Chapter 2

HOBSON MINIMUM PRESSURE VALVE, Mk. 2A AND Mk 4 (Goblin Mk. 1 and 2 engines)

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LIST OF ILLUSTRATIONS

General

1. This chapter deals with the reconditioning of the Hobson minimum pressure valve, Mk. 2A and Mk. 4, as fitted to Goblin Mk. 1 and 2 engines. An exploded view of a Mk. 4 unit is shown in fig. 1.

2. Upon receipt of the minimum pressure valve for dismantling, a preliminary swilling and cleaning of the unit must be carried out to remove all external dirt and grease, and a close visual examination should be made so that any external damage or deficiencies can be observed. It will be appreciated that if any of the main castings are beyond repair, reconditioning may not be considered economical.

Dismantling

3. When dismantling, the projecting steel spring retainer must first be unlocked and screwed off, thereby releasing the load exerted by the plunger spring which, with the setting shim, must be removed from the plunger.

4. From the opposite end, the blanking plug must be unlocked and screwed out of the valve housing, and the valve spring and valve removed from the guide.

5. The main components must now be separated by removing the holding nuts and washers from the flange securing studs. The laminated diaphragm forms the joint between the casting faces and special care must be

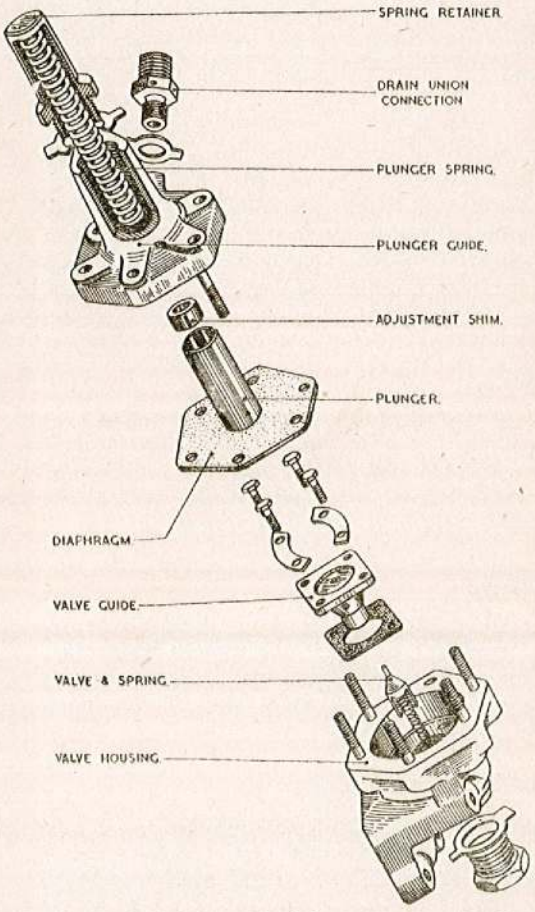

Fig. 1. Exploded view of minimum pressure valve

taken that the diaphragm adheres to one face only.

6. *Mk. 4 only.* The diaphragm assembly, comprising the plunger, diaphragm, disc and lock-nut, must be separated carefully from the casting to which it is attached. With the plunger held firmly by means of a suitable metal strip placed in the holding slots, the securing nut must be unlocked and slackened off, so that the diaphragm assembly can be dismantled with the fingers at the subsequent inspection.

7. *Mk. 2A only.* On this type, the diaphragm assembly will be retained in the intermediate casting when the two outer ones have been removed. With the lock-nut of the larger diaphragm held securely with a suitable spanner, the lock-nut to the smaller one must be removed together with the disc and diaphragms. Upon withdrawing the remainder of the assembly from the casting, the plunger must be held firmly in a suitable pair of soft-metal vice clamps so that, after removing the metal peened into the plunger slots, the lock-nut disc, and the larger diaphragm can be detached.

8. *Both types.* The valve guide must be released from the valve housing, by removing the four securing bolts, with the two tandem tab-washers fitted under the heads. It will be noted that a special "Gaco" joint washer is fitted between the guide and the housing. The drain union connection, and also the vent plugs if fitted, must be unlocked and removed from the casting.

Note . . .

A later modification introduces a ring seal of square section to replace the "Gaco" joint washer, the seal being housed in an annular recess formed in the valve housing immediately under the flange of the valve guide.

