(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: 0 383 573 A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 90301568.3

(51) Int. Cl.[5]: A62B 9/02, A62B 7/14

(22) Date of filing: 14.02.90

(30) Priority: 15.02.89 GB 8903433

(43) Date of publication of application:
22.08.90 Bulletin 90/34

(84) Designated Contracting States:
DE ES FR GB IT

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(54) Aircraft aircrew auxiliary oxygen bottle.

(57) An auxiliary oxygen bottle (11) for an aircraft aircrew breathing system is provided with an operating head (12) having a selector valve (51) for connecting either an oxygen enriched breathable gas inlet passage (54) or an auxiliary oxygen inlet passage (15) to an outlet passage (55) which is adapted for connection to an aircrew breathing demand regulator. A lever assembly (70) is automatically actuated following aircraft cabin decompression for control of a servo-pressure controlled diaphragm valve (40) to effect movement of the selector valve (51) to a position in which auxiliary oxygen is delivered to the outlet passage (55). The lever assembly (70) may be manually operated by an aircrew member for selection of auxiliary oxygen or oxygen-enriched breathable gas but re-selection of oxygen-enriched breathable gas is inhibited following cabin decompression if the aircraft is operating above a predetermined altitude.

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AIRCRAFT AIRCREW AUXILIARY OXYGEN BOTTLE

This invention relates to an aircraft aircrew breathing system auxiliary oxygen bottle and is more particularly concerned with an operating head for attachment to an auxiliary oxygen bottle.

In aircraft aircrew breathing systems it is a requirement that auxiliary oxygen be provided for breathing in an emergency, such as cabin decompression above a predetermined altitude and when the aircrew member ejects from the aircraft. The source of auxiliary oxygen is generally pressurised gaseous oxygen contained in an oxygen bottle mounted on an aircrew ejection seat. In prior art systems, such as that shown in GB-A-944933, auxiliary oxygen is supplied from the bottle by way of an operating head, which includes a gas release mechanism and pressure reducer, to a supply line joined at a T-connection with a supply line from a normal breathable gas source provided on the aircraft and a delivery line to a breathing demand regulator controlling delivery to a breathing mask worn by the aircrew member. Both the oxygen supply line and breathable gas supply line include a non-return valve to prevent backflow of gas from one line along the other line. On ejection of the aircrew ejection seat from the aircraft an arm on the operating head is operable by contact with an aircraft mounted striker to move the gas release mechanism to a position in which oxygen is supplied to the aircrew member.

There is a requirement in modern day high altitude aircraft for a system in which auxiliary oxygen is automatically selected should cabin decompression occur above a predetermined altitude as well as in the event that the aircrew member ejects from the aircraft in an emergency.

At the same time it is a requirement that if possible the aircrew member should be able to continue to fly the aircraft following a cabin decompression and, in so doing, that he be able to revert to breathing from his oxygen-enriched breathable gas source when operating within a safe altitude range whilst being prohibited from deselecting auxiliary oxygen if he is operating above the safe altitude range.

It is an object of the present invention to provide an operating head for an auxiliary oxygen bottle which enables the aforementioned requirements to be met in a small space envelope and with minimal requirement for delivery lines.

Accordingly, the present invention provides an operating head for an aircraft aircrew breathing system auxiliary oxygen bottle comprising a body having auxiliary oxygen inlet means adapted for connection to the auxiliary oxygen bottle, outlet means adapted for connection to an aircrew breathing demand regulator, passage means connecting the auxiliary oxygen inlet means to the outlet means, and means for reducing the pressure of auxiliary oxygen in flowing from the auxiliary oxygen inlet means to the outlet means, characterised in that the body further comprises oxygen-enriched breathable gas inlet means adapted for connection to a source of oxygen-enriched breathable gas, passage means connecting the oxygen-enriched breathable gas inlet means with the outlet means, selector valve means movable between a position in which the outlet means is connected with the oxygen-enriched breathable gas inlet means and a position in which the outlet means is connected with the auxiliary oxygen inlet means and means for moving the selector valve means to select oxygen-enriched breathable gas to be delivered to the outlet means during normal flight conditions and in flight within a predetermined safe altitude range following aircraft cabin decompression and to select auxiliary oxygen to be delivered to the outlet means in emergency flight conditions including flight above the predetermined safe altitude range following aircraft cabin decompression.

