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# RESTRICTED

AP 5275
BOOK No. 2
CHAP. No. 1

## TITLE

OXYGEN REGULATORS

## TYPE

MK II SERIES

## PART No.

6D 1275 (11C) 6D 1276 (11D) 6D 1277 (11E)

## FITTED TO

Vampire T11 + FB9

# RESTRICTED

# Chapter 2

# OXYGEN REGULATORS, MK. 11 SERIES

## LIST OF CONTENTS



## LIST OF ILLUSTRATIONS



## LIST OF APPENDICES



### Introduction

**1.** The Mk. 11 series oxygen regulators are of the constant flow type, the pressure of the oxygen supply from the storage cylinders being reduced and a constant flow of low-pressure oxygen passed through fixed orifices. The regulators are used in conjunction with economizers, Mk. 4.

**2.** The regulator provides a NORMAL flow of oxygen up to a cabin altitude of 25000 ft and a HIGH flow for cabin altitudes between 25000 and 40000 ft, the change from normal to high flow being achieved by operating a flow-change switch.

**3.** An emergency flow valve is incorporated in the regulator and gives a greatly increased oxygen flow for emergency use, this being additional to the normal and high flows provided for altitudes up to 40000 ft.

### DESCRIPTION

**4.** The principal components of a typical Mk. 11 series regulator (fig. 1) are housed in, or located on, a regulator body. A panel assembly attached to the body mounts the controls and indicators. The components and assemblies are as follows :—

(1) High-pressure on-off valve

(2) High-pressure contents gauge

(3) Reducing valve

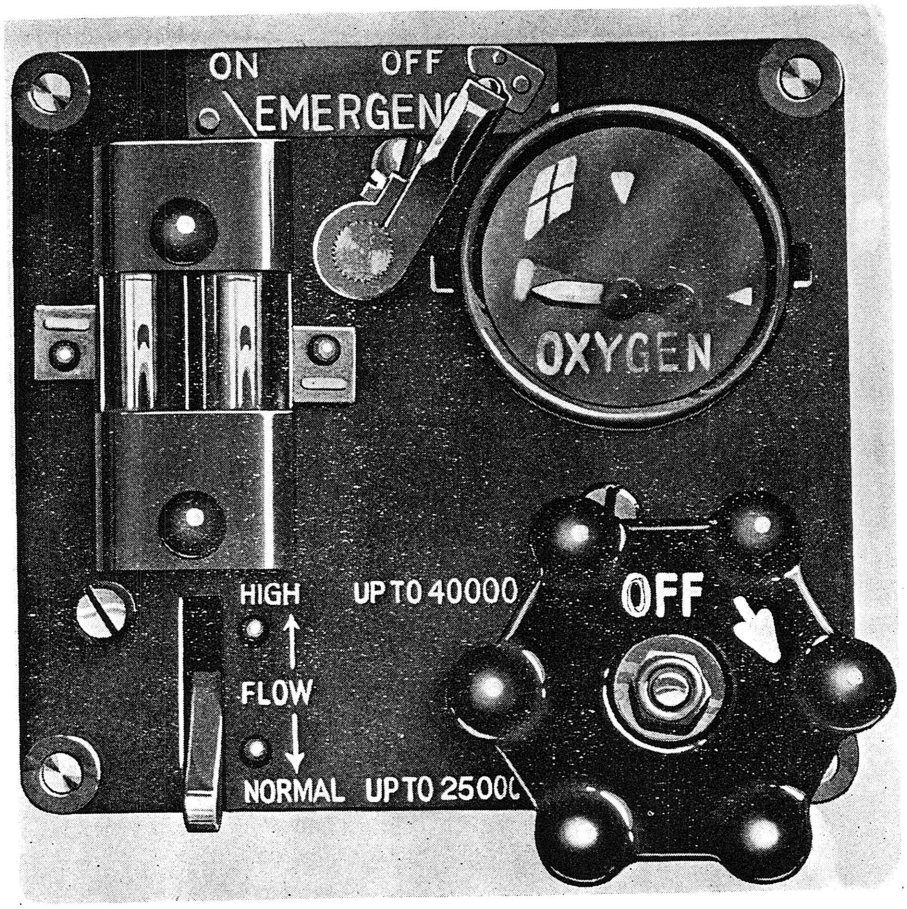



**Fig. 1. Typical Mk. 11 series regulator**

(4) Flow-change switch valve

(5) Twin-tube flow indicator assembly

(6) Emergency flow valve

(7) Relief valve.

**High-pressure on-off valve**

**5.** A sectional view of this unit is shown in fig. 2; the valve is of the glandless type, the usual gland and gland washer being replaced by a metallic bellows. The oxygen enters at high pressure through the inlet connection and passes through connecting passages and a filter to the reducing valve. A passage also leads from the valve body to a pipe connecting with the contents gauge.

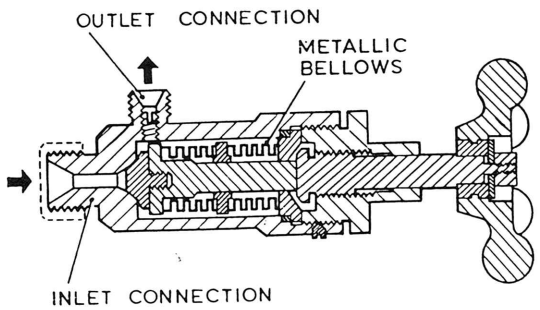



**Fig. 2. High-pressure on-off valve**

**High-pressure contents gauge**

**6.** A high-pressure contents gauge is provided in the regulator assembly to indicate the amount of oxygen remaining in the cylinders. The dial is marked at pressures corresponding to full, half-full and empty; these are indicated by the word FULL, a mark, and a red sector, respectively.

**Reducing valve**

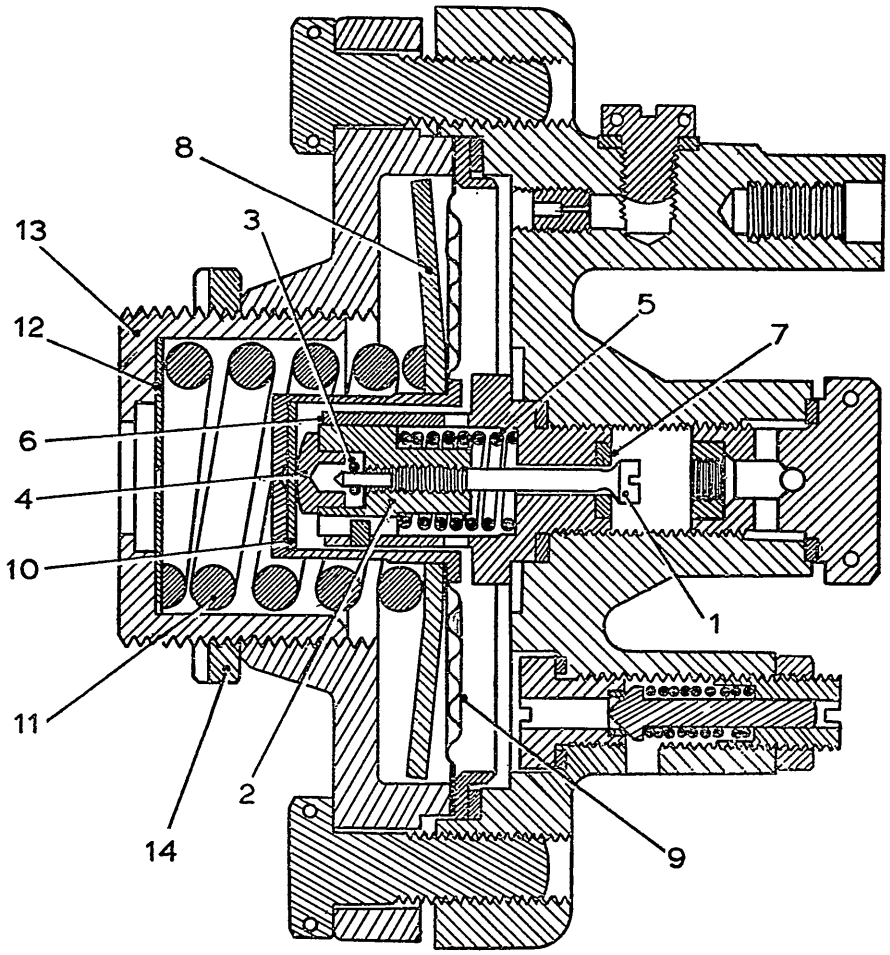
**7.** This valve (fig. 3) reduces the oxygen supply pressure from the high-pressure oxygen cylinders to a constant pressure of approximately 40 lb/in². The reducing valve is of the inverted type; that is, one in which the valve stem passes through the valve seat orifice. For descriptive purposes, the valve can be divided into a valve group and a chamber group.

*Valve group*

**8.** The valve group comprises a valve stem (1), valve plunger (2) containing a valve clip (3) and end pad (4), and a valve return spring (5). These components are assembled in a valve guide (6) which houses a valve seat (7).

*Chamber group*

**9.** The chamber group consists of a diaphragm plate (8), diaphragm (9), diaphragm thrust washer (10), regulating spring (11), end plate (12), regulating adjusting screw (13) and adjusting screw




1 VALVE STEM
2 VALVE PLUNGER
3 VALVE CLIP
4 END PAD
5 VALVE RETURN SPRING
6 VALVE GUIDE
7 VALVE SEAT
8 DIAPHRAGM PLATE
9 DIAPHRAGM
10 DIAPHRAGM THRUST WASHER
11 REGULATING SPRING
12 END PLATE
13 REGULATING ADJUSTING SCREW
14 ADJUSTING SCREW LOCKNUT

**Fig. 3. Reducing valve**

locknut (14); these components are assembled in the main body of the regulator.

**Flow-change switch valve**

**10.** The flow-change switch valve (fig. 1) is of the glandless type in which the usual spindle gland is replaced by a metallic low-pressure bellows, the seal being made by the upper end of the bellows. The valve is of a self-centring type which consists of a loose conical needle which is carried in the end of a spindle, and is held in position by a retaining washer. The valve is operated by a switch lever, the lever having two positions, marked NORMAL (up to 25000 ft) and HIGH (up to 40000 ft) respectively. The valve is open when the switch is in the HIGH position and closed in the NORMAL position of the switch lever. A spring is fitted on the outside of the bellows to provide a reasonable closing force for the valve.

**Twin-tube flow indicator assembly**

**11.** The twin-tube flow indicator (fig. 1) provides a visible indication of the oxygen supply to the pilot. Each flow tube contains a float comprising two balls, the upper being of metal to provide control force, and the lower being of perspex to carry luminous fluorescent, or white compound. Separate inlets and outlets are provided at the top and bottom of each tube respectively, the top outlet being combined into one outlet in the regulator body. The indicator is provided with a front plate covering the bottom of both tubes so that the ball floats are obscured when there is no flow. Two horizontal, luminious marks on plates at the side of each flow tube determine the correct position of the lower balls when the regulator is in use.

### Emergency flow valve

**12.** The emergency flow valve is situated between the twin-tube flow indicator and the high-pressure contents gauge (fig. 1). The valve is operated by a control lever, coloured red, which is mounted on the front of the regulator. The valve is of the screw-down type, the seal at the flat metal seat being made by a Tufnol pad inserted in the end face of the valve spindle. The spindle is sealed by a gland nut and leather gland washer.

### Relief valve

**13.** The relief valve is located in the regulator body and is in communication with the reduced pressure chamber. A drilling in the side of the body permits the escape of excess pressure. Adjustment of the relief pressure is by means of an adjusting screw locked by a locknut.

## OPERATION

**14.** The description which follows should be read in conjunction with fig. 4 which illustrates the operating principle diagrammatically.

### Normal flow

**15.** High-pressure oxygen from the storage cylinders is controlled at the regulator inlet by the high-pressure on-off valve. When the control is OFF the valve stem is seated and there is no flow. When the control is turned ON, the valve stem is lifted clear of its seat allowing high pressure oxygen to pass, through a filter, to the reducing valve. This high-pressure oxygen also passes, through a pipe assembly, to the high-pressure contents gauge. Oxygen passes through the reducing valve, enters the reduced pressure chamber and continues to flow until the pressure in the chamber, acting on the diaphragm, overcomes the loading of the regulating spring and closes the pressure reducing valve. The oxygen in the chamber is then at a predetermined pressure, which is dependent on the adjustment of the spring. The oxygen flows from the reduced pressure chamber through two passageways, one leading to the normal flow jet and its flow indication tube, while the other leads to the switch valve housing. When the flow-change switch is set to NORMAL, the switch valve is on its seating and oxygen flows through the normal flow jet and flow indicator only, and thence to the regulator outlet. As oxygen flows from the chamber, the pressure in the chamber falls and the spring pressure overcomes the reduced pressure on the diaphragm, opens the valve and more oxygen passes into the chamber until the pressure reaches the reduced value.

**16.** When oxygen is drawn off at a constant rate, the valve takes up a position of equilibrium such that the pressure in the chamber is maintained at an almost constant value, independent of the pressure of the supply.

### High flow

**17.** When the flow-change switch lever is set to HIGH, the switch valve is lifted off its seating, thus allowing oxygen to flow from the switch valve housing to the HIGH flow jet and flow indicator. This flow combines with the flow from the 'normal' flow indicator.

### Emergency flow

**18.** When the emergency flow control lever is set to ON, oxygen flows through the metering hole of the valve seat, and through passageways to the downstream side of the twin-tube flow indicator where it combines with the flow from the indicator. The control lever has a movement of approximately 90° and, after the first 10° to 20° of movement, the total flow from the regulator increases in approximate proportion to the angular rotation of the control lever. An increased flow is not obtained from the initial rotation of the control as some 10° to 20° of movement is required to unseat the valve fully. When the emergency flow control is turned ON, the existing flow from the regulator is increased to approximately 27 litres/min; the positions of the floats in the twin-tube flow indicator, however, are unaltered.

