United States Patent

Warncke

[15] **3,680,555**

[45] **Aug. 1, 1972**

[54] PROTECTIVE MASK WITH ANNULAR FLUSHING CHAMBER

[72] Inventor: **Ernst Warncke**, Lubeck, Germany

[73] Assignee: **Dragerwerk Aktiengesellschaft**, Lubeck, Germany

[22] Filed: **March 13, 1970**

[21] Appl. No.: **19,308**

[30] **Foreign Application Priority Data**

March 20, 1969 Germany.....P 19 14 224.6

[52] **U.S. Cl.**.....**128/141 R**

[51] **Int. Cl.**.....**A61f 9/06**

[58] **Field of Search**.....128/141, 142–142.3, 128/146–146.7, 142.4, 205, 140, 142.5–142.7, 145, 145.5; 137/525, 525.1, 526, 218

[56] **References Cited**

UNITED STATES PATENTS

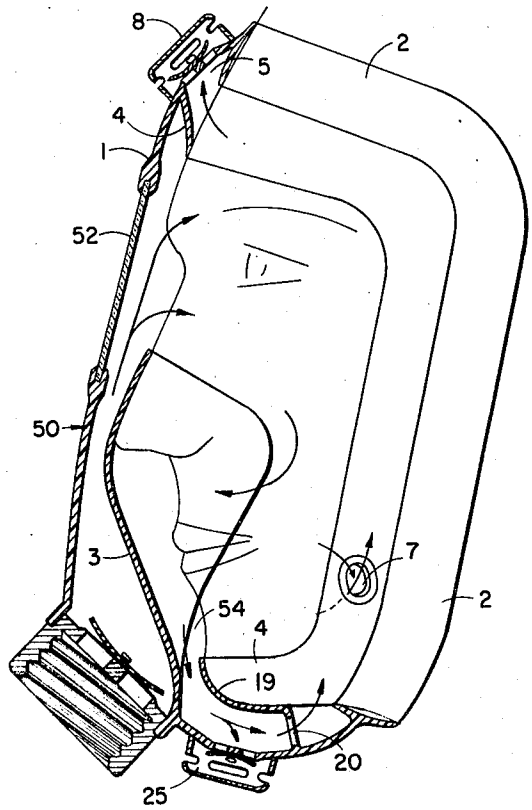
3,207,171	9/1965	Kryman	137/525.3 X
3,527,242	9/1970	Ansite	137/525.3 X
3,343,535	9/1967	Lytle et al.	128/141 R
3,401,719	9/1968	Rosser	137/525 X
3,064,089	11/1962	Ward	128/141 A X
3,011,512	12/1961	Moen	137/218

Primary Examiner—Richard A. Gaudet
Assistant Examiner—J. B. Mitchell
Attorney—McGlew and Toren

[57] **ABSTRACT**

A protective mask includes a double sealing rim or frame which defines a passageway for exhaled air which extends around the periphery of the face of the wearer to a space, for example, defined at the forehead of the wearer having an exhalation valve permitting the controlled discharge thereof. The mask is advantageously of a type which includes an outer mask portion or wall having a viewing window and an inner mask portion or wall which engages above the nose of the wearer and extends downwardly in spaced relationship from the cheeks and mouth of the wearer and defines together with a chin pocket a separate exhalation passageway which communicates with the annular passage defined around the frame of the mask. A space at the bottom of the mask between the two wall portions is provided with an inlet valve for inhaling air which moves between the space defined between the inner and outer mask walls. An exhalation valve may be positioned at the location of an opening between the exhalation space defined by the inner mask wall and the annular space of the frame leading to the discharge opening. The valve may also be located at the discharge opening itself. The exhalation valve includes a very small valve seat and a large effective pressure-sensitive area which is defined by a membrane or diaphragm. The forces which result from the accumulation of water at the valve seat are reduced due to the relatively small size of the valve seat and the opening forces are amplified because the membrane surface and thus the pressure effective surface is relatively large.