The means for moving the selector valve means to select either oxygen-enriched breathable gas or auxiliary oxygen to be delivered to the outlet means may comprise servo-pressure control valve means.

The servo-pressure control valve means may comprise vent valve means for venting a servo-pressure control chamber to ambient whereby a control valve of the servo-pressure control valve means is moved towards a position in which auxiliary oxygen is effective to move the selector valve means towards closing the passage means from the oxygen-enriched breathable gas inlet means and connecting the outlet means with the passage means from the auxiliary oxygen inlet means.

The vent valve means may be adapted for movement by an electrical solenoid connected for receiving signals from an aircraft systems computer.

In a preferred embodiment of the invention the vent valve means is further adapted for movement by lever means which is operable by both manual and automatic means.

The lever means may provide for initial selection of auxiliary oxygen and may comprise a rotatable lever assembly having means for breaking a seal provided in the passage means from the auxiliary oxygen inlet means. The lever means may project a first lever arm for connection to a handle whereby the lever means may be manually operated by an aircrew member and may further project a second lever arm for operation of the lever means when the aircrew member ejects from the aircraft in an emergency.

Means for automatic operation of the lever means may comprise a piston urged by a spring towards operating the lever means to move the vent valve means to vent the servo-pressure control chamber to ambient and restrained against such movement by a ball member held in restraining contact with the piston by an electrical solenoid connected for receiving signals from the aircraft systems computer.

Aircraft cabin altitude sensing electrical switch means may be mounted on the body of the operating head for outputting an electrical signal for initiation of automatic selection of auxiliary oxygen at a cabin pressure equivalent to a first predeterminerd altitude following cabin decompression.

After such automatic selection of auxiliary oxygen the aircrew member may choose to de-select auxiliary oxygen and revert to breathing oxygen-enriched breathing gas by manual operation of the lever means but must be prevented from so doing if he is operating above a second predetermined altitude.

For this purpose second aircraft cabin altitude sensing switch means may be provided for outputting an electrical signal to inhibit re-selection of oxygen-enriched breathable gas at a cabin pressure equivalent to the second predetermined altitude.

The selector valve means may comprise a floating piston assembly including a differential area piston adapted for movement under the effect of auxiliary oxygen on a larger end wall thereof towards a position in which it closes the passage means connecting the oxygen-enriched breathable gas inlet means with the outlet means.

The selector valve means may further comprise a second hollow piston housed internally of the differential area piston and adapted for movement under the effect of low pressure auxiliary oxygen acting on an end wall thereof through a port in the differential area piston, towards a position in which the passage means from the auxiliary oxygen inlet means is connected to the outlet means by way of the interior of the selector valve means.

In use in an aircraft breathing system an auxiliary oxygen bottle operating head in accordance with the present invention reduces the requirement for supply lines and non-return valves when compared with the prior art, and facilitates either manual or automatic selection of auxiliary oxygen whilst providing an aircrew member with the option to re-select oxygen-enriched breathable gas at safe altitudes following automatic selection of auxiliary oxygen resulting from cabin decompression.

In another aspect the present invention provides an aircraft aircrew breathing system comprising an oxygen-enriched breathable gas generating system, an aircrew breathing demand regulator connected for receiving breathable gas from said generating system and for supplying said breathable gas in response to aircrew breathing demands, and an auxiliary oxygen bottle including an operating head having inlet means connected for receiving auxiliary oxygen from said oxygen bottle and outlet means connected for delivering auxiliary oxygen to the breathing demand regulator in emergency conditions, characterised in that the breathable gas generating system is connected for delivering breathable gas to the demand regulator by way of breathable gas inlet means in the operating head, and that the operating head includes selector valve means operable by manual and automatic means for movement from a position in which the outlet means is connected with the breathable gas inlet means to a position in which said outlet means is connected to the auxiliary oxygen inlet means.

