ADMIRALTY
AIR MINISTRY

ELECTRICAL MANUAL, STATIC CONSUMER EQUIPMENT (AIRBORNE)
This is A.L. No. 10 to A.P.4343E, Vol. 1

Section 1. List of Chapters : *delete* " *(to be issued later)* " after the title of Chapter 3, and *write* " (A.L.10) " in the outer margin against the deletion. *Insert* this Chapter 3 to follow Chapter 2, and *record* the incorporation of this A.L. in the Amendment Record Sheet.

Chapter 3

ELECTRO-HYDRAULIC AND ELECTRO-PNEUMATIC VALVES (ELECTRO-HYDRAULICS LTD.)

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LIST OF ILLUSTRATIONS

LEADING PARTICULARS

Electro-hydraulic valves—

Type 8517	*Normally closed*
Rating	*3 min.*
Current	*0·8 amp.*
Orifice	*1 mm.*
Weight	*0·75 lb. (approx.)*
Type 8521	*Normally closed*
Rating	*Continuous*
Current	*0·38 amp.*
Orifice	*1 mm.*
Weight	*1·1 lb. (approx.)*
Type 8544	*Normally closed*
Rating	*Continuous*
Current	*0·38 amp.*
Orifice	*1 mm.*
Weight	*1·1 lb. (approx.)*
Type 8522	*Normally open*
Rating	*Continuous*
Current	*0·42 amp.*
Orifice	*1 mm.*
Weight	*1·0 lb.*

LEADING PARTICULARS—*Contd.*

Type A1403	*Normally open*
Rating	*20 sec. on, 2 min. off (continuous)*
Current	*1·55 amp.*
Orifice	*0·070 in.*
Weight	*1·3 lb. (approx.)*

Solenoid, Type A1102 (electro-pneumatic)—

Rating	*Continuous*
Current	*0·175 amp.*
Pull	*2 oz.*
Air gap	*0·066 in.*
Weight	*0·41 lb.*

Introduction

1. The solenoid valves described in this chapter are used for the electrical control, either directly or indirectly, of a particular service. All are for 24-volt operation, and the working hydraulic pressure throughout for the electro-hydraulic valves is up to 2,500 lb. per sq. in. Further individual details are given under Leading Particulars, and the hydraulic and pneumatic components of which these units form a part are described in A.P.1803F, Vol. 1, and A.P.4303D, Vol. 1, respectively. Reference should also be made to the appropriate aircraft handbook for information on installations in particular aircraft.

DESCRIPTION

Electro-hydraulic valves

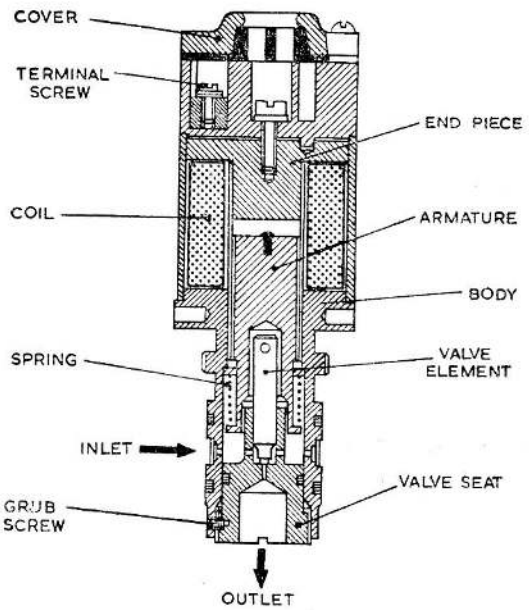
2. These solenoid valves, examples of which are shown in fig. 1, 2 and 3, are of basically similar construction. They may be normally open or normally closed, and the valve is operated, on energization of the coil, by the movement of the armature within the coil.