Cleaning

9. All component parts must then be cleaned thoroughly and swilled with kerosine. After drying off, they must be laid out in a clean and suitable work tray in readiness for detail inspection.

Detail inspection of parts

10. Personnel responsible for this inspection should be in possession of the latest issue of the relevant Parts List, together with up-to-date copies of the following Sectional General Arrangement drawings, which should be read in conjunction with Hobson Modification No. 629.

Minimum pressure valve. Mk. 2A. G.A. (CHA.53180).

Minimum pressure valve. Mk. 4. G.A. (CHA.53195).

11. At original manufacture, all castings are anodically treated and, during the initial testing, are subjected to static and working tests calculated to show up any existing defects. It is therefore not anticipated that the serviceability of any unit will be subsequently impaired either by corrosion or by porosity.

12. The body castings must be carefully examined for damage or cracks, and their joint faces must be checked with a straight edge for signs of distortion which, if apparent and after removal of the studs, can be remedied by lapping the affected faces to a suitable lapping plate. Any casting seriously distorted, or having deep indentations in any joint face that cannot be removed by lapping, must be renewed.

13. The threads of all tapped locations for unions and plugs must be examined and checked for signs of slackness by marrying the corresponding part. If slackness is present, a further check should be made with thread gauges.

14. All studs must receive their nuts without trace of binding; studs with stripped threads must be discarded. Each stud must be tested for soundness of fit in its casting; studs that show signs of pulling away must be renewed. The use of stepped studs is not permissible, and where necessary, a salvage operation on the location hole must be carried out in accordance with the relevant salvage drawing. Replacement castings will be supplied with all necessary studs fitted.

15. The diaphragms, including also the synthetic rubber joint washer or ring seal, must all be renewed and no reference is made therefore to any of them in this inspection sequence.

16. After dismantling the diaphragm assembly with the fingers, the condition of the securing nut, the diaphragm disc and the thread of the plunger can be noted.

17. Check the plunger in the bore of the guide casting. The clearance is stipulated in Part 2, Section 4, of this Volume, and can be maintained by the renewal, as may be necessary, of the plunger and/or the plunger guide casting.

18. The spring and its retainer, the drain union body, and the blanking plugs in the valve housing must be examined, particularly with reference to the threads and hexagons.

19. The valve guide must be examined for its general condition with special attention to the valve seat, and, if pitting is in evidence to an extent which cannot be removed by light lapping with the valve, the guide must be rejected. The valve bore must be dimensionally checked, and must be within the limits detailed in Part 2 of this Volume.

20. The valve must be inspected at the point of contact with its seating, and must be rejected if there is any evidence that a satisfactory seating cannot be obtained at re-assembly. The valve must be checked in the bore of the guide, and the required clearance maintained by renewal of the components as necessary.

21. *Mk. 2A only.* The additional small components peculiar to this type must be examined for general serviceability.

22. *Both types.* All rejected parts must be segregated carefully to obviate the possibility of any being refitted.

Re-assembling

23. The commencement of re-assembling operations must in all instances be preceded by a thorough swilling in kerosine, all passages, must be blown out to ensure complete freedom from swarf or dirt, particularly when any component has been subjected to machining or lapping operations.

24. When a new valve guide is to be fitted, it must first be checked in the valve housing casting; the valve also must then be checked in the guide to ensure that it is a smooth sliding fit.

25. With the "Gaco" joint washer or ring seal in position, fit the guide into the valve housing and secure it tightly with the holding bolts, with the tandem tab-washers under the heads. The locking tabs will not be turned up until a later stage.

26. The valve must again be inserted through the retaining plug aperture and a perfect seating obtained by light lapping with non-abrasive metal polish, after which all traces of the lapping medium must be removed by swilling in kerosine.

27. With the valve in position, the valve spring must be inserted and the assembly secured by the fitting of the retaining plug with its new tab-washer; the locking tab is not yet turned up.

28. The complete assembly must now be subjected to a pressure test in accordance with the requirements of the Rig Test Schedule (*para.* 63).