The invention will now be further described by way of example and with reference to the accompanying drawings in which:-

Figure 1 is a schematic tranverse cross-section through an operating head in accordance with an embodiment of the invention; and

Figure 2 is a perspective view of an auxiliary oxygen bottle assembly having an operating head similar to that shown in Figure 1.

Referring to the drawings, an auxiliary oxygen bottle assembly 10 for use in an aircraft aircrew breathing system comprises a high pressure oxygen storage bottle 11 of cylindrical construction and an operating head 12 constructed in accordance with one embodiment of the present invention.

The operating head 12 has a body 13 having a threaded connection with a neck portion 14 of the storage bottle 11 and provided with auxiliary oxygen inlet means comprised by an inlet passageway 15. The inlet passageway 15 has one end 16 in communication with the interior of the storage bottle 11 and is sealed at its opposite end 17 by a break-off tube 19 with respect to a high pressure auxiliary oxygen chamber 18 that is provided in the body 13. An auxiliary oxygen charging connection 20 is tapped into the inlet passageway 15 and is provided with a spring-loaded ball valve assembly 21 for closing the connection 20 to prevent outflow of auxiliary oxygen from the bottle by way of the charging connection. A threaded cap 22 is also provided on the charging connection as a further safeguard against leakage of auxiliary oxygen past the ball valve assembly 21 and to protect the assembly 21 against ingress of dust or other particles. A pressure relief port 23 is tapped into the inlet passageway 15 and is closed by a disc 24 which is adapted to burst if the auxiliary oxygen pressure in the storage bottle exceeds a safe limit. A temperature sensor 25 and a pressure transducer 26 are also connected into the inlet passageway 15 and supply electrical signals representative of auxiliary oxygen temperature and pressure to an aircraft systems management computer to enable the computer to calculate the true volume of oxygen in the storage bottle and display a warning signal if the volume has fallen below a desired value.

Auxiliary oxygen pressure reducing means is provided by the high pressure oxygen chamber 18 and a low pressure oxygen chamber 27, the chambers being joined by a passageway 28 in the body 13. A valve member 29 located in the high pressure chamber 18 projects a valve stem 30 through the passageway 28 into the low pressure chamber 27 and is urged towards closing the passageway 28 by a compression spring 31. The valve stem 30 contacts a centre plate 32 of a diaphragm member 33 which separates the low pressure chamber 18 from an ambient pressure chamber 34. Chamber 34 is communicated with ambient pressure by a passageway 36. A compression spring 35 located in the low pressure chamber 18 acts on the centre plate 32 to urge the valve member 29 towards opening the passageway 28 to communicate the high pressure chamber 18 with the low pressure chamber 27.

An outlet passageway 37 from the low pressure chamber 27 is provided with a valve seat 38 and communicates the chamber 27 with a chamber 39 on one side of a servo-pressure controlled diaphragm valve 40. The diaphragm valve 40 has a central valve plate 41 which contacts the valve seat 38 to close communication between the chambers 27 and 39. A passageway 42 branching from the outlet passageway 37 communicates by way of restrictor orifice 43 and a solenoid operated vent valve 44 with a servo-pressure chamber 45 on the other side of the diaphragm valve 40.

In Figure 1 the solenoid operated vent valve 44 is shown in a position closing communication between the servo-pressure chamber 45 and an ambient atmosphere vent passageway 46. The solenoid operated vent valve 44 may be electrically actuated or it may be moved by a rotatable lever assembly which will hereinafter be described, to an opposed position in which it closes communication between the low pressure chamber 27 and servo-pressure chamber 45, and vents the servo-pressure chamber to ambient.

