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E. P. V. R. GODEL
COMPENSATED ACTION NON-RETURN VALVE, MORE
PARTICULARLY FOR RESPIRATORY MASK

3,228,409

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2 Sheets-Sheet 1

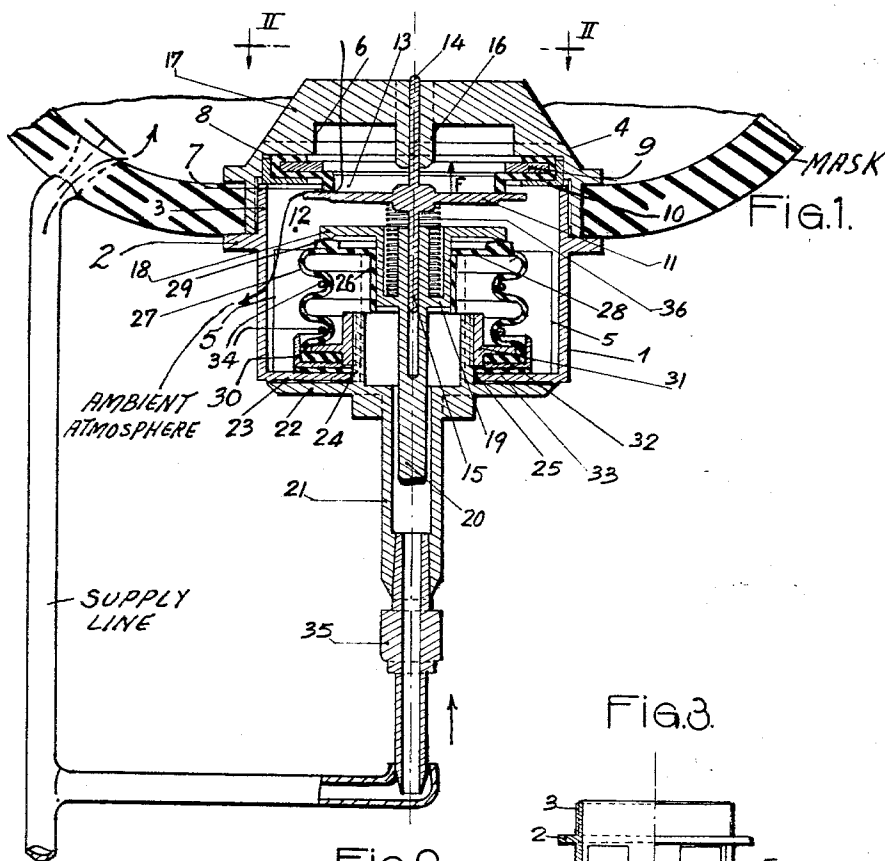
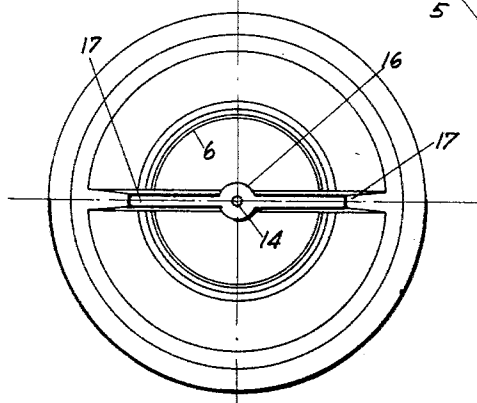
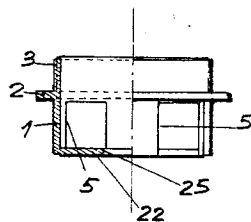


Fig. 2.

Fig. 3.