**Note . . .**

*The use of the emergency setting should be confined to the duration of the emergency in order to minimise the period of excessive flow which will be reflected in the duration of the supply.*

## INSTALLATION

**19.** If it is required to test the regulator prior to installation, apply the standard serviceability tests (App. 1). Before fitting the regulator in an aircraft, refer to the relevant air publication for details of the installation. The cut-off valve Mk. 1 cannot be used with the Mk. 11A, B, or C regulators, and a suitable stowage clip for the Mk. 4 bayonet socket is provided in the aircraft in lieu of the cut-off valve.

### Post-installation test

**20.** After the regulator has been installed, apply the in situ tests (para. 29).

## OPERATING INSTRUCTIONS

**21.** The following procedures should be carried out before, during and after flight. To obtain oxygen, it is necessary only to set the on-off valve to ON. Oxygen will then flow from the regulator to the economizer and the oxygen mask.

### Before flight

**22.** (1) Set the high-pressure on-off valve control to ON, and the flow-change switch at NORMAL. The floats in the right-hand tube of the twin-tube flow indicator should rise to the index mark.

(2) The contents gauge should indicate sufficient oxygen for the flight.

(3) Operate the flow-change switch lever. The floats in the left-hand tube of the twin-tube flow indicator (high flow) should rise and fall correspondingly.

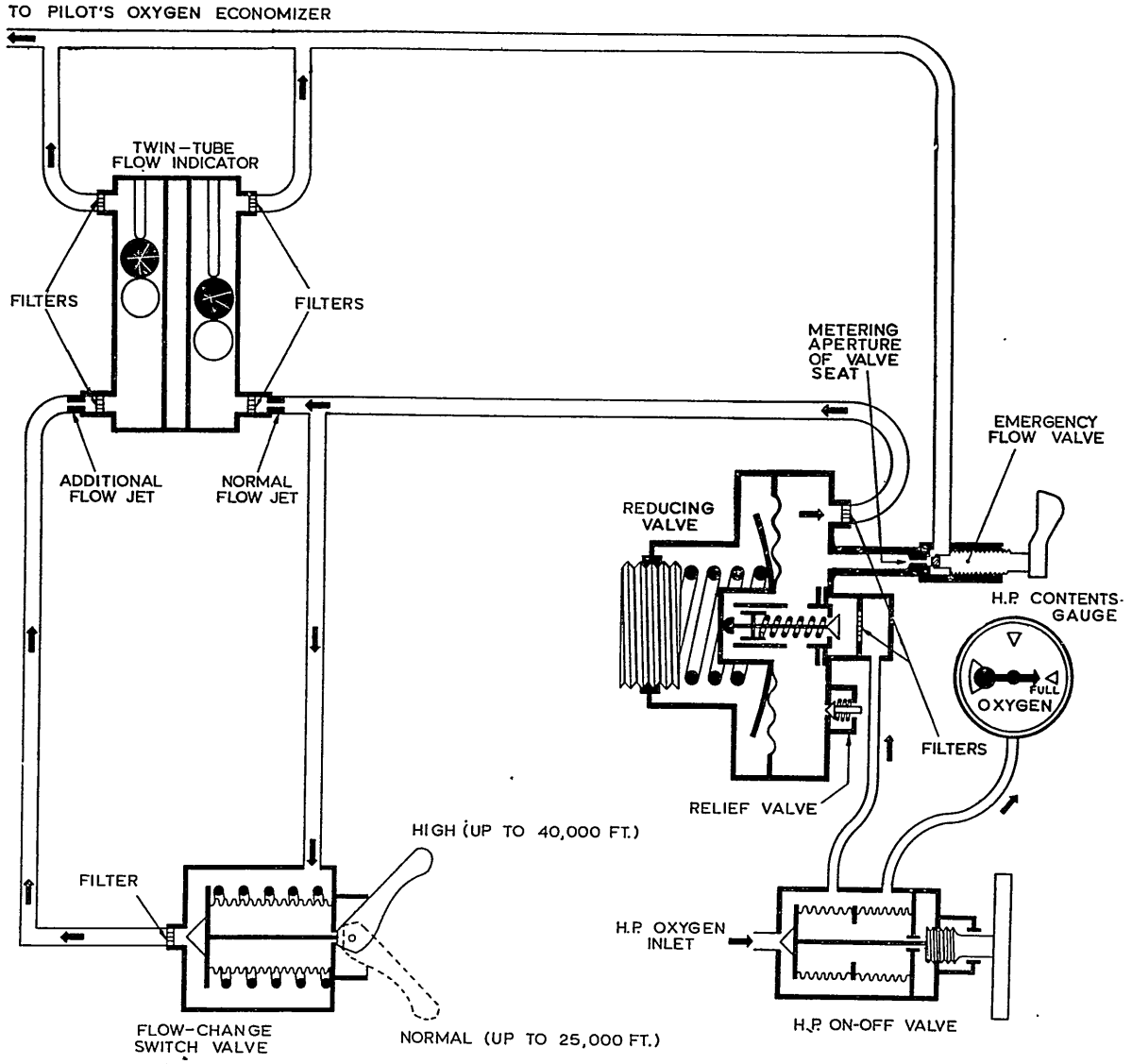



**Fig. 4. Schematic diagram of regulator**

(4) Set the on-off valve to OFF. The floats in the flow indicator should be obscured as soon as the contents gauge pointer has fallen to zero.

(5) Ensure that the flow-change switch lever is set to NORMAL.

### In flight

**23.** (1) When oxygen is required during flight, set the on-off valve to ON.

(2) In level flight, set the flow-change switch to NORMAL for altitudes up to 25000 ft and to HIGH for greater altitudes.

(3) For rates of climb of less than 2000 ft/min, set the flow-change switch to NORMAL on attaining 10000 ft and to HIGH at altitudes in excess of 25000 ft.

(4) For rates of climb exceeding 2000 ft/min, high speeds and night operations above 4000 ft, set the flow-change switch to NORMAL from ground level up to 25000 ft, and to HIGH for altitudes in excess of 25000 ft.

### After flight

**24.** Ensure that the high-pressure, on-off valve is set to OFF. This is important as it prevents moisture being deposited on the walls of the discharged oxygen cylinders.

### Emergency use

**25.** The emergency setting must be used in any emergency which demands an additional supply of oxygen. This may occur under the following circumstances.

(1) At high altitudes if lack of oxygen is suspected.

(2) At any altitude if the cabin becomes contaminated with noxious fumes.

(3) At any altitude if a temporary breakdown of the normal oxygen supply occurs.

*Suspected lack of oxygen at high altitudes*

**26.** If lack of oxygen is suspected at high altitudes, proceed as follows :—

(1) Turn the emergency control lever to ON.

(2) Leave the emergency control lever in the ON position until the cause of the loss of oxygen has been established. Descend to below 10000 ft and rectify the fault if this can be done in the air.

*Cabin contamination at any altitude*

**27.** If contamination occurs, proceed as follows:—

(1) Turn the emergency control lever to ON.

(2) Descend to below 10000 ft and land without delay.

*Temporary breakdown of the normal oxygen supply*

**28.** The procedure in the event of a temporary breakdown of the normal oxygen supply is as follows :

(1) Turn the emergency control lever to ON.

(2) Descend to below 10000 ft and endeavour to establish the cause of failure. If the fault cannot be found or remedied in the air, return to base.

(3) When using the emergency oxygen setting, observe the contents gauge frequently and ensure that the supply remaining is sufficient for the flight.

## SERVICING

WARNING . . .

**Many materials, particularly oil and grease, are subject to spontaneous combustion when exposed to undiluted oxygen under pressure. Precautions must be taken, therefore, to exclude oil, grease, dust and metal particles from the regulator and its associated equipment.**

**In situ tests**

**29.** The in situ regulator tests are as follows :—

(1) Apply the tests detailed in para. 22.

(2) Set the high-pressure, on-off valve to ON and set the flow-change switch to HIGH. Using soap solution, check the pipe connections, valve glands and flow indicator joints for leakage.

(3) Set the on-off valve to OFF and the flow-change switch to NORMAL.

Note . . .

*Soap solution should be prepared in accordance with the instructions contained in Part 1, Sect. 2, Chap. 1. On completion of the leak test, all traces of soap solution must be removed and the regulator dried thoroughly.*

(4) Set the on-off valve to ON. Connect a flow tester, Mk. 5A*, to the regulator outlet and check the flow at the NORMAL and HIGH flow settings. The flow should be between 2·6 and 3·7 litres/min at the NORMAL setting and between 5·1 and 7·4 litres/min at the HIGH setting. On completion of the test, set the on-off valve to OFF and the flow-change switch to NORMAL.

**Routine servicing**

**30.** The pipeline filter which is positioned in the high-pressure pipeline, immediately in front of the regulator, should be serviced at the periods laid down in the servicing schedule. If the high-pressure, on-off valve is found to be excessively stiff in operation, the regulator should be disposed of in accordance with current Service procedure.

**31.** The following components can be renewed in service :—

(1) High-pressure contents gauge and the connecting pipe. After renewal, check for leakage at the pipe connections using soap solution.

(2) The chokes fitted to the inlet connection of the contents gauge and in the pressure gauge connection of the on-off valve.

(3) A defective or damaged flow indicator. Ensure that the four sealing washers fitted at the top and bottom connections of each flow tube are replaced in the recesses provided in the regulator body. The two securing screws must be locked by smearing Bakelite varnish (33B/9426171) on the threads.

(4) A broken on-off handwheel should be renewed.

(5) Flow-change switch valve. After renewal, the operation of the switch is to be checked (App. 1).

**Emergency flow checks (Mk. 11C, 11D and 11E regulators)**

**32.** The checks contained in subsequent paragraphs are to be applied at the intervals specified in the Servicing Schedule.

**33.** Measure the normal and high flows at the outlet connection at frequent intervals. This is done by first disconnecting the piping at the inlet to the economizer and attaching the flow tester Mk. 5A*. With the emergency flow valve shut and the contents gauge reading between full and threequarters-full, the flows should be within the N and H bands marked on the tester. If the flows are greater than that indicated by the N and H bands this may be due to :—

(1) Leakage past the emergency flow valve seat or

(2) A faulty reducing valve.

If either of these is the case, the regulator should be regarded as unserviceable.

**34.** Check the initial opening position of the emergency valve, by turning the lever slowly from

the OFF position until the flow shown on the tester definitely increases. The initial opening should be 10° to 20° counter-clockwise from the OFF mark. If, however, the valve has been turned to OFF with excessive force, the initial opening position may occur at the OFF mark, or in extreme cases 10° to 20° in a clockwise direction of this mark. If this is the case, the control lever should be repositioned on the splined spindle by removing the central screw, and moving the lever one spline in a counter-clockwise direction. If this operation is found to be necessary, check the maximum flow when the lever is set to the ON position, as indicated in the ensuing paragraph.

**35.** With the emergency flow lever in the ON position, check that the flow is considerably greater than the maximum flow, i.e., greater than 14 litres per minute, shown on the tester. The flow should be sufficient to maintain the float hard against the top stop of the tester. If two testers are available, they can be teed off the outlet piping, and the total flow will then be equal to the sum of the flow indicated on each tester. The total flow with the switch in the NORMAL position should not exceed 29, or be less than 23 litres per minute. If two testers are not available, the increase in flow, when the emergency flow is turned on, can be checked audibly.

**36.** Check the control lever, to see that its movement is not too free. If necessary, the gland nut should be tightened to increase the friction of the gland washer on the spindle, and so prevent possible alteration of the setting by vibration in the aircraft. To tighten the gland nut it will be necessary to remove the regulator from the aircraft, and to detach the emergency control lever and front plate of the regulator.

**37.** The gland of the emergency valve should be checked periodically for leakage. This leak test should be applied using soap solution. The check should be done with the control lever set at ON. If necessary, the gland nut may be tightened as described in the previous paragraph.

**38.** At the completion of such of the above checks as are found to be necessary, the emergency control lever should be moved to the OFF position.

# Appendix 1

# STANDARD SERVICEABILITY TESTS
# for
# OXYGEN REGULATORS, MK. 11 SERIES

**Introduction**

**1.** The tests detailed in this appendix should be applied before the regulator is fitted to an aircraft, when the serviceability of the unit is in doubt and at the appropriate examination periods at Equipment Depots.

## TEST EQUIPMENT

**2.** The equipment required is as follows :—

(1) Valve, master Mk. 10A (Ref. No. 6D/2313)

(2) Pipeline filter, Mk. 2A (Ref. No. 6D/1660)

(3) Pipe, connecting straight end (Ref. No. 6D/1446)

(4) Pressure gauge 0 to 2000 lb/in² (Ref. No. 6C/264)

(5) Flow tester, Mk. 5A* (Ref. No. 6C/475)

(6) Leak tester Mk. 1 (Ref. No. 6D/1417)

(7) Blanking cap (Ref. No. 6D/428)

(8) High-pressure oxygen supply, 2000 lb/in² (50 lb/in² for Mk. 11E regulators).

## PARTICULARS OF TESTS

**3.** The tests are to be applied under normal room temperature (+15°C) and pressure (29·92 in. Hg.) conditions. The gas supply for the tests must be breathing oxygen. Unless otherwise specified, the regulator is to be supported in its normal position (front panel upright and in a vertical plane). The regulator should be lightly tapped when taking test readings. Soap solution for leak testing should be prepared in accordance with the instructions contained in Part 1, Sect. 2, Chap. 1. Precautions must be taken to prevent the solution entering the regulator, and all traces of the solution must be removed when each test is completed.

WARNING . . .