A passageway 47 communicates the chamber 39 with a chamber 48 at a larger area end wall 49 of a differential area hollow piston 50 of a floating piston assembly which provides a selector valve 51. The smaller area end wall 52 of the piston 50 has a central area arranged for closing with a valve seat 53 provided at an inner end of an inlet passageway 54 from oxygen-enriched breathable gas inlet means 54a provided at the opposite end of the inlet passageway 54 and adapted by connector means (not shown) for connection to a supply line (not shown) from a source of oxygen-enriched breathable gas such as may be produced by a molecular sieve oxygen concentrator (not shown) of an aircraft on-board oxygen-enriched breathable gas generating system. With the piston 50 in a position in which the end wall 52 is not closed with the valve seat 53, the inlet passageway 54 is connected with an outlet passageway 55 adapted for connection with a supply line (not shown) to an aircrew breathing demand regulator (not shown).

The piston 50 houses a second hollow piston 56 having an end wall 57 and being slidable within the piston 50. A central area of the end wall 57 is arranged for closing with a valve seat 58 provided interiorly of a port 59 in the larger area end wall 49 of the piston 50. The piston 56 is urged towards closing with the valve seat 58 by a compression spring 60. A series of ports 61 extend through the end wall 57 of piston 56 and are equi-spaced around the central area thereof on a pitch circle diameter which is larger than the diameter of the valve seat 58. Similarly, a series of ports 62 extend through the smaller area end wall of piston 50 and are equi-spaced around the central area thereof on a pitch circle diameter which is larger than the diameter of the valve seat 53.

A branch passageway 63 from passageway 47 connects with a pressure switch 64 screwed into the body 13 and having electrical connection with the aircraft systems management computer (not shown) by way of an electrical connector 65.

Lever means whereby the selector valve 51 may be moved for manual or automatic selection of auxiliary oxygen comprise a lever assembly 70. The lever assembly 70 is carried by a spindle 71 rotationally mounted in the body 13 and comprises a first lever arm 72 projecting from the spindle 71 outwardly of the body 13 to an end 73 which is adapted for connection to a handle (not shown) by which the lever arm 72 may be manually rotated by an aircrew member. An arm 74 projects from the spindle inwardly of the body 13 into the high pressure oxygen chamber 18 and is of a length such that it makes contact with the break-off tube 19 when the lever arm 72 is rotated in an anti-clockwise direction. A second lever arm 75 projects from the spindle 71 outwardly of the body 13 in the opposite direction from the first lever arm 72. The second lever arm 75 is arranged to contact an arm (not shown) mounted on a bulkhead of the aircraft and is rotated in an anti-clockwise direction when the aircrew member ejects from the aircraft in an emergency situation. The lever arm 75 is locked with the lever arm 72 so that rotation of the lever arm 75 also rotates the lever arm 72 and with it the arm 74. The lever assembly 70 further includes a link 76 attached at one end to the spindle 71 and at an opposite end to a rotatable cam member 77 having a D-shaped cam surface 78 in contact with the solenoid operated vent valve 44 and whereby the valve 44 may be mechanically moved from its position closing ambient outlet passageway 46 to its opposed position in which the servo-pressure chamber 45 is vented to ambient. Rotation of the lever arms 72 and 75 cause the link 76 to rotate the cam member 77 around a vertical axis as seen in Figure 1, whereby the flat side of the D-shaped cam surface is moved out of contact with the valve 44 and the curved side is brought into contact with the valve 44 to move it to its opposed position.

The first lever arm 72 is arranged to contact an outer end of a stem 79 projected by a piston 80 housed in a cylinder 81 in the body 13. The piston 80 is urged by a compression spring 82 towards moving the stem 79 outwardly from the cylinder 81 to cause rotational movement of the lever arm 72 in an anti-clockwise direction. The piston 80 is restrained against such movement by a detent ball 83 which is maintained in contact with the piston 80 by a core member 84 of a solenoid 85. The core member 84 has a tapered end 86 which allows the ball 83 to move out of restraining contact with the piston 80 when the core member 84 is retracted by the solenoid 85. The solenoid is connected for receiving electrical signals by way of the electrical connector 65.

