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W. A. WHIPPLE

2,174,503

EXHALATION VALVE

Filed June 22, 1937

Fig. 1.

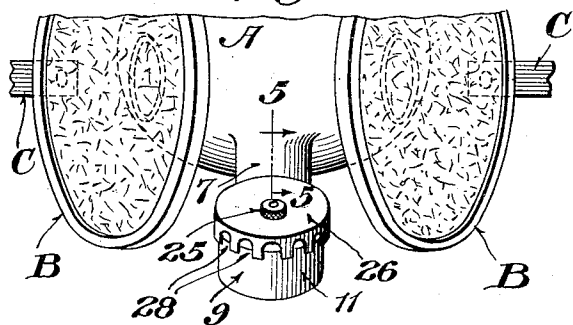


Fig. 2.

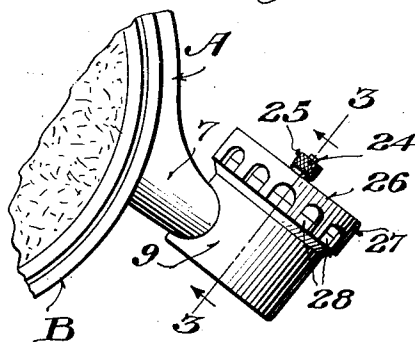


Fig. 3.

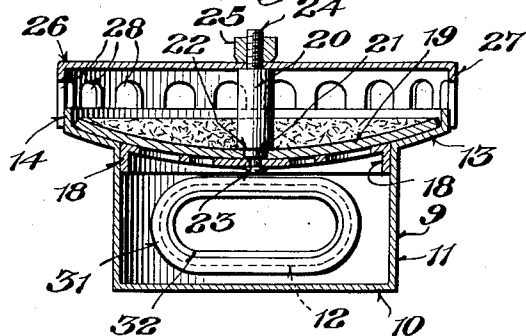


Fig. 4.

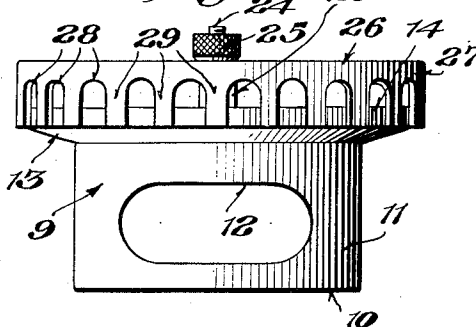


Fig. 5.

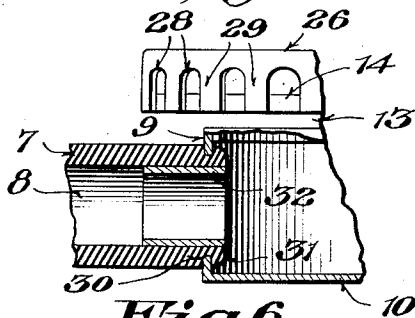


Fig. 7.

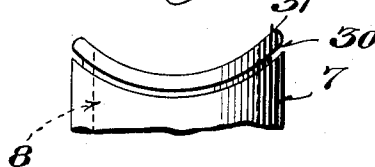


Fig. 8.

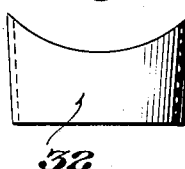
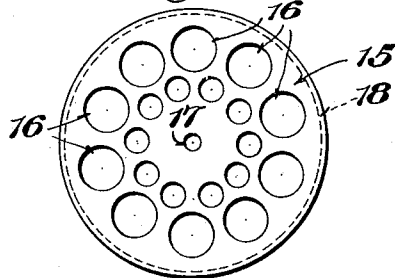


Fig. 6.



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UNITED STATES PATENT OFFICE

2,174,503

EXHALATION VALVE

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4 Claims. (Cl. 251-119)

This invention relates particularly to exhalation-valves, and to their association with facepieces of respirators.

Objects of the invention are to provide a valve structure that offers very little resistance to breathing, that affords a tight seal against entrance of air to the facepiece, that easily may be attached to the facepiece, that may be formed of parts that economically can be produced of comparatively thin and light sheet material and assembled, and that is so arranged that the valve itself readily may be removed and replaced by another.

When considered with the description herein, characteristics of the invention are apparent in the accompanying drawing, forming part hereof, wherein an adaptation is disclosed, for purposes of illustration.