29. *Mk. 2A only.* Hold the plunger firmly between the jaws of a suitable soft-metal vice clamp, and fit the requisite number of larger diaphragm laminations to the larger threaded projection of the plunger, followed by the diaphragm disc and the lock-nut with the annular rib facing outwards. With the holes of the diaphragm aligned correctly, the lock-nut is then tightened securely and locked by peening the metal of the rib into the plunger slots.

30. *Both types.* Insert the plunger into the bore of its guide from the appropriate end and then fit the stipulated number of diaphragm laminations over the long securing stud and the $\frac{1}{4}$ in. thread projection of the plunger. The insertion of one slave bolt through the diaphragm laminations and into the flange of the casting will ensure the correct location of the laminations and concentricity with the plunger. The diaphragm disc must then be fitted to the plunger, followed by the special tab-washer and the lock-nut which must be screwed on finger-tight.

31. *Mk. 2A only.* Hold the larger lock-nut with a suitable spanner, tighten the smaller one securely, and turn up the tab-washer.

32. *Mk. 4 only.* Remove the diaphragm assembly from the guide for the purpose of securing the lock-nut; the plunger is then held by means of the slots at its inner end, and the lock-nut tightened and secured by the tab-washer. The assembly must then be returned to the plunger guide after any burrs raised on the tightening slots have been removed.

33. *Both types.* The by-pass valve must now be set, and while the instructions given in the following paragraphs are applicable to a replacement valve, it will be appreciated that the fitting of a new housing or the renewal of any of the relative components, may also affect the valve setting.

34. In all instances therefore, even when no new components except the diaphragms are required, the setting of the valve must be checked and corrected as may be necessary, by the identical methods whereby the original setting is obtained (*para.* 36 *to* 48).

35. The valve setting consists of a clearance, which must be exact, between the tripper end of the valve and the end of the threaded portion of the diaphragm plunger. The clearance must exist with the valve on its seat and the diaphragm plunger fully inserted against the resistance of the diaphragm, into its guide, and should be obtained in the manner detailed in the following paragraphs.

36. The main castings, with the inclusion of the diaphragm assembly, must first be assembled together and secured tightly with alternate holding nuts only.

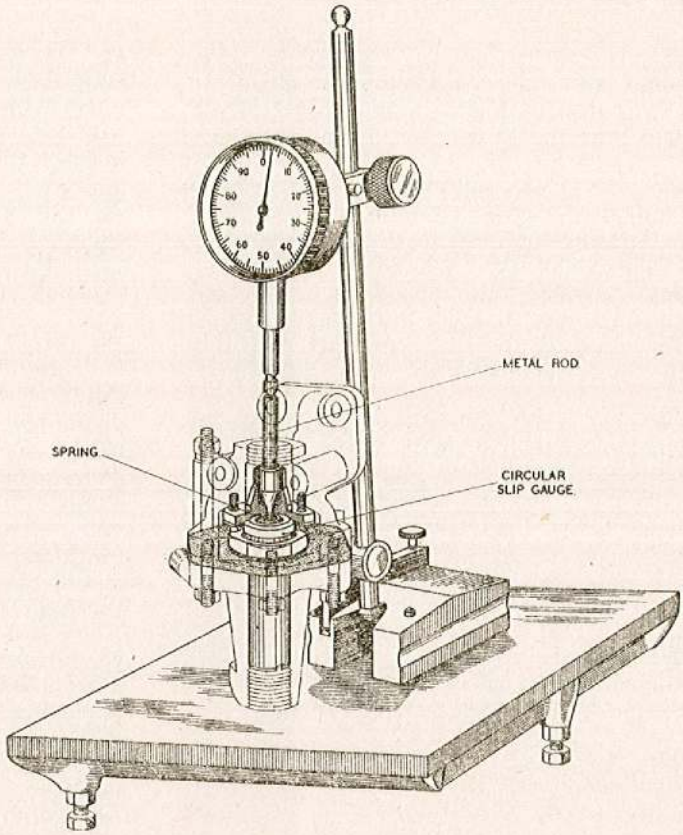

Fig. 2. Use of circular slip gauge

37. The unit must now be inverted and placed upon a suitable surface plate, the valve retaining plug screwed out and the valve spring removed. A small metal rod approximately 1 in. in length and of a diameter which will provide a free but stable fit, must be inserted into the internal bore of the valve through the aperture of the retaining plug.

Note . . .