Type 8517

3. This type is normally closed, the orifice in the valve seat being sealed by the valve element (*fig.* 1). When the coil is energized the armature is attracted upwards inside the coil, and the valve element, which is pinned to the armature, is lifted off its seat. Pressure fluid, entering through radial ports in the valve body, then escapes past the valve element, and leaves the valve through the outlet port for as long as the coil remains energized. When the electrical circuit is broken, the coil is de-energized and the armature and valve element are returned by spring pressure to their original positions to close the valve.

Types 8521 and 8544

4. Types 8521 and 8544 operate on the same principle as the Type 8517 illustrated in fig. 1, and are of similar construction. The differences in characteristics are shown under Leading Particulars.



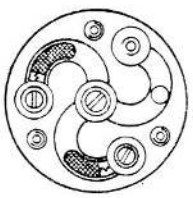


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Fig. 1. Electro-hydraulic valve, Type 8517

Type 8522

5. This valve (*fig.* 2) follows essentially the same design as those described above, with

the exception that it is normally open. When the coil is energized, the armature is attracted downwards, and transmits this movement through a push rod to the valve element, thus sealing the orifice. The valve remains closed until the coil is de-energized, when the armature returns to its original position, and the valve element rises, due to spring pressure.

Type A1403

6. This valve (*fig.* 3) is a normally open valve, and is similar to the Type 8522 apart from certain details of construction. The inlet port for this type of valve is shown at the bottom in fig. 3, the outlet being through radial ports in the valve body.

Solenoid, Type A1402 (electro-pneumatic)

7. This solenoid (*fig.* 4) is used as a safety lock on the electro-pneumatic selector valve, Type 7022, which is described in A.P.4303D, Vol. 1, Sect. 6, Chap. 1. The flanged spool carrying the coil winding has a hole of rectangular cross-section through the centre to accommodate the armature; a pole piece is riveted to the spool at the other end. The ends of the winding are taken out through holes in the spool and the pole piece to the terminal block, which is secured to the pole piece by two screws (9); spacing washers give clearance for the leads between the pole piece and terminal block.

8. The solenoid is enclosed in a metal case, open at the armature end, and with a central hole at the other end, fitted with a rubber grommet, through which the external leads are taken to the terminals. The case is held to the spool assembly by two screws (10), and the base is flanged for mounting. A top cover is secured to the spool assembly by two screws (12).

SERVICING

General

9. No servicing is permissible on these units. The following tests are given as a guide in checking for correct operation and tracing possible causes of failure. With the electro-hydraulic valves, the fluid to be used throughout for supplying pressure is oil OM–15 to Spec. D.T.D.585 (Stores Ref. 34B/159).

Pressure test (electro-hydraulic valves)

Types 8517, 8521, and 8544 (normally closed)

10. Couple a static test rig to the inlet port and apply a fluid pressure of 3,750 lb. per sq. in. There must be no leakage.