3 Claims, 2 Drawing Figures



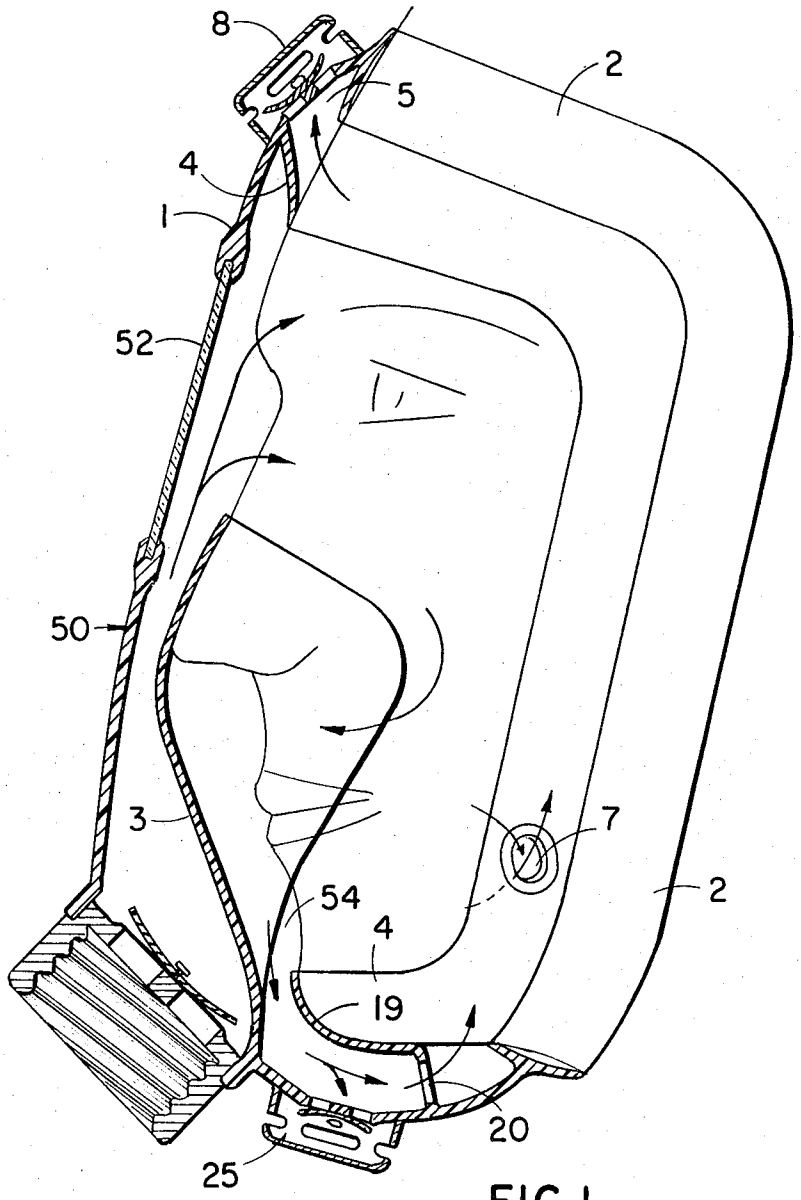


FIG. 1

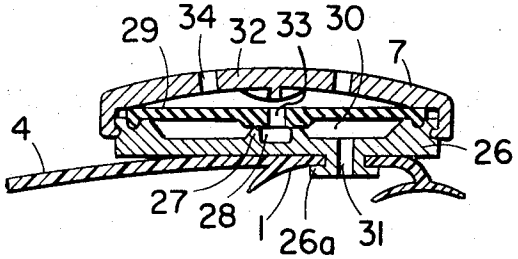


FIG. 2

INVENTOR
Ernst Warncke

by

McGlew & Toren
ATTORNEYS

PROTECTIVE MASK WITH ANNULAR FLUSHING CHAMBER

SUMMARY OF THE INVENTION

This invention relates in general to the construction of protective masks and an exhalation valve usable therewith and in particular to a new and useful mask with an exhalation valve having a relatively small valve seat but a relatively large effective pressure area for operating the valve in accordance with small pressure differences.