Two altitude switches 90, 91 (only one of which is illustrated in Figure 2) are mounted on the body 13. Each switch comprises a pressure sensitive bellows capsule 92 having an electrical contact 93 on a movable end thereof. Should aircraft cabin pressure drop below a predetermined altitude equivalent as might occur in the event of cabin decompression, the bellows capsule expands to place the electrical contact 93 in contact with a fixed electrical contact 94 and a signal is transmitted to the aircraft systems computer by way of the electrical connector 61. In this embodiment the altitude switch 90 is arranged to react if cabin pressure falls below an altitude equivalent of 7600 metres (25000 feet) whilst the altitude switch 91 is arranged to close if cabin pressure falls below an altitude equivalent of 10800 metres (35000 feet).

In use the auxiliary oxygen bottle assembly 10 is attached to an aircraft seat, the storage bottle 11 preferably having been charged with gaseous oxygen before installation although charging may be carried out after installation. Appropriate connections are made to connect the breathable gas inlet means 54a of the operating head assembly 12 with an oxygen-enriched breathable gas supply line from a molecular sieve oxygen concentrator installed in the aircraft as part of the aircraft on-board oxygen-enriched breathable gas generating system, and to connect the outlet passageway 55 with a supply line to a seat mounted breathing demand regulator. The electrical connector 65 is also appropriately connected to the aircraft systems management computer.

In operation, with the aircraft systems switched on, the temperature sensor 15 and pressure sensor 26 supply signals to the aircraft systems computer to enable the volume of oxygen in the storage bottle to be calculated and, if desired, displayed, and a warning signal to be given if the volume falls below a predetermined value. In normal flight the aircrew member breathes oxygen-enriched breathable gas delivered to his breathing mask by way of the breathing demand regulator connected with the outlet passageway 55 of the operating head assembly 12; the piston 50 of the selector valve 51 being moved by the pressure of oxygen-enriched breathable gas to a position in which connection is made between the outlet passageway 55 and the inlet passageway 54. At the same time ambient pressure in the chamber 34 acts with the compression spring 35 on the diaphragm member 33 to overcome the effect of the compression spring 31 on the valve member 29 so that the valve member is held in a position just opening the passageway 28 between the high and low pressure oxygen chambers 18 and 27, respectively.

In the event of an emergency, such as failure of the on-board oxygen-enriched breathable gas generating system, the aircrew member may manually select auxiliary oxygen to be supplied to his breathing mask from the storage bottle 11. To activate the operating head for supply of auxiliary oxygen he pulls on the handle (not shown) connected to the lever arm 72 and thereby rotates the lever assembly in an anti-clockwise direction to bring the arm 74 into sharp contact with the break-off tube 19 so that the tube 19 is sheared off and high pressure oxygen flows from the bottle 11 into the high pressure oxygen chamber 18. At the same time the link 76 rotates the cam member 77 to move the vent valve 44 to a position in which the servo-pressure chamber 45 is communicated with ambient by way of the ambient outlet passageway 46.

With the valve member 29 held in position just opening the passageway 28 oxygen flows to the chamber 27 where its pressure drops. Because the servo-pressure chamber 45 is vented to ambient, pressure in the chamber 27 acts to move the diaphragm valve 40 to an open position so that oxygen flows from chamber 27 to chamber 48.

Pressure in chamber 48 acts on the larger area end wall 49 and is effective to move the piston 50 to a position in which it closes communication between inlet passageway 54 and outlet passageway 55. Pressure in chamber 48 is effective by way of the port 59 in the end wall 49 on the end wall 57 of piston 56 to move the piston 56 off the valve seat 58 so that oxygen is able to flow through the ports 61 in the end wall 57 and the ports 62 in the smaller area end wall 52 of the piston 50 to the outlet passageway 55.

