Chapter 4

AUTOMATIC CHANGE-OVER VALVE (801919) Ref. No. 6D/2319

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Introduction

1. This valve is for use when a liquid oxygen system is fitted with an auxiliary stabilizing system, it is designed to control the operation of the stabilizing system. The overall dimensions of this valve are 4·051 × 4·332 in. × 2·3125 in. and the weight is 1·1 lb.

2. In standard liquid oxygen systems such as those described in this publication the supply pressure may drop under certain conditions. This arises as follows.

3. Liquid oxygen at atmospheric pressure boils at approximately -183°C but at higher pressures the boiling point is elevated.

4. In ground dispensers liquid oxygen is normally stored at atmospheric pressure and under such conditions its temperature is approximately

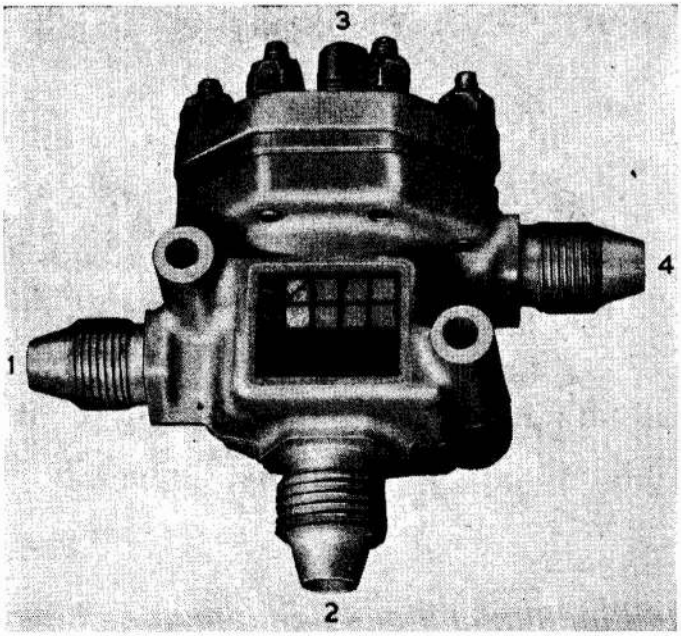

Fig. 1. Automatic change-over valve Ref. No. 6D/2319

-183°C; in a standard aircraft system that has recently been filled the gaseous oxygen pressure is raised to 150 lb/in.^{2} and the liquid pressure is pressurized to the same value, at which its boiling point is -153°C. The temperature of a thin surface layer of the liquid is then raised to -153°C by heat transfer from the gas. In this condition the system operates with all the liquid beneath the thin surface layer still at -183°C, and liquid is drawn off at the normal supply pressure of 150 lb/in^2.

5. If the liquid is agitated the cold lower layers of liquid come into contact with the pressurizing gas, cool it, causing it to contract and some to condense so that the supply pressure falls. The supply pressure then remains low until it can be re-established by the normal build-up process.

6. These pressure drops are generally limited to systems in highly manoeuvrable aircraft, being most severe when a nearly full container is subject to zero or negative "g" conditions and after 6-12 hours the normal heat inleak into a full container raises the temperature of the whole liquid mass to -153°C so that pressure drops no longer occur.

7. To overcome the difficulty an auxiliary liquid oxygen container (Sect. 3, Chap. 2) which is not thermally insulated is added to the system, together with various other components including automatic change-over valve. During the filling of the main container the auxiliary container is also filled. As soon as filling is completed the oxygen in the auxiliary container boils and the pressure generated forces liquid through the heat exchanger where it is boiled and then bubbled through the liquid in the main container where it is condensed again. In becoming liquified it gives up its latent heat of vaporization to the mass of liquid the whole of which is thus heated to approximately -153°C.

8. In addition to the automatic change-over valve a standard liquid oxygen system requires the following components :—

(1) Heat exchanger (Sect. 4).
(2) Auxiliary liquid oxygen container (Sect. 3, Chap. 2)
(3) Bursting disc assembly (Sect. 3, Chap. 2)

DESCRIPTION

9. The automatic change-over valve consists of a light-alloy housing embodying a spring-loaded valve and bellows assembly. Three conical type pipeline connectors are provided in the body, with a fourth connector located in the centre of a flange at the top of the valve. The complete mechanism is fitted into the body, enclosed with an octagonal flange and secured with eight hexagon bolts and nuts. This component which may be mounted in any position is secured with two bolts through two 0·209 in. dia. holes in the body.

