March 13, 1951 B. B. HOLMES 2,544,991

PRESSURE BREATHING REGULATOR

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Fig. 1

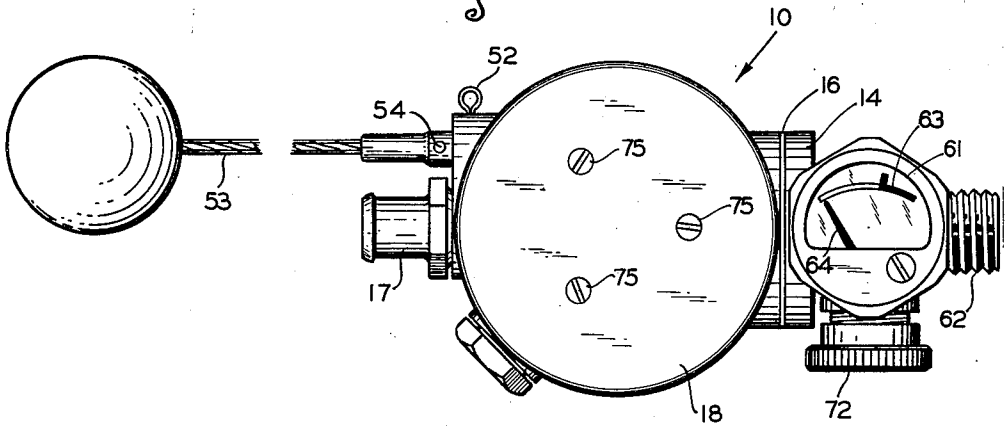
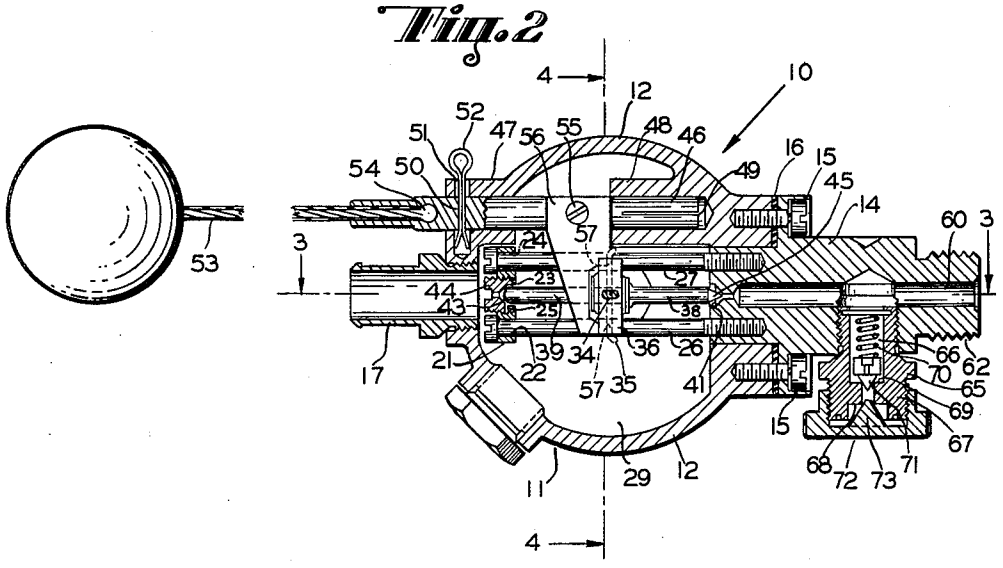