**Many materials, particularly oil and grease, are subject to spontaneous combustion when exposed to undiluted oxygen under pressure. Precautions must be taken, therefore, to exclude oil, grease, dust and metal particles from the regulator and the test equipment.**

**4.** Regulators not conforming to the test requirements are to be disposed of in accordance with current Service procedure.

## TEST PROCEDURE

**Mk. 11B regulators only**

**5.** The Mk. 11B regulators have two outlet connections. For the purpose of checking the normal functioning (para. 9) and the flow characteristics (para. 10), a flow tester (Mk. 5A*) is to be connected to each outlet connection. The emergency flow check (para. 16) does not apply to this unit.

**Mk. 11D regulators only**

**6.** Before commencing the tests detailed in this appendix, the second outlet on the Mk. 11D regulators (for interconnection with Mk. 11E regulators) must be blanked.

**Mk. 11E regulators only**

**7.** The inlet pressure for testing Mk. 11E regulators must be between 40 and 50 lb/in². The tests applicable to these regulators are as follows :—

(1) Normal functioning (para. 9)

(2) Flow characteristics (para. 10)

(3) Emergency flow check (para. 11)

(4) Leak test (para. 14).

**Zero error**

**8.** Check the zero error of the contents gauge pointer. The error should not exceed $\frac{1}{16}$ in.

**Normal functioning**

**9.** To test the normal functioning of the regulator, proceed as follows :—

(1) Connect the high-pressure oxygen supply, through the test rig valve and filter, to the regulator inlet. The pressure gauge should be connected in the line at a point 6·0 in. from the regulator inlet.

(2) Connect the flow tester to the regulator outlet.

(3) Adjust the inlet pressure to between 1700 and 1800 lb/in² (40 lb/in² for Mk. 11E regulators). With the emergency valve (Mk. 11C, 11D and 11E regulators) set to OFF and the flow-change switch set to NORMAL, turn the high-pressure, on-off valve (Mk. 11B, 11C

and 11D) to ON. The regulator contents gauge (Mk. 11B, 11C and 11D regulators) should correspond with the master gauge, and the floats in the right-hand flow indicator tube should rise.

(4) Operate the flow-change switch several times between the NORMAL and HIGH positions. The floats in the left-hand indicator tube should rise and fall with the movement of the switch.

**Note . . .**

*There must not be any audible leakage from the regulator during these tests.*

**Flow characteristics test**

**10.** With the emergency valve (Mk. 11C, 11D and 11E regulators) set to OFF, and with the high-pressure supply maintained between 1700 and 2000 lb/in² (40 lb/in² for Mk. 11E regulators), measure the flow at the regulator outlet (both outlets on Mk. 11B regulators). The flow should be between 2·6 and 3·7 litres/min with the flow-change switch set to NORMAL, and between 5·1 and 7·4 litres/min with the switch set to HIGH.

**Emergency flow (Mk. 11C, 11D and 11E regulators only)**

**11.** When the emergency lever is moved to the ON position, a considerable increase in flow should occur and should be sufficient to move the float in the flow tester to its upper stop.

**Contents gauge calibration**

**12.** With the emergency lever set to ON (Mk. 11C and 11D regulators) and the flow-change switch set to NORMAL, reduce the inlet pressure until the regulator contents gauge pointer falls to the half indication. The standard pressure gauge should then indicate between 890 and 1000 lb/in².

## ADDITIONAL TESTS ON USED REGULATORS

**High-pressure, on-off valve seal**

**13.** The on-off valve should be tightly closed on its seating and the leak tester, Mk. 2 connected to the regulator outlet (the second outlet connection on the Mk. 11B and 11D regulators should be blanked). With the pressure supply connected to the regulator inlet, the time taken for eight bubbles to escape should be not less than 10 seconds (equivalent to a maximum permissible leakage of 0·02 litres/min).

**Regulator leak test**

**14.** To test the regulator for general leakage, proceed as follows :—

(1) Blank the regulator outlet using a blanking cap (the Mk. 11B and 11D regulators have two outlets).

(2) Note the position of the emergency control lever (Mk. 11C, 11D and 11E regulators), then remove the lever from the spindle.

(3) Remove the front panel from the regulator.

(4) With the supply pressure to the regulator inlet maintained between 1700 and 1800 lb/in² (50 lb/in² for Mk. 11E regulators), turn the on-off valve to ON. There should be no leakage from any part of the regulator when the flow-change switch is set to NORMAL and then to HIGH.

**Note . . .**

*Leakage should be detected by applying soap solution to the pipe connections, all valve glands, the filter plug (located at the centre in the front of the regulator), around the switch gland, around the square flange joint, the pressure adjusting screws and the joints of the flow indicator.*

**Relief valve seal**

**15.** Set the flow-change switch to NORMAL and using the leak tester, Mk. 1, check the leakage from the relief valve; this should not exceed 0·2 litres/min. The outlet hole in the underside of the boss should be sealed while the reading is being taken, either by a finger or by the rubber tube of the tester.

**Note . . .**

*When refitting the front panel, ensure that the emergency lever is correctly positioned (para. 14(2)). The initial opening position at which the flow starts to increase is 10° to 20° counter-clockwise from the OFF mark.*

# Chapter 2A

# OXYGEN REGULATOR, MK. 11B

## LEADING PARTICULARS

| | |
|---|---|
| *Ref. No.* | 6D/752 |
| *Inlet pressure (maximum)* | 1800 *lb/in²* |
| *Reduced pressure (nominal)* | 40 *lb/in²* |
| *Delivery characteristics—* | |
| *Normal flow* | 2·6 *to* 3·7 *litres/min.* |
| *High flow* | 5·1 *to* 7·4 *litres/min.* |

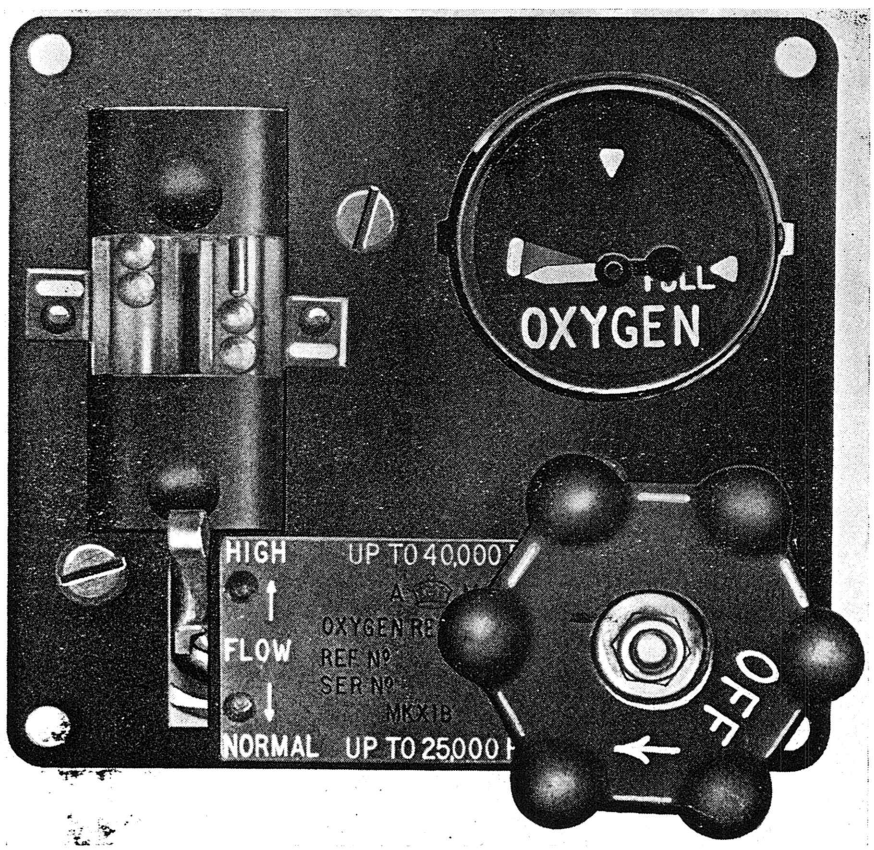



**Fig. 1. Mk. 11B regulator**

**RESTRICTED**

**Introduction**

**1.** This regulator (fig. 1 and 2) is similar to that described in Chapter 2 except for the following differences :—

(1) The emergency flow valve is not incorporated in this regulator.

(2) The regulator has two outlet connections.

**2.** The unit is employed in two-seater aircraft and has two outlet connections which deliver a metered flow of oxygen to two crew members as shown diagrammatically in fig. 3. The regulator is used in conjunction with an oxygen economizer, Mk. 4.

