cover.

3. Insert a small tommy bar through the eye of the plunger to prevent it turning, bend back the tabs on the washer and unscrew and remove the 2 B.A. setscrew from the rear of the plunger.

OP. 4. Remove the plunger stop.

5. Lightly stone any burrs which may be present on the plunger and by means of its eye end, withdraw it from the control box body.

6. Extract the seal and collar from the cover end of the plunger.

Note . . .

Upon removal of the last two parts, a small circlip will be visible but, as the purpose of this is to secure the guide bush in position, it must on no account be removed.

7. Remove the two nuts and spring washers securing the control valve dust seal cover in position at the eye end of the plunger.

8. Withdraw the cover, complete with felt washer.

9. Lift off the oil seal cover plate.

10. Extract the Gaco seal and the distance collar from the cylinder bore.

Bleed screw (if fitted)

16. Dismantle the bleed screw as follows:—

OP. 1. Using a small tommy bar screw off the bleed screw cap-nut.

2. Unlock and remove the bleed screw.

3. Unlock and remove the three bolts securing the triangular plate to the control box. Remove the plate and joint washer.

Miscellaneous

17. Complete the dismantling operations on the control box by removing the two banjo connections and their washers, then the large cap-nut and washer from the base of the shut-off valve housing, using spanner 21503. Finally remove the four retaining nuts and spring washers, and withdraw the fuel inlet connection and its washer.

CLEANING

18. Each individual component must be thoroughly cleaned in kerosine and finally flushed off in gasoline. Only approved cleaning processes may be employed, and all passages, etc., of castings must be blown through with an air line at a pressure of not less than 20-25 lb. per sq. in. to ensure the removal of any foreign matter which might cause obstruction and possible failure of the control box.

INSPECTION

Preliminary

19. At the detail strip inspection of the control boxes, the inspector concerned will be responsible for ascertaining the existing modification standard of the control box under consideration, and the approved modifications requiring embodiment in order to bring the control box up to the latest standard.

20. A strip inspection report should be compiled, to convey clearly, and in full detail the following information:—

(1) The current modification standard.

(2) The approved modifications necessary to bring the control box up to the latest standard, that are to be embodied at the overhaul, with particulars of all new parts required.

(3) Details of any salvage, machining, or processing operations required.

(4) Particulars of the component parts requiring replacement due to wear or damage.

21. The strip report should be so produced that a copy will be available to accompany the route or repair job card through the repair section, and to which reference can be made at any stage of the overhaul.

22. All scrap must be segregated, to obviate the possibility of it being refitted. It is recommended that all stressed ferrous parts should be tested magnetically for cracks and flaws, and also that all non-ferrous parts should be given a hot oil and chalk test for similar reasons. Instructions for carrying out both the magnetic and hot oil and chalk tests are given in A.P.880C, Vol. 1.

Control box body

23. During manufacture the control box body is anodically treated during the initial assembling, and is subjected to static and working tests calculated to show up any defects. It is not anticipated, that the serviceability of any unit will be impaired subsequently, by either corrosion or porosity. Proceed with inspection as follows:—

OP. 1. Examine the housing carefully for damage or cracks.

2. Check the joint faces with a straight edge for signs of distortion, which, if apparent, can be remedied by lapping the affected face on a suitable lapping plate, after the removal of any studs. Any casting seriously distorted or having deep indentations in any joint face that cannot be remedied by lapping must be scrapped.

OP. 3. Examine the threads of all tapped locations and, by trial fitting with the corresponding part, check for signs of slackness.

4. Check that all studs receive their nuts without trace of binding, and replace any studs with strained or stripped threads.

Note . . .

All replacement studs should have the fast end smeared with white lead to ensure secure fitting, and to obviate the possibility of leakage from any passage broken into by the tapped location hole.

5. Test each stud for soundness of fit in its casting, and any that show signs of slackness, or are suspected of pulling away must be renewed.

Note . . .

The use of stepped studs is not permissible, so that where necessary, a salvage operation on the location hole must be carried out.

Shut-off valve bush

24. As the shut-off valve bush is virtually an integral part of the control body, being a shrunk-in fit in position, the two components must be inspected together.

OP. 1. Visually examine the bush for general condition.

2. Check the shut-off valve in the bore of the bush and note that there is not excessive clearance.

3. Examine the bore of the bush carefully for signs of scoring, which if only slight can be removed by lightly polishing with a strip of well-worn emery cloth.