10. Referring to fig. 1 and fig. 2, details of the pipeline connections are as follows:—

(1) No. 1 A.G.S. Size "C" male cone ($\frac{3}{8}$ in. B.S.P.) connected to the heat exchanger coil.
(2) No. 2 A.G.S. Size "CC" male cone (0·750 in. × 14 TPI) connected to the auxiliary lox container.
(3) No. 3 A.G.S. Size "A" male cone ($\frac{1}{8}$ in. B.S.P.) connected via a pressure sensing line to the gas line from the container.
(4) No. 4 A.G..S Size "C" male cone ($\frac{3}{8}$ in. B.S.P.) connected to the main liquid oxygen container.

OPERATION

11. During the operation of filling the main liquid oxygen container, a pressure difference exists between the filling line where the automatic change-over valve is sited, and the container gas line to which port 3 is connected by the sensing line. This pressure difference compresses the bellows inside the valve and moves the poppet. When the pressure in ports 1, 2 and 4 exceeds the pressure in port 3 by 25 lb/in.^{2} the valve allows liquid oxygen to pass from port 2, connected to the auxiliary liquid oxygen container, to port 4 which is connected to the main liquid oxygen container, and seals off port 1, which is connected to the heat exchanger. With no pressure difference between ports 1, 2 and 4 and port 3, the valve allows flow from port 1 to port 4, and seals off port 2.

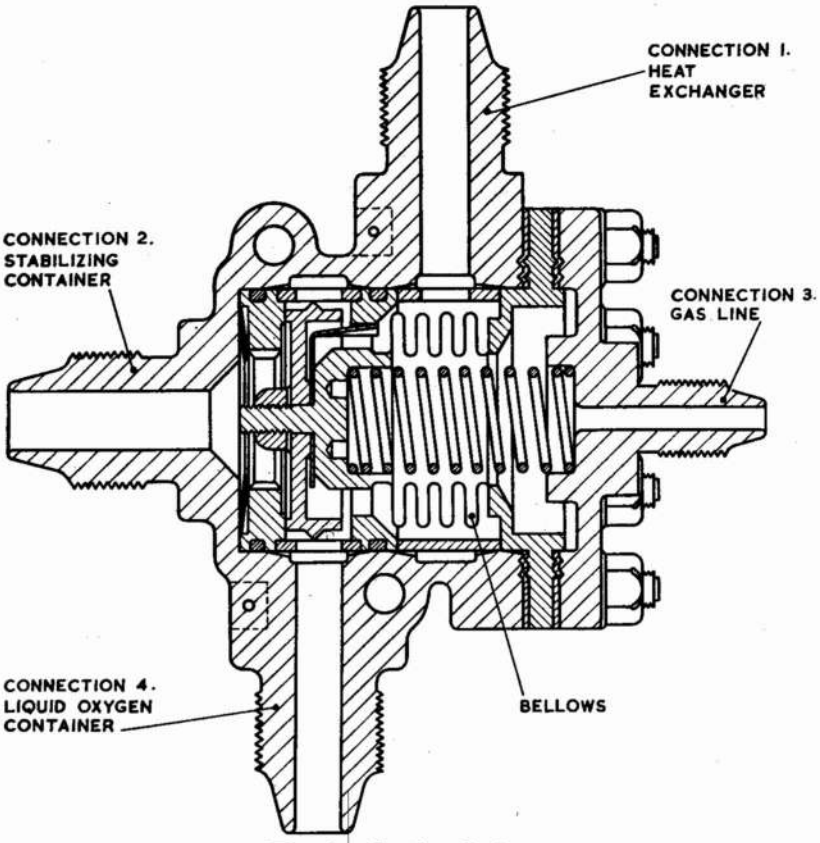

Fig. 2. Sectional view

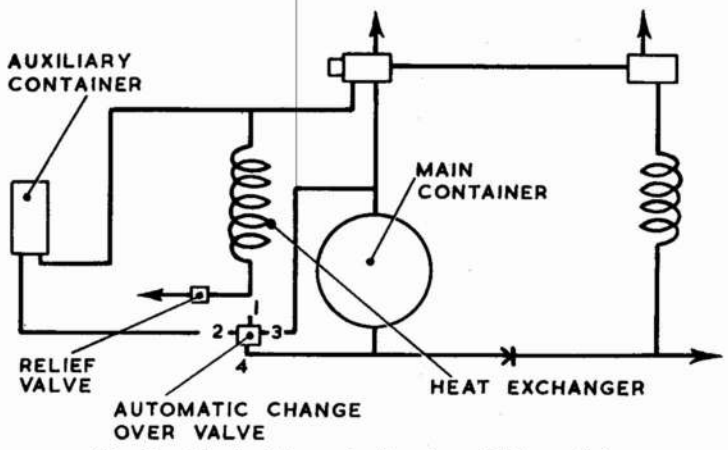

Fig. 3. Typical layout of system (Schematic)

