United States Patent [19]

Lauer

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[54] **ANTI-FOG SURGICAL FACE MASK**

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[73] Assignee: **Johnson & Johnson,** New Brunswick, N.J.

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[21] Appl. No.: **411,873**

[52] **U.S. Cl.** **128/146.2;** 128/139

[51] **Int. Cl.** **A61f 9/04**

[58] **Field of Search** ..... 128/146.2, 146.3, 146.4, 128/146.5, 146.6, 146, 142.4, 136, 132 D, 163; 2/14 K, 9 R, 206

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Primary Examiner—Richard A. Gaudet
Assistant Examiner—Henry J. Recla

[57] **ABSTRACT**

A surgical face mask which comprises a filtration medium and an air impervious element secured to the upper portion of the mask. The impervious element functions to prevent moist breath from rising over the upper portion of the mask and fogging eyeglasses of the wearer of the mask. The mask may also bear impervious elements around all the edges thereof.

16 Claims, 16 Drawing Figures

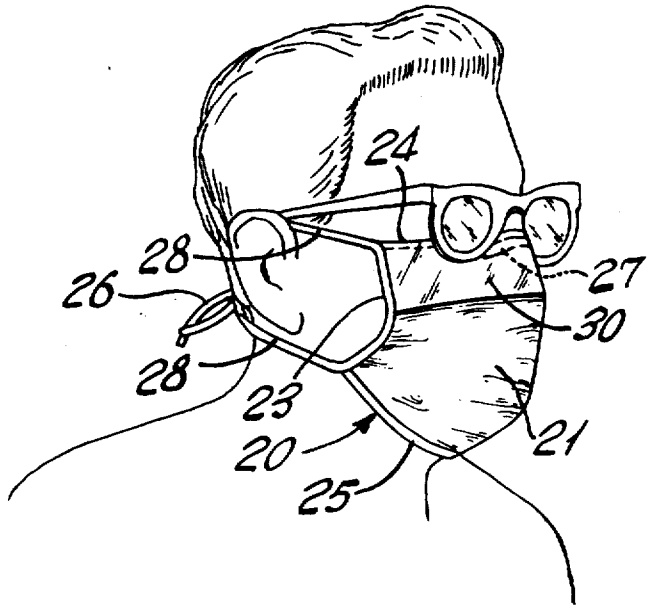


Fig. 1.

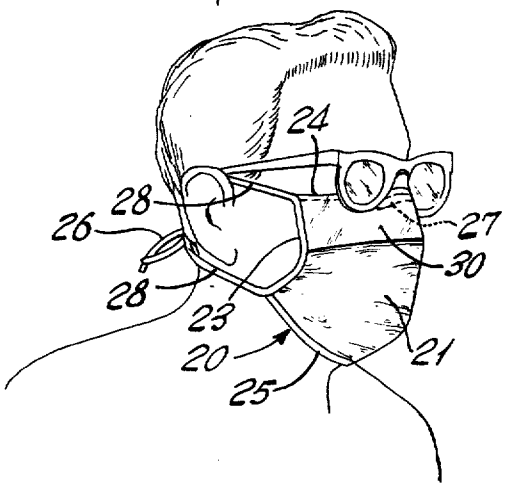


Fig. 5.

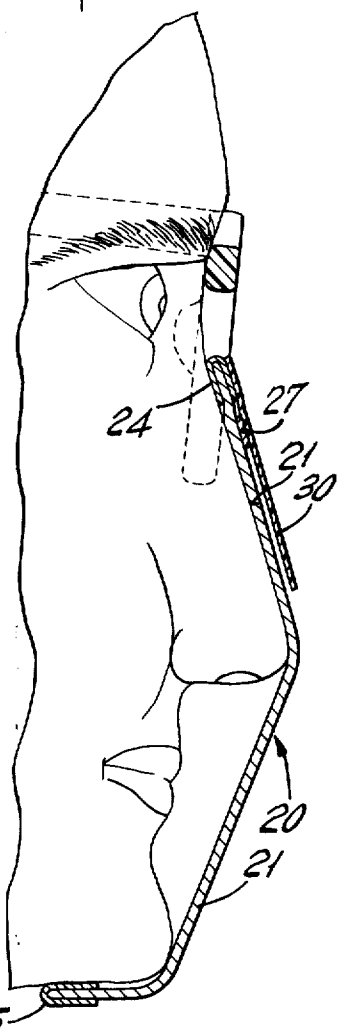


Fig. 2.