The present invention is an improvement over the prior art particularly in respect to the construction of a valve for a protective mask which permits the control of the amount of exhalation air which is discharged from the mask and also, in respect to the particular arrangement of the valve in respect to a mask of double wall configuration. The protective mask advantageously includes a double sealing rim or frame where exhaled air is led through the space between the sealing rims and is discharged outwardly through an exhalation valve. This frame construction insures that any leakage between the sealing rims and the skin surface of the wearer due to the subpressure produced by inhalation only of the exhaled air will be drawn into the interior of the mask only from the space between the sealing rims. The entering of exterior air into the interior of the mask is thus safely prevented. Any environmental air which might enter into the space between the sealing rims will be flushed out with the next breathing. A feature of the inventive construction is the arrangement of a back pressure or nonreturn or check valve in the connecting opening or openings between the interior of the mask and the space defined within the sealing rim of frame and also in respect to the discharge opening of such frame. Such valves act as exhalation valves and the space between the sealing rims serve as outwardly directed antechambers of the exhalation valve.

The present invention is particularly directed to the improved arrangement of a valve located between the exhalation space defined within an inner mask portion and an annular space defined by a rim of the mask or located at the discharge of the annular space to the atmosphere. The valve employed is an improvement over the previous so-called flushing valve inasmuch as it has a small opening resistance which is smaller than the opening resistance of the normal valves provided heretofore. The valve is constructed with a relatively small valve seat which is defined around a blind bore and which is covered by a diaphragm having a connecting opening centered over the bore but which is subject to an opening pressure of an annular space defined around the valve seat and which is of much greater area than the small valve seat portion. The construction has the advantage that a low opening resistance can be produced with a relatively small valve cross section so that even with a small opening resistance a sufficiently small overpressure in the sealing rim space is obtained and even when a relatively small partial flow of exhalation air flows outwardly through this space.

The inventive construction has the further advantage that even with the accumulation of moisture at the valve seat due to condensation from the exhalation air, the danger of increased separation resistance due to moisture is overcome by the specific design of the membrane control or diaphragm for the flushing valve. The diaphragm being arranged over the relatively small size valve seat will safely open even with minor overpressure in the space between the sealing rims.

Accordingly, it is an object of the invention to provide an improved protective mask construction which includes an annular frame portion having a discharge for exhalation air and one or more openings communicating therewith from the interior of the mask and with exhalation valves arranged at the discharge, or selectively in one or more openings between the inner portion of the mask and the annular exhalation space or channel; and which includes a pressure sensitive diaphragm for operating the valve which has a relatively low opening resistance even though the construction includes a relatively small size valve seat.

A further object of the invention is to provide an exhalation valve construction for use with a protective mask which includes a diaphragm having a central portion disposed over a blind bore and with a communicating opening for the flow of air, but includes a pressure-sensitive portion which is exposed to pressure of the exhalation air to be discharged which surrounds the seat and thus provides a relatively large area of effective control for the flow of the exhalation air.

A further object of the invention is to provide a valve construction particularly for a protective mask and to an arrangement and construction of a protective mask which is simple in design, rugged in construction and economical to manufacture.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its uses, reference should be had to the accompanying drawings and descriptive matter in which there is illustrated a preferred embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a partial side elevational and partial sectional view of a mask constructed in accordance with the invention; and

FIG. 2 is an enlarged sectional view of an exhalation valve usable with the mask indicated in FIG. 1 and constructed in accordance with the invention.