The pressure switch 64 is activated by the oxygen pressure in the chamber 48 and signals the systems computer that auxiliary oxygen has been selected.

It should be appreciated that signals from sensors monitoring the health of the breathable gas generating system may be fed to the systems computer which may activate the operating head to supply auxiliary oxygen to the breathing demand regulator automatically in the event of malfunction of the breathable gas generating system.

In the event of cabin decompression when the aircraft is operating at altitudes above 7600 metres auxiliary oxygen is automatically selected by altitude switch 91 closing so that a signal is transmitted by way of the systems computer to the solenoid 85 for retraction of the core member 84. Retraction of the core member 84 brings the tapered end 86 into alignment with the ball member 83 so that the compression spring 82 is able to overcome the restraint exercised by the ball member. The piston 80 is stroked by the spring 82 to project the stem 79 out of the cylinder 81 thereby rotating the lever arm 72 and with it the lever assembly 70, to activate the operating head as hereinbefore described for manual activation, whereby oxygen at reduced pressure is supplied to the aircrew member from the storage bottle 11.

At altitudes below 10800 metres the aircrew member may select to revert to breathing oxygen-enriched breathable gas delivered by the breathable gas generating system. To do so he manually resets the lever assembly 70 so that the vent valve 44 is moved to the position in which it closes the ambient outlet passageway 46. This allows oxygen to flow from the low pressure oxygen chamber 27 by way of passageway 42 to the servo-pressure chamber 45. Pressure builds up in the servo-pressure chamber 45 and acts on the servo-pressure controlled diaphragm valve 40 to move it to a position in which it closes the outlet passageway 37. Oxygen from chamber 27 is prevented from entering chamber 48 so that the pressure of oxygen-enriched breathable gas in the inlet passageway 54 acts on the piston 50 to move the selector valve 51 to the position in which communication is provided between the inlet passageway 54 and the outlet passageway 55.

However, above an altitude of 10800 metres the altitude switch 91 also closes and signals the systems computer so that the aircrew member is prevented from overriding the selection of auxiliary oxygen at altitudes above 10800 metres.

The operating head is also activated to select auxiliary oxygen when the aircrew member ejects from the aircraft in an emergency. As previously described the auxiliary oxygen bottle assembly is seat mounted and is installed in the aircraft so that the lever arm 75 of the operating lever assembly is located beneath an arm mounted on a bulkhead at the rear of the seat. As the seat is ejected out of the aircraft the lever arm 75 strikes the bulkhead mounted arm and is rotated in an anti-clockwise direction to activate the operating head and cause auxiliary oxygen to be selected.

De-selection of auxiliary oxygen by command of the systems computer is also possible. An electrical signal from the systems computer is used to close the solenoid operated vent valve 44 whereby auxiliary oxygen pressure is effective in the servo-pressure chamber 45 to move the servo-pressure controlled diaphragm valve 40 towards closing with the valve seat 38.

The selection of auxiliary oxygen is not affected by loss of an electrical signal from the systems computer as the solenoid operated vent valve 44 is of the power impulse type so that oxygen-enriched breathable gas cannot be reselected in the event of loss of electrical signal.

Claims

1. An operating head (12) for an aircraft aircrew breathing system auxiliary oxygen bottle (11) comprising a body (13) having auxiliary oxygen inlet means (15) adapted for connection to the auxiliary oxygen bottle, outlet means (55) adapted for connection to an aircrew breathing demand regulator, passage means (28, 37, 47) connecting the auxiliary oxygen inlet means to the outlet means, and means (18, 27, 29) for reducing the pressure of auxiliary oxygen in flowing from the auxiliary oxygen inlet means to the outlet means, characterised in that the body (13) further comprises oxygen-enriched breathable gas inlet means (54a) adapted for connection to a source of oxygen-enriched breathable gas, passage means (54) connecting the oxygen-enriched breathable gas inlet means with the outlet means (55), selector valve means (51) movable between a position in which the outlet means (55) is connected with the oxygen-enriched breathable gas inlet means (54) and a position in which the outlet means (55) is connected with the