Shut-off valve

25. Inspect the shut-off valve as follows:—

OP. 1. Dimensionally check the diameter of the shut-off valve. If wear is in excess of the figures given in Part 2, Schedule of Fits and Clearances, and the stipulated clearance between the valve and its bush cannot be

maintained, a replacement valve must be fitted.

OP. 2. Examine the valve carefully for signs of scoring; if only slight this should be dressed out by careful use of a suitable strip of well-worn emery cloth.

3. Check the dimensions of the coupling tenon at the head of the valve against the figures given in Part 2.

Dump valve housing

26. Examine the dump valve housing in a similar manner to the control box body (*para.* 23, *Op.* 1 *to* 4), and then continue with the following operations:—

OP. 1. Check the diameter of the shut-off valve spindle bore, using the plug gauge T72368.

2. Using plug gauge T72369, check the diameter of the bore forming the guide for the stem of the dump valve.

3. Examine both bores for signs of scoring, which if visible must be carefully polished out.

27. If either of the last two dimensions checked are in excess of the limits stipulated in Part 2, this will entail renewal of the casting.

Shut-off valve spindle

28. It is essential that the clearance between the spindle and its bore is maintained as stipulated in Part 2. Proceed as follows:—

OP. 1. Using a micrometer, check the diameter of the spindle.

2. Examine carefully for scores; if visible these must be lightly polished away.

3. Check the coupling slot in conjunction with the tenon of the shut-off valve

4. Visually inspect the threaded end of the spindle and the adjacent taper portion.

5. Examine the cam-slot for signs of damage.

Shut-off valve lever

29. Inspect the shut-off valve lever for general suitability for further service, paying particular attention to the condition of the ball-end.

Fuel retaining gland

30. The components comprising the gland retaining device must each be examined for serviceability.

Dump valve

31. Inspect the dump valve for general condition, using a micrometer to check the diameter of the dump valve stem against the dimensions given in Part 2. Calculate the worn clearance. Examine the head carefully to ensure that a satisfactory seating will be obtained at re-assembly.

32. The small gland locating collar, the detachable valve seat, the valve spring and the securing union, must be given a careful visual examination.

Control valve plunger

33. The several small components forming the securing and gland retaining devices at the respective ends of the plunger must be examined individually for general serviceability.

OP. 1. Check the control valve plunger for wear at the bush and cylinder bore locations.

2. Examine the plunger carefully for signs of scoring. Any slight marks must be lightly polished out.

3. Check the plunger for straightness by a straight edge, or by rolling on a surface plate.

4. Inspect the eye end of the plunger for wear in the link pin hole, and note the condition of the internal thread at the opposite end.

Control valve bush and cylinder

34. On no account must the control valve bush and cylinder be removed from the control box; the following operations must therefore be carried out in situ:—

OP. 1. Using a Mercer bore-indicator, type 1B.4515, check the dimensions of the bores against the limits given in Part 2.

2. Visually inspect for serious indications of scoring.

Note . . .

In the event of either the bush or cylinder being worn beyond the permissible limits, the control box unit must be returned to the makers for rectification.

Bleed screw (if fitted)

35. Special attention must be paid to the condition of the lock-nut, the hexagon of

which may have become damaged through repeated adjustment.

OP. 1. Examine the screw carefully for the condition of its thread, adjusting slot and taper portion; any irregularities will necessitate renewal.

2. Check the screw with its location in the control body, to ensure that the edge of the hole is not damaged.

3. Examine the triangular plate carefully and check the bleed screw in its threaded location.

4. Inspect the special cap-nut for condition of its thread, and also the small tommy bar hole at its outer end.

Glands and seals

36. Inspect carefully for signs of damage or weakness; the slightest defect will necessitate renewal.

Miscellaneous

37. The strip inspection of the control box is concluded with the examination of the gauze filter and its retaining spring fitted into the bore of the control body at the minimum pressure valve location. Make a general visual inspection of the outside of the body, i.e., the large cap-nut, the two banjo pillars with their respective union connections, and the interconnection. Also make an addition to the strip inspection report of all relevant details concerning processing, embodiment of modifications, and replacement parts required.

REASSEMBLING (*fig. 3*)

Preliminary

38. It is assumed that all processing and salvage operations have been carried out to the satisfaction of the inspectional authority, and that all parts necessary to rebuild the units to the latest standard are available.

39. Castings into which replacement bushes, studs, etc., have been fitted, or which have been subjected to processing, machining or lapping operations, must again be thoroughly flushed, and all passages blown through with compressed air to ensure complete freedom from swarf or dirt.

40. Special attention must be given to the correct fitting of new glands and seals at all the various points throughout the rebuild, by using the special insertion tools, which will be referred to, as applicable, in the following operations.