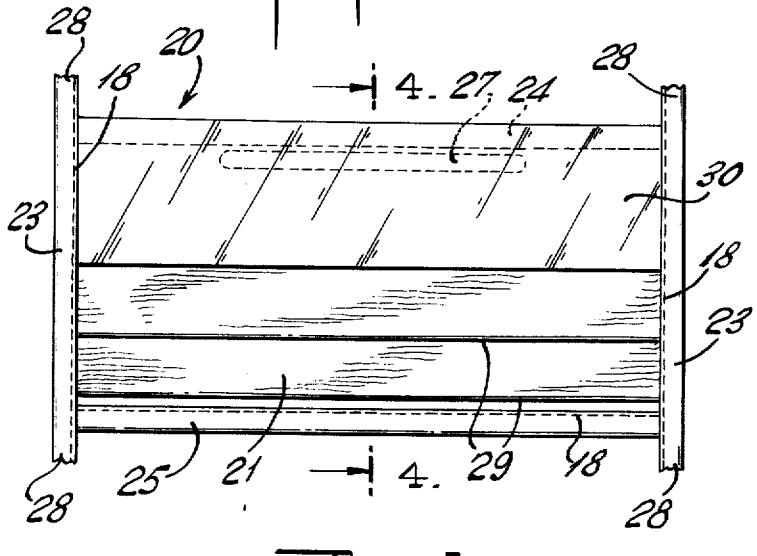
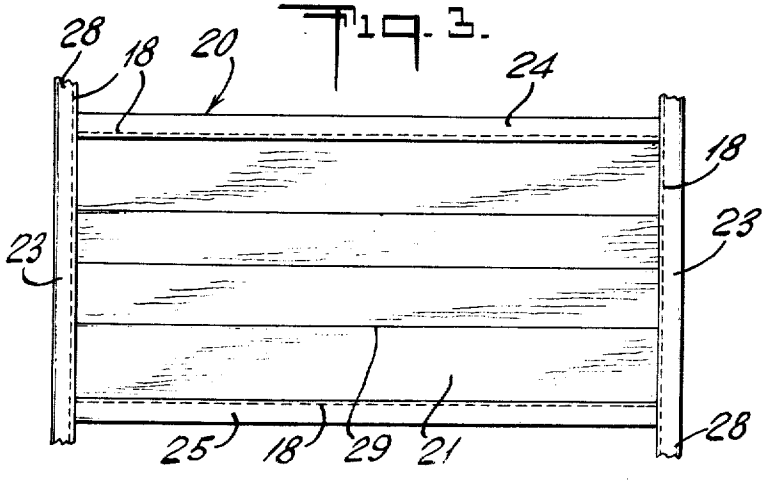


Fig. 3.



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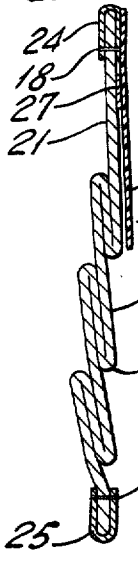
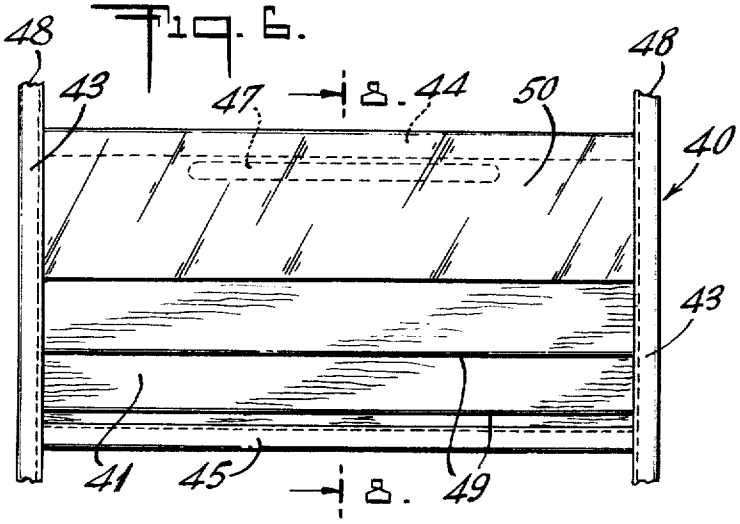


Fig. 6.