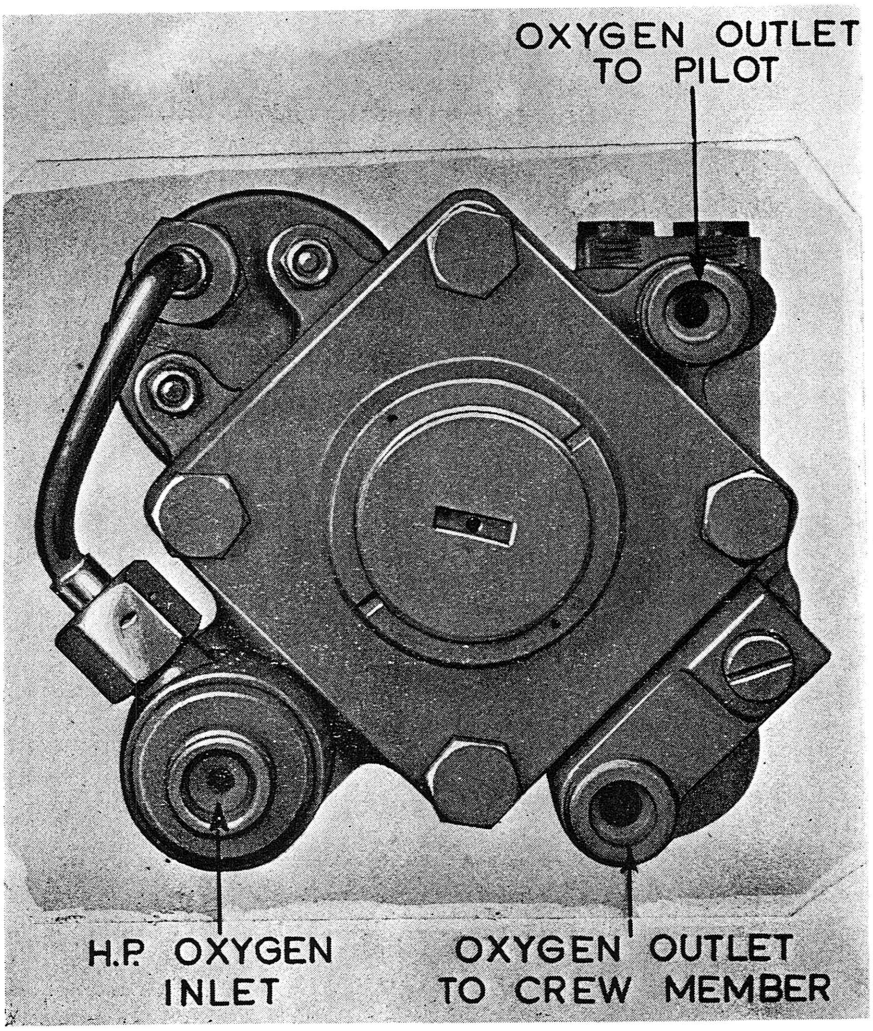



**Fig. 2. Mk. 11B regulator, rear view**

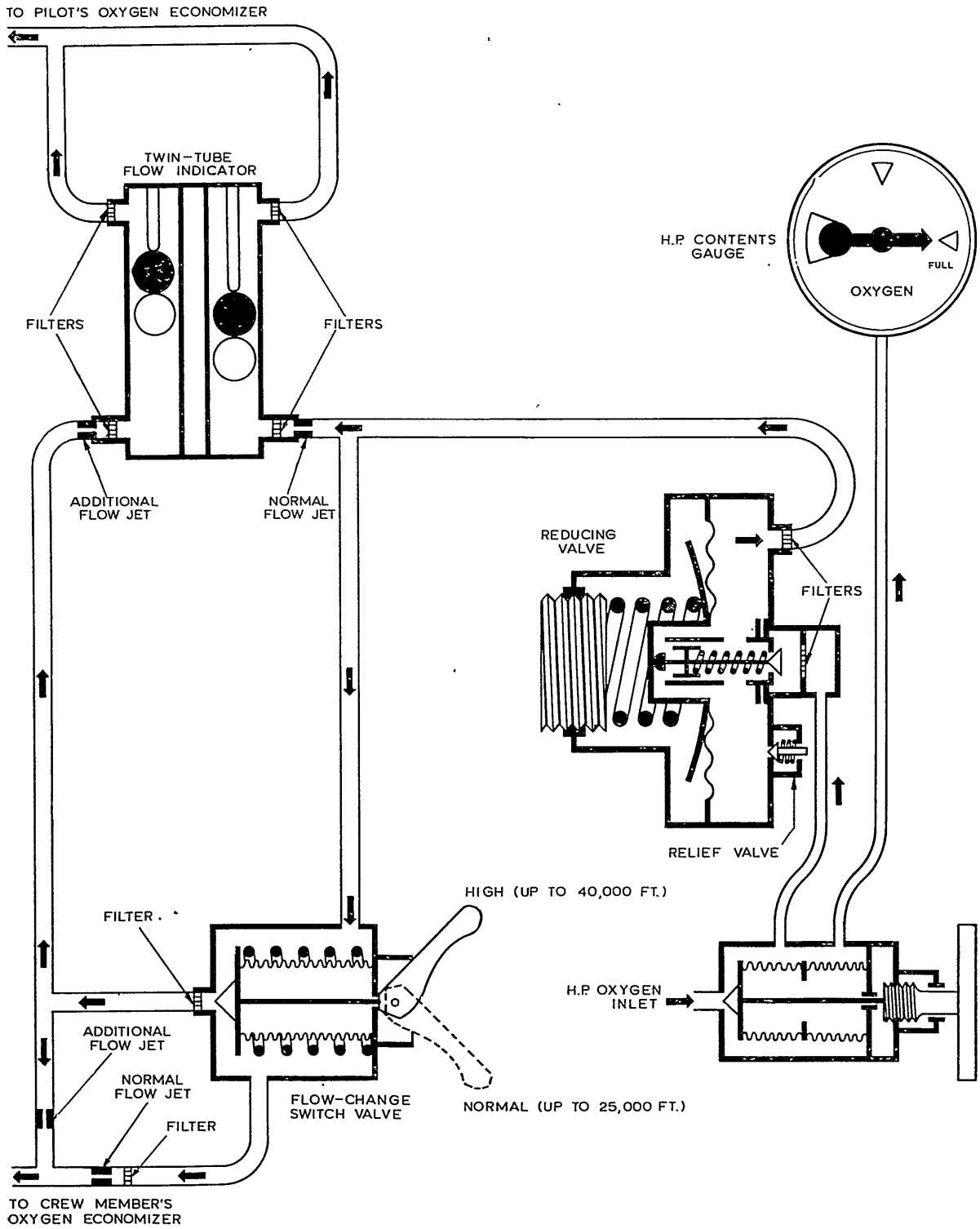



**Fig. 3. Schematic diagram of Mk. 11B regulator**

**RESTRICTED**

# Chapter 2B

# OXYGEN REGULATOR, MK. 11C

## LEADING PARTICULARS

| | |
|---|---|
| *Ref. No.* | *6D/1275* |
| *Inlet pressure (maximum)* | 1800 *lb/in²* |
| *Reduced pressure (nominal)* | 40 *lb/in²* |
| *Flow characteristics—* | |
| *Normal flow* | 2·6 *to* 3·7 *litres/min.* |
| *High flow* | 5·1 *to* 7·4 *litres/min* |
| *Emergency flow (total)* | 27 *litres/min (approx)* |

### Introduction

**1.** The Mk. 11C regulator is identical to the unit described in Chap. 2. It is fitted to single-seater aircraft and is used in conjunction with an oxygen economizer, Mk. 4.

# Chapter 2C

# OXYGEN REGULATOR, MK. 11D

## LEADING PARTICULARS

| | |
|---|---|
| *Ref. No.* | 6*D*/1276 |
| *Inlet pressure (maximum)* | 1800 *lb/in²* |
| *Reduced pressure (nominal)* | 40 *lb/in²* |
| *Delivery characteristics—* | |
| *Normal flow* | 2·6 to 3·7 *litres/min* |
| *High flow* | 5·1 *to* 7·4 *litres/min* |
| *Emergency flow (total)* | 27 *litres/min (approx)* |

**Introduction**

**1.** This unit differs from the unit described in Chapter 2 in that the regulator has a second outlet connection which is used to supply oxygen at reduced pressure, from the reducing chamber, to a second crew member. The regulator is shown diagrammatically in fig. 1.

**2.** The regulator is used in two-seater aircraft in conjunction with a regulator Mk. 11E (Chap. 2D).

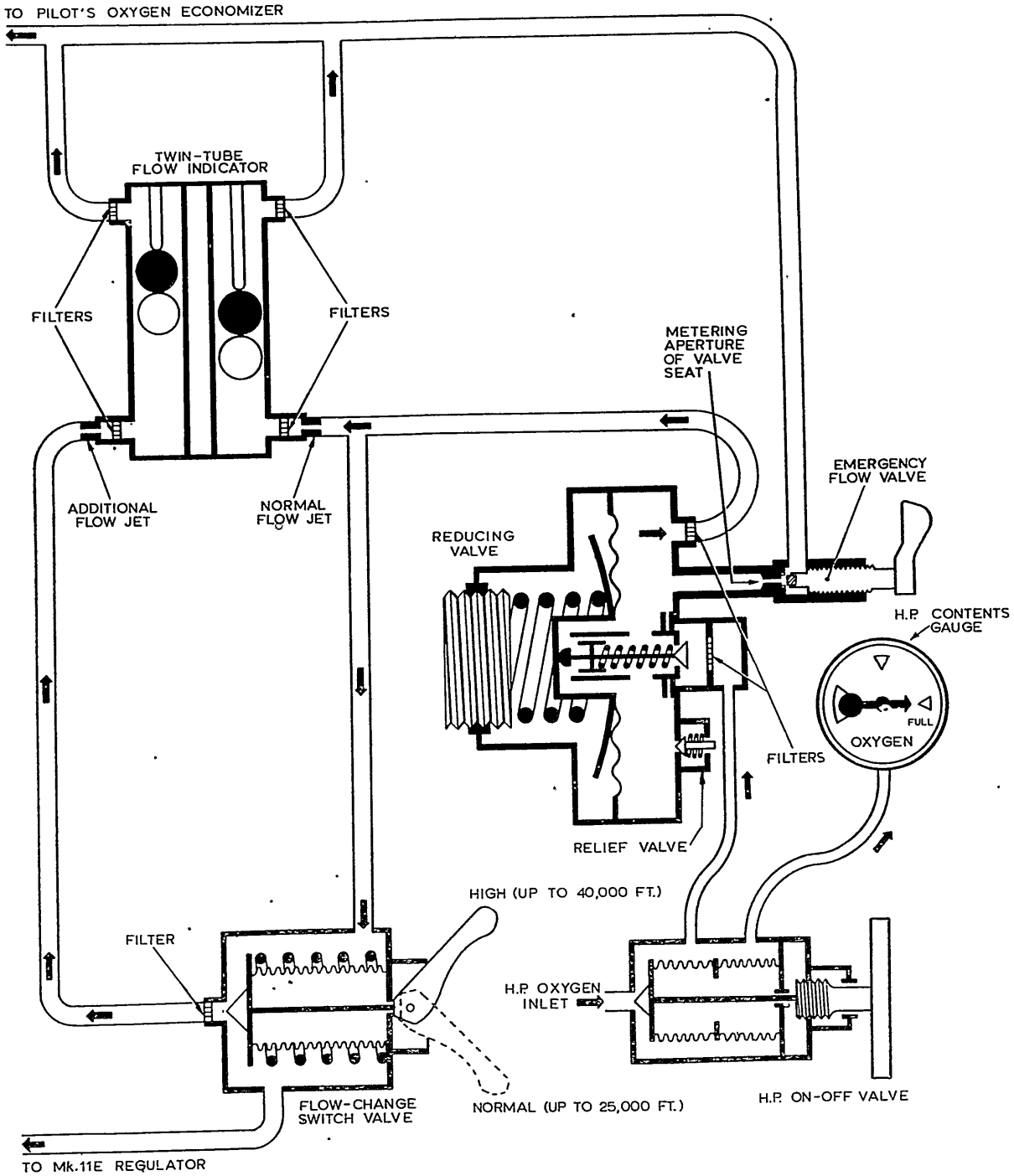



**Fig. 1. Schematic diagram of Mk. 11D regulator**

# Chapter 2D

# OXYGEN REGULATOR, MK. 11E

## LEADING PARTICULARS

| | |
|---|---|
| *Ref. No.* | 6*D*/1277 |
| *Inlet pressure (nominal)* | 40 *lb/in²* |
| *Delivery characteristics—* | |
| *Normal flow* | 2·6 *to* 3·7 *litres/min* |
| *High flow* | 5·1 *to* 7·4 *litres/min* |
| *Emergency flow (total)* | 27 *litres/min (approx)* |

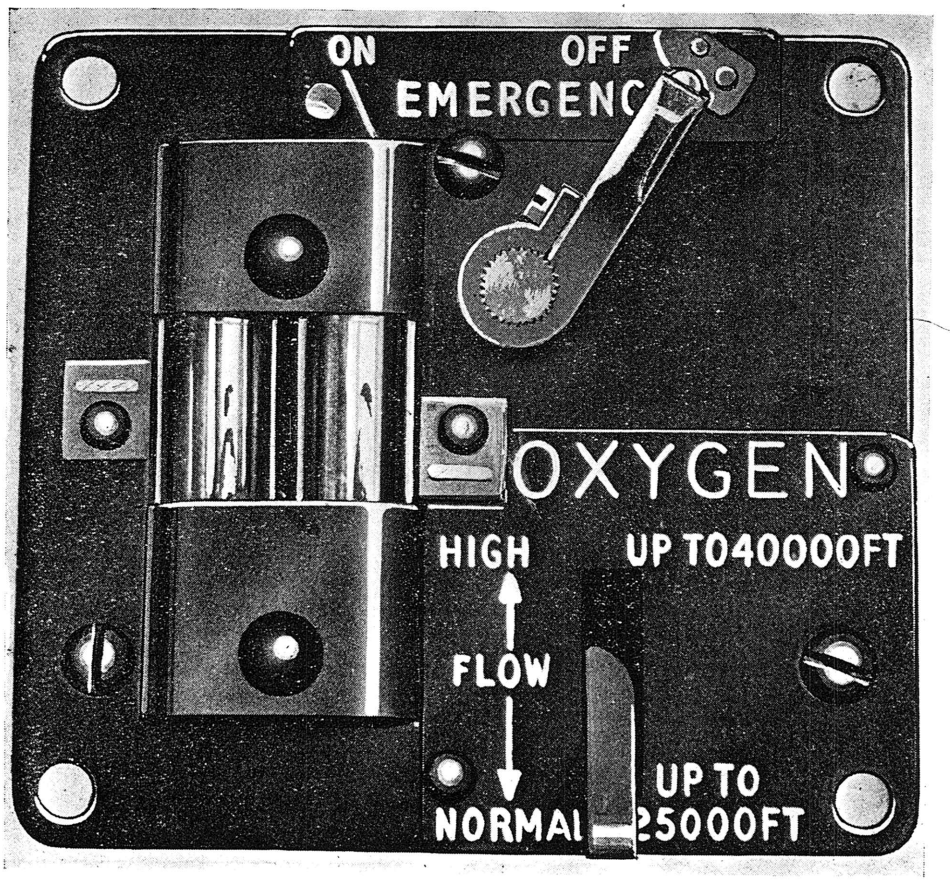



**Fig. 1. Mk. 11E, regulator**

**Introduction**

**1.** This regulator (fig. 1 and 2) is employed in two-seater aircraft for use by the second crew member and is used in conjunction with a regulator Mk. 11D (Chap. 2C). An oxygen supply, at reduced pressure, is fed to the inlet connection from the second outlet on the Mk. 11D regulator.

**2.** The unit is similar to that described in Chapter 2 except that the following components are not incorporated :—

(1) High-pressure, on-off valve.

(2) High-pressure contents gauge

(3) Reducing valve

(4) Relief valve.

**3.** A detachable gauze filter is fitted inside the inlet connection to prevent ingress of foreign matter which may be carried into the regulator from the pipeline. Due to the pressure drop in the pipeline from the Mk. 11D regulator, it may be found that the flow indicator floats on the Mk. 11E regulator drop when the emergency lever on this regulator is turned on. This is acceptable, provided that the oxygen flow is satisfactory.