41. As indicated in para. 5 of this chapter, the fitting of new parts within the category consummable spares is obligatory.

42. At certain stages, which will be stated during the reassembly sequence, some static tests are applied to the unit and while these must be in accordance with the appropriate section of the relevant test schedule, it must be remembered that they do not form any part of the functional testing of the complete unit.

43. Subject to the conditions outlined in para. 38, the shut-off valve and dump valve assembly will first be assembled to the control box.

Shut-off valve

44. Check the shut-off valve in its bore in the shut-off valve bush; it must be ensured a smooth sliding fit by lapping as may be necessary with metal polish (Stores Ref. 33D/157). When a satisfactory fit is obtained, all trace of polish must be removed by flushing in kerosine. Smear the valve with a light coating of lubricating oil and insert into the housing.

Dump valve assembly

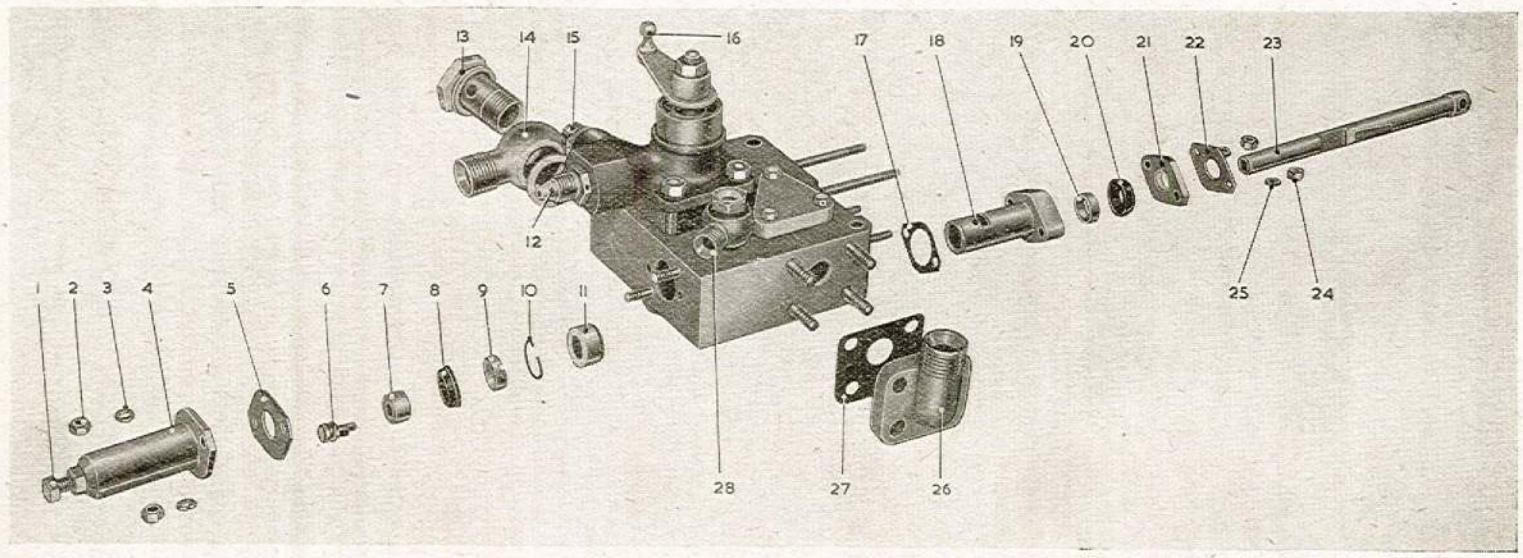
45. Lightly lap the dump valve to its detachable seat to ensure a perfect seating, and then build up the assembly as follows:—

OP. 1. Insert the small washer and dump valve seal into the bore in the housing.

2. Assemble the dump valve in its seat and place a plain washer either side of the seat, then insert this assembly into its housing.

3. Replace the valve spring and secure the assembly by fitting the retaining union connection. It is essential that the union is firmly screwed in.

4. Test the holding capacity of the valve by applying kerosine at a pressure of 800 lb. per sq. in. to the union connection. Upon completion of a satisfactory holding test, remove the dump valve, so that the shut-off valve can be inserted without risk of damage.



