# CHAPTER 4

# REGULATORS, OXYGEN, Mk. VIIIC and Mk. VIIID

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## Introduction

1. The Mark VIII series oxygen regulators now in service, i.e. the Mk. VIIIC and the Mk. VIII D comprise the following:—

(i) *Oxygen regulator Mk. VIIIC (Stores Ref. 6D/513).* This regulator has a flowmeter and a contents gauge and is installed one to each oxygen system, usually in the pilot's or captain's position.

(ii) *Oxygen regulator Mk. VIIID (Stores Ref. 6D/525).* This regulator is intended for use in systems requiring more than one regulator to be connected to a group of cylinders. In these instances the contents gauge on every regulator would be superfluous, as the contents of the cylinders are checked by the pilot or captain of the aircraft. As a measure of economy, therefore, the contents gauge is omitted and the dial orifice of the gauge is blanked off.

2. Both these types are calibrated for use with economisers Mk. II and the masks type E*, G and H, and they are identical in design with the earlier types of Mk. VIII regulators, i.e. the Mk. VIIIA* and the Mk. VIIIB, the only difference being in respect of the flowmeter calibrations, since the earlier types were used in systems not incorporating economisers. A front view of the Mk. VIIIC regulator is given in fig. 1 and for comparison of flowmeter calibrations a similar view is given of the Mk. VIIIA* regulator (now obsolete).

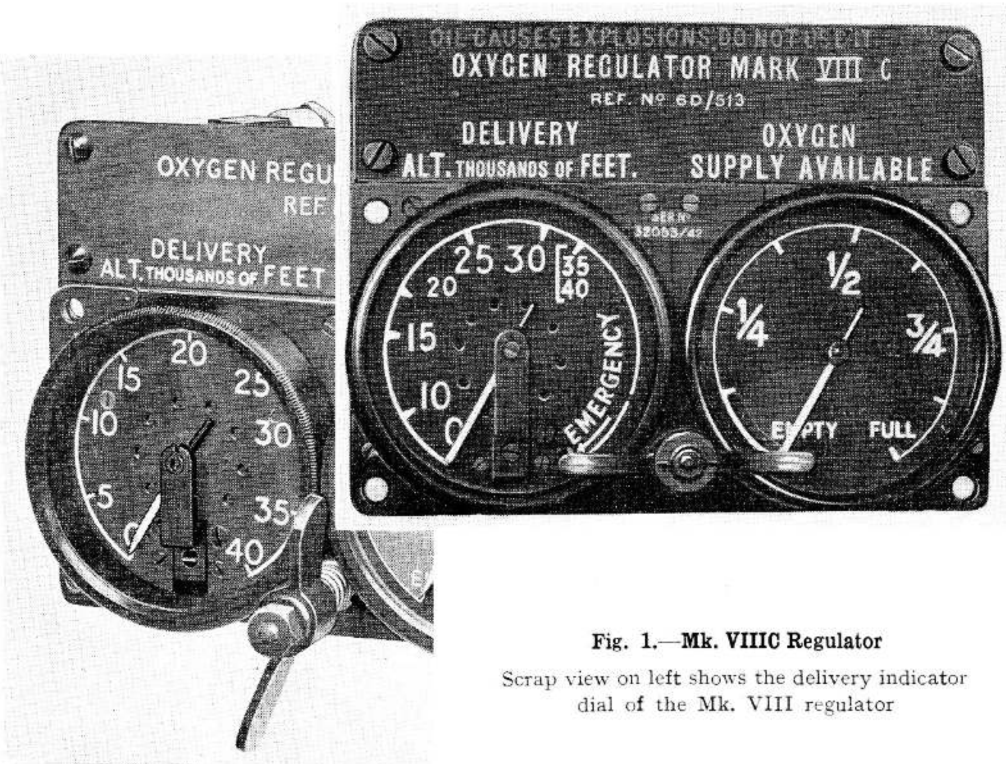



**Fig. 1.—Mk. VIIIC Regulator**

Scrap view on left shows the delivery indicator dial of the Mk. VIII regulator

3. A hand-operated control valve is provided on the regulator for adjusting the rate of supply of oxygen to the required amount. A gauge is also provided in the regulator for indicating the amount of the oxygen supply remaining in the cylinders; the time which the supply will last, may be determined by reference to a table As the oxygen is used up, the pressure in the cylinder steadily falls, and to prevent the rate of supply from falling due to the decreasing pressure on the control valve, a pressure reducing valve is incorporated, which serves to reduce the variable high pressure to a more constant lower pressure before the gas passes to the control valve. A safety valve is fitted between the reducing valve and the control valve to protect the mechanism in the event of failure of the reducing valve.