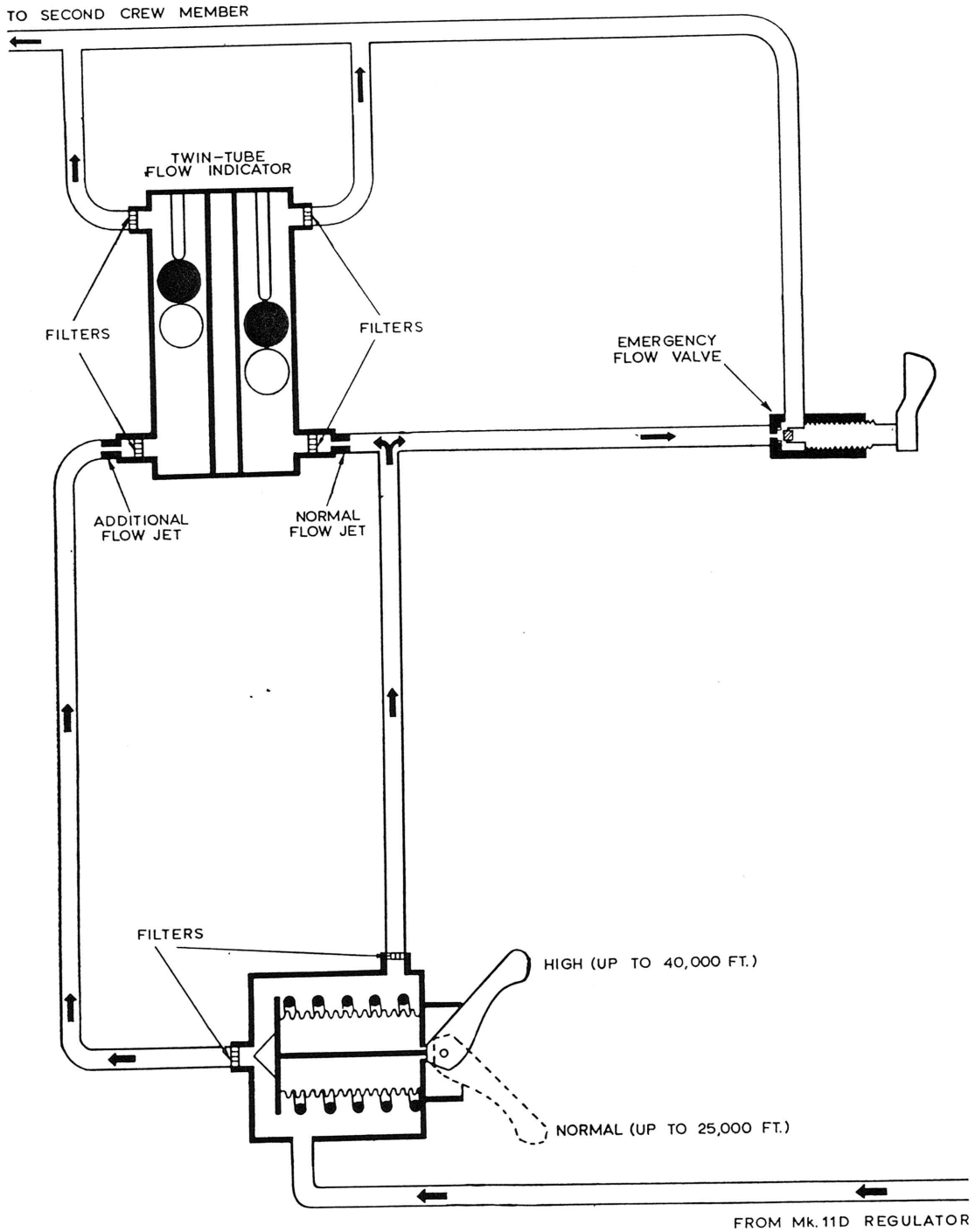



**Fig. 2. Schematic diagram of Mk. 11E regulator**

# Chapter 3

# OXYGEN REGULATORS, Mk. 11 SERIES

## LIST OF CONTENTS



## LIST OF ILLUSTRATIONS



## LIST OF APPENDICES

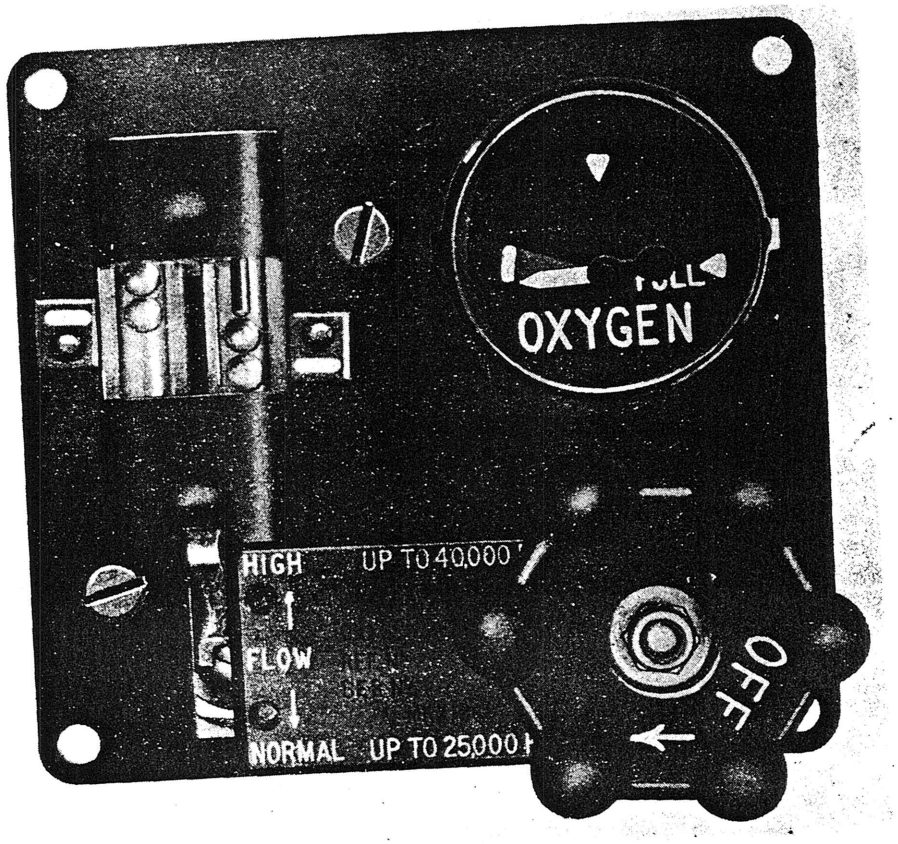



**Fig. 1. Mk. 11B regulator, front view**

**Purpose of the apparatus**

**1.** An oxygen regulator incorporates the control and indicating instruments required for the regulation of the oxygen supply in high-pressure breathing systems. All oxygen breathing installations require at least one regulator to control, relative to flying height, the flow of oxygen to the mask.

**General**

**2.** The front and rear view of a Mk. 11B regulator is shown in fig. 1 and 2. The Mk. 11A and 11B regulators are for use on single-seater and two-seater aircraft, respectively, to provide two alternative flows of oxygen to the crew, a normal flow for use at heights up to 25,000 feet, and a high flow for use in action and at heights up to 40,000 feet. The Mk. 11C regulator, illustrated in fig. 3, is the same as the Mk. 11A except for the addition of the emergency flow valve. This valve provides an increased oxygen flow for use in an emergency, and the flow is additional to the normal and high flows provided on the regulator. Some multi-seater aircraft may be fitted with more than one Mk. 11C, 11D or 11E regulators.

**3.** The regulators are for use only in conjunction with oxygen economizers, Mk. 2. The regulator is of the fixed reduced-pressure fixed flow type, the flow being determined by flow control jets.

## DESCRIPTION

**Construction**

**4.** The Mk. 11A, 11B, 11C and 11D consist of the following, but the Mk. 11C has in addition an emergency flow valve:—

| | | |
|---|---|---|
| (1) | High-pressure ON-OFF valve | Fig. 4 and 5 |
| (2) | High-pressure contents gauge | Fig. 4 |
| (3) | Reducing valve | Fig. 5 |
| (4) | Flow-change switch valve | Fig. 4 |
| (5) | Twin tube flow indicator | Fig. 4 |

**Note . . .**

*The Mk. 11E regulator, being fed directly from the Mk. 11D, is not provided with a high-pressure* ON-OFF *valve or high-pressure contents gauge.*

*High-pressure* ON-OFF *valve*

**5.** A sectional view of this unit is shown in fig. 5; the valve is of the glandless type, the usual gland and gland washer being replaced by a metallic bellows. The oxygen enters at high pressure through the inlet connection (*fig.* 2) and passes through connecting passages and a filter to the reducing valve. A passage also leads from the valve body to a pipe connecting to the contents gauge.

*High-pressure contents gauge*

**6.** A high-pressure contents gauge is provided in the regulator assembly to indicate the amount of oxygen remaining in the cylinders. The dial is marked at pressures corresponding to full, half-full and empty; these are indicated by the word FULL, a mark, and a red sector, respectively.

*Reducing valve*

**7.** A sectional view of the reducing valve is shown in fig. 5. The reducing valve is of the inverted type, i.e., one in which the valve stem passes through the valve seat orifice. It consists essentially of a valve (1), valve seat (2), valve return spring (3), valve guide (4),

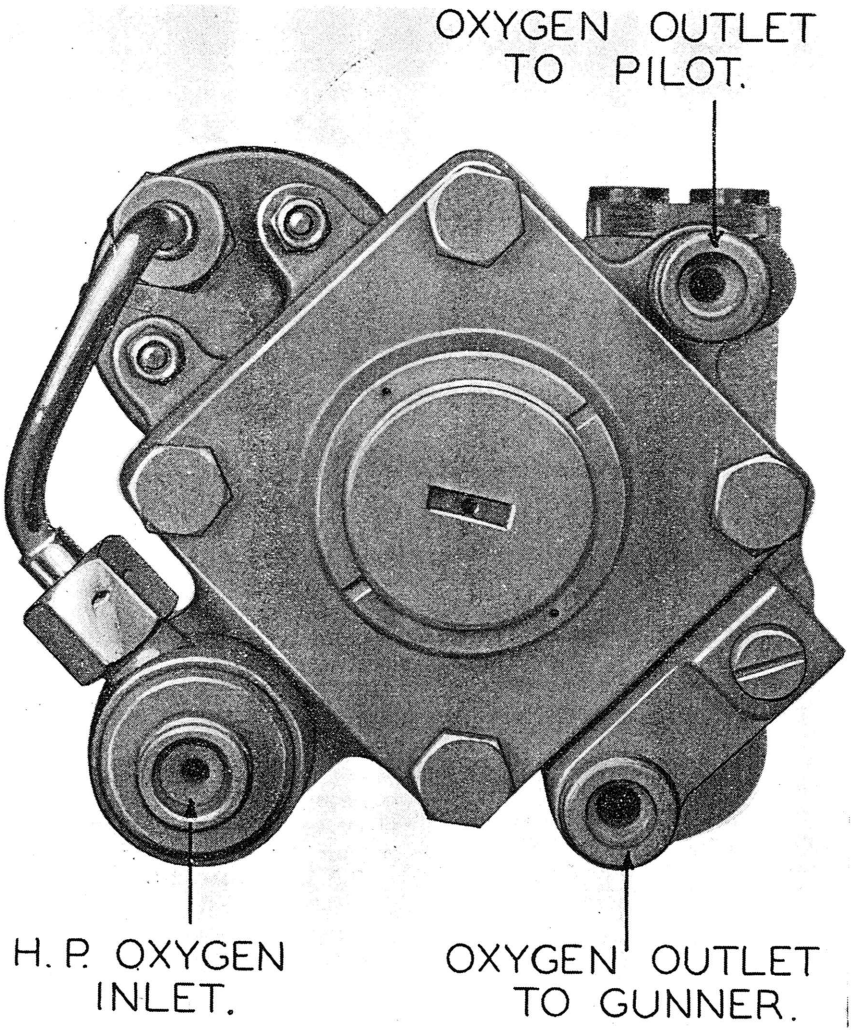



**Fig. 2. Mk. 11B regulator, rear view**

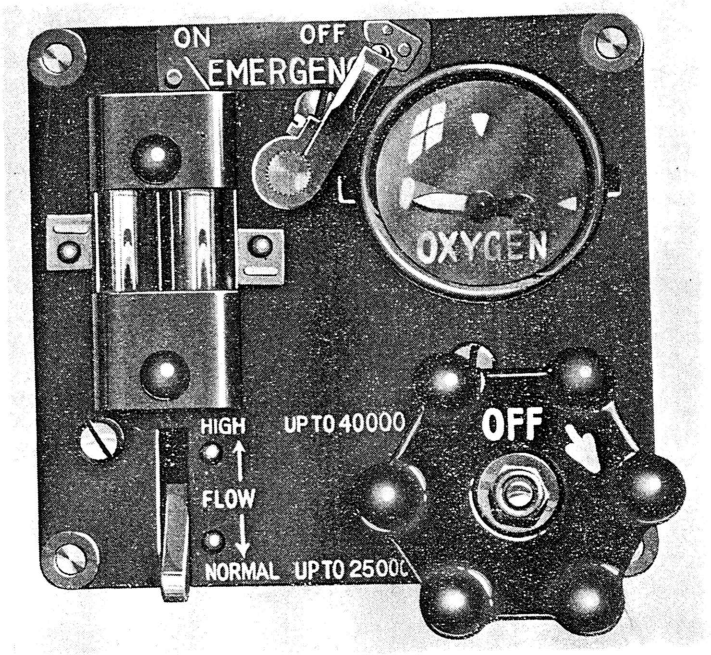



**Fig. 3. Mk. 11C and 11D regulators, front view**

regulating spring (5) and adjusting screw (6). These items are arranged as two main assemblies. The valve unit assembly comprises a valve, valve plunger (containing the valve clip and end pad) and return spring these items being assembled in the valve guide (4). The main assembly comprises a diaphragm plate (7), diaphragm (8), diaphragm thrust-washers (9), regulating spring (5), regulating adjusting screw (6) and adjusting screw lock-nut (10); these items being assembled in the main body of the regulator. The reducing valve reduces the high cylinder pressures to an approximate constant pressure of 40 lb. per sq. in.

*Flow change switch valve*

**8.** The flow switch valve is shown in fig. 4. The valve is of the glandless type in which the usual spindle gland is replaced by a metallic low-pressure bellows, the seal being made by the upper end of the bellows. The valve is of a self-centring type which consists of a loose conical needle which is carried in the end of the spindle, and is held in position by a retaining washer. The valve is operated by a switch lever, the lever having two positions, marked NORMAL—up to 25,000 ft. and HIGH—up to 40,000 ft. The valve is open when the switch is in the HIGH position and closed in the NORMAL position of the switch lever; a spring (shown in fig. 7) is fitted on the outside of the bellows to provide a reasonable closing force for the valve.

*Twin tube flow indicator*

**9.** The twin tube flow indicator is shown in fig. 4. The indicator provides a visible indication of the oxygen supply to the pilot. Each flow tube contains a float comprising two balls, the upper being of metal to provide control force, and the lower being of perspex to carry luminous fluorescent, or white compound. Separate inlets and outlets are provided at the top and bottom of each tube respectively, the top outlet being combined into one outlet in the regulator body. The indicator is provided with a front plate covering the bottom of both tubes, the ball floats are thereby obscured when no flow is passing through the regulator. Two horizontal luminous marks, fitted on the front plate at the side of each flow tube, determine the correct position of the lower balls when the regulator is in use.

*Emergency flow valve*

**10.** The emergency flow valve, fitted on the Mk. 11C regulator, is situated between the

twin tube flow indicator and the high-pressure contents gauge, as shown on fig. 8. The valve is operated by a control lever, coloured red, which is mounted on the front plate of the regulator. See para. 17.

**11.** The valve is the normal screw-down type, the seal at the flat metal seat being made by a Tufnol pad inserted in the end face of the valve spindle. The spindle is sealed by a gland nut and leather gland washer.