1 SLOW-RUNNING ADJUSTING SCREW
2 COVER RETAINING NUT
3 WASHER
4 CONTROL VALVE PLUNGER COVER
5 WASHER
6 PLUNGER SET-SCREW
7 PLUNGER STOP
8 SEAL
9 COLLAR
10 CIRCLIP
11 GUIDE BUSH
12 DUMP VALVE INLET
13 SHUT-OFF VALVE OUTLET BOLT
14 SHUT-OFF VALVE OUTLET BANJO
15 DRAIN
16 SHUT-OFF VALVE LEVER
17 JOINT WASHER
18 CYLINDER
19 DISTANCE COLLAR
20 SEAL
21 OIL SEAL COVER PLATE
22 DUST SEAL COVER
23 PLUNGER
24 RETAINING NUT
25 WASHER
26 MAIN FUEL INLET UNION
27 JOINT WASHER
28 ANTI-HAMMER CONNECTION

Fig. 3. Control box showing plunger assembly exploded

OP. 5. Insert the shut-off valve spindle into its housing.

Note . . .

It is necessary to repeat the warning given in para. 10 *of this chapter. On no account must any attempt be made either to insert or remove the shut-off valve spindle with the dump valve in its housing.*

6. Temporarily fit the dump valve housing with spindle fitted to the four locating studs on the control box.

7. Turn the spindle so that its coupling slot engages with the tenon of the shut-off valve. It will be noted that the coupling is off-set, so that engagement can only be effected in one position.

8. Fit the dump valve housing to the control box, giving special attention to the fit of the housing over the dowel peg in the shoulder of the shut-off valve bush.

9. Secure the housing temporarily to the control box by two of the holding nuts.

Setting the dump valve

46. The correct coupling of the shut-off valve and dump valve spindle will provide the working position of the cam-slot in the spindle and also, by reason of the dowel peg controlling the valve rotation, the correct range of operational movement. The setting of the dump valve may now be completed.

47. This setting consists of a specified amount of valve opening, and although the following instructions apply to a new valve and spindle, it is equally important that, at major reconditioning, the existing valve and spindle are checked and corrected in a similar manner, as may be necessary.

OP. 1. Re-insert the dump valve assembly, less the valve spring, into the valve housing and secure with the union connection.

2. Insert a small metal rod into the union connection until it makes contact with the head of the dump valve. The rod should be approximately 1½ in. in length and of a diameter which will provide a free but stable fit in the orifice of the union connection.

OP. 3. Hold the dump valve assembly in a soft-jawed vice, and mount a dial test indicator so that it contacts the top of the metal rod, as shown in fig. 4.

4. Turn the shut-off valve spindle throughout its full range of movement, when the lift of the dump valve will be recorded on the indicator.

Note . . .

If the amount of lift is less than 0·050 *in. to* 0·060 *in., a new valve must be fitted; when this amount is exceeded the length of the valve must be adjusted by filing, until the D.T.I. readings fall within the limits. When filing the end of the valve stem during the process of valve adjustment, special care must be taken to radius the edge slightly, as indicated in fig.* 5, *to obviate any possibility of picking up during operation. Before disturbing the position of the D.T.I., the inspector must check and approve the setting.*

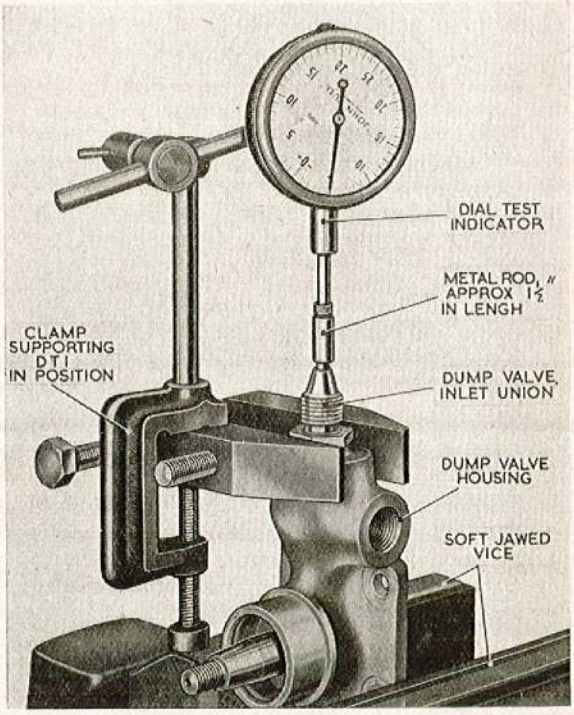


Fig. 4. Setting the dump valve

OP. 5. Remove the dump valve assembly, detach the housing from the control box body and withdraw the shut-off valve spindle, thus enabling all parts to be flushed thoroughly to remove all traces of swarf or filings.

