

March 21, 1944.

M. E. BARKER ET AL

2,344,669

DUST RESPIRATOR

Filed May 12, 1942

3 Sheets-Sheet 1

FIG. 1

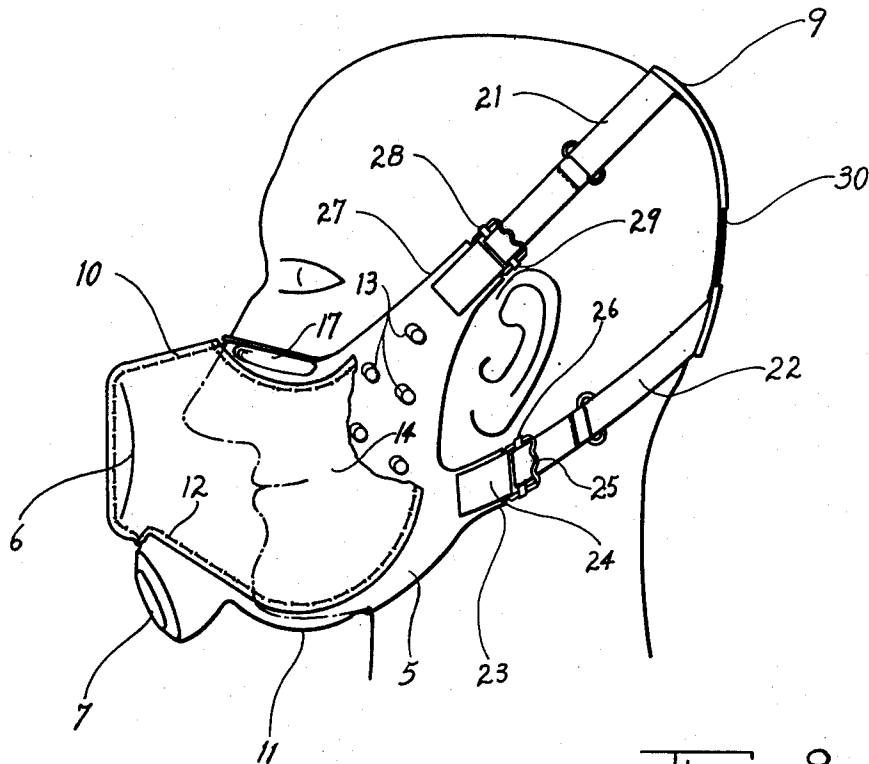


FIG. 8

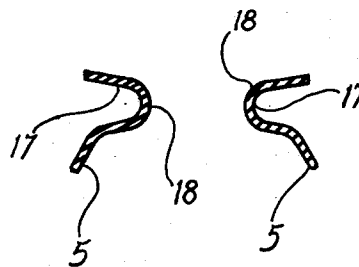
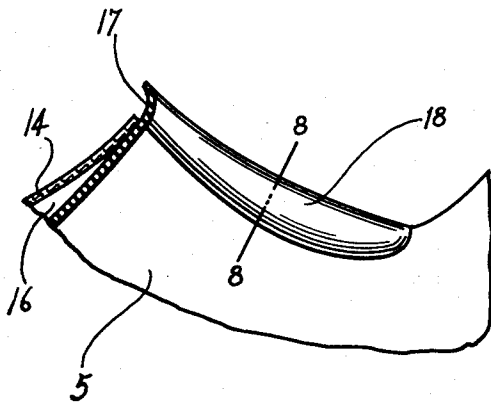


