Aug. 22, 1961 J. J. FERGUSON 2,997,050

VALVE

Filed Feb. 10, 1959

Fig. 1

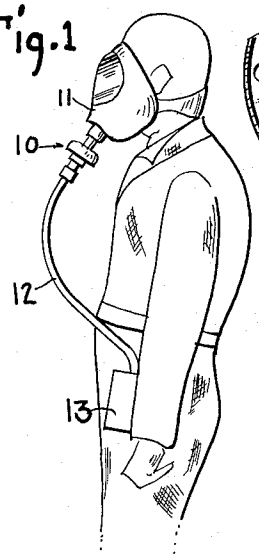


Fig. 5

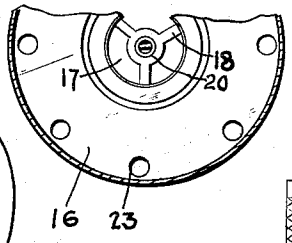
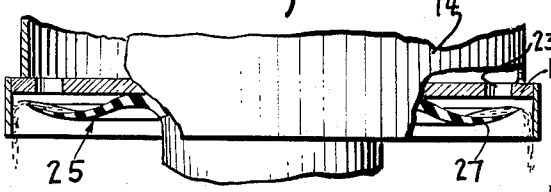


Fig. 2

Fig. 3



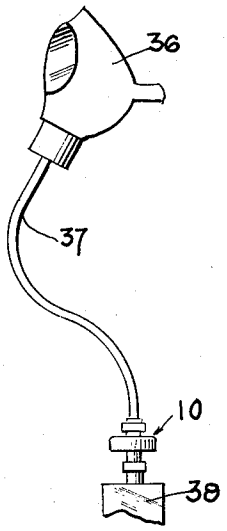


Fig. 4

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VALVE

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This invention relates to breathing apparatus, and particularly to a valve arrangement including check valves therefor.

In breathing apparatus such as a gas mask, it is conventional to connect a face piece by a flexible hose to a chemical cannister unit. Upon inhalation by the wearer, a check valve which may be in the bottom of the cannister opens and permits the inflow of air. Upon exhalation, a check valve which may be proximate to the face piece opens and releases the exhaust breath of the wearer. With such a construction, the hose provides an open passageway to the internal portion of the cannister containing the active chemical elements. Under certain conditions of usage, it is possible for water to enter the face piece and pass down the connecting hose into the cannister. This condition may arise when the wearer has the face piece removed from face but exposed and held in a ready position. Firemen, while attending a fire, may keep the mask removed from their faces in a ready condition before entering the smoke filled interior of a burning building. With such use, it is very probable that water can enter into the connecting hose of the gas mask. The standard chemical elements for the cannister being water soluble are partially or completely destroyed by the entry of the water. Since the water damage may occur rapidly, an individual may apply the mask and be unaware that it is in a defective or unusable condition.

One of the objects of the present invention is to provide an arrangement of check valves which permit the normal use of breathing apparatus while precluding the entry of water into the cannister or other breathing equipment.

A further object of the invention is to provide a means for controlling the air flow of breathing equipment while at the same time permitting the separation of water from the normal air passages.

In one aspect of the invention, the valve device includes a housing having an opening therein. A wall of the housing is provided with primary and secondary openings. A check valve overlies and normally closes the primary opening. In response to negative pressure within the housing, the check valve opens and permits the passage of the air flow into the housing. An additional check valve overlies and normally closes the secondary openings in the wall of the housing. This check valve opens in response to positive pressure within so as to permit gas flow through the housing and out through the secondary openings. In the case where a liquid enters within the housing and comes into contact with the additional check valve, the weight of the liquid effects an opening of the additional check valve sufficiently to permit the liquid to escape through the secondary openings.

These and other objects, advantages and features of the invention will become apparent from the following description and drawings.

In the drawings:

FIG. 1 is a view of a person wearing breathing equipment including the valve device.

FIG. 2 is an elevational sectional view of the valve device.