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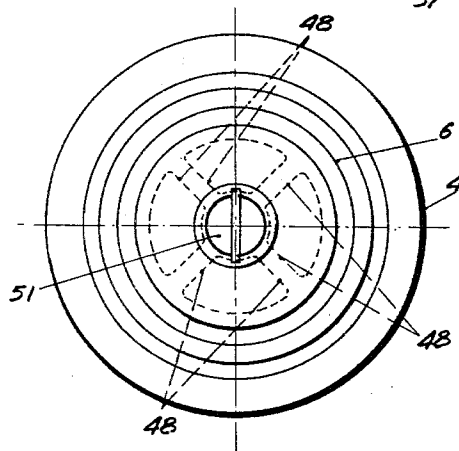
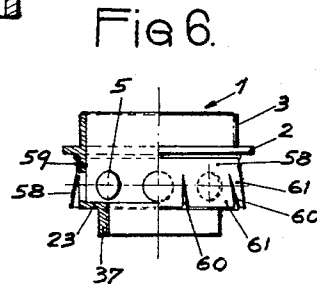
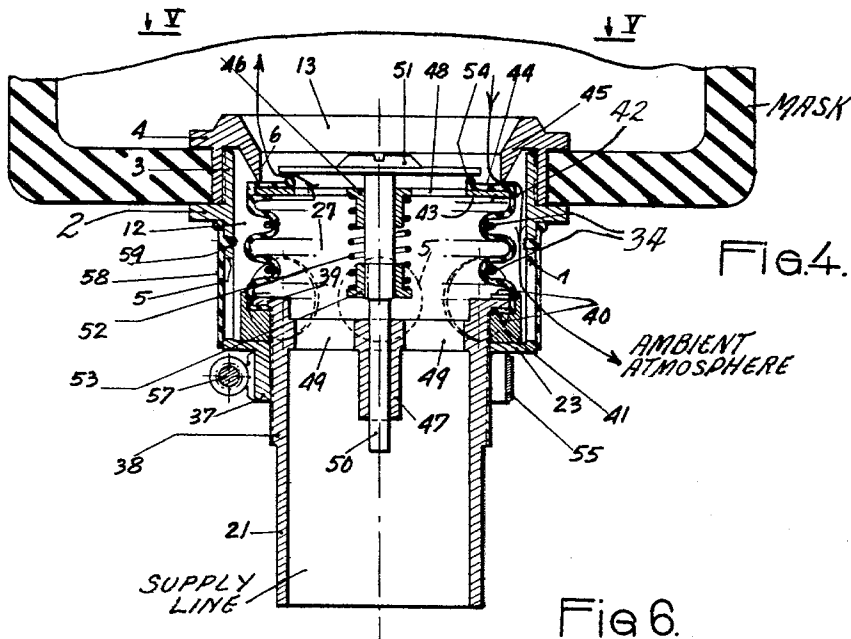
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COMPENSATED ACTION NON-RETURN VALVE, MORE PARTICULARLY FOR RESPIRATORY MASK

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The present invention relates to a compensated action non-return valve, more particularly for equipping respiratory masks.

Masks, applying a non-return valve of the present type, whose simple design leads to the making of an inexpensive article and whose working is dependable, can be used for providing oxygen at over-pressure to aeroplane pilots, in order to neutralize the effect of the rarefaction of the air at high altitudes and may also be used for insufflating certain patients under air or mixed gaseous pressure in order to ensure the ventilating of their lungs. Another application of a non-return compensated valve in accordance with the present invention is for the regulating of a circuit conveying a gaseous fluid.

An important advantage of the invention lies in the fact that the valve can be used without compensation, i.e., for supplying a gaseous mixture at the ambient air pressure and opposing any entry of air that might run the risk of denaturing the latter.

According to the invention, the non-return valve, more particularly for a respiratory mask, comprises a perforated casing, communicating with the exterior and capped by a cover also perforated emerging in the mask, such cover being provided with an annular seating cooperating with a closing plate with which a pneumatic chamber is associated, distortable along the axis of the casing and which is housed in such casing, then fixed by extending a pipe of the latter branched on to a gaseous source for supplying the mask, the plate being, moreover, subjected to the action of a resilient component calibrated so as to tend to close it.

Various other characteristics of the invention will moreover be revealed by the detailed description which follows.

Two forms of embodiment of the object of the invention are shown, by way of non-restrictive examples, in the attached drawings.

FIGURE 1 is a longitudinal section of a first form of embodiment of the valve forming the object of the invention.

FIGURE 2 is a view from above taken along the line II—II of FIGURE 1.

FIGURE 3 is an elevation, partly in section and on a smaller scale, of one of the elements of this first form.

FIGURE 4 is a view similar to FIGURE 1 of a second form of embodiment.

FIGURE 5 is a plane view taken along the line V—V of FIGURE 4.

FIGURE 6 is an elevation, partly in section and on a smaller scale, of the element of this second form corresponding to that shown in FIGURE 3.

FIGURES 1 to 3 show a first form of embodiment of a compensated action non-return valve. This valve comprises a cylindrical casing 1 having an annular collar 2 projecting radially and a threaded cap 3 extending axially beyond the collar 2 for screwing on a cover 4. The casing 1 and cover 4 are perforated so that their internal space respectively communicates with the ambient air as shown and with a respiratory mask or other component on which this unit is fixed adjacent the small collar 2. To this end, the casing 1 delimits lateral windows 5 and the cover 4 is provided with a circular central opening 6.