auxiliary oxygen inlet means (15), and means (70) for moving the selector valve means to select oxygen-enriched breathable gas to be delivered to the outlet means during normal flight conditions and in flight within a predetermined safe altitude range following aircraft cabin decompression and to select auxiliary oxygen to be delivered to the outlet means in emergency flight conditions including flight above the predetermined safe altitude range following aircraft cabin decompression.

2. An operating valve head as claimed in Claim 1, further characterised in that the means for moving the selector valve means comprise servo-pressure control valve means (40).

3. An operating head as claimed in Claim 2, further characterised in that the servo-pressure control valve means comprise vent valve means (44) for venting a servo-pressure control chamber (45) to ambient whereby a control valve (40, 41) of the servo-pressure control valve means is moved under the effect of auxiliary oxygen pressure towards a position in which auxiliary oxygen pressure is effective to move the selector valve means towards closing the passage means from the oxygen-enriched breathable gas inlet means and connecting the outlet means with the passage means from the auxiliary oxygen inlet means.

4. An operating head as claimed in Claim 3, further characterised in that the vent valve means is adapted for movement by an electrical solenoid (44).

5. An operating as claimed in Claim 3 or Claim 4, further characterised in that the vent valve means is adapted for movement by lever means (70) operable by manual means or by automatic means.

6. An operating head as claimed in Claim 5, further characterised in that the automatic means comprise a piston (80) urged by a spring (82) towards operating the lever means to move the vent valve means to vent the servo-pressure control chamber to ambient and restrained against such movement by a detent member (83) held in a restraining position by an electrical solenoid (85).

7. An operating head as claimed in any preceding claim, further characterised in that aircraft cabin altitude sensing electrical switch means (90, 91) are mounted on the body.

8. An operating head as claimed in Claim 7, further characterised in that the switch means comprise a first altitude sensing switch (90) adapted to output an electrical signal at a cabin pressure equivalent to a first predetermined altitude and a second altitude sensing switch (91) adapted to output an electrical signal at a cabin pressure equivalent to a second predetermined altitude.

9. An operating head as claimed in any preceding claim, further characterised in that the selector valve means comprises a differential area piston (50) adapted for movement under the effect of auxiliary oxygen pressure on a larger end wall (49) thereof towards a position in which it closes the passage means connecting the oxygen-enriched breathable gas inlet means with the outlet means.

10. An operating head as claimed in Claim 9, further characterised in that the selector valve means further comprises a second hollow piston (56) housed internally of the differential area piston and adapted for movement under the effect of auxiliary oxygen acting on an end wall (57) thereof through a port (59) in the differential area piston, towards a position in which the passage means from the auxiliary oxygen inlet means is connected to the outlet means by way of the interior of the selector valve means.

11. An aircraft aircrew breathing system comprising an oxygen-enriched breathable gas generating system, an aircrew breathing demand regulator connected for receiving breathable gas from said generating system and for supplying said breathable gas in response to aircrew breathing demands, and an auxiliary oxygen bottle (11) including an operating head (12) having inlet means (15) connected for receiving auxiliary oxygen from said oxygen bottle and outlet means (55) connected for delivering auxiliary oxygen to the breathing demand regulator in emergency conditions, characterised in that the breathable gas generating system is connected for delivering breathable gas to the demand regulator by way of breathable gas inlet means (54a) in the operating head (12), and that the operating head includes selector valve means (51) operable by manual and automatic means (70) for movement from a position in which the outlet means (55) is connected with the breathable gas inlet means (54a) to a position in which said outlet means is connected to the auxiliary oxygen inlet means (55).