FIG. 4

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FIG. 2

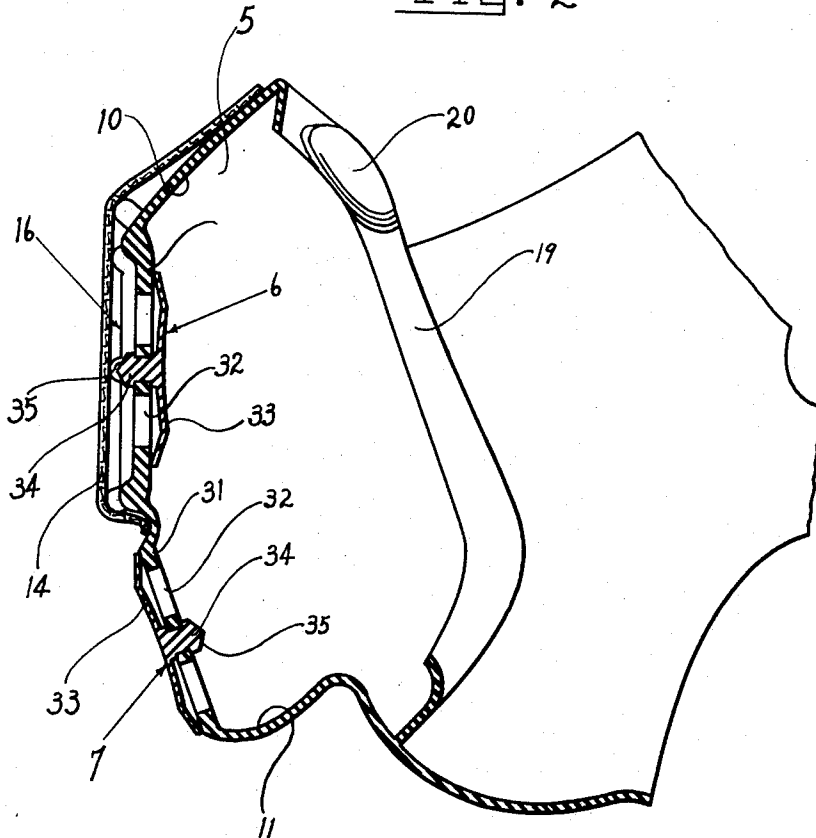


FIG. 5

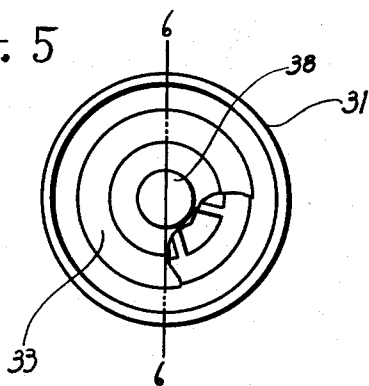
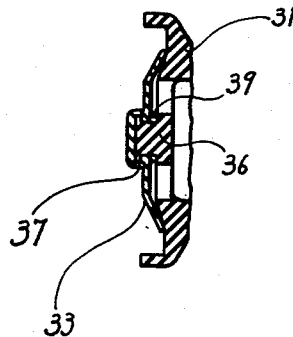


FIG. 6



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3 Sheets-Sheet 3

FIG. 3

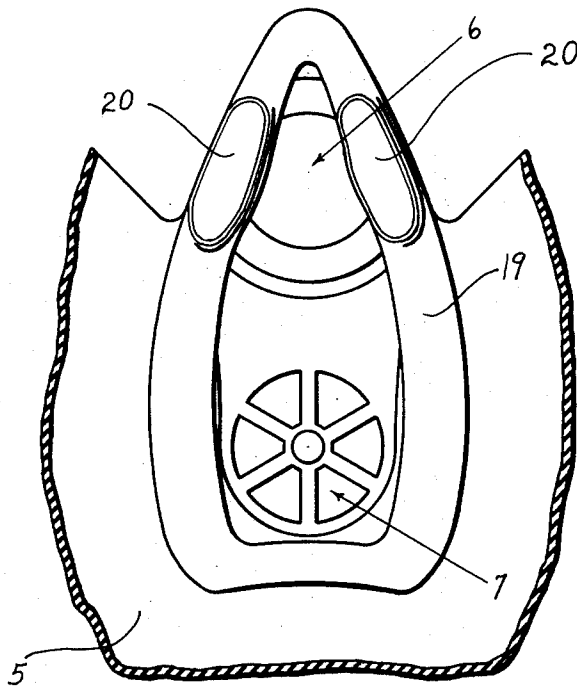
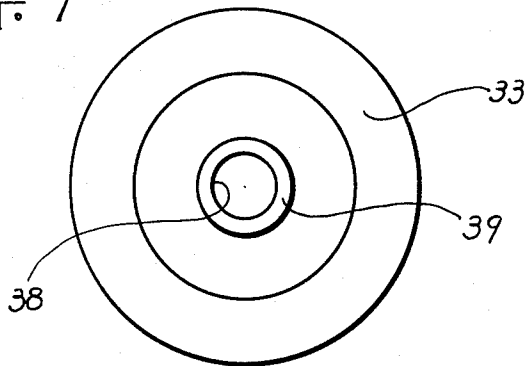


FIG. 7



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UNITED STATES PATENT OFFICE

2,344,669

DUST RESPIRATOR

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Application May 12, 1942, Serial No. 442,616

3 Claims. (Cl. 128—146)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to us of any royalty thereon.

This invention relates to respirators used to promote healthful breathing in dust-laden or smoke-charged atmospheres.