6. Withdraw the shut-off valve from its housing.

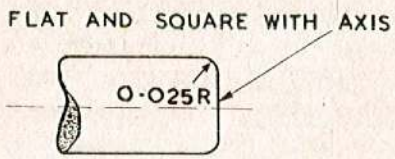


Fig. 5. Dump valve stem showing radius

Control valve plunger

48. Smear the plunger evenly with metal polish (Stores Ref. 33D/157) and lightly lap it to the cylinder and bush; it is important to remember that this lapping operation is merely to remove slight scores and running marks and is not a specific fitting operation. Remove all traces of metal polish, paying particular attention to all internal passages which must be blown out by compressed air.

49. The control box is now ready for internal inspection; all parts must be in scrupulously clean condition, and laid out in a clean work tray with all external fittings, glands, joint washers, etc., which although not yet fitted, will be used at final assembly.

Internal inspection

50. The inspector concerned must ensure that all modifications necessary to bring the control box up to the latest standard have been incorporated, and that all replacements called for in the strip report are included.

51. The issue number engraved on the control body must be altered as necessary, so that it will indicate clearly the amended standard to which the control box is being rebuilt.

52. The correct fit of all components must be ensured, where required, by provisional assembly, with particular attention to the satisfactory operation of all working parts.

53. When all parts are considered satisfactory the unit must be returned in its work tray to the fitting bench for complete assembly.

COMPLETE ASSEMBLY

Control valve plunger assembly

54. Before replacing the components at the rear of the plunger ensure that the circlip retaining the plunger bush is a tight fit in its location, and that it has not turned and blanked off the small bleed hole in the body.

OP. 1. Insert the distance collar, slots innermost, into the counterbores at either end of the plunger location. It is important that the slot in the collar at the rear end fits over the leg of the circlip.

2. Using insertion tool T70038, renew the glands at either end of the plunger location, inserting them with their grooves located over the distance collars. Ensure that the glands are below the surface of the housing; if necessary, the slotted side of the distance collar may be filed to give this result.

3. Replace the two gland retaining plates, the one at the rear being temporarily secured to the locating studs with one of the holding nuts; at the opposite end replace the dust cover with a new felt washer inserted in the counterbore and secured loosely.

4. Insert the control valve plunger into its location, the plunger being entered into each gland in turn, by using the special guide plug T70063.

5. Tighten the two holding nuts securing the dust cover, the insertion of the plunger having secured correct alignment of the felt washer.

6. Replace the plunger stop and screw in the plunger set-screw; then assemble the tubular plunger cover, and secure lightly with two attachment nuts.

7. Screw the slow-running adjustment screw into the end of the cover and secure with its lock-nut.

Fuel cut-off valve

55. Insert the fuel cut-off valve and position the special reinforced joint washer over the four locating studs and dowel peg in the housing.

Dump valve assembly

56. Rebuild the assembly as follows:—

OP. 1. Replace the fuel cut-off valve spindle distance collar in the housing, followed by the Gaco spindle gland which must be inserted by using the inserter T70053.

2. Secure the gland with its retaining washer and circlip.

OP. 3. Replace the dump valve stem distance collar in its housing.

4. Using the inserter T70041, replace the dump valve seal.

5. Lightly smear the tapered portion of the cut-off valve spindle with oil to facilitate its passage through the gland, and carefully insert the valve into its housing, positioning so that it will couple to the fuel cut-off valve.

6. Replace the dump valve housing to the control box body and secure with its four retaining nuts and washers.

7. Assemble the cut-off valve lever to the taper portion of the cut-off valve spindle and secure with the tab-washer and lock-nut.

8. Smear the stem of the dump valve with oil to facilitate its passage through the gland and insert the dump valve assembly.

9. Replace the valve spring and secure the assembly with the union connection.

Bleed screw (if fitted)

57. Attach the triangular plate, with a new joint washer fitted, to the control box body by its three securing bolts, complete with three new sealing washers under their heads. Tighten the bolts finger tight. Bring the plate into correct alignment by inserting the bleed screw until it makes contact with its seating hole in the body. Carefully release the bleed screw, and secure the plate finally with the three bolts. Assemble the lock-nut, sealing washer, and special cap-nut to the bleed screw, and secure temporarily pending final adjustment.

Miscellaneous

58. Assemble the two banjo connections and secure to the control body by their respective bolts, special care being taken to ensure that the correct type of sealing washer applicable to each connection is used.

59. The interconnection, with its reinforced joint washer, must be fitted and secured tightly, and the large cap-nut with a new sealing washer, screwed tightly on to the boss of the fuel cut-off valve housing.

