

PART 2

CHAPTER 16—OXYGEN SYSTEM

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DESCRIPTION**General**

1. Six oxygen cylinders, containing a total of 19,200 litres, are in the tunnel on the right-hand side of the nose of the aircraft. Oxygen is available to the flight deck crew at all times and, if the cabin altitude rises to 14,000 feet, is automatically available to the cabin crew and passengers. Oxygen for therapeutic purposes may be made available in the passenger cabin irrespective of cabin altitude.

2. The distribution of oxygen to the flight deck and passenger cabin is controlled from a panel on the engineer's bulkhead (panel C). The total flight deck supply is at 20 litres per minute and the cabin passenger supply is at 612 litres per minute.

3. Six portable oxygen sets (Mk 8) and two Mk 9 breathing sets are also provided.

4. *Controls and Indicators—Oxygen System.* See **Table 1.**

GASEOUS OXYGEN SYSTEM

Description

5. Gaseous oxygen is stored in six cylinders, each fitted with a hand operated shut-off valve, pressure gauge and safety relief valve. As oxygen capacity is dependent on pressure at a given temperature it is necessary, in order to achieve the required capacity, that the system is charged in accordance with the charging chart, provided at the external charging panel. A temperature gauge for this purpose is adjacent to the oxygen cylinders.

6. From the cylinder safety relief vent connection, piping is connected into a common line which vents oxygen overboard via a fuselage connection if the pressure in the cylinders become excessive.

7. The oxygen cylinder supply lines are connected into two manifolds from which a single line runs to the main reducing valve (1850 to 350 PSI). Downstream of this reducing valve the line divides to the passenger and crew system supplies.

8. Oxygen is piped to the flight deck ring main through the crew shut-off valve. A crew supply pressure gauge is fitted between the shut-off valve and the ring main. At each crew station oxygen is fed to a Mk 17F regulator.

9. In the passenger supply, upstream of the engineer's control panel, is fitted a pressure closing valve, the purpose of which is to retain a crew reserve of approximately 2000 litres. This corresponds to a pressure of 250 PSI.

Oxygen Regulators — Crew

10. Mk 17F regulators at each of the five crew stations control the supply of oxygen automatically. The pilots' regulators are on the flight deck walls outboard of their seats. The navigator's and engineer's regulators are at their normal stations. The regulator for the supernumerary is on the rear of the centre console.

11. The regulator is a pressure-demand type and must be used with one of the masks specified in para 16. Supply through the mask is on demand, ie when inhaling, at all altitudes. Below 12,000 feet cabin altitude, the supply is delivered at ambient pressure. Between 12,000 and 40,000 feet cabin altitude, supply pressure is increased to 2 mm HG above ambient to prevent inward leaks at the mask and consequential oxygen dilution. Supply pressure increases with cabin altitude above 40,000 feet to a maximum of 30 mm HG above ambient at 45,000 feet.

12. A magnetic indicator on the regulator shows a vertical white line when oxygen is drawn during inhalation and black when flow ceases during expiration or if there is no electrical supply to the regulator. A repeater magnetic indicator is provided at each crew station except for the supernumerary.

13. With the air-mix control at NORMAL OXYGEN, a mixture of air and oxygen in suitable proportions is delivered up to a cabin altitude of 32,000 feet; undiluted oxygen is delivered above this altitude. With 100% OXYGEN selected, undiluted oxygen is delivered at all altitudes.

14. The EMERGENCY test facility should be used before flight for checking the absence of mask leaks. Pressing in the toggle causes oxygen to be delivered under pressure, the pressure increasing as the toggle is pressed in further; when fully in, the pressure is approximately five times as great as with the switch deflected to the EMERGENCY setting on either side. Pressing in the toggle and holding the breath should cause the blinker mechanism to show black. In flight, the toggle can be deflected sideways to give safety-pressure at altitudes below 12,000 feet (cabin), where safety-pressure comes on automatically, or to double the safety-pressure at that height. An appropriate use would be where noxious fumes are present in the cabin.

15. The blinker mechanism operates from a 28-volt DC supply.

Oxygen Masks — Crew

16. An oxygen mask stowage is at each crew station. Oxygen masks suitable for use with the Mk 17F regulator are Type P6B or Q6 with Mk 7 bayonet connection.

Passenger Cabin System — General

17. Oxygen from the pressure closing valve is fed to the passenger ring main via the passenger shut-off valve and the isolating valve (connected to the green knob). Ring main pressure is controlled by the double pressure regulator. When pressure is applied to the ring main a microswitch operates the passenger supply magnetic indicator. The ring main has numerous bayonet outlets so that connectors can be fitted from the passenger facility units (PFU) to suit the seating configuration.

18. The oxygen mask arrangement consists of two and three-mask presentation units distributed in the passenger cabin, toilets and galleys. All passenger masks are identical and supply a continuous calibrated free flow at emergency pressure (80 to 100 PSI) and pressure on demand at normal pressure (40 to 50 PSI).

19. A three-mask unit is located in each passenger facility unit, above each block of passenger seats, in the forward galley and in the urinal. A two-mask unit is in a stowage at six locations in the roof along the cabin centre line, in the rear galley and in each of the four toilets.

Pressure Control System

20. The double pressure regulator comprises a ball valve opened by a needle, connected to a double diaphragm. When normal pressure is required the large diaphragm will open the ball valve below 40 to 50 PSI. When emergency pressure is required, the smaller of the two diaphragms controls the ball valve at 80 to 100 PSI. The baromatic valve decides which of the two diaphragms sense the reduced pressure chamber pressure.

21. The baromatic control valve has a primary capsule which will cause the inter-diaphragm chamber of the double pressure regulator to vent (emergency pressure) and a secondary capsule which will cause the vent to shut-off again, by the action of the resetting piston. The speed of operation of the resetting piston is governed by the time delay reservoir. Operation of the red knob overrides the action of the capsules.

22. *Automatic Operation.* Emergency pressure is automatically supplied to the cabin ring main if cabin altitude reaches 14,000 feet and the supply reverts to normal pressure if the cabin altitude does not exceed 17,000 feet within 8 to 30 seconds. If the cabin altitude continues to rise, emergency pressure is re-applied by 19,500 feet. When the cabin altitude descends to 16,500 feet, reversion to normal pressure takes place.

23. When the emergency pressure is applied by the double pressure regulator, the green knob pops out and remains out until the system pressure is depleted. The red knob remains in under automatic operation.

24. *Manual Operation.* Oxygen can be fed to the passenger ring main at any time at:

- a. NORMAL pressure, for therapeutic purposes: by pulling the green knob.
- b. EMERGENCY pressure, to present the passenger masks: by pulling the red knob.
- c. Pressure up to 250 PSI from the crew reserve supply: by opening the crew supply shut-off valve and the crossfeed inter-connecting valve (both indicators in line) and operating the system as in a. or b. above.

25. When emergency pressure is applied manually, after the masks have dropped down, normal pressure may be reinstated, if required, by pushing in the red knob. If emergency pressure remains in the ring main a calibrated free flow of oxygen is present in the cabin, reducing the endurance of the system and providing a fire hazard.

26. To reset to normal pressure manually, the red knob must be pushed in further than the normal detent position and held there until pressure drops to the NORMAL sector on the passenger pressure gauge.

Three-Mask Presentation Unit

27. Each passenger three-mask assembly comprises a manifold and control valve unit, a hose to connect to the ring main, a latch actuator and a latch hose. The control valve red button is inside the mask compartment.