**Functioning**

*Mk. 11B*

**12.** A diagram illustrating the action of the Mk. 11B oxygen regulator is shown in fig. 7. The action of the regulator is as follows. Gas at high pressure enters through the inlet union and passes through a filter to the reducing valve, a passage also leads from the inlet chamber to a pipe connecting to the H.P. contents gauge. The gas enters the reducing chamber through the reducing valve and continues to flow until the pressure in the chamber is sufficient to displace the diaphragm against the pressure of the adjusting spring. The gas in the chamber will then be at a certain predetermined reduced pressure, depending on the adjustment of the spring. If some of the gas is drawn off from the chamber the pressure will fall, and the spring pressure which now is not overcome by the reduced pressure on the diaphragm will again open the valve. Further gas at high pressure will enter the chamber until the gas pressure reaches the predetermined reduced value. When gas is drawn off at a constant rate (i.e.,

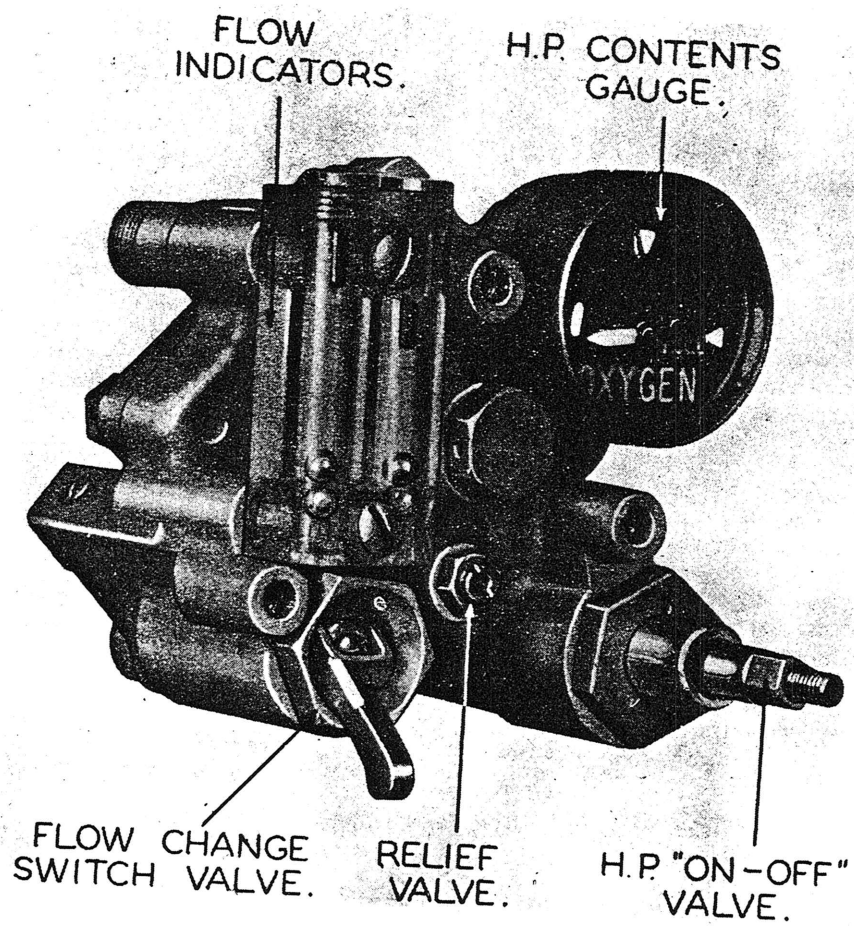



**Fig. 4. Mk. 11B regulator, without cover**

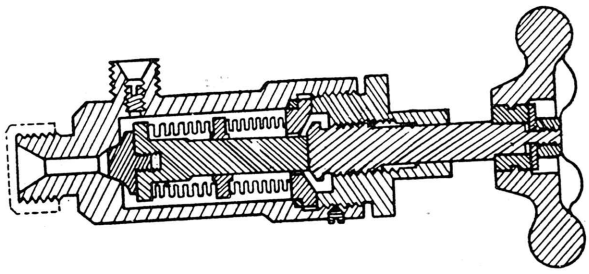


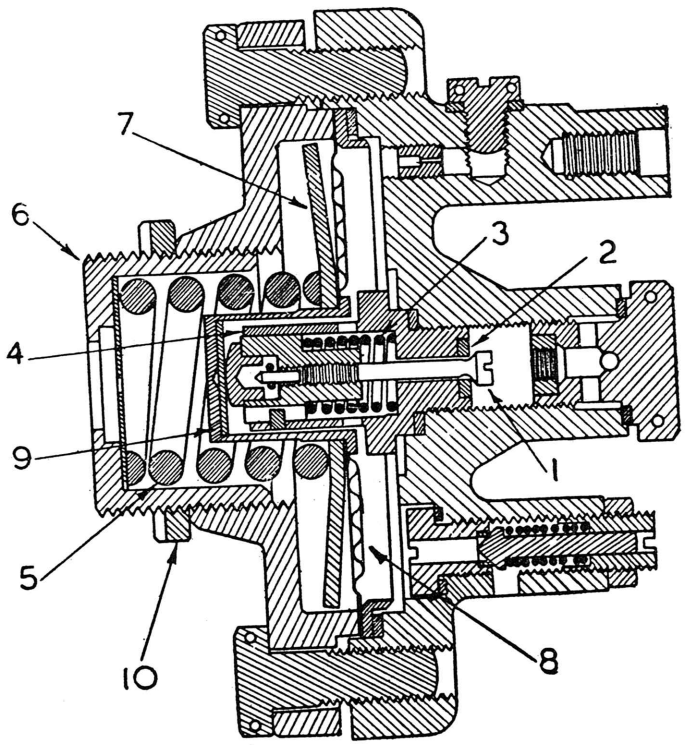
**Fig. 5. H.P. ON-OFF valve**

when in use by pilot or pilot and second crew member) the valve will take up a position of equilibrium such that the pressure in the chamber is maintained at an almost constant value independent of the pressure of the supply. A relief valve, which is shown in fig. 4, is fitted in the low-pressure chamber to protect the mechanism against high pressure which would build up in the event of failure of the reducing valve. This valve fits into a recess inside the reduced pressure chamber and projects through the front of the housing to facilitate adjustment. The relief valve is adjusted to operate at between 55 and 60 lb. per sq. in.

**13.** The flow to each outlet connection is controlled by two jets (*fig.* 7) one of which is always open to reduced pressure, the left-hand tube being isolated from this pressure when the switch valve is closed. Thus in the NORMAL position of the switch (i.e., when the valve is closed) the flow from the outlet connection will be that from one control jet only. When the switch is in the HIGH position (i.e., when the valve is open), the flow will be the combined flow from the two jets.

**14.** The right-hand tube of the twin tube indicator indicates the flow from the jet which is always open to the reduced pressure, the other being isolated from its pressure when the switch valve is closed. Thus in the NORMAL position of the switch (i.e., when the valve is closed), the flow from the outlet connection will be that from one control jet only. When the switch is in the HIGH position (i.e., when the valve is open), the flow will be the combined flow from both jets.

**15.** The flow to which a particular indicator refers may be readily determined by the fact that the normal flow float rises only half-way up its tube, whereas the high flow float rises to the top of its tube. The position of the ball floats at various settings of the instrument is as follows:—




1 VALVE STEM
2 VALVE SEAT
3 VALVE RETURN SPRING
4 VALVE GUIDE
5 REGULATING SPRING
6 ADJUSTING SCREW
7 DIAPHRAGM PLATE
8 DIAPHRAGM
9 DIAPHRAGM THRUST WASHERS
10 ADJUSTING SCREW LOCK-NUT

**Fig. 6. Reducing valve assembly**

| On-off valve | Switch setting | Position of float in left-hand indicator tube | Position of float in right-hand indicator tube | Flow |
|---|---|---|---|---|
| Closed | NORMAL or HIGH | Not visible | Not visible | Nil |
| Open | NORMAL | Not visible | At index mark half-way up tube | Normal |
| Open | HIGH | At index mark at top of tube | At index mark half-way up tube | High |

*Mk. 11C*

**16.** The functioning of the Mk. 11C regulator is the same as that of the Mk. 11A and 11B for normal and high flow, but the introduction of the emergency flow valve allows a further increased flow of oxygen to the economizer. The inlet of the emergency valve is connected to the reduced-pressure chamber of the regulator, as shown in fig. 8, and the outlet from the valve is connected by drilled passage-ways into the down-stream side of the flow indicator. This leads directly into the outlet connection of the regulator. The bore of the valve seat is calibrated in order to act as a metering jet to control the maximum flow passed by the valve.

**17.** The setting of the emergency control lever, to obtain full emergency flow or to shut off the emergency flow, is clearly marked on the front plate of the regulator by an oblique line surmounted by the words ON and OFF respectively. In earlier regulators of this Mark, the control lever was wired in the OFF position, but Mod. Inst.A/57 called for the removal of this wire, and appropriate information is given in A.P.1275A, Vol. 2, Part 1, leaflet H.20. On later type regulators a spring-loaded plunger is incorporated in the emergency lever to prevent inadvertent movement of the lever from the OFF position.

**18.** When the emergency flow is OFF, the regulator functions normally, i.e. the flow is controlled by setting the switch to NORMAL up to 25,000 ft. or HIGH up to 40,000 ft., and is indicated by the position of the floats in the twin-tube flow indicator.

**19.** When the emergency flow is turned on, the position of the flow indicator floats is not altered. With the emergency lever in the ON position the existing normal or high flow is increased by an amount equal to the additional flow from the metering jet seating of the emergency valve, i.e., approximately 25 litres per minute. Thus, the emergency flow is slightly greater when the switch is set at HIGH than when at NORMAL. When the switch is in either position, however, the total flow is ample for emergency use.

**Note . . .**

*The bottom outlet connection for second crew member is blanked off on the Mk. 11C regulator. When the switch is in either position, however, the total flow is ample for emergency use.*

**20.** The control lever has an opening movement of approximately 90 deg., and the total flow from the regulator increases approximately in proportion to the angular rotation of the lever from the OFF position after the first 10 deg. to 20 deg. of movement. It should be noted that no increased flow is obtained during the first 10 deg. to 20 deg. of rotation, this amount of movement being necessary to ensure a proper seal at the valve seat.

**21.** The control lever is splined on to the valve spindle. This permits of it being repositioned as necessary to compensate for the wear of the Tufnol insert.

**22.** Due to excessive flow when in use, and hence the adverse effect on the endurance of the supply, the emergency setting should be used only so long as the emergency exists.

**Note . .**

*The maximum emergency flow is eight times normal or four times high flow.*

*Mk. 11D*

**23.** The oxygen regulator, Mk. 11D (*fig.* 9 *and* 10) is for use in two-seater aircraft. It is similar to the Mk. 11C (*para.* 16 *to* 21) with the exception of a second outlet connection