GENERAL DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings and in particular the invention embodied therein comprises a protective mask construction generally designated **50** which includes an outer frontal mask portion **1** having a viewing window **52** which becomes aligned in front of the eyes of a wearer and which includes a mask rim or frame **2** which is designed as a so-called swimming sealing frame. The frame **2** is an integral part of the mask and its cross-section is approximately arc-shaped. The outer wall of the mask engages the annular frame portion **2**. An inner sealing rim **4** is located to bear on the face of the person wearing the mask and it defines an annular space or channel **5** with a discharge at the upper part of the mask which is closed by an exhalation valve **8**. The

sealing rim 4 is inwardly directed in order to facilitate the slipping of the face into the mask. The sealing rim 4 is designed to provide a lip sealing between the face and the sealing rim 4 which can be opened in the direction toward the interior space 5.

An inner mask portion 3 seals a space slightly above the nose and around the cheeks and it defines a space 54 in front of the mouth of the wearer and between the inner mask portion 3 and a chin pocket 19. Below the chin pocket 19 there is an opening 20 through which exhalation air is led from the space 54 into the space 5 so that the exhalation air may also be led through an opening of an exhalation valve 7 located in the cheek area of the sealing rim 4. The opening 20 advantageously includes an exhalation valve which is not shown in FIG. 1.

In the embodiment shown, the exhalation air flows into the space 5 from both sides of the face and from the bottom below the chin pocket 19 that is discharged through the exhalation valve 8 which, in the embodiment shown, is arranged above the forehead. The exhalation valve 7 and the exhalation valve 8 as well as a valve in the opening 20 may also be of a design similar to the valve 7 which is described in detail in respect to FIG. 2.

Exhalation valve 25 is arranged at the lower end of the mask as indicated in FIG. 1 and this valve and the valve 8 are adjusted such that in consideration of the resistance of the space 5 only part of the exhalation air is led out through the space 5. Thus a sufficient flushing effect can be obtained and, on the other hand, the exhalation resistance is reduced by the additional provision of the exhalation valve 25. The cross-sectional area for flow through the space 5 can be kept small without incurring an increase of the exhalation resistance. The exhalation valve 8 is designed in the same manner as the valve 7 which is described in detail in respect to FIG. 2 and it comprises a lower portion 26 having a button type projection 26*a* which permits it to be engaged over the wall 1 or the rim portion 4 in accordance with which location it is employed.

The feature of the valve construction of the valve 7 or 8 is that it includes an annular valve seat 27 of a relatively small diameter which is arranged around a blind bore 28. A control membrane, or diaphragm, 29 is stretched over the annular valve seat 27and extends there beyond a considerable distance into an annular groove of the lower portion 26. The lower portion 26 is provided with an annular hollow portion defining an annular space or pressure control area 30 which is directly below the diaphragm 29 and which is connected with exhalation air pressure through a conduit or passage 31. The diaphragm 29 is sealed around its outer edge by the rim of the lower portion 26 and it is provided with a central opening 33 which is centered over the blind bore 28 and within the valve seat 27. In addition, a closure lid which holds the diaphragm 29 in position is provided with openings 34 for the passage of the exhalation air. The construction is such that as soon as a slight overpressure develops in the pressure control space 30, the diaphragm 29 is lifted from the valve seat 27, thereby enabling the exhalation air either to be discharged from the space 30 through the opening 33 and out through the openings 34 in the lid to the atmosphere or directed into the space 5 in accordance with the location of the valve in the mask construction. The valves 7 and 8 are advantageously made in the design of a flushing valve but include a very small valve seat 27 but a relatively large effective pressure surface area. The forces which may result from the accumulation of water at the valve seat are reduced because of the relatively small size of the valve seat. On the other hand the opening forces are amplified because the diaphragm surface or area 30 which is exposed to effective pressure is enlarged. The valve 7 may be accommodated within the opening 20 or the opening 7 as desired. The surface of the diaphragm 29 upon which the control pressure acts in the annular space 30 is larger than the cross-section of the flow-through opening 33.

The main flushing exhalation valve 25 may be designed as a disk or lip valve of known construction.