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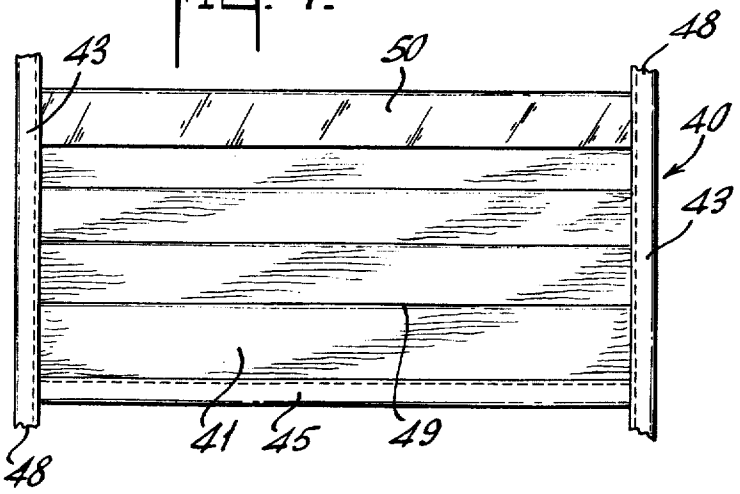


Fig. 8.

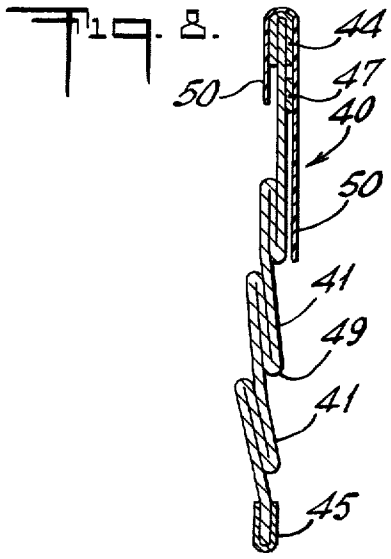


Fig. 9.

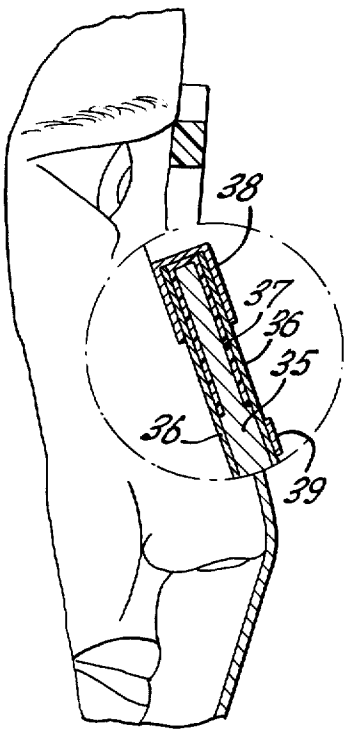


Fig. 10.

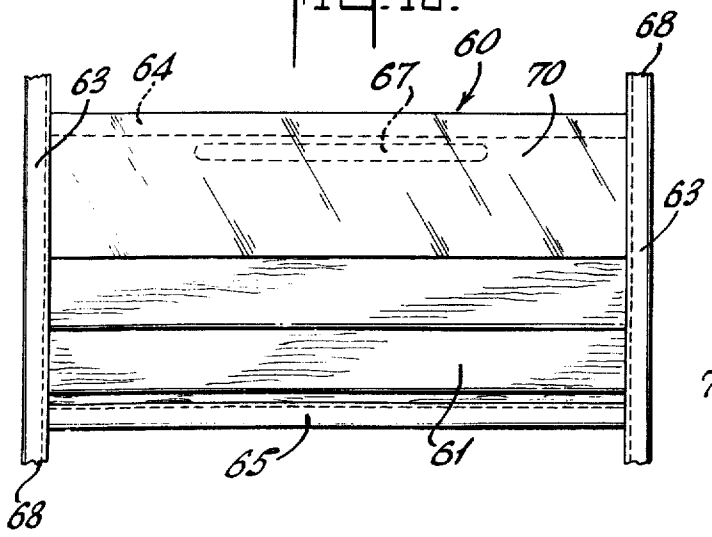


Fig. 12.

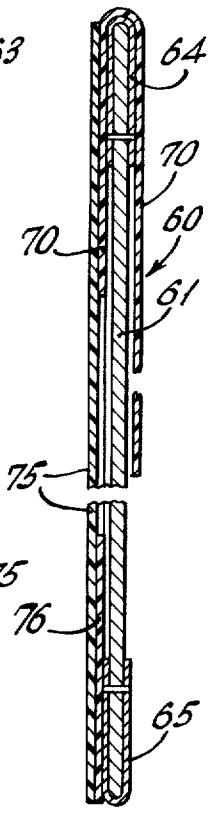


Fig. 13.