60. The control box is now completely assembled, and ready for testing.

RIG TESTING

General

61. Carefully record all calibrations and endurance test results for subsequent entry into the official test record sheet. It must be remembered that unless new parts have been fitted all tests and calibrations carried out after overhaul are in the nature of check calibrations and normally no adjustment should be necessary.

62. The fuel used throughout the test is aviation kerosine to specification D.ENG. R.D.2482 to which 1 per cent. by volume of lubricating oil to specification D.E.D. 2472B/O has been added (specific gravity 0·805 at 15 deg. C.). The temperature of the fluid entering the control box must be between 20 deg. C. and 25 deg. C. and must be supplied through a fabric or fine mesh filter. The supply pressure must be maintained at 1,030 to 1,090 lb. per sq. in. measured at the inlet to the control box.

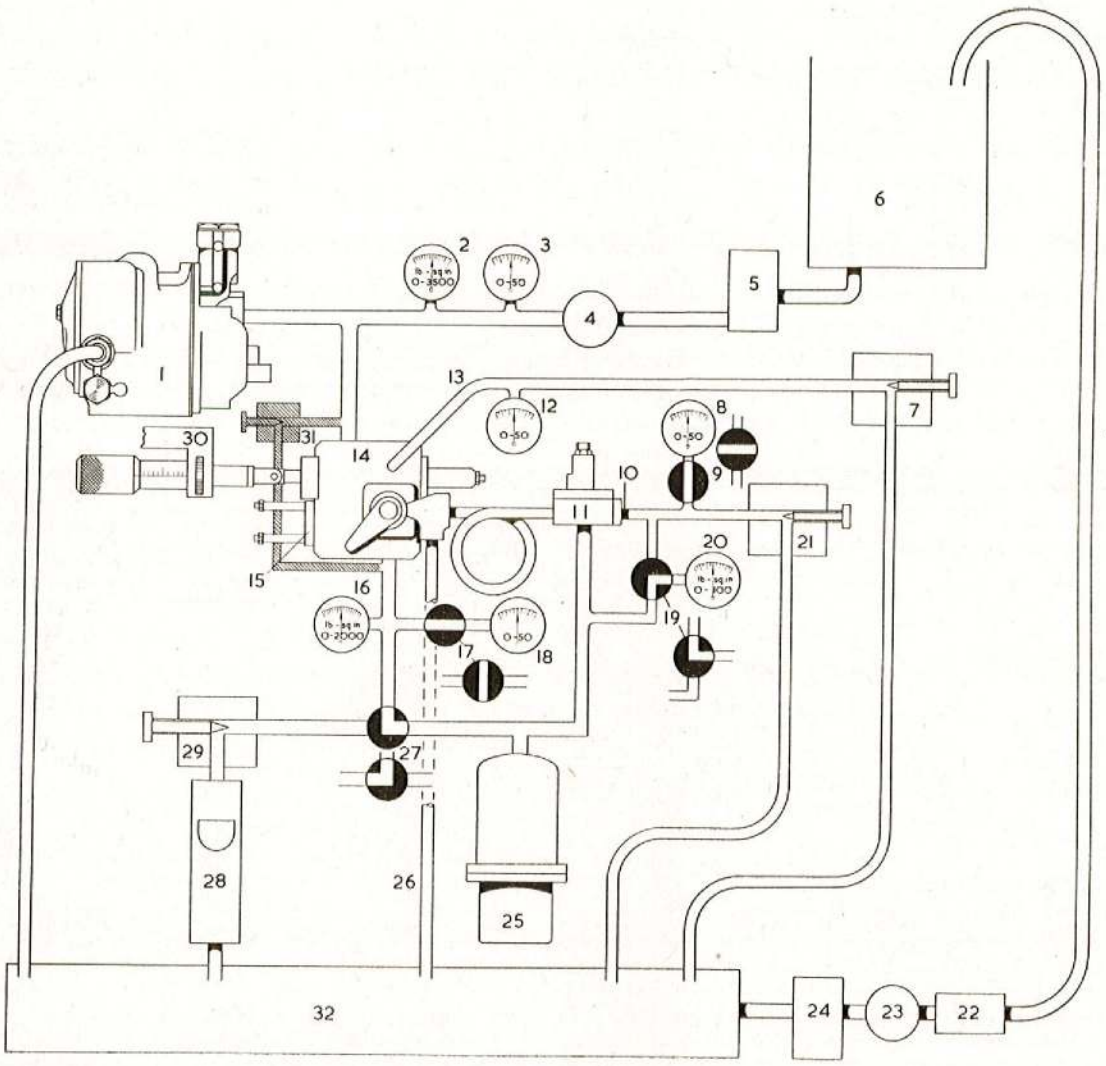
63. The test equipment necessary is illustrated diagrammatically in fig. 6. Before commencing to test, blank off the minimum pressure valve face with a suitable blank. The outlet from the control box must be fitted with a regulating valve to enable the outlet pressure to be adjusted from zero to 1,050 lb. per sq. in.