Various types of respirators for protection against dust, fumes, and injurious gases have been proposed or used, but all of them have been found objectionable for any one or more of a variety of reasons. In general, high breathing resistance, either initially or in the course of time; weightiness, causing tiring of the facial muscles of the user; lack of a consistent air-excluding seal between the wearer's face and the face-engaging surface of the facepiece; cumbersomeness, tending to destroy normal vision and interfere with the wearing of glasses or protective goggles, and otherwise presenting obstacles to the user in the efficient performance of his work; a too limited filtering area; and either a total lack of, or inefficient provision for protecting the filter against moisture of respiration, are some of the major drawbacks militating against the various types of prior respirators.

It is, therefore, the broad aim of this invention to provide a respirator for the purpose indicated that will, to a material degree, meet all of the exacting requirements of a respirator that would be free of those objections noted in the preceding paragraph against the various types of respirator heretofore available.

A specific object of the invention is to improve upon the several parts of the respirator in such a manner that they combine to present an efficient respirator characterized by its ability to retain low breathing resistance over an extended period of use, notwithstanding the presentation of a filtration area materially larger than heretofore employed, and a constant air-excluding seal with the wearer's face that is not broken by disturbance of the facial muscles incidental to, for example, an effort to speak on the part of the wearer.

A feature of the invention is the provision of a filter having an area substantially slightly less than the area of the facepiece and co-acting with the latter to provide an air chamber of maximum area within a limited space.

Another feature of the invention resides in the location of the inhalation valve, the exhalation valve, and the filter element with respect to one another whereby adequate provision is made for protecting the filter against moisture of respiration thereby assuring against substantial increase

in the initial low breathing resistance of the respirator with use.

Still another feature of the invention is the provision of a face-engaging surface for the facepiece that is readily conformable to the facial contour of the wearer so that an air-excluding seal is maintained between the wearer's face and the face-engaging surface regardless of the action of the facial muscles, and thus the influx of noxious gases or dust-carrying air is prevented while, for example, the wearer is in the act of speaking.

Yet another feature of the invention is the provision of a valve characterized by simplicity of construction, durability, reliability in use either as an inhalation or an exhalation valve, and which, at the same time, is capable of quantity production.

The above and other features of the invention, combining to make a respirator having all of the qualities above enumerated as desirable in a respirator of this general character will be better understood and appreciated from a study of the following description made in connection with the accompanying drawings, wherein:

Figure 1 is a perspective view of one form of respirator embodying the features of the invention, and with certain parts broken away.

Figure 2 is a vertical section through an alternate form of respirator.

Figure 3 is an elevational view from the rear of the respirator shown in Figure 2, certain parts being shown in section.

Figure 4 is a fragmentary vertical section through the respirator shown in Figure 1.

Figure 5 is a top plan view of a valve forming part of the invention with part of the closing disc broken away.

Figure 6 is a transverse section through the valve, taken substantially on line 6—6 of Figure 5.

Figure 7 is a plan view of the valve disc from the seating side or face thereof.

Figure 8 is a detail sectional view taken substantially on line 8—8 of Figure 4.

Essentially the respirator comprises a facepiece 5, equipped with an inhalation valve 6 and an exhalation valve 7, a filter element 14 secured to the facepiece, and a head harness 9 for securing the respirator in position on the wearer.

In each of the illustrated forms of the invention the facepiece 5 is adapted to cover the mouth and nostrils. Advantageously, it is made of flexible material, preferably soft rubber or other material readily moldable to shape, and conformable to the facial contour of the wearer. It is sufficiently firm to retain its general shape and to hold parts

secured to it, and has a nose covering portion 10 conforming substantially to the contour of the lower portion of the wearer's nose; and a mouth and chin covering portion 11 conforming substantially to the shape of the mouth and chin, as shown in Figures 2 and 4.

The nose covering portion 10 is provided with the inhalation valve 6 that opens inwardly of the part 10, and the mouth covering portion of the facepiece has incorporated therewith the exhalation valve 7, opening outwardly with respect to the mouth and chin covering portion 11.