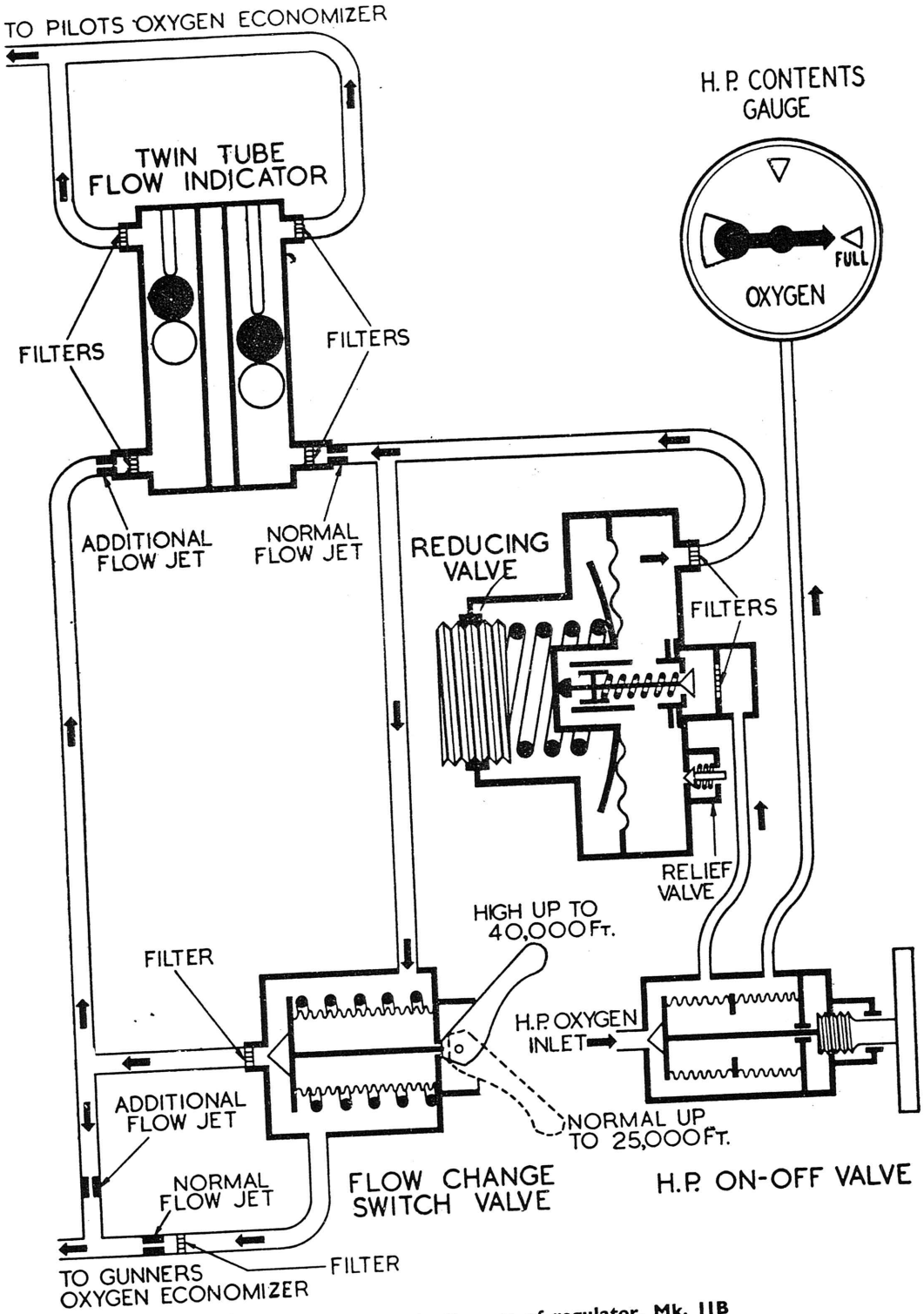



**Fig. 7. Schematic diagram of regulator, Mk. IIB**

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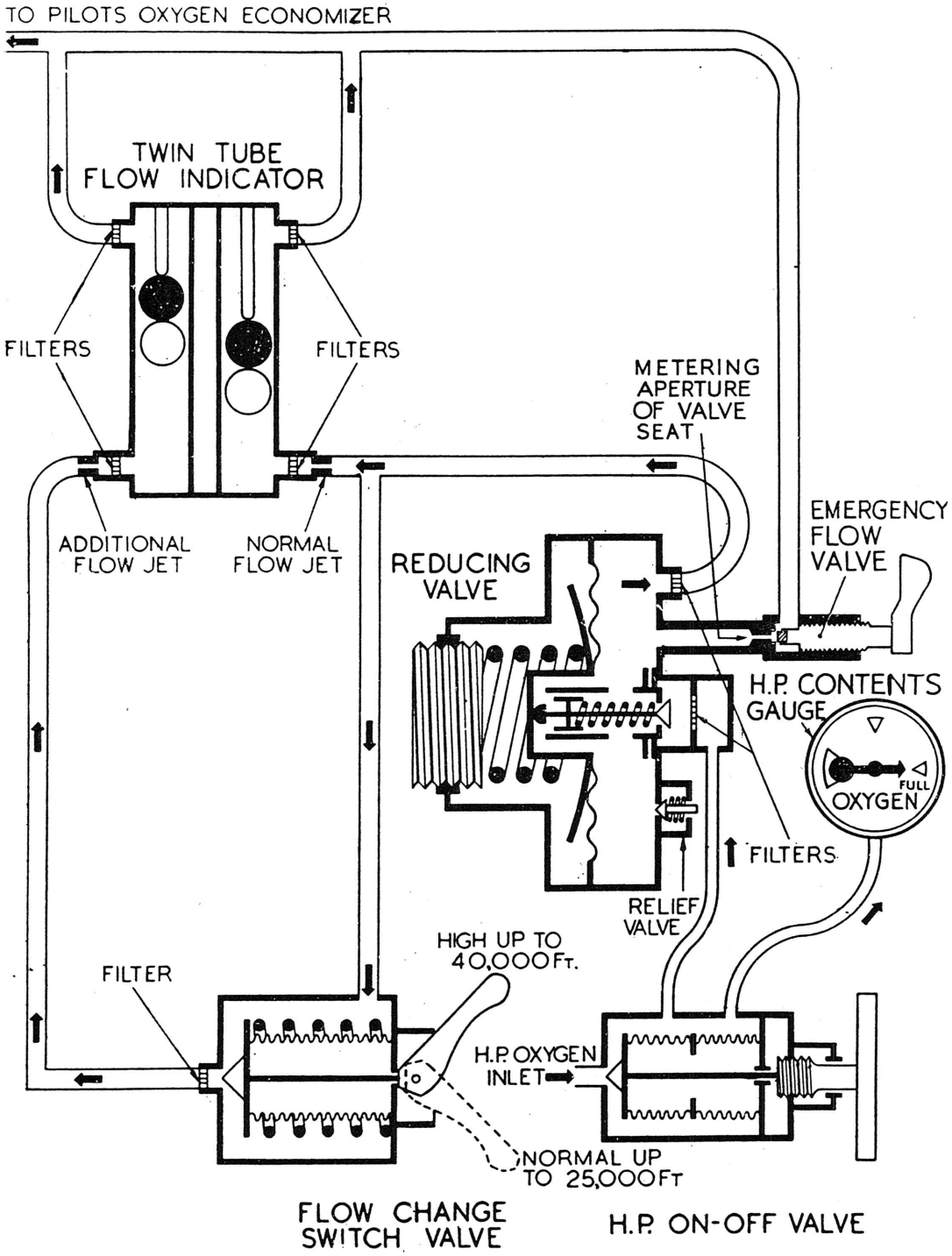


**Fig. 8. Schematic diagram of regulator, Mk. 11C**

which is fed directly from the reduced pressure chamber. The second outlet connection is connected by piping to the Mk. 11E regulator (*para.* 26 *to* 29), which is installed in the second station of the aircraft, and supplies a NORMAL, HIGH and EMERGENCY flow of oxygen to the second member of the crew. A diagrammatic illustration of the complete installation is shown in fig. 9. The second outlet connection of the Mk. 11D regulator is fitted with a flow jet to limit the loss of oxygen which occurs if the connecting piping between these two regulators is damaged during flight.

**24.** The flow to the pilot's outlet connection is controlled by two jets. One jet is connected to the switch valve chamber which is always open to the reduced pressure. The second jet is isolated from the switch valve chamber when the switch is closed, i.e., in the down position. In this position of the switch the flow from the outlet connection will be that from one control jet only, i.e., NORMAL flow. In the up position of the switch, the valve is open and the reduced pressure is admitted to the second control jet. This will provide the combined flow of both jets, i.e., HIGH flow.

**25.** The emergency flow is obtained through a screw-down type valve, identical to that used in the Mk. 11C regulator described in para. 16 to 22.

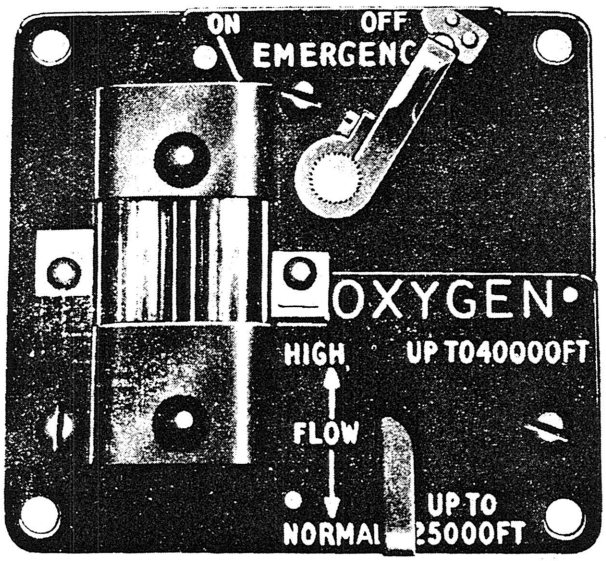


**Fig. 10. Mk. 11E regulator, front view**

*Mk. 11E*

**26.** The oxygen regulator, Mk. 11E (*fig.* 10) is for use in two-seater aircraft to provide a supply of oxygen to the second member of the crew.

**27.** The supply to the Mk. 11E regulator obtained from the reduced-pressure chamber of the Mk. 11D regulator used by the pilot of the aircraft. Both the Mk. 11D and Mk. 11E regulators are used only in conjunction with the oxygen economizers, Mk. 3 and 4.

**28.** The oxygen received at reduced pressure from the Mk. 11D regulator is metered by two calibrated flow control jets which are identical to those used on the Mk. 11C and 11D regulators. The flow of oxygen from these jets may be selected as required by a switch type valve similar to that used in Mk. 11C and 11D regulators which opens or shuts the pressure supply to one jet. Two flows are therefore available. A NORMAL flow, from one jet only, is sufficient for use at altitudes below 25,000 feet, while a HIGH flow, from both jets, is used between the altitudes of 25,000 feet and 40,000 feet.

**29.** The emergency flow is obtained through a screw-down type valve located between the inlet and outlet connections and this supply by-passes the two flow control jets. Visual indication of NORMAL and HIGH flow is provided by a twin-float type indicator identical to that used on all the Mk. 11 series of regulators. A detachable gauze filter is fitted inside the connections to prevent ingress of foreign matter which may be carried into the regulator from the pipe-line. The flow-change switch is similar to that used on all Mk. 11 series regulators. The valve is open when the switch lever is in the "Up" position and closed when in the "Down" position. Due to the pressure drop in the pipe lines between the Mk. 11D and Mk. 11E regulators, it may be found that the flow indicator floats on the Mk. 11E drops when the emergency lever is turned ON that regulator. This is acceptable, providing the oxygen flow is satisfactory.

**INSTALLATION**

**30.** The regulator should be mounted with the axis of the

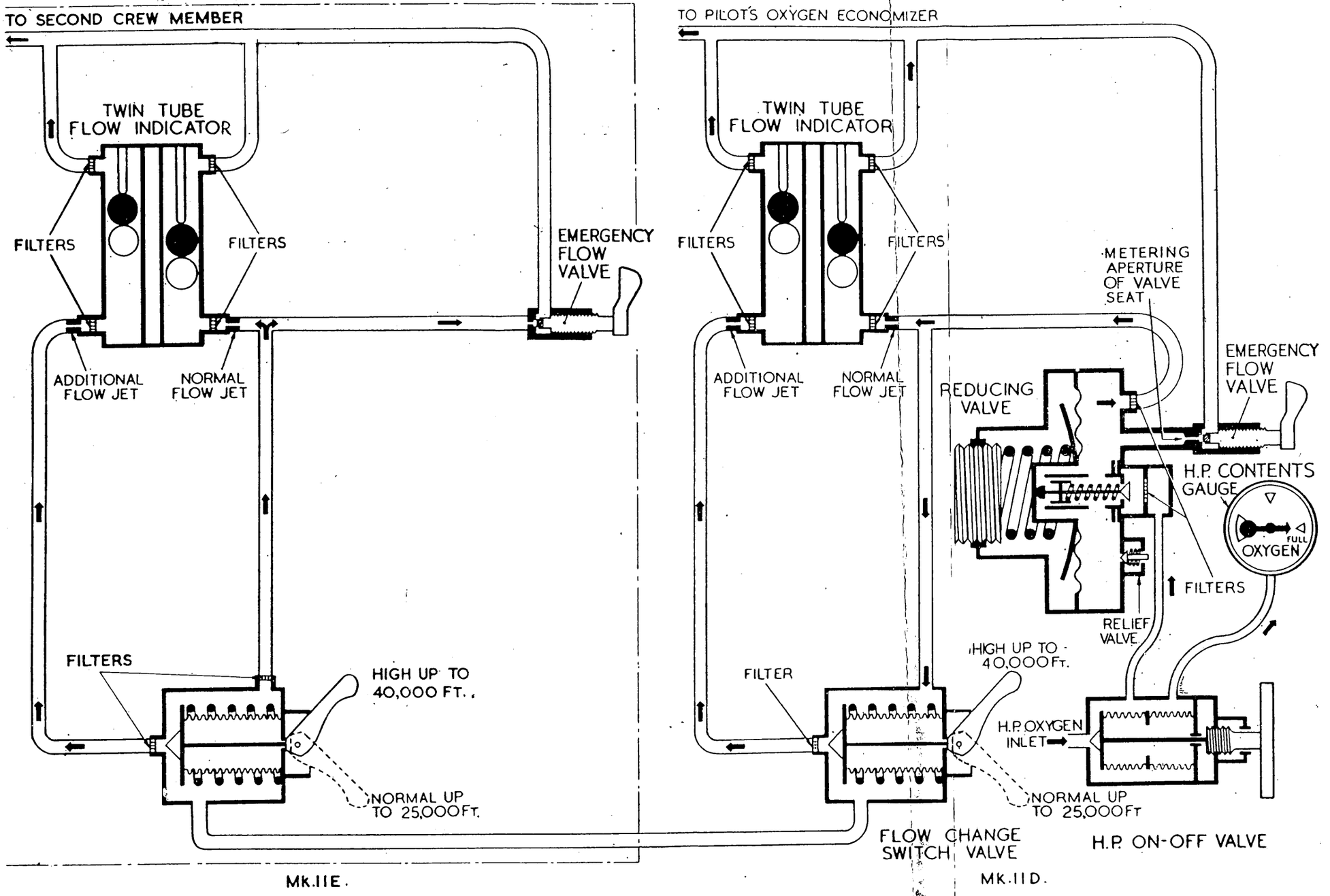


Fig.9 Diagrammatic view of Mk.IID. and Mk.IIE. installation

indicator flow tube is not more than 15 deg. from the vertical. The contents gauge dial and the flow indicator must be readily visible from the pilot's position and the ON-OFF valve handwheel and flow change switch must be within easy reach of the pilot.

**31.** The high-pressure inlet connection and the outlet connections should be, as far as possible, accessible from the back of the panel for the purpose of testing for leakage and tightening. The appropriate elbow adapters should be used at these connections if this is found to be more convenient.

**32.** The upper outlet connection is connected to the pilot's oxygen economizer. The lower outlet connection of the Mk. 11B regulator is connected to the separate flow indicator and economizer used by the second member of the crew. The lower outlet connection of the Mk. 11B or 11C regulators is securely blanked off and it is not possible to use this connection as an additional outlet.

**33.** The cut-off valve Mk. 1 cannot be used with the Mk. 11A, B, or C regulators, and a suitable stowage clip for the Mk. 4 bayonet socket is provided in the aircraft in lieu of the cut-off valve.

## OPERATION

### Normal use

**34.** To obtain oxygen for use it is necessary only to open the on-off valve, when oxygen will flow from the regulator to the economizer and oxygen mask. The following procedures should be carried out by the pilot before, during, and after the flight:

*Before take-off (Mk. 11C regulator, pilot's oxygen supply)*

(1) (*a*) Open the ON-OFF valve and check that the floats in the indicator rise smartly to the index mark.