28. The manifold incorporates a self-sealing check valve with a bayonet type outlet connection for therapeutic oxygen supply, connections for the ring main, mask and latch actuator hoses and the control valve. Emergency pressure applied to the ring main operates the control valve, pushing out the red button. The latch actuator releases the lid and oxygen flows to the mask outlet. When normal pressure is applied to the ring main the red button may be reset, isolating the masks in that unit.

29. On the units in the forward galley and urinal, the therapeutic outlet is blanked off, the actuator body is secured to a box structure and the piston operates the latch.

30. Each mask comprises a soft rubber face-piece complete with head band and an inlet valve connected to the manifold by a hose into which a flow indicator is fitted. The flow indicator on the units in the forward galley and urinal incorporates a flow check valve which is retained in a quick release clip secured to the box structure. Mask hoses on the remaining units are looped initially round a stowage disc secured in the compartment.

Two-Mask Presentation Unit

31. This unit is similar in construction and operation to the three-mask unit with the exception that the therapeutic bayonet outlet is blanked off and the mask hose has a check valve fitted to the flow indicator.

Emergency Supply

32. Under normal conditions, with the passenger shut-off valve open, there is no oxygen supply to the ring main in the passenger cabin. If the cabin altitude rises to 14,000 feet a capsule in the baromatic valve of the passenger cabin regulator allows oxygen to be delivered at emergency pressure to the passenger ring main and to each mask unit manifold. This pressure opens the unit stowage control valve to allow oxygen to flow to the latch actuator which operates to open the units allowing the masks in the PFU to fall to the free length of the hose connection ready for use, with a continuous flow of oxygen available.

33. This emergency pressure pushes out the green knob on the oxygen control panel and the PASSENGER supply magnetic indicator shows in-line.

34. Oxygen flow from each PFU mask is instantaneous. The galley, toilets, urinal and cabin roof units require the mask to be pulled down to disengage the flow indicator from its clip. This action allows the spring-loaded check valve in the hose to open and oxygen to reach the mask. A green bobbin is visible in each mask unit when oxygen is flowing through the hose.

35. The oxygen supply to the three-mask units in the passenger service units can be isolated by pushing the red button on the stowage control valve after the pressure has dropped to normal.

36. If the pressure control system does not function automatically or if oxygen is required at any time the red PASS MASK MANUAL RELEASE PULL knob must be pulled and, after the masks have been presented, reset immediately the cabin altitude is below 16,500 feet.

Low Pressure Supply (Therapeutic)

37. When a supply of oxygen is required for therapeutic purposes the green PULL FOR THERAPEUTIC SUPPLY knob at the engineer's station must be pulled to open the isolating valve on the pressure regulator. Oxygen at normal pressure is then supplied to the cabin ring main and from there to a therapeutic outlet at each three-mask unit stowage on the passenger service units. At this low pressure the compartment lids remain closed to retain the masks in the stowed position and separate therapeutic masks are required. Therapeutic oxygen is also made available to the stretcher manifolds when operating in the aeromedical role.

38. If the main supply pressure is in the red sector (crew reserve) oxygen can be supplied to the passenger cabin from the crew system for therapeutic

purposes, irrespective of the position of the passenger supply valve, by opening the crew shut-off valve and the interconnecting valve.

39. When a therapeutic supply is no longer required, push in the green knob and hold in for a few seconds, until the residual supply in the pressure regulator has dissipated.

Aeromedical Role Supplies

40. When the aircraft operates in the aeromedical role, provision is made for a supply of oxygen to each stretcher position. Both therapeutic and emergency requirements are met, catering for patient and nurse simultaneously. Each stretcher head post has three interconnected manifold and control valve units and a hose to connect to the ring main. The manifolds incorporate a self-sealing check valve with a bayonet-type outlet connection for the use of nursing attendants and also connections for the interconnect and mask hoses. The upper unit on the stretcher post is connected to the ring main.

41. Each stretcher position has a mask comprising a rubber facepiece with head band and an inlet valve, the latter being connected to the manifold by a hose into which is fitted a flow indicator.

42. When a patient requires oxygen for therapeutic purposes, the green PULL FOR THERAPEUTIC SUPPLY knob at the engineer's station must be pulled. Oxygen at normal pressure is then supplied to the ring main and from there to the manifold and control valve unit on the stretcher posts. The red button on the appropriate stretcher control valve unit can then be pulled to supply oxygen to the patients. Emergency supplies operate as described in para 32.

Servicing and Test Points

43. The oxygen servicing panel is on the lower right side of the fuselage. On the panel is a pressure gauge, charging connection and a charging stop valve.

44. Two test points, one marked SUCTION TEST and the other marked ALT TEST on the engineer's oxygen panel are used for in-situ testing of the barometric control valve in the passenger system regulator.

PORTABLE EQUIPMENT

Portable Oxygen Sets — Mk 8

45. Six portable oxygen sets (Mk 8) of 120 litres capacity each, complete with oxygen masks and

Table 1 — Controls and Indicators — Oxygen System

<i>Item</i>	<i>Location</i>	<i>Marking/Description</i>
Pressure gauges (four)	(1) Engineer's oxygen panel	System contents 0 to 2000 PSI
	(1) Engineer's oxygen panel	Crew supply pressure RESERVE (red sector) NORMAL (green sector)
	(1) Engineer's oxygen panel	RING MAIN PRESSURE NORMAL (green sector) EMERGENCY (red sector)
	(1) Servicing panel	0 to 2000 PSI
Passenger shut-off valve	Engineer's oxygen panel	Manually-operated. In-line; cross-line
Crew shut-off valve		Manually-operated. In-line; cross-line
Interconnecting valve		Manually-operated. In-line; cross-line
Suction test point		SUCTION TEST
Altitude test point		ALT TEST
Manual release for passenger masks		PASS. MASKS MANUAL RELEASE PULL (red knob)
Therapeutic supply control		PULL FOR THERAPEUTIC SUPPLY (green knob) PRESS TO RESET
Passenger supply indicator	PASSENGER SUPPLY magnetic indicator. In-line; cross-line	
Remote blinker for engineer's supply		AIR ENGINEER'S SUPPLY. Black — no flow; white line — flow
Remote blinkers for crew supplies (four)	One on each crew member's panel	OXYGEN magnetic indicator. Black — no flow; white line — flow
Air dilution controls (five)	One on each regulator	NORMAL OXYGEN/100% OXYGEN
Blinker mechanisms (five)		Magnetic indicator. Black — no flow; white line — flow
Pressure gauges (five)		OXYGEN LB PER SQ INS × 100
Emergency toggles (five)		EMERGENCY/PRESS-TO-TEST MASK (Guarded)
Oxygen supply valves (five)		ON/OFF (wire-locked ON)
Air temperature gauge	Right tunnel	°F

Table 2 — Endurance of Portable Breathing Set

<i>Cabin Altitude</i> × 1000 feet	<i>TIME (minutes)</i>		
	<i>Heavy Work Rate</i> (40 litres per minute)	<i>Medium Work Rate</i> (30 litres per minute)	<i>Light Work Rate</i> (20 litres per minute)
Sea level	11	14	22
5	13	18	27
10	16	22	33
15	20	27	41
20	26	34	52
25	33	44	67

carrying bags are in the passenger cabin. Three are in the forward entrance equipment unit and three are at the ALM aft station. Each set is charged with oxygen to a pressure of 1800 PSI; contents are indicated on a gauge marked $\frac{1}{4}/\frac{1}{2}/\frac{3}{4}/\text{FULL}$, on the side of the bottle. An adapter is supplied with each set so that the mask may be plugged into the main therapeutic oxygen supply at a passenger point.