The filtering element 14 is suitably made of cloth of low breathing resistance and high filtering capacity. Felt will be found most advantageous, and particularly if wool felt of the type commercially used for filters is employed. The sheet from which filter 14 is formed is cut, shaped and dimensioned to provide for the filter a laterally reduced intermediate portion that is disposed over the valve equipped nose cover part 10 of the facepiece, and enlarged end portions that cover opposite sides of the facepiece for considerable areas thereof. Stitching 12, as shown, or other suitable means may be resorted to for securing the filter at its marginal edges to the facepiece. Also, the filter 14 may be formed of two identical sections stitched together at the transverse center of the filter as shown, or alternately, embody but a single continuous piece of material.

The thickness and weight of the cloth from which the filter 14 is fabricated will, of course, be such as will permit the filter to respond to any tendency to flex under the action of the breathing cycle. Suitable spacing between the filter 14 and the adjacent surface of the facepiece is maintained under all conditions by protuberances, teats, or undulations 13 provided on the outer surface of the facepiece 5 in any suitable manner, preferably by being integral therewith. Consequently, more efficient filtering action and easier inhalation than heretofore are made available.

The spacing of the filter as above noted, and the extent or area of the same are also important in that a relatively large air chamber 16 is formed and communicates with the interior of the respirator through the inhalation valve 6. As a consequence, air of inhalation does not merely pass directly through the filter 14 and valve 6 but may circulate after passing through the filter within the air chamber 16 prior to passage through the inhalation valve. Thus for its entire area, the filter is effective to filter and purify the air, and the chamber 16 serves as a storage for the purified air, so that this increased filtration, as contemplated by the invention, is made available without increasing the breathing effort of the wearer.

Preferably, and as shown, the valves 6 and 7 are disposed centrally of the facepiece 5 and filter 14 and thus are out of the line of vision of the wearer, and give good balance to the respirator. In addition the exhalation valve 7 is so removed from filter 14 that the latter will not be affected by the moisture contained in the exhaled air. This is advantageous because such moistening of the filter would be bound to cause a decrease in efficiency and an increase in breathing resistance.

As set out in the statement of invention, a salient feature thereof resides in the provision of means for making an unusually effective seal to the face to prevent inward passage of noxious

or unfiltered air. To be totally effective for the indicated purpose, there must be a perfect fit with the nose. To obtain such a fit and yet not interfere with the normal action of the nostrils has been a problem which this invention has solved to substantially complete satisfaction. One means for accomplishing this is shown in the embodiment of Figures 1 and 2, while an alternate means to the same end is illustrated in that embodiment of the invention shown in Figures 3 and 4.

A perfect fit of the facepiece to the nose with a consequent constant seal between the facepiece and nose is obtained by indenting the facepiece adjacent the upper edge and at opposite sides of the center of the facepiece as at 17, 17 to provide thereat inward, opposed, resilient projections 18, 18, and of a shape substantially conforming to the hollows on each side of the wearer's nose, as illustrated in Figures 1 and 4. The flexibility of the projections 18, 18, enable them to readily conform to the shape of the nose at the hollows thereof, while the inherent tendency of the elastic projections to expand assures constant contact of the projections 18, 18 for the full lengths of the convex edges thereof laterally with the nose at the hollows thereof. Thus these projections form nose-engaging surfaces by reason of which a constant air-excluding seal is maintained between the wearer's nose and such nose-engaging surfaces without undue pressure on the nose or cause for irritation to the wearer.

Figures 2 and 3 illustrate an alternate construction whereby not only is an effective air-excluding seal between the wearer's nose and the nose-engaging surfaces having all the advantages of the seal of Figures 1 and 4 effected but also an air-excluding seal between the wearer's face and the face-engaging surface of the facepiece is obtained with results not heretofore attained. In this alternate construction facepiece 5 at the back of the nose and mouth and chin covering portions 10 and 11 respectively, is constructed with an integral continuous internal bead 19. The bead 19 is adapted for air-excluding contact with the nose, face and chin of the wearer, and is formed to substantially conform to the hollows on each side of the wearer's nose, to the chin, and to the facial contour of the wearer.