4. Oxygen passes from the control valve to a delivery indicator and thence through the bayonet union and flexible tubing to the mask. Since a definite flow is required for any particular altitude the delivery-indicator scale is marked in thousands of feet. In operation the flow is adjusted by means of the control valve till the indicator reads an altitude corresponding to, or a little above, the altitude of the aircraft.

**Warning**.—The presence of oil or grease in contact with oxygen at high pressures, either in the regulator or on test apparatus, is extremely dangerous since this introduces a grave risk of explosion. A label bearing the words "Use no oil or grease, they cause explosions" is stuck to the top of the case covering the rear of the regulator.

## DESCRIPTION

### Mk. VIIIC regulator

5. The front view of a Mk. VIIIC regulator is given in fig. 1 and the rear view in fig. 2. The oxygen enters at high pressure through the inlet union, shown on the left in fig. 2, and passes through a filter to the reducing valve. A passage also leads from the inlet channel to the supply indicator, which is housed in the same casing as the reducing valve. The supply indicator consists essentially of a pressure gauge. From the reducing valve the oxygen passes to the control valve, which is housed in an extension of the reducing valve casing and is operated by a handle in front of the panel. It then passes through the connecting pipe to the delivery indicator, shown on the right of fig. 2, which indicates the rate of flow, and thence to the low-pressure outlet.

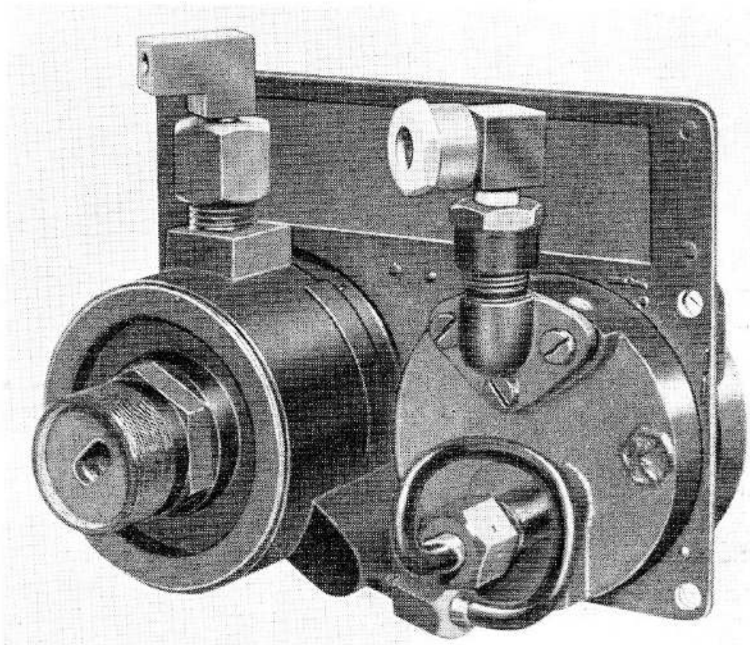
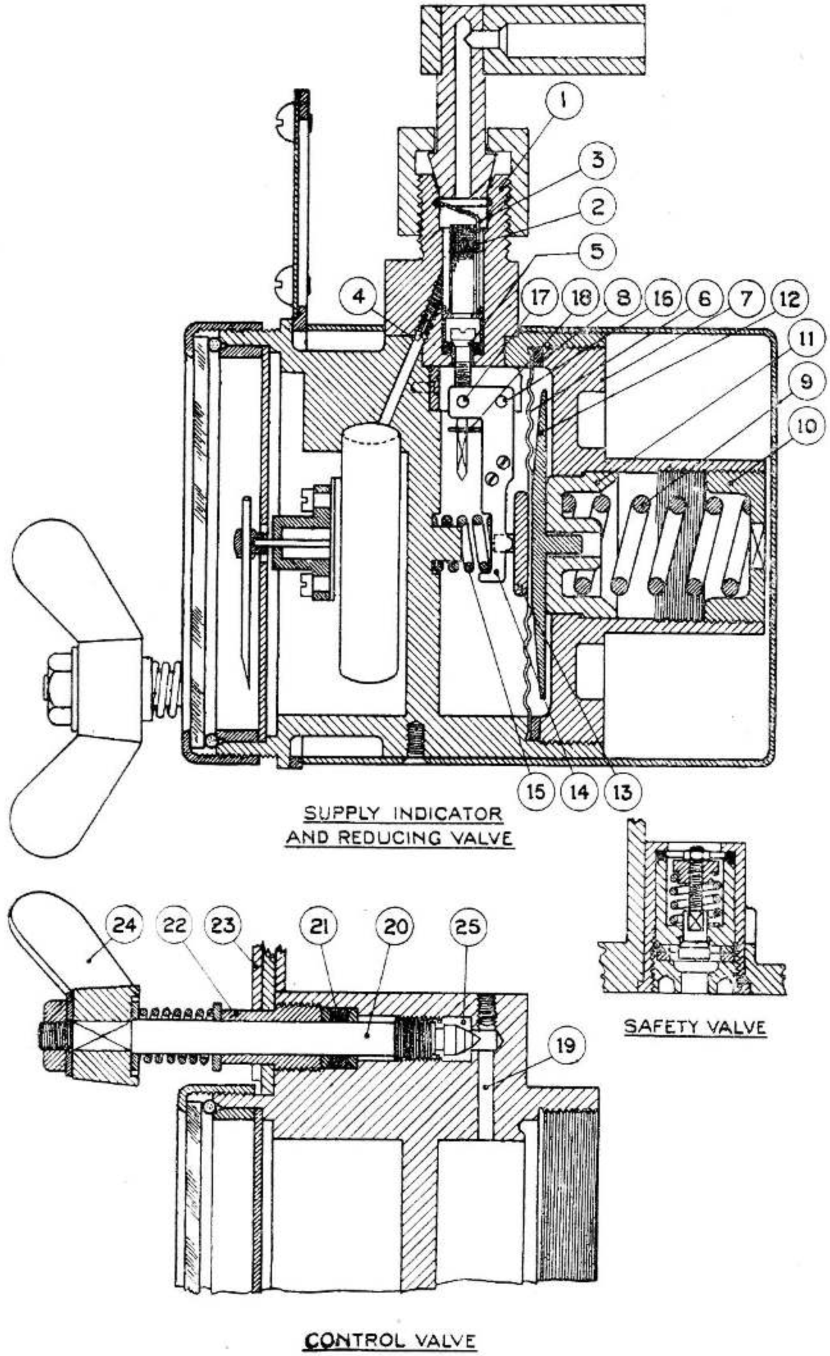