46. Flow from a portable bottle is controlled by an ON/MEDIUM/HIGH control knob. Medium flow is at 2 litres per minute and HIGH flow at 4 litres per minute. A green bobbin is visible in a flow indicator in each mask hose when oxygen is flowing through the hose.

Portable Breathing Sets — Mk 9

47. Two Mk 9 portable breathing sets are provided for use against smoke and fumes or against decompression up to a height of approximately 35,000 feet. When not in use they are stowed, one at the forward end of the cabin roof and one in the miscellaneous stowage cabinet at the No 3 galley unit.

48. Each set consists of four basic items, a cylinder pack, a face-piece, a demand regulator and an expiratory valve.

49. A cylinder pack assembly comprises two horizontally-mounted 1800 PSI oxygen cylinders, each having a capacity of 200 litres of free gas at normal temperature and pressure. A charging point, with blanking cap and a non-return valve is below one end of the cylinders; the charging point is connected to both cylinders which, in turn, are connected to a pressure-reducing valve via a shut-off valve, the knob of which projects through the end cover, on the left-hand side of the cylinder pack.

50. A pressure gauge on the left-hand side of the cylinder pack, facing the wearer, indicates cylinder

pressure irrespective of the setting of the shut-off valve.

51. A face-piece supply hose is fitted to a quick-release socket adjacent to the pressure gauge. Whenever the hose is disconnected from this socket, the outlet automatically closes.

52. A pack is supported by a harness consisting of a neck strap and a waist strap. Both straps are adjustable. Harness attachment points are provided on the cylinder pack for the attachment of dog clip type connectors on both straps; a carrying handle, for use when a set is used without the harness, is fitted at the top of the cylinder pack.

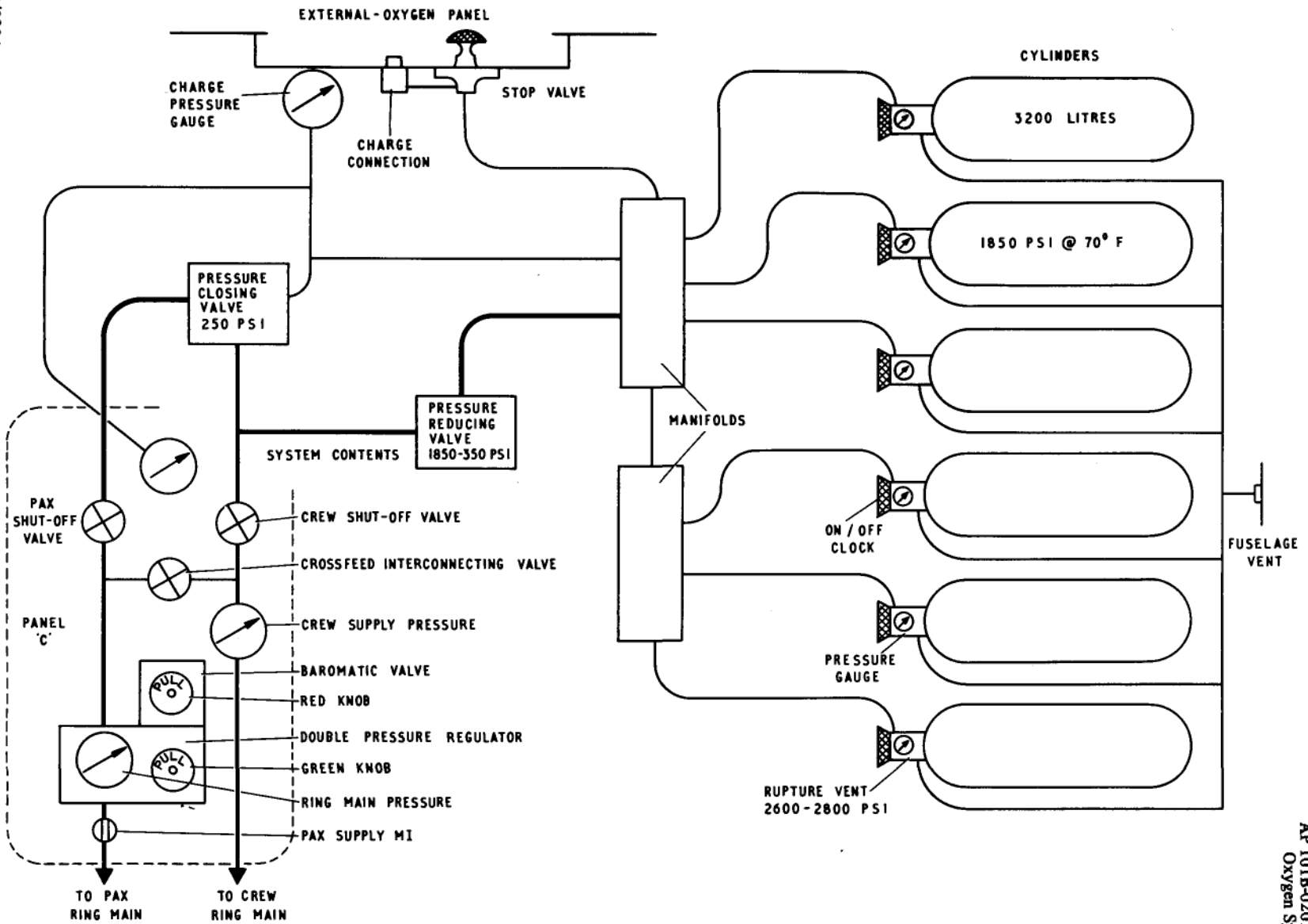
53. A face-piece comprises an integral visor and an adjustable head harness of six straps; it carries a central speech diaphragm, an expiratory valve on the right side and a demand regulator on the left.

54. Incoming dry oxygen in the face-piece provides for demisting of the visor. The speech diaphragm permits direct speech or via a standard boom microphone head-set.