FIG.1

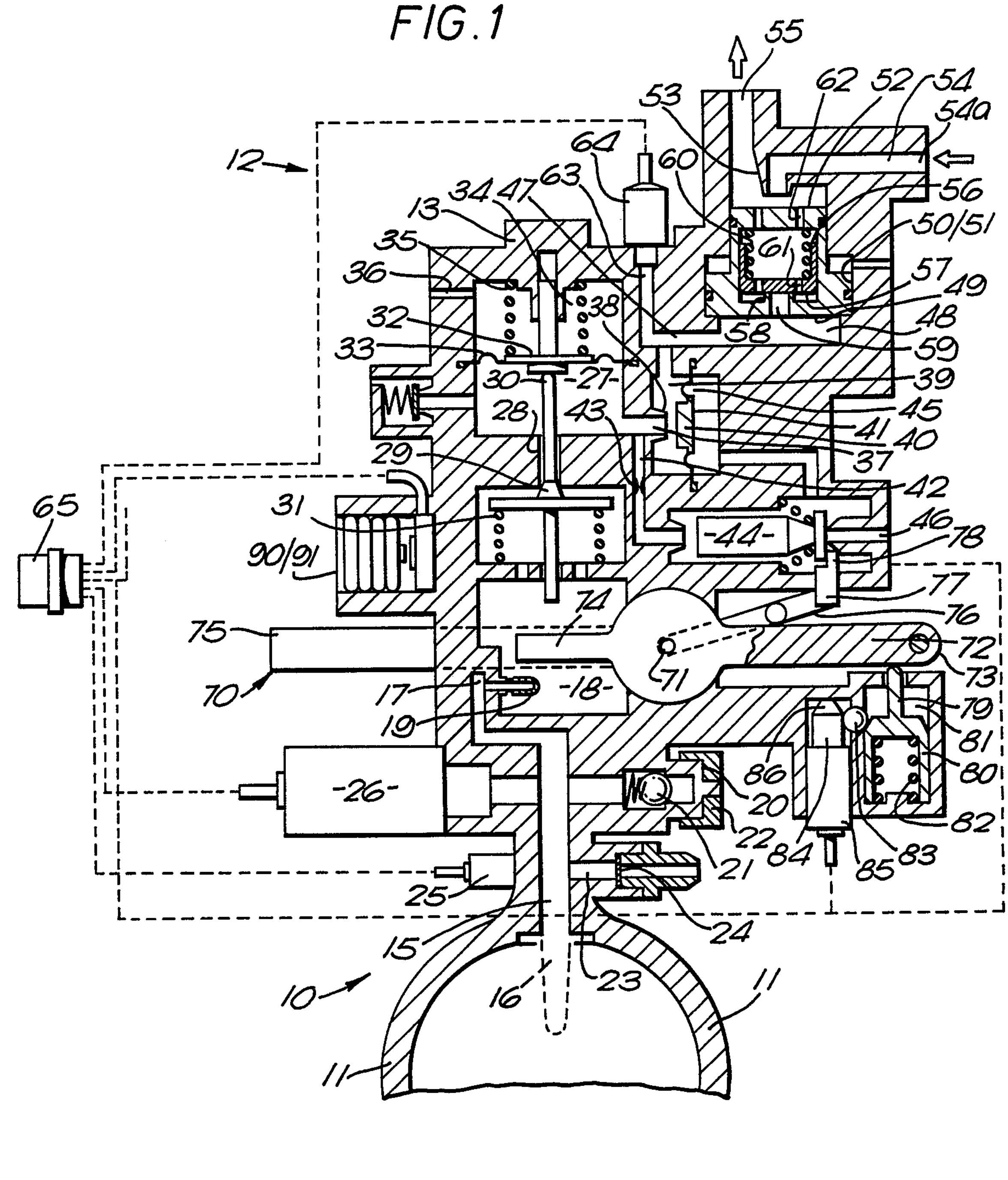

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FIG. 2