FIG. 3 is a fragmentary elevational sectional view of the valve device in operation.

FIG. 4 is a view of the valve device installed proximate to a gas mask cannister.

FIG. 5 is a fragmentary sectional view taken along line 5—5 in FIG. 2.

In FIG. 1, valve device 10 is shown connected to gas mask 11 and hose 12 which leads to cannister 13. Upon inhalation by the wearer, air enters the bottom of cannister 13 through an opening (not shown) and passes through valve device 10 into gas mask 11. Upon exhalation, the breath of the wearer escapes to the atmosphere through valve device 10.

Valve device 10 (FIG. 2) may be provided with a cylindrical housing 14 to which is attached threaded boss 15. Plate 16 covers the lower portion of housing 14. The center portion of plate 16 is provided with a valve opening 17 in which is attached spider 18. Poppet valve 19 fabricated from a flexible material such as rubber is secured at its central portion by stud 20 passing through opening 21 in spider 18. Cone 22 attached to stud 20 locks the stud with respect to spider 18. Plate 16 may be provided with a plurality of secondary valve openings 23, proximate to the junction of housing 14 with plate 16. Plate 16 supports tube 24 which surrounds primary valve opening 17. Diaphragm valve 25 comprises a cylindrical portion 26 and a skirt portion 27 which may have a contoured form. Skirt portion 27 with its contoured form extends along plate 16 and the outer edge 28 of diaphragm valve 25 contacts plate 16 near its perimeter. Tube 24 may be provided with serrations 29 so as to enhance the seal between cylindrical portion 26 of diaphragm 25 and tube 24. Ring 30 of resilient material such as rubber serves to clamp diaphragm valve 25 in position with respect to tube 24 and plate 16. The end of tube 24 opposite plate 16 may be provided with a shoulder portion 31 so as to retain coupling nut 32.

Valve device 10 (FIG. 1) may be connected to gas mask 11 and hose 12 which connects to cannister 13. Coupling nut 33 attached to the entrance connection 34 of the breathing apparatus such as gas mask 11 may be threadably attached to threaded boss 15 of valve device 10. Coupling nut 32 may be threadably engaged with fitting 35 of hose 12. In this manner, valve device 10 is connected in series between cannister 13 and gas mask 11. Inhalation by the wearer establishes a negative pressure condition within housing 14 which causes poppet valve 19 to deflect upwardly thereby permitting air flow through hose 12, past poppet valve 19 and upward into gas mask 11. The negative pressure within housing 14 results in a closing force tending to clamp diaphragm valve 25 tightly against plate 16. Upon exhalation by the wearer, a positive pressure condition is established within housing 14 which closes poppet valve 19 tightly against the inner surface of plate 16 while at the same time forcing open diaphragm valve 25. The breath then may be exhausted through secondary openings 23 to the surrounding atmosphere.

In the case where water or other liquids enters the gas mask 11 and passes through entrance connection 34 into housing 14, the water or other liquid will flow to the tube plate 16 and pass through secondary openings 23 thereby contacting diaphragm valve 25. As shown in FIGS. 2 and 3, skirt portion 27 of diaphragm valve 25 is of a thin cross section. The thin cross section is provided with a contoured form which terminates at outer edge 28 in contact with plate 16. Due to the thin section of skirt portion 27, the weight of the water in contact with it is sufficient to deflect the skirt portion 27 sufficiently to part outer edge 28 from contact with plate 16. In his manner, any water or liquid is immediately separated by the action of diaphragm valve 25. Any droplets of water in contact with diaphragm valve 25 or along the outer surface of plate 16 will be effectively discharged when the wearer exhales and his breath is

forced past diaphragm valve **25**. Since, in the normal state, poppet valve **19** tightly covers primary valve opening **17** and with the above described liquid separating action of diaphragm valve **25**, it is evident that water or other liquids cannot pass through valve device **10** and enter hose **12**. Furthermore, due to the normally closed condition of poppet valve **19** and diaphragm valve **25**, there can be no circulation of moisture laden air into hose **12** and thence into cannister **13**. Poppet valve **19** and diaphragm valve **25** are maintained closed by their inherent internal forces due to the resilient properties of their material and their form. Thus, the valves remain in a closed condition regardless of the position of valve device **10**. Of course, it is evident that the liquid separating action will only be self acting when valve device **10** is positioned with housing **14** some way above the horizontal.

