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

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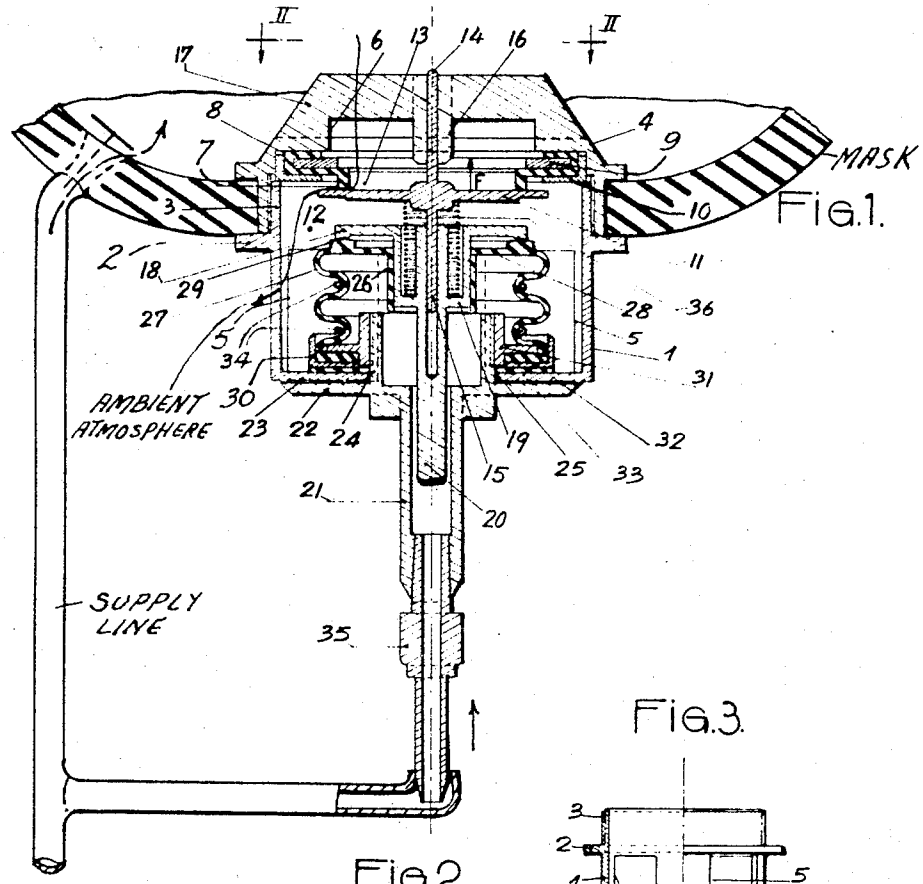


Fig.1.

Fig.2.

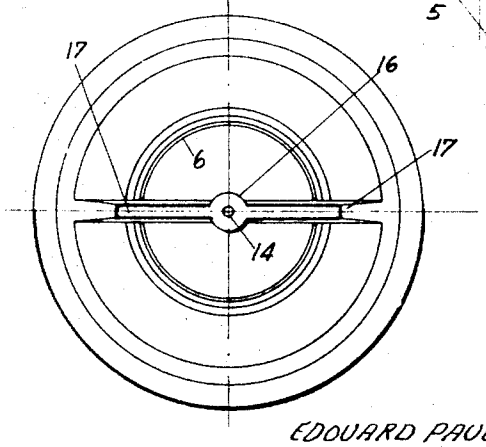
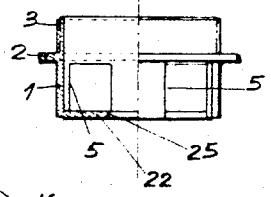


Fig.3.



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COMPENSATED ACTION NONRETURN EXHALATION VALVE, MORE PARTICULARLY FOR RESPIRATORY MASK

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Original application Mar. 19, 1962, Ser. No. 180,741, now Patent No. 3,228,409, dated Jan. 11, 1966. Divided and this application Oct. 11, 1965, Ser. No. 494,709
Int. Cl. A62b 7/02, 23/06
U.S. Cl. 128—142 4 Claims

ABSTRACT OF THE DISCLOSURE

Exhalation valve associated with a respiratory mask comprising a bellows supplied with a gas at a pressure corresponding to the respiratory pressure, a spring placed in series with said bellows at the exterior thereof and a flat valve urged together by said spring and said bellows against a seat to close an opening through which exhaled air escapes to atmosphere.

This application is a division of parent application Ser. No. 180,741, filed Mar. 19, 1962, now Patent 3,228,409.

The present invention relates to an exhalation 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 regulating a circuit conveying a gaseous fluid.

An important advantage of the invention lies in the fact that the valve can be used also 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.