Due to interference of the securing studs, it will be necessary on the Mk. 2A type, to include a parallel metal strip between the casting and the surface plate.

38. A clock gauge must now be mounted on the surface plate, and suitably supported in contact with the end of the metal rod. The dial must be turned so that the pointer registers zero, which adjustment will indicate a positive setting of the valve. This will be the datum for the valve setting and must on no account be upset, during the ensuing sequence of operations, by any disturbance of the position of the clock gauge.

39. The unit must be carefully removed from the surface plate, the metal rod withdrawn from within the valve, the holding nuts released and the plunger guide, with the diaphragm assembly attached, removed from the valve housing.

40. The special circular slip gauge, Part No. CH.62504, corresponding to the exact clearance stipulated, together with its small coil spring, Part No. CH.62505, will now be required and must be placed within the valve housing and located, spring downwards, over the tripper end of the by-pass valve, as shown in fig. 2.

41. With the slip gauge in this position, the plunger guide and diaphragm assembly must be refitted to the valve housing and again secured with the three holding nuts; if possible the nuts should be tightened to the same extent as on the previous occasion. The introduction of the slip gauge and spring will ensure that the diaphragm plunger is now in its required position.

42. The unit must again be inverted, the metal rod replaced within the valve and the unit returned to the surface plate and placed beneath the clock gauge, as shown in fig. 2.

43. If the clearance is correct, as would normally occur where no new components have been fitted, the pointer on the clock gauge should again register zero. If, however, a plus reading is obtained this will indicate the distance that the valve is raised off its seat through contact with the slip gauge and, therefore, the amount by which the length of the valve tripper must be reduced to allow the valve to return to its seat and, at the same time, provide the required clearance represented by the dimension of the slip gauge.

44. If the clearance is incorrect proceed as follows:—without disturbing the clock gauge the unit must be removed, the metal rod withdrawn, and the valve extracted from its guide through the retaining plug location. The overall length of the valve and its tripper must be ascertained by means of a micrometer, so that the removal of the surplus metal from the end of the tripper with a suitable file and smooth emery cloth, can be controlled.

45. In view of the extreme delicacy of this setting, and the fact that the reduction in length must on no account *exceed* the amount indicated by the clock gauge, this operation must be carried out under the supervision of an approved inspector, who will take his own micrometer readings before, during, and after the operation.

46. It will be advisable to remove the surplus metal in stages so that the progress can be checked as often as may be considered necessary, with the micrometer and also, if desired, by means of further readings under the clock gauge.

47. When the correct amount of metal has been removed, providing always that the position of the clock gauge has not been disturbed, the final setting of the gauge will be zero. While this will indicate a return to the datum, which is the positive setting of the valve, it must be appreciated that it provides no check as to whether or not an excess of metal has been removed from the tripper. This important point however, will have been determined by the micrometer.

48. The castings comprising the assembly must once again be separated. The locking tabs of the two tandem tab-washers under the heads of the valve guide securing bolts must now be turned up.

49. When the various components have been thoroughly swilled with kerosine, the plunger guide, the spring retainer with its new tab-washer, and the union connection must be screwed loosely into their respective castings, and the valve, valve spring, and retaining plug fitted loosely into the valve housing. In this condition, the unit must be submitted for internal inspection.

Internal inspection

50. At this stage, the inspector responsible must ensure that all development alterations and/or approved modifications required to bring the unit to the latest standard are being embodied, that all necessary new replacement parts are being fitted, and that a satisfactory standard of workmanship and general cleanliness is being maintained.

51. Check the correct locking of the tab-washers to the four bolts securing the valve guide, and also the tab-washer to the lock-nut of the diaphragm assembly.

52. *Mk. 2A only.* The peening of the larger lock-nut to the diaphragm assembly is an additional point requiring visual attention.

53. *Both types.* A close examination must be made between the visible surfaces of the diaphragms to ensure complete freedom from any trace of swarf or foreign matter.

54. The plunger spring retainer and the valve retaining plug must be checked, without their tab-washers, to ensure that their shoulders retain a satisfactory fit to their respective joint faces.

55. The valve must be a smooth sliding fit through its guide, with no trace of sticking or binding at any point.

56. When all parts have been viewed and are considered satisfactory, they must be laid out in a clean work tray in preparation for final re-building.