**Fig. 2.—Rear view of Mk. VIIIC Regulator with cover removed**

6. A sectional view of the supply indicator and the reducing valve is given in fig. 3. The gas enters at the union (1) and passes through the cylindrical gauze filter (2), which fits into the channel and is held in position by the spring ring (3). The filter can be removed for cleaning by separating the union and removing the spring ring. A channel leads to the supply indicator from the inlet through a choke orifice (4), which is fitted to restrict the flow of gas in the event of a leak developing in the indicator. The supply indicator mechanism is that of the usual Bourdon-type pressure gauge, and the detailed construction is left to the discretion of the manufacturer. To prevent building up of a pressure which would be occasioned by a fractured Bourdon tube, the case of the supply indicator is vented, the aperture being sufficiently large to discharge to atmosphere any oxygen entering the case. The dial is not calibrated to read pressures but reads directly the fraction of the full charge remaining in the cylinders. As shown in fig. 1 the position of zero pressure is marked EMPTY, and that of the maximum pressure, actually 120 atmospheres, is marked FULL; intermediate positions are marked in fractions. The sector of the dial between the $\frac{1}{8}$th mark and EMPTY is coloured red to indicate that the supply has become dangerously low.

7. The reducing valve is situated directly in the inlet channel. The valve piece (5) fig. 3 consists of a small screw which has a cheese head with a conical base. This conical surface forms the valve face and sits on a solder seat. After passing through the valve the gas enters the low-pressure chamber, of which one wall is formed by a diaphragm (6). The diaphragm is soldered in position on a shoulder in the housing, and the cap (7) screws into the housing over it, a fibre washer (8) being interposed. The cap forms a housing for the control spring (9), the pressure of which may be adjusted by screwing the plug (10) into or out of the cap. The pressure of the spring is transmitted to the diaphragm by the plunger (11) and the plate (12). The button (13) is placed over the end of the cranked lever (14) and is held in contact with the diaphragm by means of the small spring (15). The lever is pivoted at (16), and the other arm, which is forked, carries a small block mounted on trunnions (17). The valve piece screws into this block, and the small wire springs (18) pressing against two of the four flats on the end of the screw, form a locking device.