In FIG. 4, valve device **10** is shown connected in series with gas mask **36**, hose **37** and cannister **38**. In this case, gas mask **36** and cannister **38** may include the necessary valves required for breathing. Thus, valve device **10** is inserted into this equipment merely to provide the water separating function so as to protect cannister. In such an installation, during breathing, valve device **10** will operate in a manner as previously described. In the case where the valve equipment of gas mask **36** permits the entrance of water or other liquid into hose **37**, valve device **10** will separate these entering liquids and prevent them from passing into cannister **38**. Thus, it is evident that valve device **10** may serve the twofold purposes of breathing check valves and a water separating valve or it may be used as a component with existing breathing valve equipment to provide the water separating feature alone.

It should be apparent that variations may be made in the construction as needed without departing from the spirit of the invention except as defined in the appended claims.

What is claimed is:

1. A valve device comprising housing means having an opening therein, said housing means having a wall member with primary and secondary openings, check valve means within said housing means overlying and normally closing said primary opening, said valve means opening in response to negative pressure within said housing to permit gas flow through said primary opening and said housing opening, and diaphragm check valve means of flexible and resilient material, having a concave peripheral portion facing said wall member and overlying said secondary opening, the peripheral portion being normally in contact with said wall member so as to close said secondary opening, said diaphragm check valve means opening in response to positive pressure within said housing to permit gas flow through said housing opening and said secondary opening, said diaphragm check valve being adapted to open locally under the locally applied force of a predetermined weight of liquid in said concave peripheral portion, whereby said predetermined weight of liquid upon entering said housing means deflects said concave portion of said diaphragm check valve means sufficiently to open said peripheral portion from contact with said wall member and to permit said liquid to escape through said secondary openings.

2. A valve device comprising housing means having an opening therein, said housing having a wall member with primary and secondary openings, poppet valve means of flexible and resilient material normally closing said primary opening, said poppet valve means opening in response to negative pressure within said housing to permit gas flow through said primary opening and said housing opening, and diaphragm check valve means of flexible and resilient material, having a concave peripheral portion facing said wall member and overlying said secondary opening, said diaphragm check valve means opening in response to positive pressure within said housing to permit gas flow through said housing opening and said secondary opening, said diaphragm check valve being adapted to open locally under the locally applied force of a predetermined weight of liquid in said concave peripheral portion, whereby liquids entering said housing means deflect said concave portion of said diaphragm check valve means sufficiently to open said peripheral portion from contact with said wall member and to permit said liquid to escape through said secondary openings.

3. A valve device comprising housing means having an opening therein, said housing means having a wall member with central and peripheral portions having primary and secondary openings, respectively, said central portion being located in a plane further toward the interior of said housing than the plane containing said peripheral portion, check valve means within said housing means overlying and normally closing said primary opening, said valve means opening in response to negative pressure within said housing to permit gas flow through said primary opening and said housing opening, and diaphragm check valve means of flexible and resilient material, having a concave peripheral portion facing said wall member and overlying said secondary opening, the concave peripheral portion being normally in contact with said wall member so as to close said secondary opening, said diaphragm check valve means opening in response to positive pressure within said housing to permit gas flow through said housing opening and said secondary opening, said diaphragm check valve being adapted to open locally under the locally applied force of a predetermined weight of liquid in said concave peripheral portion, whereby liquids entering said housing means and passing beyond the plane of said central portion enters upon and deflects said concave portion of said diaphragm check valve means sufficiently to open said peripheral portion from contact with said wall member to permit said liquid to escape through said secondary openings.

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