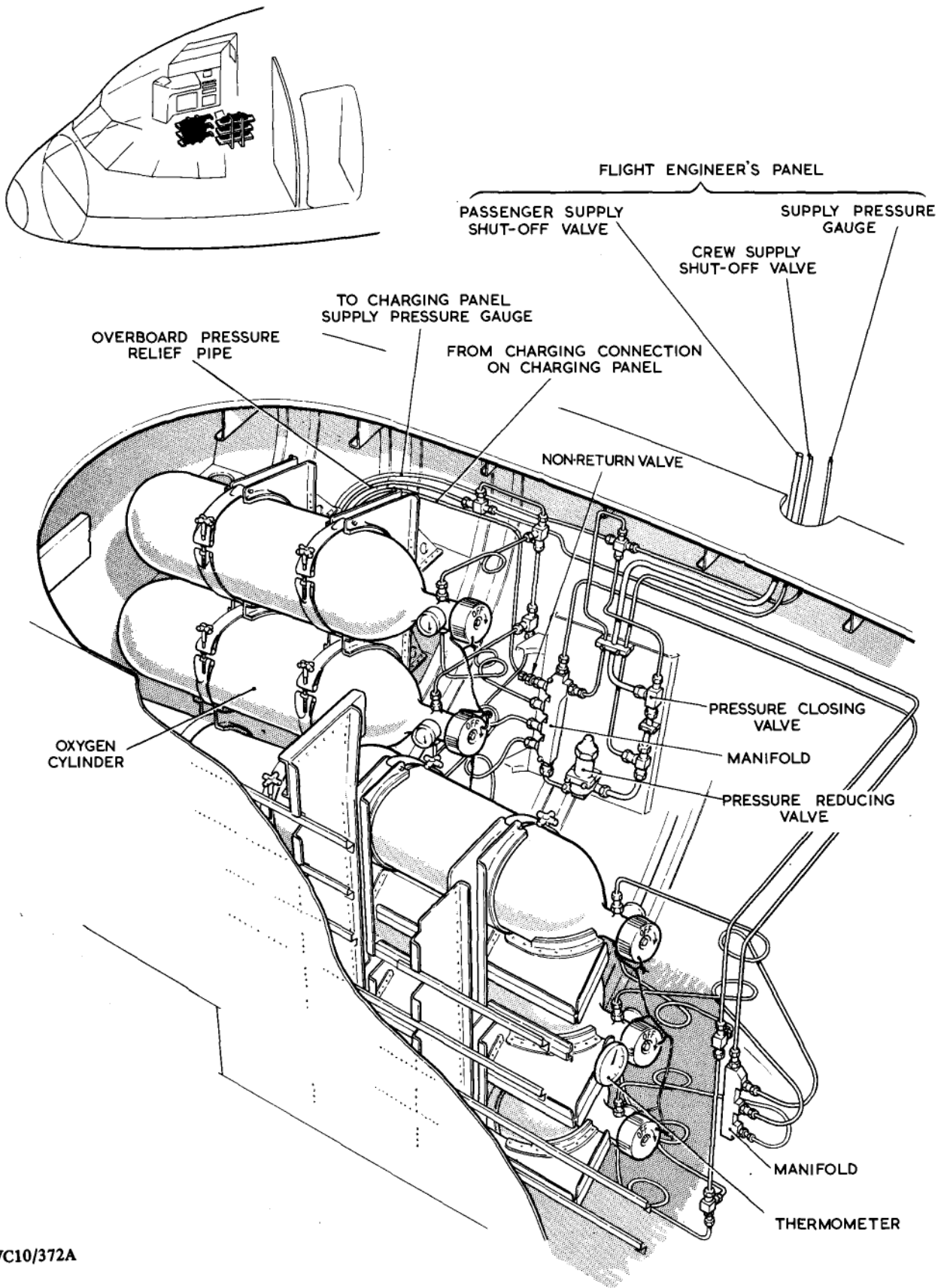
55. A demand regulator controls the supply of oxygen to an inspiratory valve inside the face-piece and consists of a valve and a diaphragm; it is designed so that the wearer is supplied automatically with sufficient oxygen according to the degree of demand. The regulator can also be manually operated, if required, by pressing on the diaphragm through a central hole in the outer casing. An oxygen supply hose from the cylinder pack connects to the regulator.

56. The expiratory valve offers low resistance to the flow of exhaled gases and has a rapid closing action to prevent the intake of ambient air.

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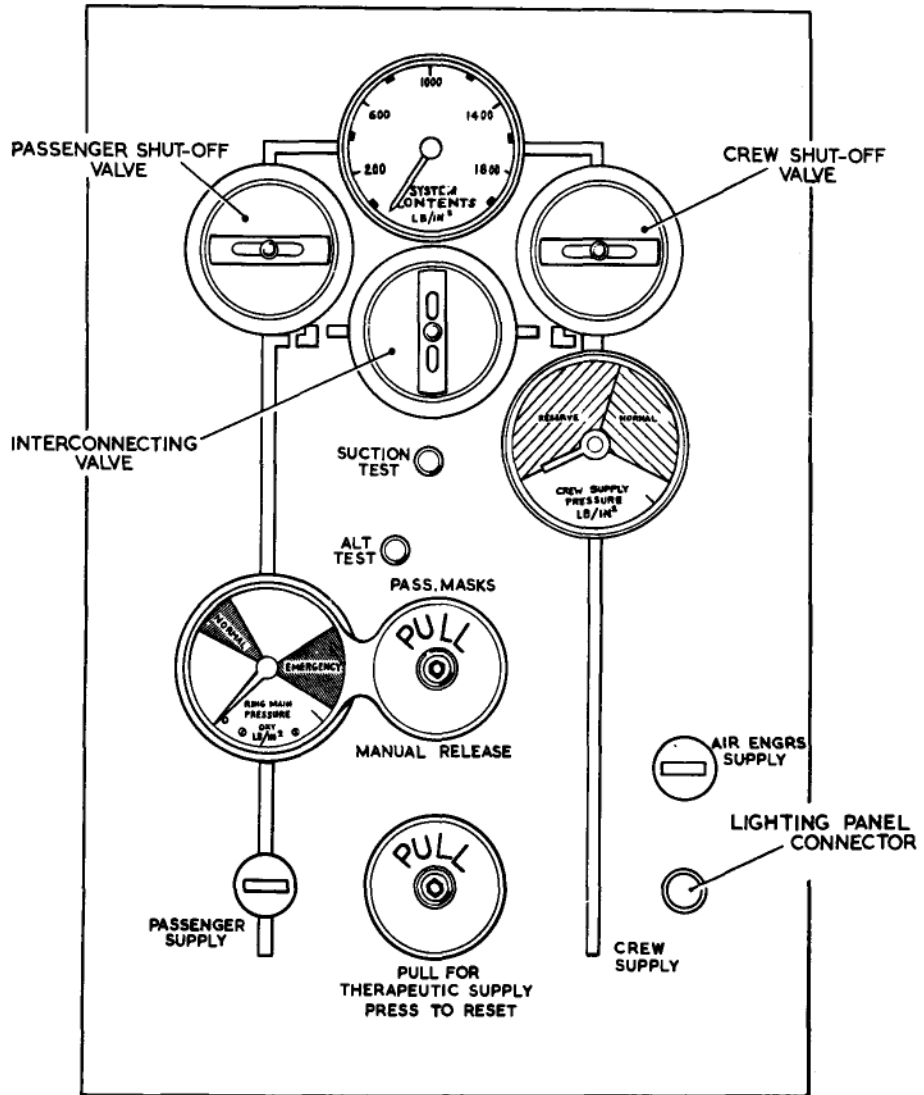
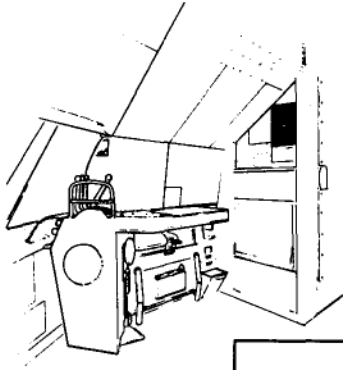


2-16 Fig 1 Gaseous Oxygen System



VC10/372A

2-16 Fig 2 Oxygen Supply System



VC10/373A

2-16 Fig 3 Oxygen Control Panel

DOUBLE-PRESSURE REGULATOR

- R1 INLET VALVE
- R2 REDUCED-PRESSURE CHAMBER
- R3 ISOLATING VALVE
- R4 NON-RETURN VALVE
- R5 RELIEF VALVE CHAMBER
- R6 RELIEF VALVE
- R7 TRANSFER PORT (OUT)
- R8 TRANSFER PORT (IN)

- R9 INTER-DIAPHRAGM CHAMBER
- R10 H.P. DIAPHRAGM
- R11 L.P. DIAPHRAGM
- R12 MAIN SPRING
- R13 GREEN KNOB
- R14 PUSH ROD
- R15 RELIEF VALVE ADJUSTING SCREW
- R16 RELIEF VALVE BODY
- R17 ADJUSTING CAP (MAIN SPRING)
- R18 ACTUATOR PISTON