Bead 19 is in the form of a thin flexible strip of the same material as the facepiece 5, and extends inward and at an acute angle to the wall of the facepiece as shown so as to present a surface that comfortably and intimately impinges the skin of the wearer whereby an air-tight seal is advantageously effected and maintained between the bead and the face when the respirator is used. The skin-contacting surface of the bead conforms to the contours of the cheeks, the hollow of the chin, and the hollows on each side of the wearer's nose; the bead being provided with indentations presenting on the skin-contacting surface thereof raised portions or projections 20, 20 corresponding to the before-described projections 18, 18 and, like the last named projections, adapted to substantially fit within the lateral hollows of the nose. Thus through the medium of this flexible and resilient bead 19, a comfortable, non-irritating seal against the influx of noxious gases, dust-laden or other kinds of unfiltered air around the nose and face of the wearer is provided, so that only filtered air will be breathed by the wearer.

The pre-shaping of the skin-contacting surface of the bead to complement the mentioned

parts of the face, and the provision of the bead itself are major contributions to the art especially insofar as the factor of chance is involved with respect to obtaining and consistently maintaining an effective air-excluding seal between the respirator and the skin of the wearer. In this connection it will be understood that the pre-shaping of the bead will not adversely affect the ability thereof to readily adapt itself to various facial contours and compensate for any irregularities in the features of the wearer. Prior art respirators, it will be found, depend entirely upon elasticity or the compression of the material of the facepiece to adapt the skin-contacting surfaces thereof to various facial contours and hence do not provide an efficient seal as is obtained by this invention characterized as it is by elastic formations, (projections 18, 18 in the in the embodiment of Figures 1 and 4, and the bead 19 as an entirety in the embodiment of Figures 2 and 3) which are free to act independently of that part of the material forming the facepiece proper in following the contours of the face to maintain constant contact therewith to the full extent of such formations. In other words, the construction and arrangement contemplated by this invention, there is much less likelihood of spacing occurring between the skin-contacting surface of the facepiece and the skin of the wearer at any point, thus breaking the desired seal, than is the case with any known prior respirator.

The effectiveness of the seal obtained by this invention is further enhanced by the particular type of head harness 9 forming part of the invention. In the illustrated embodiment, harness 9 embodies upper and lower head straps 21, 22, that are preferably of some elastic material. At its respective opposite sides facepiece 5 is provided with rearwardly directed ears 23 to which are secured in any suitable manner, and as indicated at 24, buckles 25 equipped with means 26 for securing the strap 22 at the desired adjustment, the ends of the strap 22 being trained through the buckles and associated adjusting means as illustrated. Upper strap 21 is similarly connected to the facepiece 5; the facepiece 5 being provided with rearwardly and upwardly directed ears 27 to which are secured buckles 28 having means 29 for securing strap 21 at the desired adjustment. The end portions of the strap 21 are trained through the buckles 28 and associated strap-adjustment means 29.

Intermediate their respective opposite ends the head straps are secured to the respective opposite ends of a spacer strip 30 of some suitable ductile material which, if desired, is covered with elastic fabric or the like. Spacer strip 30 serves to hold the straps separated and against entanglement thereby facilitating adjustment of the respirator to the wearer.

It will be noted in connection with the harness that the angular relation between the ears 23 and 27 is about 45°, and such has been found most advantageous as the consequent pull of the straps is in direct opposition to the tendency of the valve-equipped portions of the facepiece to exert a downwardly acting strain thereon. Thus with this head harness good balance is given to the respirator, a snug fit of the facepiece to the wearer is maintained with a consequent preservation of the effective air-excluding seal characterizing this invention, and maximum comfort is afforded the wearer.

Each of the valves used is characterized by a seat 31 of spider-like construction presenting apertures or ports 32, and a flexible valve disc 33 adapted to engage seat 31 for closing ports 32.

In each of valves 6, 7, the hub of seat 31 is provided with an opening through which a centrally positioned button 34 of resilient material and formed integrally with the valve disc is passed to secure the disc on its seat. Button 34 is provided with an enlarged head 35 that centrally engages the valve seat in a manner to exert an elastic tension at the center of the disc sufficient to permit the disc to respond to the slightest variations in pressure or suction.