Final assembly and inspection

57. The unit must be assembled as already described, and all the flange holding nuts

and washers fitted and tightened securely and evenly all round.

58. Insert the valve and valve spring, fit the retaining plug and tighten it to its locking position. The union connection in the plunger guide must be fitted and tightened, and the plunger spring and retainer also fitted, but still only loosely. In this condition, submit the unit for diaphragm and valve leakage checks, in accordance with the requirements of the relevant Rig Test Schedule (*para.* 64 *and* 65).

59. If these checks are satisfactory, the plunger spring and retainer must be removed for the insertion of a provisional setting shim. At replacement, the spring retainer must be fitted with its new tab-washer and tightened to its locking position. The unit must now be tested for flow and valve bias setting, in accordance with the Rig Test Schedule. The required calibration is obtained by the adjustment, as may be found necessary, of the thickness of the setting shim. This dimension, when determined, must be engraved on the shim.

60. The unit must again be submitted for final examination; it will be noted that the union connection must now be tabbed up, but the valve retaining plug and the plunger spring retainer will not be locked in view of the possibility of further adjustments during functional testing and/or installation.

Test procedure

61. The following test instructions are reproduced from the current Provisional Rig Test Schedule, Issue 3, for Mk. 2A and Mk. 4 minimum pressure valves.

Test fluid

62. The fluid to be used throughout the test is Aviation Kerosine to Specification D. Eng. R.D.2482.

High-pressure test

63. During the first assembly stage the internal valve and seating must be pressure tested. With a fluid pressure of 1,500 lb. per sq. in. applied to the inlet connection, the valve must not leak, nor must there be any leakage from under the flange of the valve guide.

Diaphragm leakage check after assembly

64. Before setting up for the calibration test, fit a blanking plate over the fluid inlet connection and couple the outlet connection to the fluid pressure line. Then apply a fluid pressure of 1,000 lb. per sq. in. for two minutes whilst an examination is made for leaks, particularly around the diaphragm joint, from the drain connection and from the joint face adjacent to the outlet connection. Leakage from the drain connection will indicate a punctured diaphragm. Leakage is not permissible at any point.

Valve leakage check after assembly

65. The valve must now be set up on the test rig with no fluid pressure at the outlet, and a pressure of approximately 10 lb. per sq. in. applied to the inlet connection. The valve and piping will thus become filled up, as will be indicated by the flow of fluid from the outlet connection. As soon as the flow commences, unscrew the spring retainer and withdraw the spring and shim. Then increase the fluid pressure at the inlet connection to 200 lb. per sq. in. when any flow from the outlet connection will represent the leakage past the internal valve; this leakage must not exceed 60 c.c. measured over a period of two minutes, i.e., three pints per hour.

Valve setting

66. During this test the fluid must be maintained at a temperature of 20 deg. C.

Note . . .

It has been found that the temperature of the test fluid has an appreciable effect on the flow obtained during this test. For this reason it is important that this temperature is not varied from that quoted.

67. With a fluid pressure of 230 lb. per sq. in. applied to the inlet connection, adjust the test rig pressure until the outlet pressure from the valve is 28 lb. per sq. in. and then measure the flow from the outlet connection. The time required for a flow of one pint of fluid must be between 12 and 12½ seconds, i.e., 36 to 37½ gallons per hour. If the time taken exceeds 12½ seconds, remove the spring retainer and fit a thicker shim under the spring, taking care to replace the tab-washer with the spring retainer.

68. On completion of the tests, drain the valve and tighten the spring retainer to the locking position.

Inhibiting

69. To prevent the diaphragm drying out during storage or lengthy despatch, the unit

must be filled with an inhibiting mixture comprised of 80 per cent. kerosine and 20 per cent. Intava 620 fluid. Fit a blanking plate to the attachment flange and a blanking cap to the drain connection to retain the inhibiter and to prevent damage.

70. *Mk. 2A only.* Cover the vent plugs with a suitable adhesive material.,

Preparation for despatch and packing

71. After inhibiting, and in the event of the unit requiring to be stored over an indefinite or lengthy period, the unit must be pre-packed with approved wrapping, etc., and cushioned in a suitable carton, in accordance with the instructions contained in the Spares Packaging Specification 602, method 1A.

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