TIME-DELAY RESERVOIR

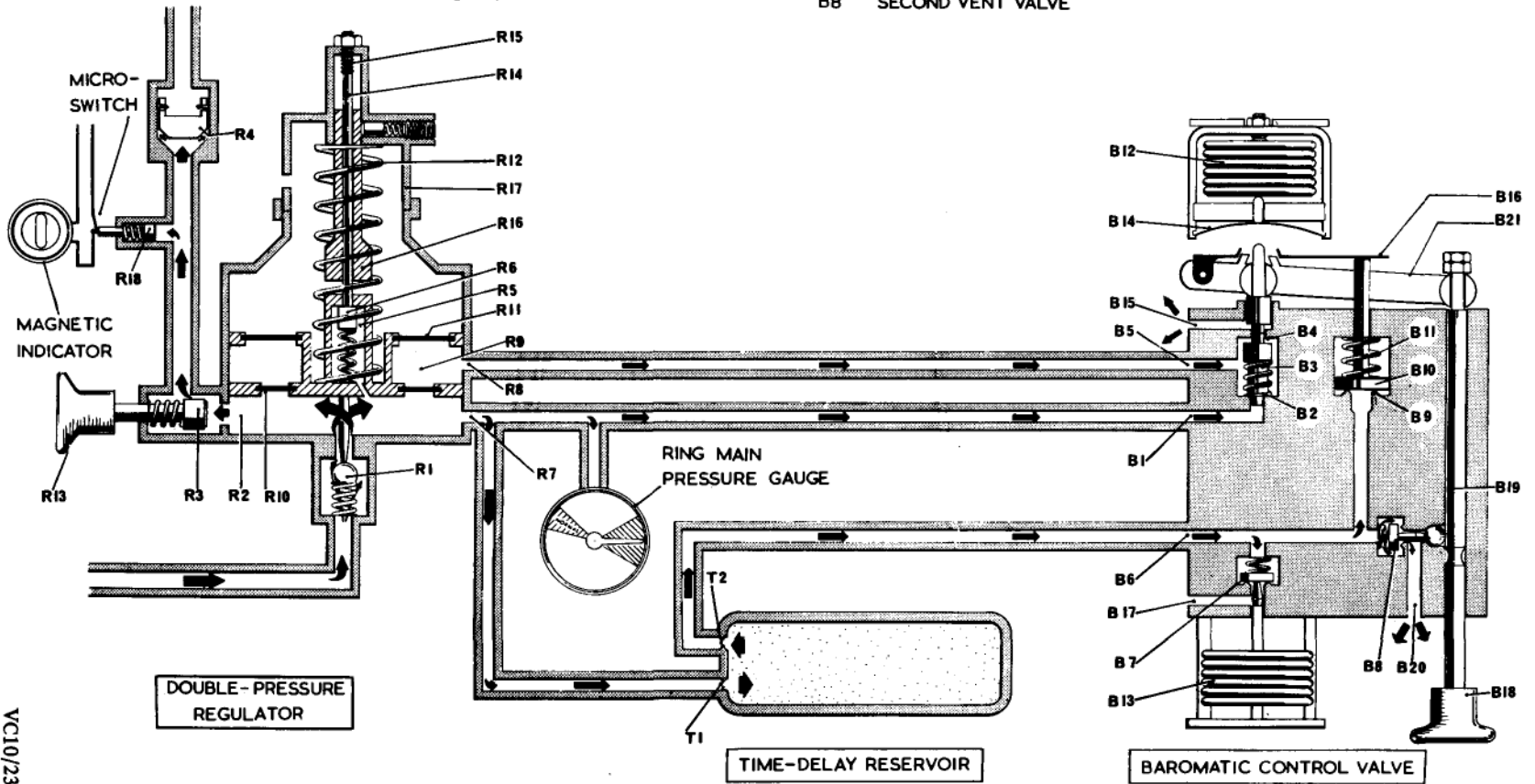
- T1 INLET
- T2 OUTLET

BAROMATIC CONTROL VALVE

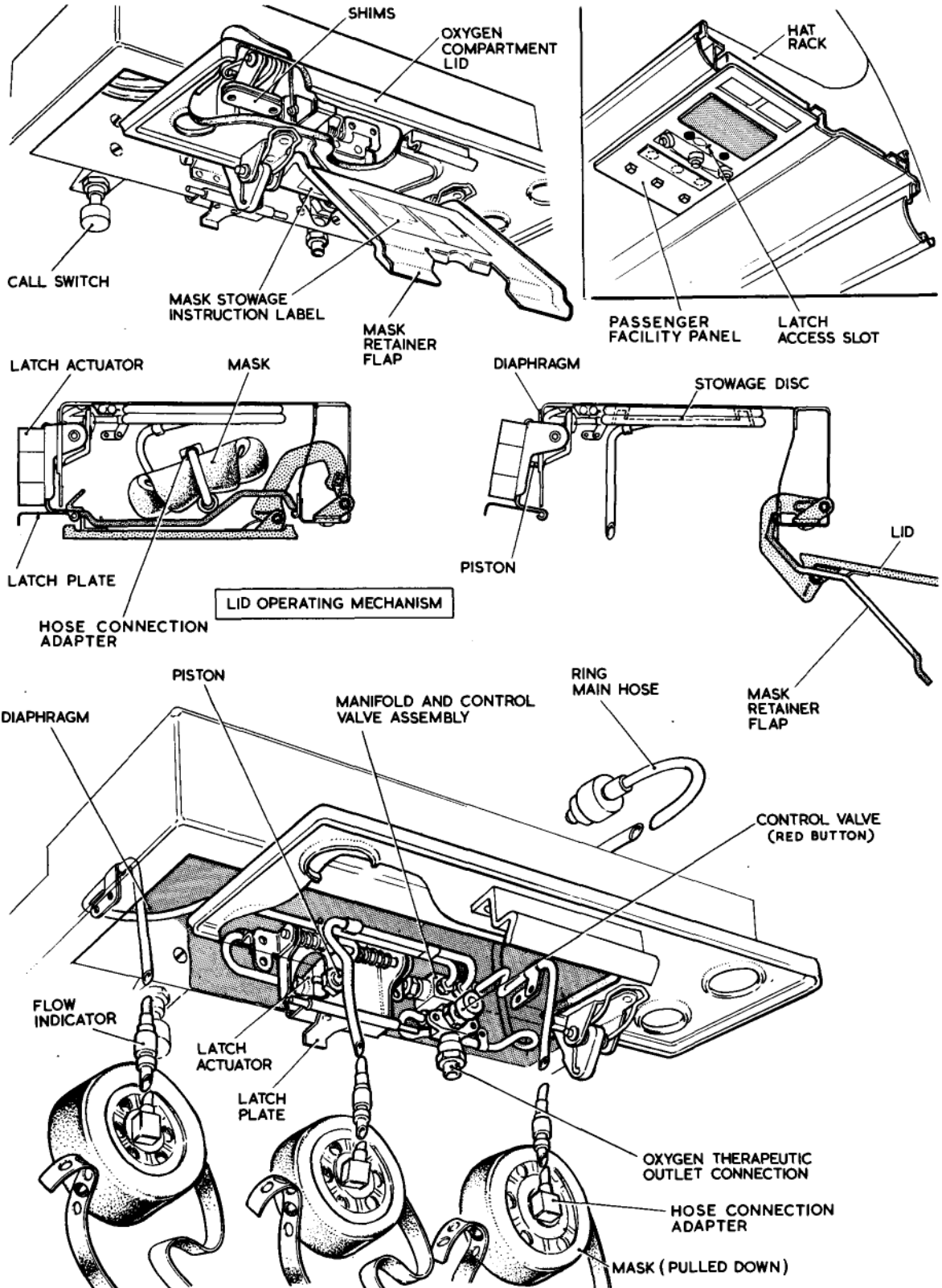
- B1 INLET PORT
- B2 LOWER SEAT OF SHUTTLE
- B3 SHUTTLE VALVE
- B4 UPPER SEAT OF SHUTTLE
- B5 OUTLET PORT
- B6 RESETTING PORT
- B7 FIRST VENT VALVE
- B8 SECOND VENT VALVE