Fig. 2



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Fig. 3

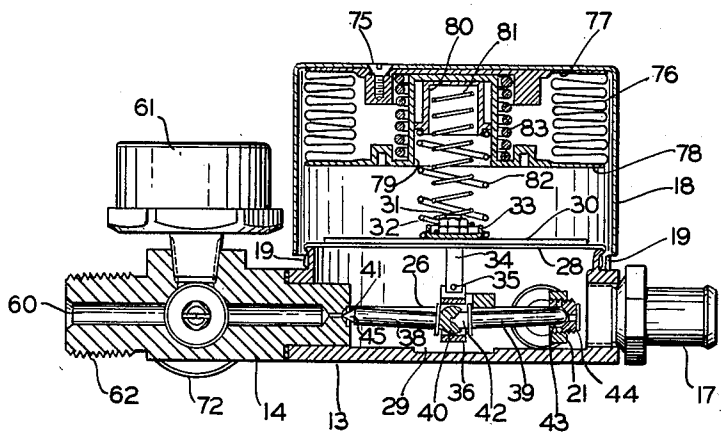
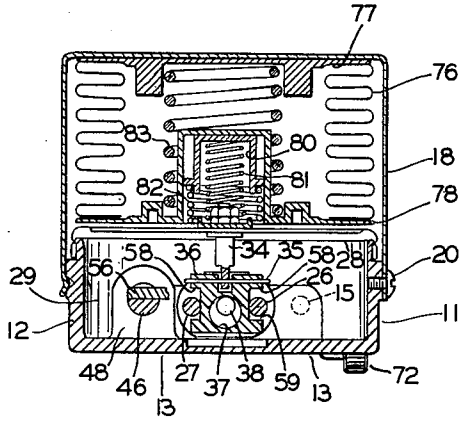


Fig. 4



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UNITED STATES PATENT OFFICE

2,544,991

PRESSURE BREATHING REGULATOR

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7 Claims. (Cl. 128—141)

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The present invention relates to a pressure breathing regulator, and more particularly to an oxygen breathing regulator to be used by parachutists, or during emergencies when regular breathing or pressure apparatus fails in high altitude planes.

An object of my present invention is to provide an oxygen breathing regulator for use with a small high pressure oxygen flask and a mask.

A further object of this invention is to provide an oxygen breathing regulator in which a respiration actuated diaphragm will operate a toggle mechanism to open and close an inlet valve to supply a flow of oxygen to a mask.

Another object of my invention is to provide an oxygen breathing regulator in which a pressure responsive member actuated by the ambient atmospheric pressure will coact with a respiration actuated diaphragm to open the inlet valve to supply oxygen to the mask.

Still another object of the present invention is to provide an oxygen breathing regulator of the character described with means for holding the inlet valve closed when the regulator is not in use, said means being released by a rip cord to permit operation of the regulator.

Still another object of this invention is to provide an oxygen breathing regulator of the character described with a removable sealing cap and a check valve whereby the oxygen supply of the small oxygen flask may be replenished from larger oxygen storage facilities.

Yet another object of my invention is to provide a highly improved oxygen breathing regulator which shall be small in size, light in weight; which may be worn comfortably by a parachutist in jumps from great altitudes, or worn as a walk-around regulator by crew members in high altitude planes, or by passengers in pressurized cabin planes during emergencies.

Other objects of this invention will in part be obvious, and in part hereinafter pointed out.

The invention accordingly consists in the features of construction, combinations of elements, and arrangement of parts which will be exemplified in the construction hereinafter described, and of which the scope of application will be indicated in the appended claims.

In the accompanying drawings in which one of the various possible illustrative embodiments of this invention is shown,

Figure 1 is a top plan view of a regulator embodying the invention,

Figure 2 is a longitudinal cross-sectional view of the regulator, a portion of which has been broken away to show a feature of construction, other portions of which are shown in elevation,

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Figure 3 is a cross-sectional reversed view taken along line 3—3 of Figure 2, portions of which are in elevation, showing the respiration actuated diaphragm and valve mechanism, and the aneroid for controlling the diaphragm, while

Figure 4 is a cross-sectional view taken along line 4—4 of Figure 2, showing the expanded aneroid acting upon the respiration actuated diaphragm.

Referring now in detail to the drawings, 10 designates a regulator embodying the invention. The regulator 10 comprises a cylindrical body 11 having arcuate side walls 12 and a bottom wall 13; an inlet and gauge section 14 to which is threaded an oxygen flask (not shown), fixed to said body by screws 15 and a gasket 16; an outlet port 17 threaded into said body diametrically opposite the section 14 over which is slipped a hose line connected to a mask (not shown); and a vented cover 18 provided with openings 19, snapped over the body 11 and fixed thereto as by screws 20.

Fixed within the cylindrical body 11 in a suitable manner is a bracket 21 provided with three aligned openings 22, 23 and 24, opening 23 being threaded and formed with a shoulder 25. Received within openings 22 and 24 are two parallel guide rods 26 and 27, the ends of which are threaded into the section 14.