8. The action of the valve is as follows. Gas at high pressure enters through the valve, which is held open by the pressure of the spring (9), until the pressure in the chamber is sufficient to displace the diaphragm against the pressure of this spring, when the valve will close. The gas in the chamber will then be at a certain predetermined pressure depending on the adjustment of the spring. If some




1. Inlet union
2. Cylindrical gauze filter
3. Spring ring
4. Choke orifice
5. Valve piece
6. Diaphragm
7. Cap
8. Fibre washer
9. Control spring
10. Spring adjusting plug
11. Plunger
12. Plate
13. Button
14. Cranked lever
15. Spring to contact cranked lever and diaphragm
16. Pivoting point of cranked lever
17. Trunnion bearing for block
18. Wire spring locking valve piece
19. Channel connecting low-pressure chamber and control valve
20. Control valve spindle
21. Gland
22. Gland nut
23. Serrated locking plate
24. Control valve handle
25. Cavity

**Fig. 3.—Mk. VIIIC Regulator, sectional view**

of the gas is now drawn off from the chamber the pressure will fall, and the spring (9), which now is not overcome by the gas pressure on the diaphragm, will again open the valve. Further gas at high pressure will enter the chamber until the pressure in it reaches the predetermined value. When gas is being drawn off at a constant rate 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. Slight variation of the reduced pressure does occur owing to the high pressure acting on the top of the valve piece and tending to close it, so that for high inlet pressure the pressure in the chamber is somewhat lower. This effect is reduced by the mechanical advantage which the diaphragm has over the valve, owing to its greater distance from the pivot, and the actual variation in the reduced pressure is small and its effect negligible.

9. A safety valve is fitted in the low-pressure chamber to protect the mechanism against the high pressure which would build up if the reducing valve were to fail. It fits into a recess at the side of the casing and is held in position by a plug as shown in fig. 3, a bakelite washer being used to make a gas-tight joint. The valve is similar in construction to the reducing valve, but is held closed by a compression spring acting on a collar screwed on to the stem of the valve. The collar is locked by means of a nut. The safety valve is adjusted to operate at a pressure between 80 and 100 lb. per sq. in.

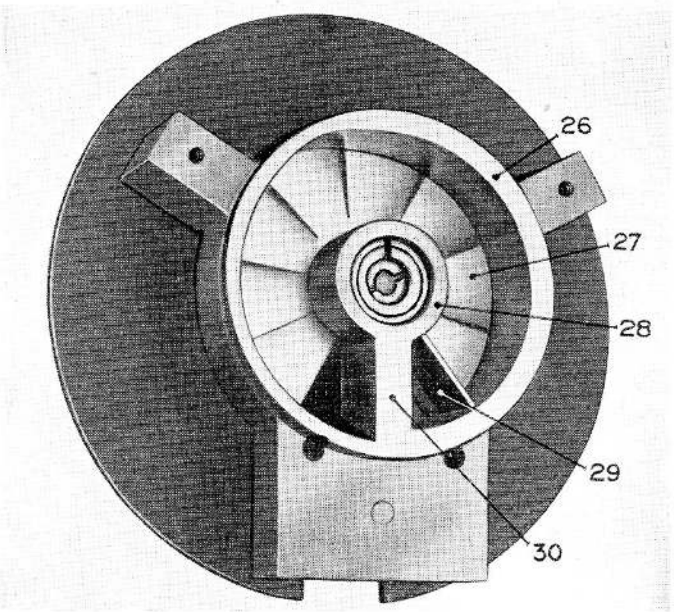
10. The gas passes from the low-pressure chamber through the channel (19) to the control valve. This consists of a spindle (20) with a tapered face to engage on the valve seat. The end of the spindle is tapered off more abruptly so as to obtain a quicker action after the first few turns of the handle. Leakage along the spindle is checked by the gland (21), compressed by the gland nut (22). The nut is square and is accessible from the front of the instrument. It is locked by a serrated plate (23) fixed by two small screws to the mounting plate. The valve is operated by the handle (24) on the outer end of the spindle, and a spring is interposed between this and the gland nut to provide a friction control to prevent the setting being disturbed by vibration. The gas passes from the valve through a channel leading from the cavity (25) to the connecting pipe shown in fig. 2.