It can thus be seen that there has been provided according to this invention a protective mask structure having an outer frontal mask portion equipped with a viewing window and also having a rearward frame portion, which portions are adapted to be worn on a wearer's head and having an inlet for air flow carried by said outer mask portion; the combination of at least one control exhalation valve means having a relatively reduced opening resistance, with an inner mask wall portion 3 spaced inwardly from said outer mask portion 50 and shaped to come in contact with the wearer's nose, an inner sealing rim 4 spaced inwardly from said inner mask wall portion and structured to form a support for the wearer's chin, an annular channel 5 having a first part running from the space between said inner mask wall portion 3 and said inner sealing rim 4 and further a second channel part extending from said first channel part and in communication with the latter and said upper part of said frontal mask portion, said exhalation valve means being, respectively, located at least in one of said channel parts, each of said exhalation valve means including a valve base plate 26 provided with an air passageway 31 and with an upturned valve seat 27 centrally located on said valve plate and provided with a central blind bore 28, a control diaphragm 29 provided with an opening 33, said diaphragm being normally stretched over said valve seat and providing an annular space through said valve seat between said diaphragm and said valve base plate, said opening being aligned with said bore and smaller in diameter than that of said bore, and a perforated closure lid structured to catch said valve base plate thereby to anchor said diaphragm on the latter with the valve seat normally in contact with said diaphragm, said lid being shaped to provide space between the inner surface of said lid and the top surface of said diaphragm, so that slight overpressure of exhalation air introduced via said passageway of said valve base plate against said diaphragm displaces the latter to enable the same to discharge exhalation air either from said annular space via said central opening of said diaphragm through said perforated lid 32 or to direct air into the annular channel 5.

While a specific embodiment of the invention has been shown and described in detail to illustrate the application of the principles of the invention, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. A protective mask structure having an outer frontal mask portion equipped with a viewing window and terminating in an upper part and also having a rearward frame portion, which portions are adapted to be worn on a wearer's head and having an inlet for air flow carried by said outer mask portion; the combination of a main flushing exhalation valve and at least one control exhalation valve means having a relatively reduced opening resistance, with an inner mask wall portion spaced inwardly from said outer mask portion and shaped to come in contact with the wearer's nose, an inner sealing rim spaced inwardly from said inner mask wall portion and structured to form a support for the wearer's chin, an annular channel having a first part running from the space between said inner mask wall portion and said inner sealing rim and further a second channel part extending from said first channel part and in communication with the latter and said upper part of said frontal mask portion, said control exhalation valve means being respectively located at least in one of said channel parts, each of said exhalation valve means including a valve base plate provided with an air passageway and with an upturned valve seat centrally located on said valve plate and provided with a central blind bore, a control diaphragm provided with an opening, said diaphragm being normally stretched over said valve seat and providing an annular space through said valve seat between said diaphragm and said valve base plate, said opening being aligned with said bore and smaller in diameter than that of said bore, and a perforated closure lid structured to catch said valve base plate thereby to anchor said diaphragm on the latter with the valve seat normally in contact with said diaphragm, said lid being shaped to provide space between the inner surface of said lid and the top surface of said diaphragm, so that slight overpressure of exhalation air introduced via said passageway of said valve base plate against said diaphragm displaces the latter to enable the same to discharge exhalation air either from said annular space via said central opening of said diaphragm through said perforated lid to the atmosphere into the annular channel.

2. A protective mask according to claim 1, wherein said outer mask portion has an air inlet located adjacent the lower end thereof, said inner mask wall portion being spaced from said outer mask portion and defining an inflow passage extending from the lower end of said outer mask portion upwardly toward said upper part of said frontal mask portion, said inner mask wall portion being adapted to be engaged over the nose and around the cheeks of the wearer and defining an inhalation space, said rearward mask frame portion extending downwardly for communication at the lower end with the first channel part formed by the space between said inner rim and said rearward frame portion.

3. A protective mask according to claim 1, said control valve means being located at the connection of the space defined by said annular frame portion with the space defined by the inner mask wall portion.

* * * * *