Fixed to the arcuate side walls 12 of said body is a membrane or diaphragm 28 forming a chamber 29 within said body. Membrane 28 is provided with a rigid support plate 30. Fixed to said plate as by a screw 31 and nuts 32 is a spring seat 33 and a depending link 34. Pivoted to the end of said link as by pin 35 is an I-shaped black 36 (Figure 4) having an enlarged opening 37.

Received within the opening 37 of block 36 are two rods 38 and 39. Rod 38 is formed at one end with an enlarged bearing section 40 to receive one end of rod 39. Section 40 is approximately a sphere having a diameter equal to the diameter of opening 37. The other end 45 of rod 38 is conical in shape, and rests in a valve seat 41 provided in section 14. Rod end 45 will hereinafter be referred to as valve 45. The rod 39 is provided with a conical pivot 42 resting in the bearing surface provided by section 40, and a spherical bearing surface 43 abutting a bearing cap 44 threaded into the opening 23 of bracket 21.

It will be apparent that valve 45 will engage the seat 41 when the membrane 28 is in its normal position as shown in Figure 3. To insure a leak

proof seating of the valve 38, the bearing cap 44 may be turned to increase the pressure of said valve against its seat 41, proper alignment of rod 39 and valve 38 being maintained by the bearing surface of cap 44 and shoulder 25 and pivot 42 in bearing 40, the bearing being held in place by the block 36.

In operation, depression of the membrane 28 will actuate the toggle mechanism formed by the block 36 and the rods 38 and 39. Downward movement of block 36 will deflect the bearing 40 and the pivot 42 in said bearing. Rods 38 and 39 will both be deflected, rod 38 unseating the valve 45 to permit the oxygen under pressure to enter the chamber 29. The oxygen will then be drawn out of the chamber through outlet 17 into the mask. Upon expiration, the pressure within chamber 29 becomes positive, causing the membrane 28 to lift. Block 36 will thus be moved upwardly partially reseating the valve 45.

Means is now provided to retain block 36 in its normal position when the regulator is not in use.

To this end there is provided a rod 46 slideably received within a boss 47 provided on the exterior surface of body 11, and within a boss 48 provided within the chamber 29. One end of said rod is formed with a longitudinal slot 49 to increase the frictional resistance offered said rod upon its withdrawal from boss 48. The other end of said rod is provided with a transverse opening 50 adapted to register with an opening 51 in boss 47. A cotter pin 52 placed within openings 50 and 51 holds the rod 46 in place. A rip cord 53 is fixed to the rod 46 by a rivet 54.

Fastened to a flattened portion of rod 46 by a screw 55 is a detent 56 slideably mounted on the guide rods 26 and 27. The detent 56 is provided with two cam surfaced shoulders 57 (Figure 2) which fit between the two pair of shoulders 58 and 59 provided on the I-block 36 (Figure 4). When the rod 46 is locked in place by cotter pin 52, the detent 57 will hold the I-block 36 against lateral or transverse movement, holding the valve 45 firmly in seat 41.

Removal of the cotter pin 52 and a firm pull on rip cord 53 will slide rod 46 to the left (Figure 2) to release the detent 56.

The inlet and gauge section 14 of said regulator is provided with a through opening 60 extending inwardly toward the chamber 29, having at its innermost end a reduced bore to form the valve seat 41. Communicating with the opening 60 is a passageway (not shown) to permit the oxygen pressure to actuate the pressure meter 61. The meter will give the oxygen pressure within the oxygen flask (not shown) threaded to said section as at 62; the index mark 63 on the dial of said meter indicating the operational pressure range. As shown in Figure 1, the pointer 64 indicates zero pressure.

Means is provided to connect the regulator 10 and its flask to a source of oxygen under pressure to replenish the oxygen supply of said flask.

To this end there is provided an annular member 65 threaded into member 14, the annulus 66 of said body registering with the inlet opening 60. The member 65 is further provided with an annular shoulder 67 forming two valve seats 68 and 69. Pressed against the valve seat 69, as by spring 70, is a valve 71 adapted to close off the opening 66. A cap 72 is provided for the member 65 threaded thereto and forming a pressure seal for said member by virtue of the valve 73 formed integral therewith on its interior surface. Valve 73 is adapted to abut the seat 68 of said member.

In filling the oxygen flask threaded to the regulator, the cap 72 is unscrewed and an oxygen supply line is screwed onto the member 65 in its place. The pressure of the supply line will unseat the valve 71 against the action of the spring 70. Oxygen will thus be supplied to the flask through openings 66 and 60. Since valve 45 is closed, the pressure registered by the meter 61 will indicate the pressure within the flask.