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Appendix 1

STANDARD SERVICEABILITY TEST (R.N.)
for
AUTOMATIC CHANGE-OVER VALVE
Ref. No. 6D/2319

Introduction

1. The tests laid down in this Appendix must be applied to the above-mentioned equipment immediately prior to installation in aircraft, in accordance with the appropriate Servicing Schedule and at any time serviceability is suspect. The tolerances specified must not be exceeded.

TEST EQUIPMENT

2. The following test equipment is required:—

Description	Ref. No.	Remarks
Cone cap, $\frac{3}{8}$ in., B.S.P.	28F/15579	1 off
Sleeve, outer, $\frac{3}{8}$ in., B.S.P.	28F/5604	1 off
Oxygen leak tester	6D/1418	1 off
Gauge, pressure, 0-50 lb. in^2	6C/262	1 off
N.A.T.O. air supply or dry gaseous oxygen		As required
Thermometer—200°C	6C/6685/99-943-2934	1 off

TESTS

3. All tests must be carried out in a clean, dry atmosphere.

◀**Note . . .**

Before fitting a valve which has been subjected to a long period of storage, it should be exercised under pressure.▶

WARNING . . .

The presence of oil or grease in contact with oxygen at high pressure is dangerous since it introduces a grave risk of explosion.

Visual checks

4. (1) Inspect the valve for defects and damage.

(2) Check bolts for security of attachment.

Functional checks

5. Carry out the following functional checks.

(1) Remove the transit blanks and fit a pressure blank to connection 4 (*fig.* 1).

(2) Connect the gas pressure supply to connection 1.

(3) Connect the oxygen leak tester to connection 2.

(4) Slowly increase the supply pressure and check that there is no leakage from connection 2 until the reading on the pressure gauge is between 22·5—27·5 lb/in^2.

(5) Increase the supply pressure to 30 lb/in^2, then slowly decrease the pressure. Check that the leakage from connection 2 ceases at not less than 22·5 lb/in^2.

(6) Decrease the supply pressure to zero, disconnect the valve from the test rig and remove the blank. Disconnect the leak tester.

(7) Place the valve in a drying cabinet for one hour at 70°C. After drying out, fit transit blanks to all connections immediately.

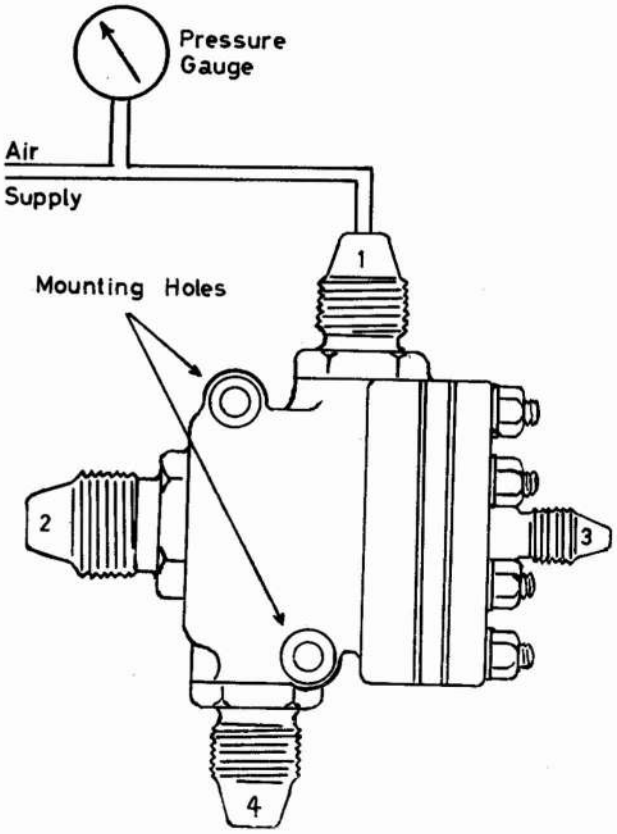

Fig. 1. Test circuit and connections

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