A seating 7 of flexible material such as synthetic rub-

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ber, is prolonged by an annular lip 8, with a U-shaped profile, surrounding a washer 9 inserted between the cover 4 and a cup 10 bearing on the threaded cap 3 of the casing. This seating, thus maintained, cooperates with a plate 11 for isolating or putting into communication two cavities 12 and 13 emerging, by the means described, in the ambient air and in the mask. The plate 11 is integral with two coaxial guides 14 and 15, the former sliding in a sheath 16, connected to the cover 4 by arms 17 extending across the opening 6, and the latter sliding in a counter-plate 18. The counter-plate 18 has a boss 19 projecting internally therefrom, then a stem 20 penetrating into a pipe 21 integral with a base 22 applied against a bottom 23 of the casing 1. Extending toward the counter-plate 18 from the base 22 is a threaded tubular portion 24 which traverses an orifice 25 in the casing 1.

The boss 19 is surrounded by a sleeve 26 projecting inside a pleated tubular diaphragm 27 one end 28 of which has an annular flange 29 applied under the counter-plate 18. The multiple pleat arrangement of the diaphragm 27 is intended to increase the response for the various working pressures. The other face 30 of the diaphragm 27 is held between a small collar of a nut 31, screwed on to the threaded tubular portion 24, and a cup 32, washers 33 forming spacers being inserted between the bottom 23 and the cup 32.

Rings 34 are placed around the tubular diaphragm 27, in hollows, so as to limit the radial distortion of this diaphragm which may be advantageously made of thin synthetic material or rubber. The pipe 21 is branched, by a connection 35, on to a gaseous source controlled by an independent pressure regulator, this source being essentially intended to supply the respiratory mask through a duct as shown. Hence, the diaphragm 27 forms a pneumatic chamber put under internal pressure equal to the supply pressure. This internal pressure may be a pressure called "compensation" intended to allow respiration at a pressure exceeding the pressure of the ambient air.

Moreover, the fact of the presence of the rings 34, enables the diaphragm to transform the compensation pressure almost entirely into axial thrust.

Furthermore, a calibrated spring 36 is housed in the boss 19, then inserted between the plate 11 and counter-plate 18.

This first embodiment of the anti-return valve operates as follows: during an inspiration of the person wearing the mask, the pressures prevailing in the cavity 13 and in the chamber within the diaphragm 27 are appreciably the same, and approximately equal, allowing for load losses in the circuits, at a supply pressure exceeding the ambient pressure when there is compensation.

The effective section of the face 28 of the diaphragm, on which the compensation pressure provided for is exerted, is greater than the passage section of the seating 7, in which the breathing out pressure of the person must be set up, so that the diaphragm 27 provides at the counter-plate 18 and plate 11, a differential force F tending to press the latter against the seating. During an inspiration, the mask is thus sealed.

When breathing out, the wearer of the mask must reject the gaseous mixture previously breathed in at a pressure slightly greater than the compensation pressure, for he must overcome the force F, by this difference in pressure. The plate 11 is released from its seating 7 freeing an annular passage opening through which the gaseous mixture breathed out escapes through the cavity 13 towards the cavity 12 communicating with the ambient air which is of lower pressure.

When the supply pressure is equal to the ambient pressure, the non-return valve still works properly. Actually, it is the spring 36 which exerts part of the force F on

the plate 11, because the pneumatic chamber within the diaphragm 27 can no longer be distorted, the pressure prevailing there being equal to the ambient pressure. Also, the spring 36 makes it possible to use the valve whatever its position, for the force that it exerts is greater than the weight of the plate 11.

FIGURES 4 to 6 show a second form of embodiment of the non-return valve. It comprises components identical with those already described, and which, on this account, are denoted by the same reference numerals, namely, 1 to 6, 12, 13, 21, 23, 27 and 34. The bottom 23 of the casing 1 is prolonged by a tapped boss 37 into which a threaded part 38 of the pipe 21 is screwed, whose section is enlarged, for, in this embodiment, said pipe forms a duct for supplying the mask with a gaseous mixture, the duct being supplied by an independent regulator connected to the source at the pressure chosen which is normally greater than the ambient pressure.

The threaded part 38 is prolonged by a shoulder 39 penetrating into an annular terminal border 40, of U-shaped section, of the pleated tubular diaphragm 27 forming the compensation chamber. The border 40 is fixed on the shoulder by means of a collar nut 41 screwed on to the pipe 21.