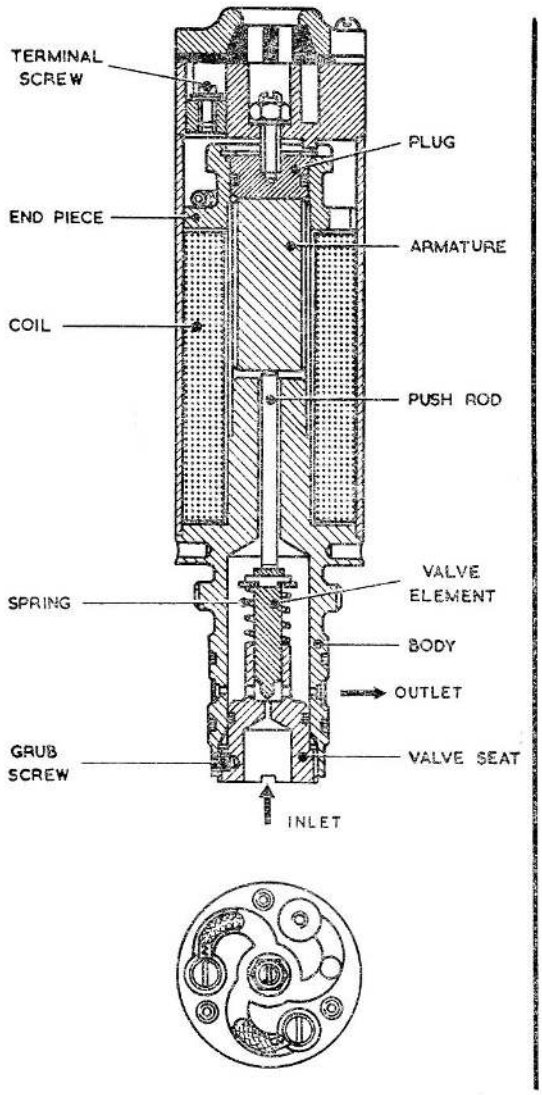

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Fig. 2. Electro-hydraulic valve, Type 8522

Types 8522 and A1403 (normally open)

11. Couple a static test rig to the inlet port, and with the outlet ports blanked off, apply a fluid pressure of 3,750 lb. per sq. in. This pressure must be held for two minutes without leakage.

Functioning test

Types 8517, 8521, and 8544 (normally closed)

12. Apply a fluid pressure of 3,400 lb. per sq. in., to the inlet ports. When the coil is energized on 15 volts, the valve should open against the fluid pressure, allowing fluid to flow from the outlet port.

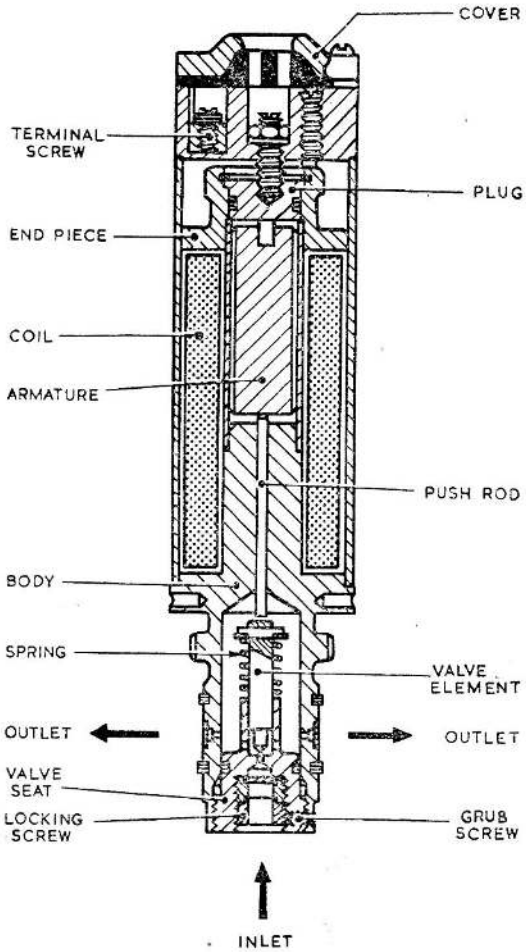

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Fig. 3. Electro-hydraulic valve, Type A1403

Type 8522 (normally open)

13. Apply a fluid pressure of 3,400 lb. per sq. in., to the inlet port. When the coil is energized on 15 volts, the valve should hold the pressure for at least two minutes without leakage. On switching off, the pressure should be released immediately.

Type A1403 (normally open)

14. Apply in turn fluid pressures of 1,000, 2,000, and 3,400 lb. per sq. in., to the inlet port. When the coil is energized on 15 volts, the valve should hold each pressure for at least two minutes without leakage. On switching off, the pressure should be released immediately.