Like reference-characters refer to corresponding parts in the views of the drawing, of which—

Fig. 1 is a fragmentary view of a facepiece of a respirator with the valve structure of the invention associated therewith;

Fig. 2 is a side view of the valve structure attached to a part of the facepiece;

Fig. 3 is a section on the line 3-3, Fig. 2;

Fig. 4 is an elevation of the valve structure;

Fig. 5 is a section on the line 5-5, Fig. 1;

Fig. 6 is a plan view of the diaphragm-plate;

Fig. 7 is a view of the end of the neck;

Fig. 8 is a view of the thimble.

A designates a respirator facepiece, which advantageously may be formed of molded rubber or similar material; B the air-filter devices mounted on the facepiece, through which air is drawn during inhalation by the user, and C a headband attached to the air-filter devices, by which the respirator is held in place during use. These parts may be conventional ones, and they are shown merely as illustrative of the association of the valve structure of this invention with a respirator.

The material of the facepiece is formed at its lower part with a depending protuberance or neck 7, containing an exhalation-port 8.

The valve structure includes a casing 9, containing an exhalation-chamber, having a bottom or end wall 10, and a circular side wall 11, which has a somewhat elongated opening 12.

The side wall 11 extends radially at its top as a rim 13, which is formed at its outer edge with an axially-extending annular flange 14. These parts and the casing-walls may be formed of a single piece of sheet material stamped to shape. The chamber in the casing constitutes a passage from the exhalation-port to the valve.

A perforate diaphragm-plate 15, formed with a plurality of openings 16 for passage of air therethrough and with a center hole 17, is fixed in the open end of the casing by an annular

flange 18, integral with the plate, which, in assembly, is pushed inwardly in contact with the side walls 11 until the outer surface of the plate is flush with that of the rim 13 and there held by friction. The plate is concave on its outer surface, the outer surface of the rim 13 has concave curvature that is an extension of that of the plate, and the plate and rim constitute a base or seat for the valve.

The valve 19 is a circular resilient and flexible diaphragm of sheet rubber or other suitable pliable material. It covers the diaphragm-plate and extends over the joint between the flange thereof and the casing-wall onto the rim 13.

A stud 20 has at one end a smaller shank 21 that extends through the center of the valve and the center hole 17 of the diaphragm-plate. At the juncture of the stud proper and its shank there is a circular abutment or shoulder 22 that bears against the outer surface of the valve at its center, and the shank has a head 23 that holds the stud to the plate and the valve at its center against the plate. The stud has a threaded pin 24 at its other end carrying a thumb-nut 25.

As the valve is held at its center by the stud against the plate, the valve is caused to have concavity conforming throughout to that of the plate and its rim and normally to lie closely to the surface thereof with a tight seal against entrance of air under the suction influence occurring in the inhalation intervals. This is because the valve was initially flat and has a tendency to resume that condition. In the intervals of the user's exhalations, the valve easily is raised from the plate, with little breathing resistance and air is permitted to exit through the openings thereof. The fact that the valve is of greater diameter than the perforate diaphragm base and extends therebeyond onto the continuing base surface of the rim contributes to its efficiency in preventing back entrance of unfiltered air into the facepiece.

Association of the valve with the plate in the permanent manner described is of advantage over screwed-in or other easily removable fastening means, because there is no danger of its becoming loosened and permitting the valve to lift and leak at undesired times.

A vented cover 26, to protect the valve from damage, has a flange 27 that fits over the flange 14. The cover may be vented by having openings 28 in its flange positioned beyond the flange 14 when the cover is in place to permit exit of exhaled air. These openings 28 may be provided by cutting the cover-flange inwardly from its free edge, whereby fingers 29 are produced that clasp the flange 14. The cover has a hole in its center through which the pin 24 is dis-

posable, and it is held in place by the thumb-nut 25.

Although the flange of the diaphragm-plate ordinarily fits against the casing-wall sufficiently close to prevent leakage of air at that joint while the user is inhaling, such leakage, if it would occur, is prevented by the valve, which extends across the joint into the rim 13. Because of this, it is necessary to have a fit of the diaphragm-flange with the casing-wall that is only enough for frictional retention of the diaphragm-plate in place, and this permits comparatively easy withdrawal of that plate and the valve thereon by pulling on the stud. Moreover, it thus is unnecessary so precisely to form the parts that leakage between the flange and the wall cannot occur in normal use of the device, and, therefore, production expense is lessened.