(*b*) Check that the contents gauge is showing sufficient oxygen for the flight.

(*c*) Operate the switch and check that the float in the left-hand tube of the indicator rises and falls correspondingly.

(*d*) Shut the ON–OFF valve and check that both floats drop out of sight as soon as the contents gauge has fallen to zero.

(*e*) Check that the emergency control is set in the OFF position.

*Before take-off (Mk. 11D and 11E regulators, pilot and one crew member's oxygen supply)*

(2) (*a*) Open the ON–OFF valve on the Mk. 11D regulator and check that the floats in the right-hand flow indicator of the Mk. 11D and 11E instruments rise smartly to the index mark.

(*b*) Check that the contents gauge on the Mk. 11D regulator indicates sufficient oxygen for the flight.

(*c*) Operate the flow change switch on the Mk. 11D regulator and check that the floats in the left-hand flow indicator rise and fall correspondingly.

(*d*) Repeat this check for the Mk. 11E regulator.

(*e*) Shut off the ON–OFF valve on the Mk. 11D regulator and check that all floats drop out of sight as soon as the pointer of the contents gauge returns to zero.

(*f*) Check that the emergency control lever on both regulators is set in the OFF position.

*During flight (All Mk. 11 series of regulators)*

(3) To obtain oxygen during flight, open the ON–OFF valve on the Mk. 11C and/or Mk. 11D regulator.

(*a*) *Level flight:* On reaching level flight (at oxygen height), set the flow change switch to NORMAL up to 25,000 ft. and at HIGH above this height.

(*b*) *Low rates of climb (less than 2,000 ft. per minute):*
Set to NORMAL on reaching 10,000 ft. and at HIGH at heights in excess of 25,000 ft.

(*c*) *High rates of climb (exceeding 2,000 ft. per minute): High speeds and night operations (above 4,000 ft.):*
Set to NORMAL from ground level up to 25,000 ft. and at HIGH at heights in excess of 25,000 ft.

*On landing*

**35.** On landing check that the ON–OFF valve of the Mk. 11C and/or Mk. 11D regulator has been shut off. This is important as it prevents moisture being deposited on the walls of empty cylinders.

(A.L.42, Aug. 57)



RESTRICTED

**Emergency use**

**36.** The emergency setting on the Mk. 11C, 11D and 11E regulators must be used in any emergency which calls for an additional supply of oxygen. This may occur:—

(1) At high altitudes, if the pilot suspects lack of oxygen;

(2) At any altitude, if, as a result of enemy action or any other cause, the cockpit has become contaminated with noxious fumes;

(3) At any altitude, if a temporary breakdown of the normal oxygen supply occurs.

**37.** The procedure to be adopted, in the circumstances outlined in the previous paragraph is as follows:—

*Suspected lack of oxygen at high altitudes*

(1) (*a*) Turn the emergency control lever to ON;

(*b*) Leave the control lever at ON until the cause of the loss of oxygen has been ascertained. Descend to below 10,000 ft. to remedy the fault if this can be done in the air;

*Cockpit contamination at any altitude*

(2) (*a*) Turn the emergency control lever to ON;

(*b*) Descend to below 10,000 ft., and land the aircraft at the earliest possible moment.

*Temporary breakdown of the normal oxygen supply*

(3) (*a*) Turn the emergency control lever to ON;

(*b*) Descend to below 10,000 ft., and endeavour to ascertain the cause of the failure. If the fault cannot be found or remedied in the air, remain below 10,000 ft., and return to base.

(*c*) When using the emergency oxygen setting, observe the oxygen contents gauge on Mk. 11C or 11D regulators and check frequently that the supply remaining is sufficient for the flight.

**Note . . .**

*When the second crew member uses the emergency oxygen supply from the Mk. 11E regulator, the pilot must be notified and must frequently check, on the Mk. 11D regulator contents gauge, that the supply remaining is sufficient for the flight.*

**Pre-oxygenization**

**38.** With Mk. 11C regulators, at cabin pressures representing high altitudes or in non-pressurized aircraft at these altitudes, pre-oxygenization may be adopted to reduce the incidence and severity of decompression sickness (bends). The procedure to be adopted is as follows:—

(1) Before take-off, set the switch to HIGH and open the emergency valve until oxygen is felt to be puffing into the mask before each breath is drawn. It will not be necessary to open the emergency lever to fully ON to obtain this condition;

(2) On reaching 15,000 ft., turn the emergency flow to OFF, leaving the switch at HIGH.

**Note . . .**

*The breathing of 100 per cent. pure oxygen during ascent assist in reducing the incidence of "bends". It is of assistance, too, if 100 per cent. oxygen is inhaled at ground level for a period of 15 minutes, although ideally a longer period, for instance 1 hour, should be used for long flights at high altitudes.*

## SERVICING

**39.** The servicing described in the following three paragraphs is applicable to all Mk. 11C series regulators, and the additional servicing required for the Mk. 11C and 11D regulator occasioned by the emergency flow valve, is detailed in para. 43 to 48.

**40.** Periodically remove and clean the pipeline filter which is positioned in the high-pressure pipe-line immediately in front of the regulator. If the ON–OFF valve is found to be excessively stiff in operation, the regulator must be returned to the depot for repair. **Under no circumstances must oil or grease be applied to the valve spindle or to any part of the regulator.**

**41.** The following parts should be replaced by Units:—

(1) A defective or damaged contents gauge or connecting pipe should be replaced by removing the necessary fixing nuts and connections. After replacement check for leakage with soap solution.

(2) The choke fitted to the inlet connection of the contents gauge or in the pressure gauge connection of the ON–OFF valve, should be renewed if found to be blocked or damaged.

(3) A defective of damaged flow indicator should be replaced by removing the two fixing screws holding the indicator to the main body. Make sure that the four sealing washers fitted at the top and bottom connections of each flow tube are replaced in the recesses provided in the main body. The two fixing screws should be locked by smearing bakelite varnish on the threads.
(4) A broken ON–OFF handwheel should be renewed.

**Tests and tolerances**

**42.** The tests permitted at Units and the tolerances specified for these tests apart from the emergency flow valve in the Mk. 11C regulator are given in Appendix 1 to this chapter under the title Standard serviceability test (S.O.7). The tests and tolerances for the emergency flow valve are given in the following paragraphs.

**Emergency flow valve**

**43.** Measure the normal and high flows at the outlet connection at frequent intervals. This is done by first disconnecting the piping at the inlet to the economizer and attaching the flow tester Mk. 5A*. With the emergency flow valve shut and the contents gauge reading between full and $\frac{3}{4}$-full, the flows should be within the N and H bands marked on the tester. If the flows are greater than the N and H bands this may be due to:—
(1) Leakage past the emergency flow valve seat or
(2) A faulty reducing valve.
If either of these is the case the regulator should be regarded as unserviceable.

**44.** Check the initial opening position of the emergency valve, by turning the lever slowly from the OFF position until the flow shown on the tester definitely increases. The initial opening should be 10 deg. to 20 deg. anticlockwise from the OFF mark. If, however, the valve has been turned to OFF with excessive force, the initial opening position may occur at the OFF mark, or in extreme cases 10 deg. to 20 deg. in a clockwise direction of this mark. If this is the case, the control lever should be repositioned on the splined spindle by removing the central screw, and moving the lever one spline in an anti-clockwise direction. If this operation is found to be necessary, check the maximum flow when the lever is set to the ON position, as indicated in the ensuing paragraph.

**45.** With the emergency flow lever in the ON position, check that the flow is considerably greater than the maximum flow, i.e., greater than 14 litres per minute, shown on the tester. The flow should be sufficient to maintain the float hard against the top stop of the tester. If two testers are available, they can be teed off the outlet piping, and the total flow will then be equal to the sum of the flow indicated on each tester. The total flow with the switch in the NORMAL position should not exceed 29, or be less than 23, litres per minute. If two testers are not available, the increase in flow, when the emergency flow is turned on, can be checked audibly.

**46.** Check the control lever, to see that its movement is not too free. If necessary, the gland nut should be tightened to increase the friction of the gland washer on the spindle, and so prevent possible alteration of the setting by vibration in the aircraft. To tighten the gland nut it will be necessary to remove the regulator from the aircraft, and to detach the emergency control lever and front plate of the regulator.

**47.** The gland of the emergency valve should be checked periodically for leakage. This leak test should be carried out with soap solution. The check should be done with the control lever set at ON. If necessary, the gland nut may be tightened as described in the previous paragraph.

**48.** At the completion of such of the above checks as are found to be necessary, the emergency control lever should be moved to the OFF position.

# Appendix I

## STANDARD SERVICEABILITY TEST (S.0.7)

## for

## OXYGEN REGULATORS, Mk. IIB and IIC

**Introduction**

**1.** The tests laid down in this Appendix are to be applied to the above-mentioned equipment immediately prior to installation in aircraft, and whenever the serviceability is suspect. The tolerances specified must not be exceeded.

**METHOD OF TEST**

**2.** The method of testing the equipment is as follows:—

(1) Test the regulator in the normal position, i.e., with the front panel upright and in a vertical plane. Tap lightly when taking test readings.

(2) The tests are to be made only with breathing oxygen or any other clean dry gas listed in, and in accordance with, the requirements laid down in the appropriate Standard Serviceability Test.

**TEST EQUIPMENT**

**3.** The following equipment is required to perform the tests listed below and is available as follows:—

| Description | Stores Ref. | Remarks |
|---|---|---|
| Mk. 8* valve<br>◀ Mk. 10 valve | 6D/223 or<br>6D/1872 ▶ | |
| Pipe-line filter Mk. 2<br>◀ Pipe-line filter Mk. 2A | 6D/1443 or<br>6D/1660 ▶ | For use with oxygen |
| Pipe connecting straight end<br>or<br>Pipe connecting elbow end<br>◀ Pipe connecting | 6D/1446<br><br>6D/1447 or<br>6D/1599 | Fitted between pipe-line filter Mk. 2 and regulator |
| Felt pad filter | 6D/630 | Using air from an oil free compressor or |
| Standard pressure gauge | 6C/264 | Range 0 to 2,000 lb. per sq. in. Any similar oxygen gauge with the same range, and having a dial not less than 7 in. in diameter, may be used as an alternative |
| Tester, flow, Mk. 5A* | 6C/475 | See A.P.1275T, Vol. 1, Sect. 6, Chap. 6. |
| Cap, blanking | 6D/428 | |

In addition, a graduated flowmeter with a graduation at 0·2 litres is required. The high pressure test supply should be at a pressure of 1,500 to 1,800 lb. per sq. in.

*(A.L.47, Mar. 58)*

## TESTS

**4.** The tests to be applied are as detailed below. In the case of the Mk. 11C regulator the emergency flow valve must be at the OFF position during these tests.

### Zero error

**5.** Check that the zero error of the gauge pointer does not exceed $\frac{1}{16}$ in. and that the floats in the indicator tubes slide freely when the regulator is rocked.

### Normal functioning

**6.** Connect the regulator inlet to the test supply via the filter, Monel connecting pipe, and line valve, and tee in the standard pressure gauge at a point about 6 in. from the regulator. Connect a flow tester to each outlet with the switch set at NORMAL, open the regulator valve, and check that the gauge indicates correspondingly, and that the floats rise in the right-hand flow tube. Operate the switch several times and check that the floats in the left-hand tube rise and fall with the switch. There should be no audible leaks from the regulator during these tests.

### Delivery

**7.** With the supply pressure held at between 1,700 and 1,800 lb. per sq. in., the indicated flow from each outlet should be within the green band marked N on the tester, when the switch is set at NORMAL, and within that marked H when the switch is set at HIGH. The N and H flow bands on the Mk. 5A* tester correspond to flows of 2·6 to 3·7 and 5·1 to 7·4 litres per minute respectively.

### Pressure gauge calibration

**8.** Set the switch to NORMAL and throttle the supply until the pointer of the regulator gauge has fallen to the HALF mark. The standard gauge should then indicate between 890 and 1,000 lb. per sq. in.

### Additional tests

**9.** The following tests should be applied in addition to those detailed in the previous paragraphs to regulators that have been in use in aircraft:—

#### *On-off valve seal*

**10.** Close the regulator valve tightly. Connect a length of rubber tube, terminating in a short length of $\frac{1}{4}$ in. bore metal tube, to the regulator outlet. If a Mk. 11B regulator is tested, seal the second outlet with a blanking cap. Immerse the end of the tubing 2 in. in water, ensuring that it is in a vertical position. The time taken for eight bubbles to escape should not be less than 10 seconds, i.e., the maximum permissible leakage is 0·02 litres per min.

#### *Leakage*

**11.** Remove the front plate. With the regulator valve open and the switch set at HIGH, check the regulator for leakage. This is done by applying soap solution to the following:—All pipe connections, all valve glands, the filter plug (located at the centre in the front of the regulator), around the switch gland, around the square flange joint, the pressure adjusting screws, small plug screws, and the joints of the flow indicator.

#### *Relief valve seal*

**12.** Where suitable measuring equipment is available, check that, with the switch set at NORMAL, the leakage from the relief valve does not exceed 0·20 litres per min. Seal the outlet hole in the underside of the boss with the finger, or by pushing a rubber tube from the flowmeter over it, while taking the reading.

**Note . . .**

*In the case of the Mk. 11C regulator, when putting the front plate back in position, check that the emergency flow control lever has been re-positioned correctly. The initial opening position of the emergency flow valve, i.e., the position at which the flow starts to increase, should be approximately 10 deg. to 20 deg. anti-clockwise from the* OFF *mark. Finally the emergency lever should be locked to the* OFF *stop with 28 s.w.g. soft copper wire.*