64. Care must be taken to isolate the low-pressure gauges before high-pressure tests are carried out.

65. Damage will occur to the gauges if the rate of pressure rise in the system is too high. *Before opening* the shut-off valve against the full supply pressure, it is important to first close fully the control valve.

Control valve plunger flow check

66. When checking the control valve plunger flow, the shut-off valve must be fully open and the collar which forms the plunger stop must not be fitted. Instructions for the removal of this collar are given in para. 15. Assuming that a test rig similar to that illustrated in fig. 6 is being used, the isolating cock (27) should be set so that the fuel delivery flows through the regulating valve (29) and the flow meter (24).



1 ADJUSTABLE RELIEF VALVE OR BAROSTAT SET AT 1030–1090 lb. per sq. in. with 160 gall. per hr. spill
2 PRESSURE GAUGE, 0–3500 lb. per sq. in.
3 TEMPERATURE GAUGE, 0–50 deg. C.
4 PUMP
5 FILTER
6 HEADER TANK
7 REGULATING VALVE
8 PRESSURE GAUGE, 0–50 lb. per sq. in.
9 ISOLATING COCK
10 STARTING VALVE OUTLET CONNECTION
11 STARTING VALVE
12 PRESSURE GAUGE, 0–50 lb. per sq. in.
13 ANTI-HAMMER CONNECTION
14 CONTROL BOX
15 P.L.V. FACE BLANKED OFF
16 PRESSURE GAUGE, 0–2000 lb. per sq. in.
17 ISOLATING COCK
18 PRESSURE GAUGE, 0–50 lb. per sq. in.
19 TWO-WAY VALVE
20 PRESSURE GAUGE, 0–100 lb. per sq. in.
21 REGULATING VALVE
22 COOLER
23 PUMP
24 FILTER
25 FUEL ACCUMULATOR
26 DUMP VALVE DRAIN RETURN TO TANK
27 ISOLATING COCK
28 DE-AERATOR AND FLOW METER, 0–6500 lb. per hr.
29 REGULATING VALVE
30 MICROMETER ADJUSTMENT FOR CONTROL VALVE PLUNGER TRAVEL
31 ADJUSTABLE NEEDLE VALVE (Shaded). Required with control boxes not fitted with a bleed screw or variable characteristics valve.
32 SUPPLY TANK

Fig. 6. Diagram of control box and starting valve test rig

Setting the adjustable needle valve

Note . . .

This needle valve is required only when testing control boxes not fitted with bleed screws or variable characteristics valve. The valve circuit is shown shaded in fig. 6.

67. Apply a pressure of 1030–1090 lb. per sq. in. at the inlet to the control box. Release the lock-nut and unscrew the slow-running adjusting screw until the control valve plunger is in the fully closed position. With the outlet pressure regulating valve (29) fully

REQUIRED FLOWS AND PRESSURE DROPS

Valve travel (inches)	Pressure drop (lb. per sq. in.)	Flow in lb. per hour	
		Minimum	Maximum
·0	846	710	765
·10	829	1000	1100
·20	809	1220	1330
·30	780	1440	1560
·40	744	1660	1790
·50	701	1880	2020
·60	650	2120	2270
·70	585	2370	2530
·80	502	2640	2820
·90	400	2900	3140
1·00	290	3160	3500
1·10	167	3425	3860
1·20	65	3700	*

*No maximum is quoted as the majority of engines will be under governor control.

open, adjust the needle valve (31) to give a total flow of 300 lb. per hour. This needle valve must remain at this setting throughout the control valve plunger calibration.

68. Hold the control valve plunger firmly against the slow-running adjusting screw and adjust the position of this screw until a net flow of 710 lb. per hour with a pressure drop (inlet to outlet of control box) of 846 lb. per sq. in. is obtained; adjust the outlet regulating valve (29) to obtain the required pressure drop. When these conditions are obtained, measure the distance (axial clearance) between the collar adjacent to the eye end of the plunger and the dust seal cover on the front of the control box; this becomes the datum, or zero setting, of the plunger from which calibration commences.