The neck 7 of the facepiece on which the valve structure is mounted is formed at its free end to conform to the shape of the opening 12 in the wall of the casing, with a groove 30 therearound, and with a terminal laterally-extending integral shoulder 31 therearound, as seen more particularly in Figs. 5 and 7.

The end of the neck extends into the opening, the shoulder 31 abuts the inside of the casing-wall, and the edge of the wall around the opening seats in the groove, whereby the casing is held on the neck.

As the neck is of rubber or other suitable pliable material, it preferably is slightly larger in the groove than the opening in the casing-wall. The pliability of the material of the neck, of course, permits the shoulder 31 to be squeezed through the opening and the edge thereof to seat in the groove. Such connection keeps the exhalation-port in communication with the passage to the valve.

In order to prevent the shoulder 31 from being pulled through the opening 12, and also to insure a tight seal, and to keep the neck from dissociation from the valve structure, a tapered thimble 32, corresponding in shape to the opening 12 and the inside of the neck, and slightly larger than the latter at its larger end, is pushed into the neck. This expands the neck against the edge of the opening seated in the groove 30 and insures a tight seal at this place against entrance of air to the facepiece during inhalation by the user of the respirator.

As already explained, the casing of the valve structure easily and economically can be produced in quantity by stamping from a single piece of sheet material. This, too, is true as to the diaphragm-plate, cover, and thimble, and the stud may be cheaply produced from commercial elongated stock.

The valve structure easily may be associated with a facepiece. Before the diaphragm-plate and valve thereon, and the cover, are assembled with the casing, the end of the neck 7 is squeezed into the opening of the casing until its shoulder 31 is inside thereof. Then the thimble 32 is shoved from inside of the casing into the neck, the neck thus expanded against the edge of the opening, and a tight seal produced.

As the casing is open at this time, a finger or thumb may be inserted into it to assist insertion of the neck and the lapping disposition of the shoulder thereof against the casing-wall, and to shove the thimble into place. Then the dia-

phragm-plate, which carries the valve, is shoved into place with its flange in frictional contact with the casing-wall, and the cover put on and held by the thumb-nut.

After the cover is removed, the diaphragm-plate may be pulled from the casing by grasping the stud 20. Accordingly, when it is necessary to install a new valve because the one that has been in use no longer functions properly, all that is necessary is to remove the cover, withdraw the old plate with the valve thereon, push in a new one, and restore the cover.

What I claim as new, and desire to secure by Letters Patent, is:

1. A respirator valve structure comprising a casing having an opening to receive air from the respirator and having also a circular wall, a laterally-extending circular rim on an end of said wall, a circular perforate diaphragm normally flush with said rim having an annular flange at its periphery extending into said wall and in removable frictional contact therewith, and a flexible valve on and attached to said diaphragm, covering the perforations of the latter, and extending across the joint between said rim and diaphragm.

2. As a ready-for-use article of manufacture, a valve structure for respirators adapted for association with a facepiece and comprising a thin metal box-like casing having a circular side wall formed with an opening for communication with a facepiece air passage, the chamber in said side wall being closed at one end by an end wall, and an outwardly flaring rim at the other end of said side wall, a thin circular perforate diaphragm flush with said rim having an annular flange at its periphery extending into said circular side wall and in removable frictional contact therewith, and a flexible valve on and attached to said diaphragm, covering the perforations of the latter, and extending across the joint between said rim and diaphragm.

3. A respirator valve structure comprising a casing having an opening to receive air from the respirator and having also a circular wall, a laterally extending circular rim on an end of said wall, a circular perforate diaphragm plate normally flush with said rim having an integral annular flange at its periphery extending into said casing in removable frictional holding contact with said circular wall, and a flexible valve on and attached to said plate, covering perforations of the latter and extending across the joint between said rim and diaphragm.

4. As a ready-for-use article of manufacture, a valve structure for respirators adapted for association with a facepiece and comprising a thin-metal box-like casing having a circular side wall formed with an opening for communication with a facepiece air passage, the chamber in said side wall being closed at one end by a wall, and an outwardly flaring rim at the other end of said side wall, a thin circular perforate diaphragm plate flush with said rim having an integral annular flange at its periphery extending into said casing and in removable frictional holding contact with said circular wall, and a flexible valve on and attached to said plate, covering the perforations of the latter, and extending across the joint between said rim and diaphragm.

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