- B9 SEAT (RESET PISTON)
- B10 RESET PISTON
- B11 SPRING (RESET PISTON)
- B12 PRIMARY CAPSULE
- B13 SECONDARY CAPSULE
- B14 REED
- B15 VENT PORT
- B16 RESET LEVER (AUTO)
- B17 VENT FOR B7
- B18 OVERRIDE KNOB (RED)
- B19 OVERRIDE SPINDLE
- B20 VENT FOR B8
- B21 RESET LEVER (MANUAL)

2-16 Fig 4 Oxygen Pressure Control System

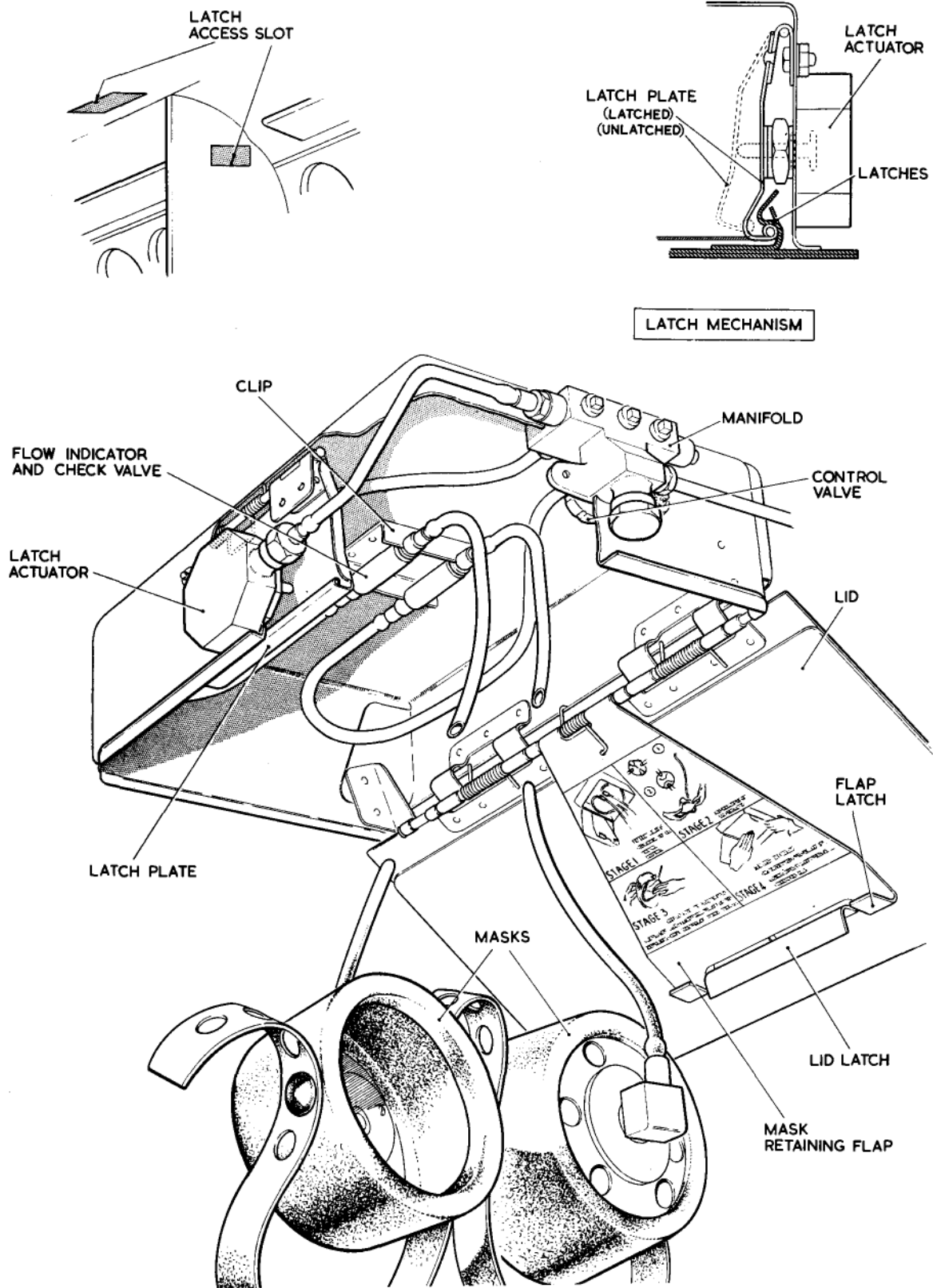


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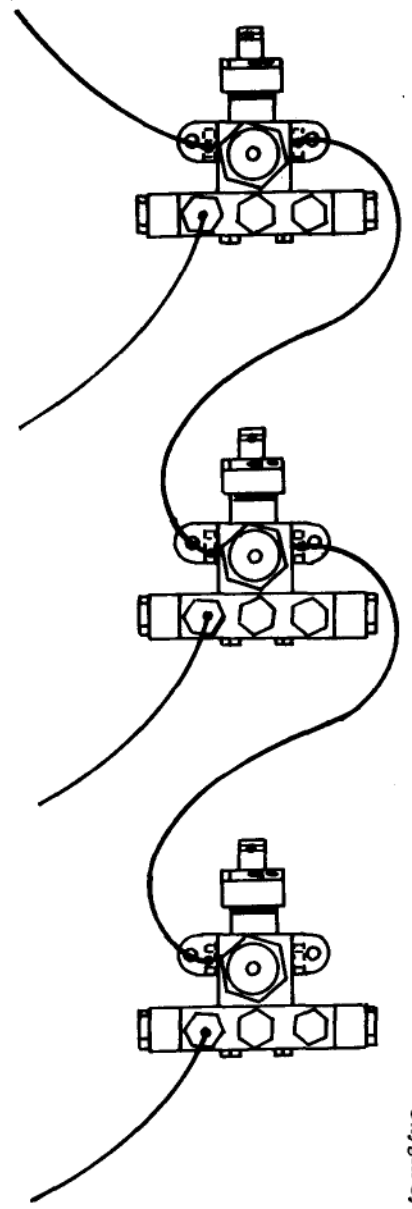
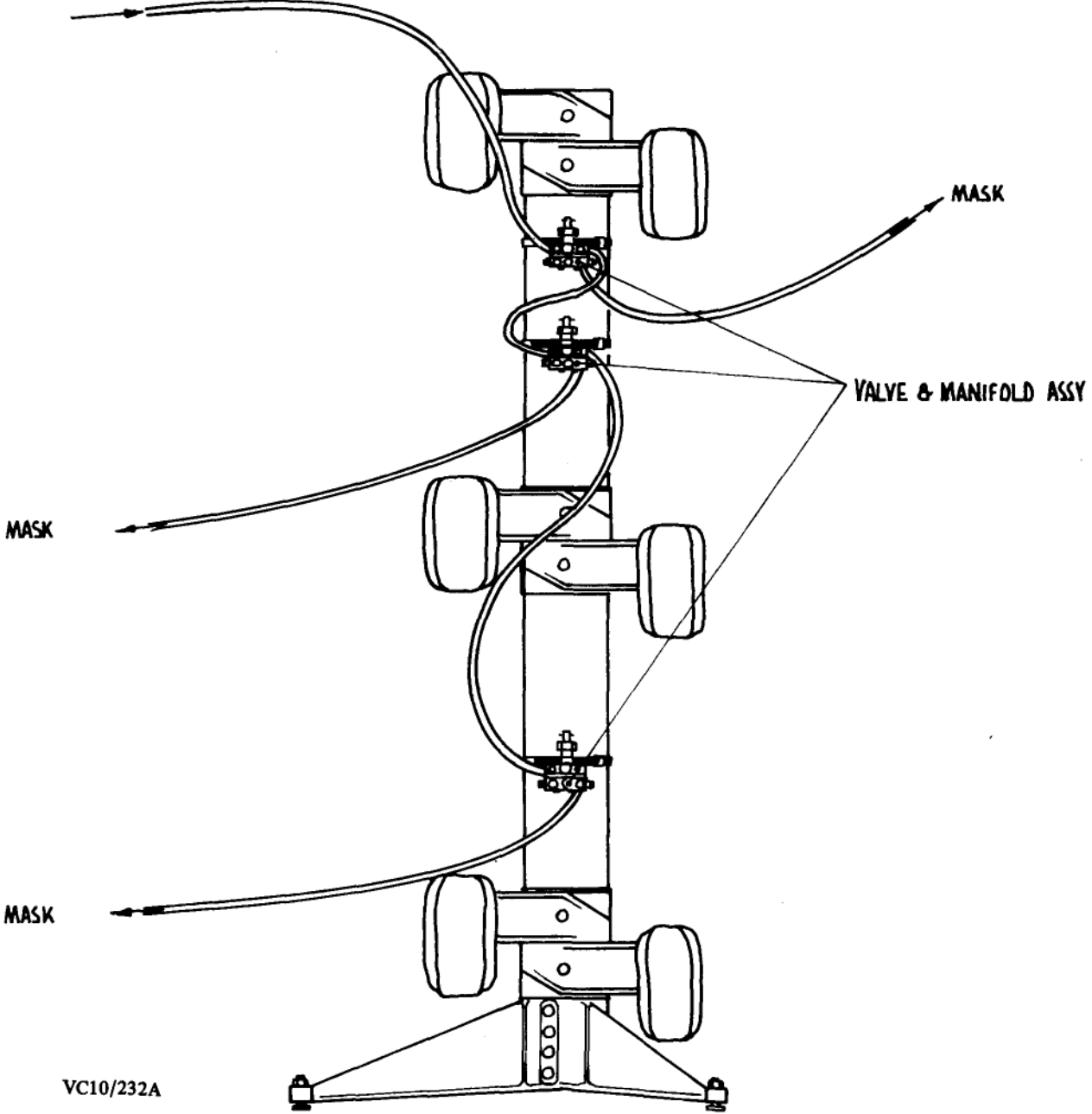
2-16 Fig 5 Passenger Three-Mask Presentation Unit



VC10/133A