In a known device of that type, a valve has been proposed having a pneumatic distortable chamber, the top portion of which is delimited by an annular distortable fold constituting a diaphragm and surrounding an open casing in which is disposed a spring to urge a plate against a seat, said plate being guided in said cover by an annular flange. In this known structure, the pneumatic chamber also contains a spring urging said diaphragm toward said cover and hence toward said plate and further gas pressure is applied into the pneumatic chamber. It has been observed that the known structure presents drawbacks. Particularly the exhalation pressure must overcome the pressure exerted both by the two springs and the gas pressure in the pneumatic chamber, gas pressure which is at least equal to the pressure in the breath of the user. Further, particularly when the exhalation valve is used in airplane breathing equipments there are important risks of ice formation between the cover and the annular flange guiding the plate urged against the seat. To eliminate in part the above risks, the known valve is generally provided with heating means but such heating means cannot prevent oxidation between said cover and annular flange oxidation due to the fact that the exhausted air is necessarily wet and since the surface in contact of said cover and annular flange is important; such an oxidation may rapidly cause blocking of the flange and plate.

The invention creates a new structure whereby any risk of blocking is eliminated and in which further heating means are also eliminated.

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 axially guided plate with which a pneumatic chamber is connected by a calibrated spring interposed between said plate forming valve and said pneumatic chamber constituted by an axially distortable bellows having means preventing radial distortion, axial guiding of said plate being caused by substantially needle shaped members.

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

An embodiment providing the objects of the invention is shown by way of a non-restrictive in the attached drawings.

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

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

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

The 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 rubber or other plastic material, 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** constituting a flat valve 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 substantially needle shaped 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 plug **18**. The plug **18** has a disc-like shaped upper portion and a boss **19** projecting downwardly and a stem **20** extending in a pipe **21** integral with a base **22** bearing against the bottom **23** of the casing **1**. Extending toward the boss **19** of the plug **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 bellows **27** the upper end **28** of which has an annular flange **29** applied under the disc-like shaped upper portion of the plug **18**. The lower portion **30** of the bellows **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 bellows **27**, in folds thereof, so as to prevent radial distortion of this bellows which may be advantageously made of thin synthetic material or rubber. The pipe **21** is branched, by a connection **35**, on to a gas supply line controlled by an independent pressure regulator (not shown) this supply line being essentially intended to supply the respiratory mask through a duct as shown. Hence, the bellows **27** forms a pneumatic

chamber put under internal pressure equal to the supply line 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 bellows to transform the compensation pressure almost entirely into axial thrust.

Furthermore, a calibrated spring **36** is housed partially in the boss **19**, to be interposed between the plate **11** and the plug **18**, i.e. between the flat valve constituted by said plate and the bellows.

This non-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 bellows **27** are appreciably the same, and approximately equal, at the exception of drop 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 bellows, on which the compensation pressure provided for its 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 bellows **27** provides a differential force F tending to press the flat-valve **11** 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 presusre, for he must overcome the force F, by this difference in pressure. The flat valve **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 at 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 flat valve **11**, because the pneumatic chamber within the bellows **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 flat valve **11**.

Further spring **36** constitutes an emergency member because in case the pressure inside the bellows would accidentally drop it maintains the flat valve **11** against its seat thus preventing the inside of the mask to be put in communication with the atmosphere.

What is claimed is:

1. In an exhalation valve of the character described comprising a casing having apertures for communication with atmosphere, an open cover connected to said casing and defining an aperture therebetween, said cover providing for communication to the inside of a respiratory mask, valve seating means surrounding said aperture between said casing and said cover, a movable flat-valve for closing said aperture between said casing and cover, a distortable diaphragm disposed inside said casing, a gas supply line connected to said diaphragm and to the mask and supplying gas substantially at the same pressure to the inside of said distortable diaphragm and to the inside of said mask, said distortable diaphragm urging said movable flat-valve towards said seating means, and spring means also urging said flat valve towards said seating means, the improvement wherein said diaphragm comprises a bellows, the lower portion thereof being connected to the bottom of said casing with said supply line opening also in said bottom of said casing to communicate with the inside of said bellows, a plug closing said bellows at the upper part therefor, said plug having a central bore extending axially to said bellows, said flat-valve having a substantially needle shaped central guide engaged in said central bore of said plug, said spring being interposed between said plug and said flat-valve to urge said flat-valve towards said seating means, said seating means comprising a lining made of flexible synthetic material, said cover further having a central guide aperture and said flat-valve having a second substantially needle shaped guide extending upwardly and engaged in said cover whereby axial guiding of said bellows and of said flat-valve is ensured by cooperating action of said guides protruding on both sides of said flat-valve.

2. An exhalation valve as set forth in claim **1** in which further said plug closing said bellows has a downwardly extending stem containing said central bore, and said casing has a base having a downwardly extending pipe extension connected to said supply line, said stem being engaged in said pipe extension, said plug closing said bellows being further recessed along its upper surface whereby said spring interposed between said plug and said flat-valve is seated in said recess.

3. An automatically adjusted valve as set forth in claim **1** in which further said bellows has a diameter slightly greater than the diameter of said seating means and in which further rigid rings are inserted in the folds of said bellows whereby radial distortion thereof is prevented.

4. An automatically adjusted valve as set forth in claim **1**, comprising further annular ribs provided on both said casing and said cover and extending laterally therefrom for connection with said mask when said cover is threaded on said casing.

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128—146.4; 137—529