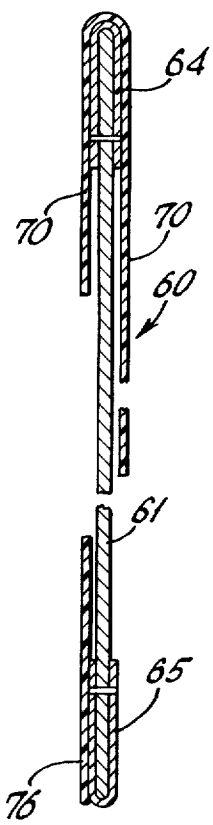


Fig. 11.

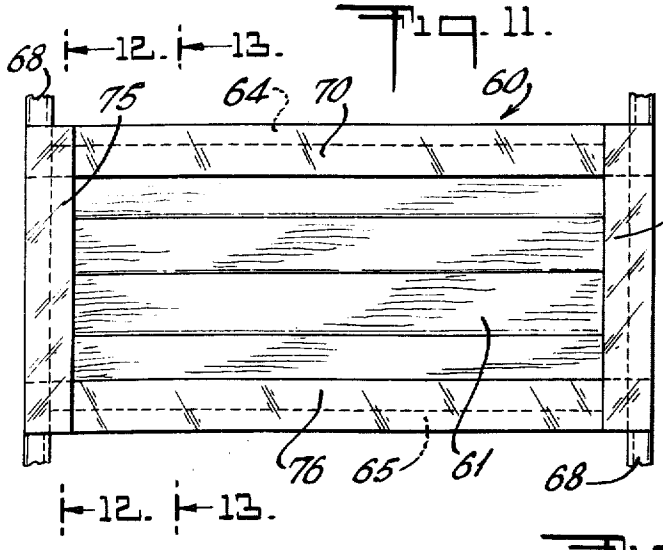


Fig. 16.

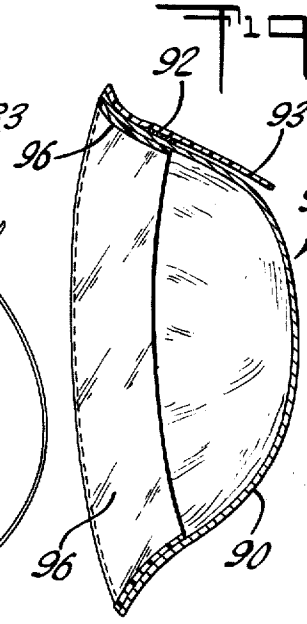


Fig. 15.

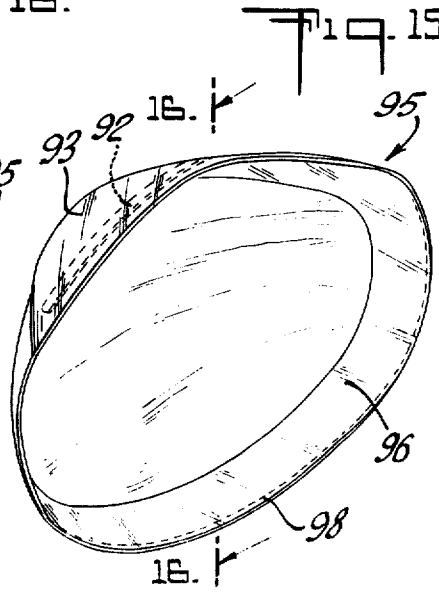
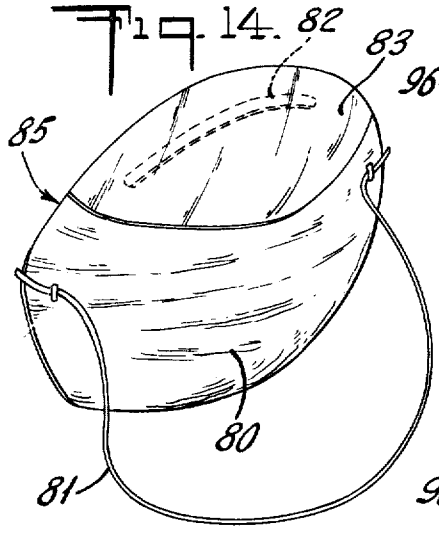


Fig. 14.