11. The connecting pipe leads the gas to the back of the delivery indicator. This is enclosed in a casting shaped as shown in fig. 2, the front being closed by the dial and made gas-tight by means of the glass, the bezel and a rubber washer. The movement, attached to the back of the dial, is shown in fig. 4. The dial and movement are secured to the casing by the two larger screws seen in fig. 1, which pass through the clearance holes in the block shown in fig. 4 and screw into the casing. The ring (26) fits into a spigot in the back of the case of the instrument, and a closed annular channel is thus formed. The front wall of this channel is formed by the disc (27), which is cut into segments. In the unstrained position these segments are spaced from the ring, but each is separately pressed towards it by means of a grub screw in the dial. These grub screws may be seen in fig. 1. The position of each segment may thus be adjusted independently. A spindle is mounted on bearings in the boss (28) and to it are fixed the pointer and the vane (29). The gas enters through an aperture in the back of the casing between the web (30) and the vane, and presses the vane round against the torque of a hairspring until a position of equilibrium is reached. It escapes around the edges of the vane and also through the space between the ring and the adjustable segments, and passes through a gauze-covered aperture at the back of the case to the low-pressure union.

12. Each of the adjustable segments corresponds to a calibration mark on the dial, so that the instrument can be adjusted for accuracy at each marking. Intermediate pointer positions are not necessarily accurate, and cannot be considered reliable for interpolation. The indicator is calibrated by adjusting each screw in turn to give a certain flow for each scale marking. The grub screws are split, and spring in so as to be self-locking. The flowmeter is set initially to give the correct oxygen supply at altitude, and no attempt should be made by unit personnel to alter this setting.

13. The flowmeter dials are calibrated for flows necessary between 0 and 40,000 ft. Beyond the "40" mark is engraved the word EMERGENCY and an arrow. If a shortage of oxygen is suspected the control valve should be operated to increase the delivery until sufficient oxygen is obtained. This should be done in increments of 5,000 ft. In an emergency, for example the temporary failure of part of the installation, it may be necessary to increase the supply so that the pointer will move over that part of the scale marked EMERGENCY to maximum reading. This would supply almost pure oxygen to the lungs and would be adequate for 40,000 ft. in the event of the economiser not functioning. The breathing of pure oxygen for a time likely to be spent in flight is in no way harmful. In this latter circumstance, however, the emergency flow should be used only so long as the emergency exists, since the endurance of the oxygen supply available will be adversely affected.

14. In addition to the safety valve which is fitted to ensure against damage to the whole instrument by high pressure, a by-pass is fitted in the control valve as a safeguard against damage to the diaphragm. This may be formed by a wire inserted in a hole through the valve end or by a small hole in the latter. It allows a passage for gas which may have slowly escaped through the reducing valve, and serves to eliminate the risk of a pressure injurious to the diaphragm, as the result of gas which would otherwise accumulate in the chamber when the control valve is closed. In these circumstances the delivery indicators may show a reading up to 15.




26. Ring 27. Disc 28. Boss 29. Vane 30. Web

**Fig. 4.—Delivery indicator movement**

## INSTALLATION

15. The appropriate Mk. VIII regulator used by the pilot in single-seater aircraft, or by the captain in aircraft having a larger crew complement, is normally mounted vertically in the instrument panel and in such a position that both dials are readily visible and the control valve easily accessible.

16. It is attached to the panel by four 2 B.A. bolts and nuts, for which holes are provided in the instrument. The board is cut away to take the cover on the back of the instrument and is also cut away behind the name plate so that access can be obtained to the union from the front of the board by removing the nameplate.

17. Regulators which are to be used in aircraft having a large crew complement, should be installed in a convenient position on the appropriate subsidiary instrument panel. When this is not practicable, a suitable mounting panel will have to be installed at some point in the fuselage near to the user.

18. The regulators are provided with a high-pressure elbow adaptor on the high-pressure inlet, which is used if the tubing is to be run horizontally to the instrument, the copper tubing being sweated into the adaptor instead of into a spherical nipple. If the tubing approaches the regulator vertically the adaptor is not used, and the spherical nipple and union nut are used instead to make connection to the union, the radius of the loop being not less than 4 inches. The tubing between the loop and the regulators should be secured to the fuselage at least every 2 feet by means of leather-lined metal clips.

19. The low-pressure connections between the regulator and the socket of the economizer, are made by aluminium tubing, the junctions being made with Mk. I low-pressure unions having either straight or elbow connectors. Tubing is supplied in 12 ft. 6 in. lengths and is cut and joined as required. If it is required to connect the regulator to two sockets a T-connection will be used to branch the pipe. The regulator outlet is provided with a low-pressure elbow adaptor, which is used if it is required to run the tubing horizontally from the instrument. If a vertical approach is to be made the adaptor is not used.