The free end of the diaphragm 27 is integral with another annular border 42, also of U-shaped section, for inserting on a bracing 43 of washer shape. The latter is entirely covered by the upper lip 44 of the border 42 which thus forms a closing plate cooperating with a seating 45 projecting in the cover 4 and at the edge of the divergent orifice 6.

Sleeves 46 and 47 are connected by radiating arms 48 and 49, respectively, to the bracing 43 and pipe 21, respectively, for the coaxial guiding of a shouldered stem 50 which supports a plate inlet valve 51. The latter is subjected to the action of a calibrated resilient component 52 inserted between the flange of the sleeve 46 and a shouldered nut 53 screwed on to a threaded part of the stem 50. This resilient component tends to apply the valve 51 against a seating 54 projecting from the lip 44, for forming the compensation chamber delimited by the diaphragm 27.

When the ambient pressure and intake pressure are balanced, the mask must be always isolated from the exterior while the wearer is breathing in, and hence, the lip 44 remains in contact with the seating 45 of the cover. To this end, the position of the pipe 21 in relation to the casing 1 is initially regulated by screwing or unscrewing, then this pipe is locked by means of a collar 55 surrounding the boss 37 having at least one resilience slot, this collar cooperating with a tightening bolt 57.

To make more certain that the wearer of the mask cannot breathe the ambient air, a non-return valve 58 is associated with the casing 1. This valve is formed by a slip of flexible material surrounding the latter to which it is fixed, at the top, by nipples 59. Slots 60 are made in the slip for freeing shutters 61 closing the windows 5 from the outside, which, in this example, are circular.

This second embodiment of the non-return valve works in the same way as the first one, in that it relates to the compensation of exhalation in the case of a supply to the mask at over-pressure or ambient pressure, for, actually, the valve 51, subjected to the action of the resilient component 52, becomes preponderant at the time of this exhalation, and closes the compensation chamber.

Nevertheless, it is the particularity of being associated with a coaxial supply valve 51 which opens during an inspiration creating a sufficient depression in the cavity for overcoming the action of the resilient component 52, and which closes, during an exhalation whose excess pressure intended to collapse the diaphragm 27 cumulates its ef-

fect on this valve with that of said resilient component.

I claim:

1. An automatically adjusted non-return valve having a delivery end and supplied from a supply line, the improvement comprising an opened and perforated casing for said valve, a perforated cover fixedly connected to said casing on the opening thereof, said perforated cover having its perforation opening at the delivery end of said valve, an annular seating integral with said cover and extending toward the inside of said casing, an axially distortable thin walled bellows connected at its lower portion to said casing at the bottom thereof, a perforated plate connected to said bellows at its upper part and partially overlapped by an upper annular portion of said bellows, said overlapping portion defining an opening in said upper part of said bellows and constituting a flexible lining to cooperate with said annular seating the diameter of which is slightly smaller than the diameter of said perforated plate, a flexible seating extending toward said cover and lying at the inner periphery of said upper overlapping portion of the bellows, means preventing radial deformation of said bellows, a stem flat-valve mounted to bear onto said flexible seating thus closing the upper portion of the bellows, two guiding sleeves respectively carried by said perforated plate and by said casing to guide said stem of said stem flat-valve, an abutting member mounted on said stem, a loaded spring interposed between said abutting member and said perforated plate, said spring being loaded such that it equilibrates substantially the weight of said stem flat-valve so that the flat-valve is urged closed for any position of the casing, and a duct carried by said casing and leading from the supply line to the inside of said bellows so that said overlapping upper portion of the bellows is maintained seated against said annular seating when the pressure in the supply line is greater than the pressure at the delivery end of said valve, the stem flat-valve being then raised to supply said delivery end and said bellows preventing communication between the supply line and the inside of the casing and atmosphere, and said stem flat-valve closing said bellows when the pressure is greater at the delivery end than in the supply line thus causing compression of said bellows and allowing passage from the delivery end to the inside of said casing and through perforations thereof to the atmosphere.

2. An automatically adjusted valve as set forth in claim 1 comprising further means for adjusting the loading of said spring interposed between said perforated plate and abutting member.

3. An automatically adjusted valve as set forth in claim 1 in which said casing is of cylindrical shape, the perforations thereof being provided in its lateral wall and said casing being further provided with a resilient annular non-return valve member fitted at its periphery and overlapping said perforations.

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