2-16 Fig 6 Passenger Two-Mask Presentation Unit

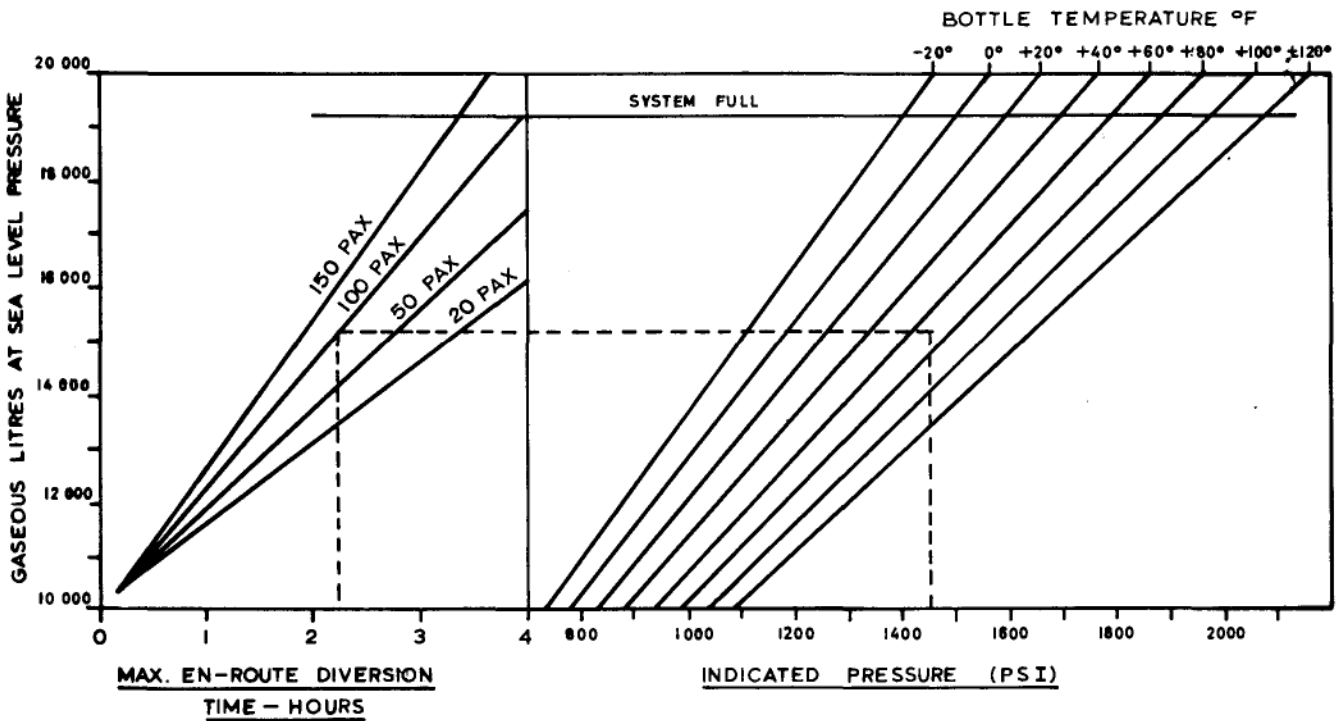
FROM AC RING MAIN



2-16 Fig 7 Aeromedical Oxygen System

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AP 101B-0201-15A
Oxygen System



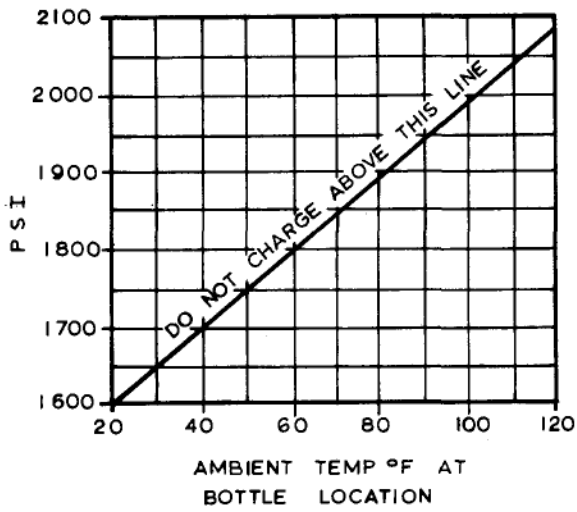
GRAPH BASED ON FOLLOWING DATA:-
 10 MIN OF DESCENT - 5 FLIGHT CREW
 2 ALM
 153 MASKS
 1 INVALID @ 5 LITRE/MIN

REMAINDER OF FLIGHT
 25% PAX FOR 1/2 TOTAL FLIGHT
 1 INVALID AT 2 1/2 LITRE MIN TOT. FLIGHT
 2 PAX AT 2 1/2 LITRE MIN FOR 30 MINS
 1 FLIGHT DECK CREW 5 1/4 LITRES PRIOR TO EMERGENCY DESCENT.