ANTI-FOG SURGICAL FACE MASK

BACKGROUND OF THE INVENTION

Surgical face masks have been employed for some time by the operating room staff during surgical procedures. The purpose of the face mask is to prevent bacteria exhaled by the surgeon, or other of the operating room staff, from contaminating the patient undergoing surgery. The face masks contain a filter medium which is of sufficiently small pore size to prevent bacteria from flowing through the mask.

A potential problem connected with the use of surgical face masks exists in situations where the surgeon, or other of the room staff, wears eyeglasses. The exhaled breath of the wearer is usually warmer and more moist than the surrounding air, and, when it rises upwardly from the mask, has a tendency to fog eyeglasses. This is a very annoying and potentially dangerous situation as, for example, the surgeon must delay his surgical procedure in order to clear the eyeglasses so that his full vision can be restored. This problem has become more significant in recent years because the filtration ability of face masks has increased. Older surgical face masks, which were made of folded squares of linen or gauze, had relatively low air resistance and were poor bacteria filters. Current face masks are extremely good bacteria filters but generally have higher air resistance than the older masks. As the air resistance of a mask increases, there is an increased tendency for air being exhaled by the wearer to escape at the top of the mask. As noted, this air is generally warmer and more moist than the surrounding air, so that there is a tendency of the moisture therein to condense on the eyeglasses worn by surgeons and other operating room staff.

"Air resistance," as used herein, is a measure of the resistance to air flow through the mask. Air resistance is determined by measuring the pressure drop across the mask when the mask is placed in a stream of air flowing at a rate of 85 cubic feet per minute. Air resistance is considered to be "low" when the pressure drop is less than about 0.03 inches of water. Air resistance is considered to be "high" when the pressure drop exceeds about 0.45 inches of water. Masks having pressure drops between about 0.30 and about 0.45 inches of water are considered to have intermediate air resistance.

SUMMARY OF THE INVENTION

I have now discovered a relatively simple method of preventing eyeglass fogging without any substantail decrease in the bacteria filtering efficiency of a mask. I accomplish this result by employing an air impervious element on at least the upper portion of the mask. The air impervious element may be placed only on the outer surface of the mask or only on the inner surface of the mask. Alternatively, the mask may have an air impervious element overlying both its inner and outer surfaces. As a variation of the latter arrangement, a single air impervious element may be used to cover not only the inner and outer surfaces, but also the top edge of the mask. In still another arrangement, the air-impervious element may be disposed within the main body of the face mask. The air-impervious element prevents exhaled breath from moving upwardly from the upper portion of the mask and fogging the wearer's eyeglasses. Thus, according to the present invention, there is provided a surgical face mask comprising a body portion having upper and lower parts, said body portion comprising a filtration medium for filtering bacteria, means for securing the mask over the mouth and nose of the wearer, and an air impervious element across the upper part of said body portion.

In another embodiment of the invention, an air impervious element is provided on both the inner and outer surfaces of the upper part of the mask. Preferably, in this embodiment, a single piece of the air impervious material is used, that is, the air impervious material overlies the outer surface of the mask, is folded over the uppermost edge of the face mask and is continued downwardly over the inner surface of the mask.

In a preferred embodiment, the top, bottom, and side peripheries of the inner surface of the mask have thin, elongated strips of air impervious material secured thereto.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood with reference to the annexed drawings in which:

FIG. **1** is a view of a first embodiment of the mask of this invention shown in position on the face of a wearer.

FIG. **2** is a plan view showing the outer surface of the mask of FIG. **1.**

FIG. **3** is a plan view showing the inner surface of the mask of FIG. **1.**

FIG. **4** is a cross sectional view taken along line **4—4** of FIG. **2.**

FIG. **5** is a side view, partially in section, showing the mask of FIG. **1** in position on the face of a wearer.

FIG. **6** is a plan view showing the outer surface of a second embodiment of the mask of the invention.

FIG. **7** is a plan view showing the inner surface of the mask of FIG. **6.**

FIG. **8** is a cross sectional view taken along line **8—8** of FIG. **6.**

FIG. **9** is a side view, partially in section and with certain portions enlarged, of a third embodiment of the mask of this invention shown in position on the face of a wearer.

FIG. **10** is a plan view showing the outer surface of a fourth embodiment of the mask of the present invention.

FIG. **11** is a plan view showing the inner surface of the mask of FIG. **10.**

FIG. **12** is a cross sectional view, with parts broken away, taken along line **12—12** of FIG. **11,** at an enlarged scale.