69. By means of the micrometer adjustment provided on the test rig, open the control valve progressively from the datum setting by the amounts given in Column 1 of the table and record the flow under the specified pressure drops across the control box. Plot these valves and compare with the design flow given in the table. The flow must be on a smooth curve within the limits given. If necessary, adjust the slow-running stop to give the best agreement with the design curve. Lock the slow-running stop and record the axial clearance between the collar on the control valve plunger and the dust seal cover on the front of the control box with the record of the flow check results.

70. Remove the control valve plunger cover and fit the collar which forms the control valve plunger stop, as described in para. 54. If necessary adjust the length of the collar to allow the plunger 1·20 in. travel from the datum setting recorded (*para.* 68). When this is satisfactory, lock the 2 B.A. bolt.

71. Fully close the adjustable needle valve (31) on the test rig, and holding the control valve plunger firmly against the slow-running adjusting screw, adjust the position of this screw until a net flow of 710–765 lb. per hour with a pressure drop of 846 lb. per sq. in. is obtained. Lock the slow-running adjusting screw.

72. With the control valve plunger in the fully open position and a fuel flow of 4,000 lb. per hour at an inlet pressure to the control box of 1030–1090 lb. per sq. in. Adjust the anti-hammer spill (13) to give a pressure of 12–13 lb. per sq. in. The axial force necessary to cause movement of the control valve plunger in any position and in either direction must not exceed 10 lb. There must be no visible leakage of fuel from the control valve seals.

Note . . .

Before commencing the next test, the regulating valve (13) *in the anti-hammer pipe must be fully open. The flow from the anti-hammer connection — leakage along the cylindrical portion of the control valve plunger—must not exceed* 300 *lb. per hour with the plunger in any position.*

(A.L.16, Sep. 55)

Shut-off valve flow test

73. With the plunger still in the fully open position and a fuel flow of 4,000 lb. per hour at an inlet pressure to the control box of 1030–1090 lb. per sq. in., the maximum torque required to close the shut-off valve must not exceed 40 lb.

74. With the plunger in the fully open position, an inlet pressure of 1030–1090 lb. per sq. in. and the shut-off valve closed, the leakage at the outlet connection must not exceed 200 cc. per min.

Dump valve leakage test

75. Set the isolating cock (27) so that the fuel delivery flows to the accumulator (25) and the starting valve (11) and isolate the low pressure gauge (18), checking that the connection from the starting valve to the dump valve has been made.

76. With the shut-off valve open and an inlet pressure of 1030–1090 lb. per sq. in. apply a pressure of 1030 lb. per sq. in. to the dump valve by closing the outlet regulating valve (21). The leakage from the dump valve drain connection must not exceed one pint per hour.

Note . . .

Excessive leakage may be due to a faulty dump valve seating or a faulty dump valve seal permitting leakage via the valve stem. To locate the fault, close the shut-off valve maintaining pressure on the control box and disconnect the pipe from the starting valve to the dump valve at the dump valve inlet. Any leakage now occurring from the open dump valve will be entirely past the dump valve seal.

77. (1) With the plunger in the slow-running position, the shut-off valve open, and an inlet pressure of 1030–1090 lb. per sq. in. and an unrestricted outlet, measure the flow.

(2) Open the adjustable needle valve (31) to give an additional flow of approximately 50 lb. per hour.

(3) Operate the shut-off valve five times and check that the dump valve opens and closes correctly as indicated by the flow from the drain connection.

(4) Check that the dump valve opens at not less than 20 deg. angular movement of the shut-off valve lever from the shut-off valve open position.

78. Turn the isolating cock (27) back to its original position, and close down the adjustable needle valve (31).

Note . . .

Before commencing the following test the regulating valve (13) *in the anti-hammer line must be fully open; during this test the anti-hammer passage must on no account be blanked off.*

Static pressure tests

79. With the shut-off valve and the dump valve fitted to the control box, blank off the control box outlet connection. Fully open the control valve and the cut-off valve and apply a fluid pressure of 3000 lb. per sq. in. at the control box inlet connection. There must be no visible leakage from the control valve seals, or from any joint. Refit the control valve plunger cover.

FINAL INSPECTION

80. Upon the statisfactory conclusion of the tests, the control box must be submitted to the inspector concerned for final examination and acceptance.

81. The inspector must ensure that all nuts and bolts are secure, and also test manually the satisfactory operation of the working parts. It will be noted that all external locking and wiring operations will be carried out at installation.

82. All relevant information, including the current issue number, must be entered on the job card, which must then be signed for final acceptance of the control box.

INHIBITING AND PREPARATION FOR DESPATCH

83. Drain off all surplus fuel after test, and inhibit the unit as detailed in A.P.4471A.