In the form of valve shown in Figures 5 to 7 the seat 31 is provided at the center thereof with a preferably integral rigid button 36 having an enlarged head 37. The disc 33 of the valve of Figures 5 to 7 is formed at the center thereof to complement button 36 to form a leakproof seal therebetween. To that end disc 33 of Figures 5 to 7 at the substantially convex side thereof has formed integrally therewith a centrally positioned, raised, hollow formation presenting a socket 38 that contractingly fits the head 37 of button 36. At the opposite or substantially concave or seating side thereof, the disc is provided with an integral elastic flange 39 that rims the entrance opening of the socket 38 and is contractable about the shank of the button and compressibly received between the head 37 of the button and the central portion of the valve disc to cause an exertion of tension on the disc at the center thereof. Accordingly disc 33 in this form of valve functions in the same manner as do the discs of the respective valves 6, 7, with the added advantages of affording a more effective leakproof seal in the region of positive connection between the valve disc and its seat.

The flutter valves, herein illustrated and described, operate substantially on the usual principle. When the respirator is in use air is drawn into the facepiece through the filter 14, passing between the filter and facepiece and circulating within the air space or chamber 16 and then through valve 6, being thus delivered to the wearer for breathing in a purified, clean state, free of smoke, dust particles, and the like. Valve 7 remains closed during inhalation, but upon exhalation valve 6 is closed and the valve 7 opens to allow the escape of exhaled air. The valve construction of Figures 5 to 7 inclusive may be employed optionally either as an intake or inhalation valve, or as an exhaust or exhalation valve, or both.

Again referring to the various illustrated and described valve structures, it will be noted that preferably the valve seat is formed integrally with the facepiece, but may be secured thereto and associated therewith in any other desirable or advantageous manner. Hence the showing herein is purely illustrative and is not to be deemed restrictive.

The shape of the facepiece is such, as is believed to be obvious, as to permit the wearer to use spectacles, goggles or other vision-assisting or protecting mediums without interference on the part of the respirator, and also to enable the wearer to have desired vision in substantially all directions without discomfort to the wearer or adverse effect on the efficiency of the respirator. Likewise, by having the filter element 14 of an edge contour conforming substantially to the

shape of the facepiece, the former is conveniently and advantageously of an area slightly less than the overall area of the facepiece to cover a material portion thereof and thereby present a maximum filtering area of minimum thickness. At the same time, the filter in nowise interferes with the effective operation of the inhalation valve which it overlies, and is so removed with respect to the exhalation valve as to be out of the zone of expired air and consequently is not exposed to the moistening effect of such air and hence will not add to the weight of the respirator or increase in breathing resistance in the course of time.

It will also be observed that in addition to the above enumerated advantages, the respirator has good balance, and secures the supply of filtered air to the wearer to the exclusion of noxious smoke or dust-laden air without irritation or discomfort. This latter advantage is secured by reason of the improved skin-contacting surface of the facepiece and the cooperative effect of the novel head harness therewith, all in the manner hereinbefore set forth in the detailed description of construction and function.

Having thus described the invention what is claimed is:

1. A rubber facepiece for respirators adapted to have a sheet of filtering material secured in confronting relation thereto and provided with surface protuberances moldably formed thereon within the area thereof to be presented to the filtering material for spacing the latter from the facepiece.

2. A filter type respirator including a facepiece having a portion adapted to enclose and substantially conforming to the shape of the wearer's

nose, and a portion adapted to enclose and substantially conforming to the shape of the mouth and chin, an inwardly opening inhalation valve mounted in the region of the nose-enclosing portion and an outwardly opening exhalation valve mounted in the region of the mouth-enclosing portion of the facepiece, a filter of sheet material secured at its marginal edges to the facepiece exteriorly of the latter and fashioned so as to have a portion thereof overlie the inhalation valve and all portions thereof sufficiently removed from the exhalation valve as to be out of the zone of influence of moisture carried by expired air, and the facepiece having undulations on the surface thereof confronting the filter sheet and spacing the sheet therefrom.

3. A respirator including a facepiece having a nose covering portion and a mouth and chin covering portion, an inhalation valve associated with the nose covering portion and an exhalation valve associated with the mouth and chin covering portion of the facepiece, said facepiece having the material thereof adjacent the upper edge of the nose covering portion and at opposite sides of the center of the facepiece indented to provide inward, opposed, resilient projections of a shape and flexibility readily conforming to the shape of the nose at the lateral hollows thereof; a filter of sheet material secured at its marginal edges to the facepiece and having a portion thereof overlying the inhalation valve, and a plurality of protuberances moldably formed on the surface of the facepiece confronting the filter sheet and spacing the sheet therefrom.

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