When the pressure within the flask has been brought up to operational level as indicated by pointer 64 and index 63, the supply line is disconnected. The pressure within the oxygen flask and the spring 70 will close valve 71 to prevent any leakage. The cap 72 is then screwed in place with valve 73 on seat 68 to form a second seal against leakage.

Means is now provided to deflect the membrane 28 to open the valve 45 and to hold the same wide open at high altitudes.

To this end there is affixed to the underside of the vented cover 18, as by screws 75, an aneroid 76 whose top wall 77 is fixed to said cover, and whose bottom wall 78 is movable upon expansion thereof. The bottom wall 78 is provided with a well 79, and a second smaller diameter well 80 within the well 79.

Fixed within the inner well 80 is a light coil compression spring 81, the lower end of which abuts the spring seat 33 fixed to the membrane plate 30. Placed within the outer well and spaced about spring 81 is a second coil compression spring 82, said second spring being stronger than said first spring. The lower end of spring 82 abuts against the plate 30 on the membrane 28. Fixed within aneroid 76 and placed about the well 79, is a coil extension spring 83, one end of which abuts against the top wall 77, the other end against the bottom wall 78. Spring 83 aids in the expansion of the aneroid upon the lowering of the ambient pressure. The aneroid 76 is subjected to the ambient pressure through the vents 19 to cover 18.

In operation, the small spring 81 maintains at all times a small positive pressure on the diaphragm 28 of about one inch of water partially opening the valve. The aneroid 76 will expand upon increase in altitude due to the decrease in ambient pressure. At about 35,000 feet the expansion of the aneroid will increase the pressure of spring 82 on membrane 28 to depress the same. Block 36 will be lowered further to open the valve 45. From 35,000 feet to 50,000 feet the aneroid will continue to expand until the bottom wall 78 of the aneroid abuts against the diaphragm plate 30 (Figure 4). Spring 82, and spring 81, will be completely compressed to exert the greatest pressure on the membrane 28. The working pressure exerted on the membrane builds up from one inch to 12 inches of water. Thus at greater altitudes where oxygen is needed most, the deflection of the membrane 28 by the aneroid will cause the valve 45 to remain wide open. Upon descent, the aneroid will contract partially closing the valve again; expiration of the user partially closing the valve. No suction is required of the user to open the valve, the small pressure exerted by spring 81 will hold the valve partially open.

It will thus be seen that there is provided a pressure breathing regulator in which the several objects of this invention are achieved, and which is well adapted to meet the conditions of practical use.

As various possible embodiments might be made of the above invention, and as various changes

might be made in the embodiment set forth above, it will be understood that all matter herein set forth, or shown in the accompanying drawings is to be interpreted as illustrative, and not in a limiting sense.

Having thus described my invention I claim as new and desire to secure by Letters Patent:

1. Emergency respiratory apparatus for use with a breathing mask and a flask containing a respiratory gas under pressure comprising, a casing, a pressure responsive membrane forming one side of said casing, an inlet for said casing having means for affixing thereto a flask and an outlet for said casing having means for affixing thereto a hoseline connected to a breathing mask; a valve seat formed within said inlet, a toggle mechanism within said casing actuated by said membrane, one end of said mechanism being the valve for said valve seat whereby said inlet is closed and opened upon actuation by said membrane, a detent for said toggle mechanism to hold said inlet closed, a rip-cord for said detent for releasing said toggle mechanism, a pressure responsive member actuated by the ambient pressure coacting with said membrane to open said inlet upon a reduction in ambient pressure. a pressure gauge cooperating with said inlet for indicating the pressure within the flask affixed thereto, a member fixed to said inlet having an annulus registering with said inlet, a check valve within said annulus whereby the gas supply of the affixed flask may be replenished, said check valve preventing pressure leakage through said annulus, and a sealing cap for the last said member to further seal said annulus against leakage.