EXAMPLE:-
 2 1/4 HOURS TO NEAREST DIVERSION
 100 PASSENGERS
 BOTTLE TEMP. 70° F
 MINIMUM PRESSURE REQUIRED 1450 PSI.

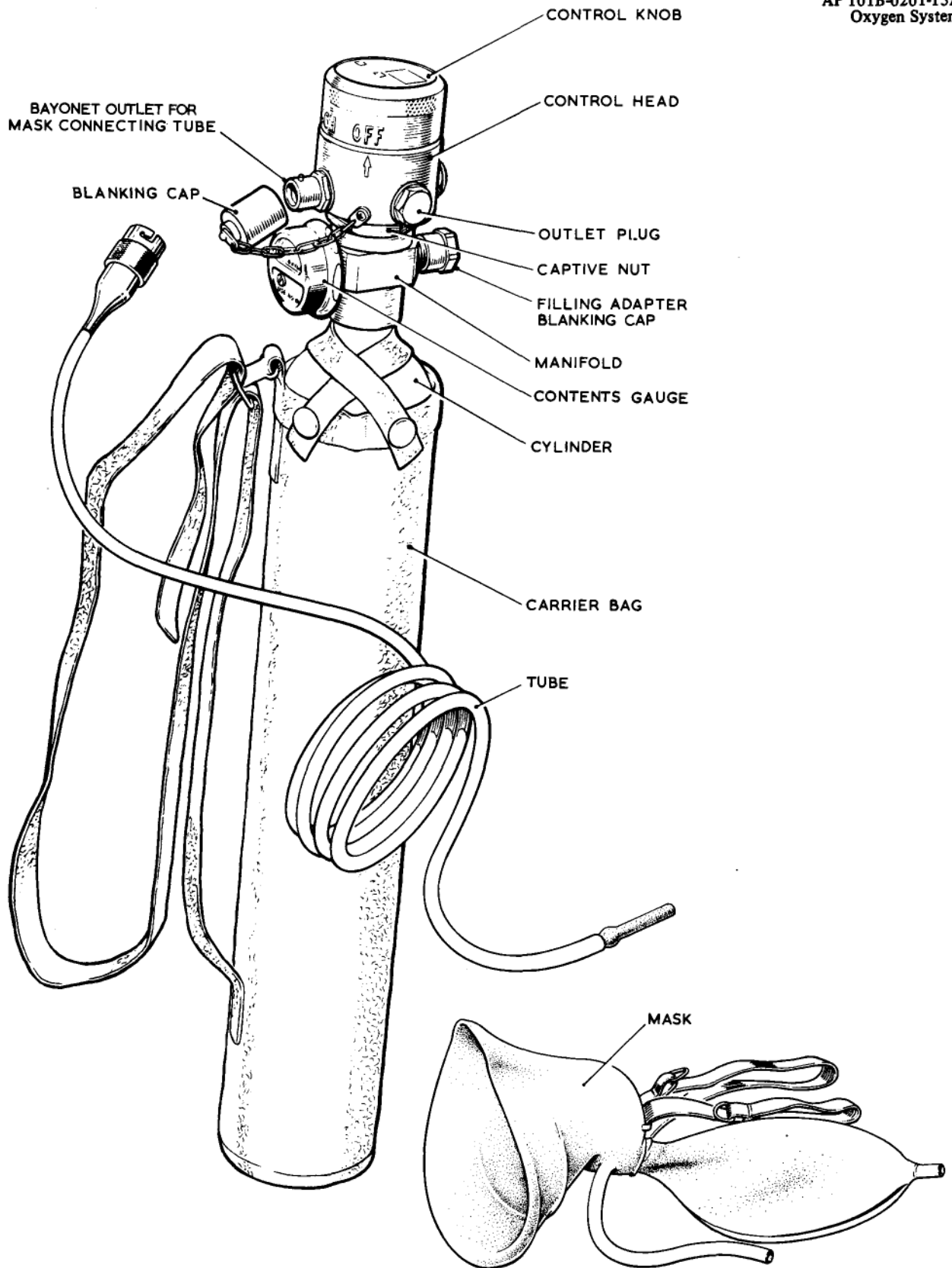
VC10/227A

2-16 Fig 8 Oxygen Endurance Graph



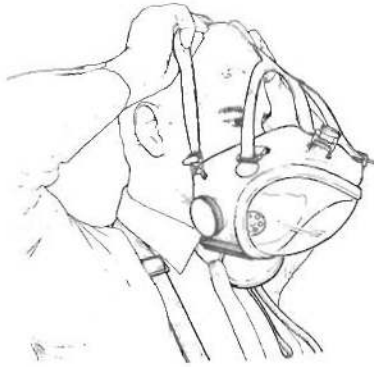
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2-16 Fig 9 Oxygen Charging Graph

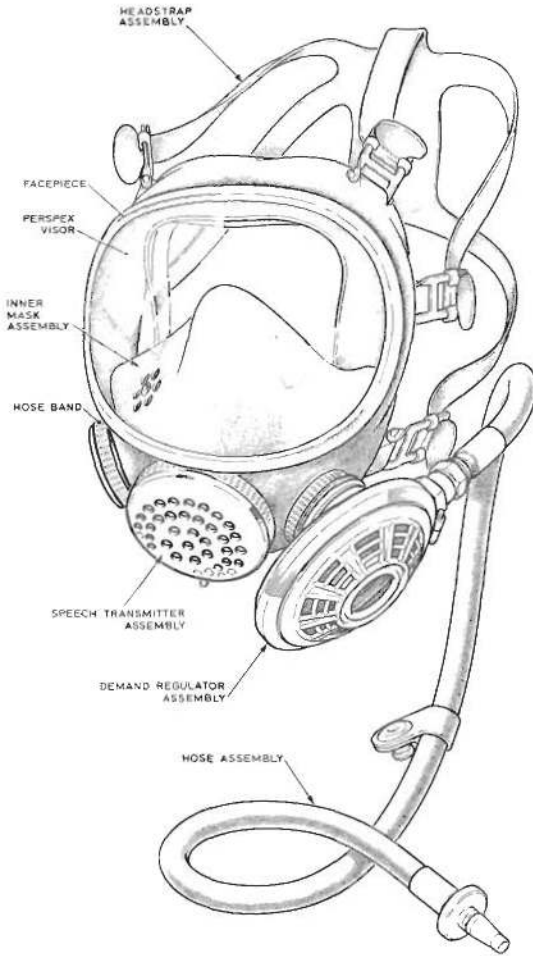


VC10/374A

2-16 Fig 10 Portable Oxygen Set-Mk 8



PUTTING ON THE MASK



SET IN NORMAL USE



ALTERNATIVE METHOD OF CARRYING THE SET

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Instrument panel from a MiG-21 (XP558)