WARNING

During valve operation, the temperature of the coil must not exceed 80 deg. C. above ambient temperature. This figure is usually obtained in two minutes, after which time the coil must be de-energized and cooled to approximately ambient temperature before being re-energized. An air blast may be used for cooling provided the valve body is protected.

Type A1102

15. Fit the armature inside the solenoid. With an air gap of 0·066 in. and a current of 0·12 amp. flowing through the coil, check that the solenoid will lift a minimum weight of 2 oz.

Flow test (electro-hydraulic valves)

Types 8517, 8521, and 8544 (normally closed)

16. Couple the inlet ports to a vessel of 9 in., diameter containing 2 litres of alcohol, with the bottom 24 in., above the inlet ports. With 29 volts applied to the coil, the volume of fluid delivered should not be less than 15 cc. in 10 sec. On switching off, the flow should cease immediately.

Type 8522 (normally open)

17. Close the valve by applying 29 volts to the coil. Couple the inlet port to a vessel of 9 in., diameter containing 2 litres of alcohol, with the bottom 24 in., above the inlet ports. When the coil is de-energized, fluid should flow from the outlet ports; the flow should be not less than 15 cc. in 10 sec.

Type A1403 (normally open)

18. Close the valve by applying 29 volts to the coil. Couple the inlet port to a vessel of 9 in., diameter containing 2 litres of alcohol, with the bottom 24 in., above the inlet port. When the coil is de-energized, fluid should flow from the outlet ports ; the flow should be not less than 70 cc. in 15 sec.

Note . . .

The coil must be de-energized and cooled to approximately ambient temperature between each application of fluid pressure.

Coil resistance (all types)

19. Measure the resistance of the coil. At 20 deg. C. the value should be as given in the following table :—

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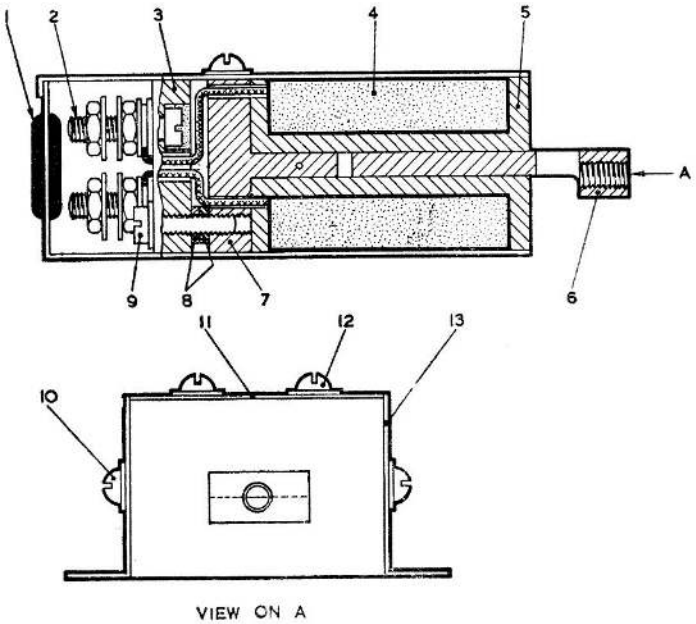
Type	Resistance (ohms)
8517	30±10%
8521	64±10%
8544	64±10%
8522	58±10%
A1403	15·5±10%
A1102	136±10%

Residual magnetism (all types)

20. Energize the coil on 32 volts, and check that the armature does not stick in the operated position.

Insulation resistance (all types)

21. The insulation resistance between the terminals and the outer casing, measured with a standard insulation resistance tester, should not be less than 20 megohms.



1 RUBBER GROMMETT
2 TERMINAL SCREW
3 TERMINAL BLOCK
4 WINDING
5 SPOOL
6 ARMATURE
7 POLE PIECE
8 WASHER
9 SCREW
10 SCREW
11 TOP COVER
12 SCREW
13 CASE

Fig. 4. Solenoid, Type A1102

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