2. Emergency respiratory apparatus for use with a breathing mask and a flask containing a respiratory gas under pressure comprising, a casing, a pressure responsive membrane forming one side of said casing, an inlet for said casing having means for affixing thereto a flask and an outlet for said casing having means for affixing thereto a hoseline connected to a breathing mask; a valve seat formed within said inlet, a toggle mechanism within said casing actuated by said membrane, one end of said mechanism being the valve for said valve seat whereby said inlet is closed and opened upon actuation by said membrane, a detent for said toggle mechanism to hold said inlet closed, means for moving said detent for releasing said toggle mechanism, a pressure responsive member actuated by the ambient pressure coacting with said membrane to open said inlet upon a reduction in ambient pressure, a member fixed to said inlet having an annulus registering with said inlet, a check valve within said annulus whereby the gas supply of the affixed flask may be replenished, said check valve preventing pressure leakage through said annulus, and a sealing cap for the last said member to further seal said annulus against leakage.

3. Emergency respiratory apparatus for use with a breathing mask and a flask containing a respiratory gas under pressure comprising, a casing, a pressure responsive membrane forming one side of said casing, an inlet for said casing having means for affixing thereto a flask and an outlet for said casing having means for affixing thereto a hoseline connected to a breathing mask; a valve seat formed within said inlet, a toggle mechanism within said casing actuated by said membrane, one end of said mechanism being the valve for said valve seat whereby said inlet is closed and opened upon actuation by said membrane, a pressure responsive member actuated by the ambient pressure coacting with said membrane to open said inlet upon a reduction in ambient pressure, a member fixed to said inlet having an annulus registering with said inlet, and a check valve within said annulus whereby the gas supply of the affixed flask may be replenished, said check valve preventing pressure leakage through said annulus.

4. Emergency respiratory apparatus for use with a breathing mask and a flask containing a respiratory gas under pressure comprising, a casing, a pressure responsive membrane forming one side of said casing, an inlet for said casing having means for affixing thereto a flask and an outlet for said casing having means for affixing thereto a hoseline connected to a breathing mask; a valve in said inlet, means actuated by said membrane for opening and closing said valve, a detent for holding said valve closed, means for releasing said detent to permit opening of said valve, a pressure responsive member actuated by the ambient pressure coacting with said membrane to open said valve upon a reduction in ambient pressure, a member fixed to said inlet having an annulus registering with said inlet, a check valve within said annulus whereby the gas supply of the affixed flask may be replenished, said check valve preventing pressure leakage through said annulus, and a sealing cap for the last said member to further seal said annulus against leakage.

5. Emergency respiratory apparatus for use with a breathing mask and a flask containing a respiratory gas under pressure comprising, a casing, a pressure responsive membrane forming one side of said casing, an inlet for said casing having means for affixing thereto a flask and an outlet for said casing having means for affixing thereto a hoseline connected to a breathing mask; a valve in said inlet, means actuated by said membrane for opening and closing said valve, a pressure responsive member actuated by the ambient pressure coacting with said membrane to open said valve upon a reduction in ambient pressure, a member fixed to said inlet having an annulus comprising a pair of valve seats registering with said inlet, and a check valve within said annulus for one of said seats whereby the gas supply of the affixed flask may be replenished, and a cap containing valve means for the other seat, said check valve and cap preventing pressure leakage through said annulus.

6. Respiratory apparatus comprising, a casing having an inlet and an outlet; a valve in said inlet, a toggle mechanism forming a part of said valve, pressure responsive means to actuate said toggle mechanism for opening and closing said valve, a detent for holding said valve closed, means for releasing said detent to permit opening of said valve, and a pressure responsive member subject to ambient pressure coacting with said pressure responsive means for applying an increasing pressure on said pressure responsive means with a decrease in ambient pressure to increase the opening of said valve.

7. Respiratory apparatus comprising a casing having a membrane mounted therein and actuated by respiratory pressure, and forming a first pressure responsive member, a wall member actuated by ambient pressure defining a second pressure responsive member, resilient means acting between said first and second members to maintain a small positive pressure on said first member, and a second resilient means brought into

action by movement of said wall member past a predetermined position to coact with said first resilient means for increasing the positive pressure on said first member with a decrease in ambient pressure.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,631,262	Gourdou	June 7, 1927
1,848,232	Swope et al.	Mar. 8, 1932
1,926,069	Sutton	Sept. 12, 1933
2,223,570	McMillin	Dec. 3, 1940
2,268,172	Sinnett	Dec. 30, 1941
2,376,348	Fox	May 22, 1945
2,383,649	Heidbrink	Aug. 28, 1945
2,406,888	Meidenbauer	Sept. 3, 1946