FIG. **13** is a cross sectional view, with parts broken away, taken along line **13—13** of FIG. **11,** at an enlarged scale.

FIG. **14** is a perspective view of the outer surface of a preformed, contoured face mask embodying the present invention.

FIG. **15** is a perspective view of the inner surface of another preformed, contoured face mask, similar to that shown in FIG. **14,** embodying the present invention.

FIG. **16** is a cross-sectional view taken along the lines **16—16** of FIG. **15.**

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention may be employed in a flat face mask such as those shown in FIGS. **1–13** or in a preformed contoured mask such as those shown in FIGS.

14–16. A flat mask has a body portion which has two major surfaces, i.e., an inner major surface and an outer major surface, and comprises a suitable filtration medium. The body portion may include, if desired, a facing material disposed on one or both major surfaces of the filtration medium. A flat face mask may be pleated or unpleated, as desired.

The terms "outside" and "outer surface," as used herein, refer to that portion, or surface, respectively, of the mask (or of any element thereof) which is disposed away from the face of the wearer when the mask is in place; the terms "inside" and "inner surface" refer to that portion, or surface, respectively, of the mask (or of any element thereof) which contacts or is disposed toward the face of the wearer when the mask is in place. The term "upper," as used herein, refers to that part of the mask (or of any element thereof) which is nearer the nose and eyes of the wearer when the mask is in place; the term "lower" refers to that part of the mask (or of any element thereof) which is nearer the chin of the wearer when the mask is in place.

Referring now to FIG. **1**, there is illustrated, on the face of a wearer, a first embodiment **20** of the face mask of the present invention. Face mask **20** includes a body portion **21** which has a binding **24** along its upper edge and a binding **25** along its lower edge. Body portion **21** also has bindings **23** along the side edges thereof which bindings may be extended at the corners of the mask, if desired to provide tie strings **28** which may be tied at the back of the head of the wearer as shown at **26** of FIG. **1** in order to secure the mask in its desired position. As is well known in the art, side bindings **23** and tie strings **28** may comprise biased fabric tapes and may, if desired, have elastic characteristics. The upper, outer surface of body portion **21** carries an air impervious element **30** which comprises a thin film or sheet of suitable plastic such as polyethylene, polypropylene, poly(vinyl chloride), or poly(ethylene-vinyl acetate). The upper portion of mask **20** carries a nose clip **27** which may be formed, for example, from a thin strip of aluminum.

The first embodiment of the present invention will now be described in greater detail with reference to FIGS. **2**, **3** and **4** of the drawings.

Referring particularly to FIG. **2**, main body portion **21** is folded to form pleats **29** which unfold to better conform the mask to the face of the wearer when the mask is put on. As indicated, in order to prevent exhaled breath of the wearer of the mask from rising and fogging his eyeglasses, mask **20** is provided with an air impervious element **30** which is disposed across the upper outer surface of the mask. Air impervious element **30** may be secured to body portion **21** by any suitable securing means. The securing means may be employed in a thin line or band along the upper and side peripheries of air impervious element **30**, or in a pattern over the entire air impervious element, or in continuous over-all coating. In the embodiment of FIG. **2**, it will be seen that the upper periphery of air-imperivous element **30** is secured to upper binding **24**. The side peripheries of element **30** are disposed between main body portion **21** and side bindings **23** and are held in place by stitching indicated by dotted line **18**.

When, as shown in FIGS. **2** and **4**, air impervious element **30** is secured only along its upper and side peripheries, only a very small percentage of its total surface area is in sealing engagement with main body portion **21**; as a result, impervious element **30** is free to act as a "flap" which deflects exhaled breath downwardly away from the eyes of the wearer. This "flap-like" arrangement is illustrated in the upper right hand portion of FIG. **4** which also shows element **30** overlying nose clip **27** and the outer surface of body portion **21**. At the same time, however, element **30** is free to move outwardly from the surface of the mask, for example, under the stress applied by exhaled breath. It has also been found that mask **20** functions to prevent fogging of eyeglasses even where most, or substantially all, of the surface area of impervious element **30** is in sealing engagement with main body portion **21**. Any desired means may be used to secure impervious element **30** to the outer surface of main body portion **21** in the desired manner. These means would include, for example, stitching and heat sealing, and use of the well-known water or solvent-based adhesives, such as a plasticized polyvinyl acetate resin dispersion.

Main body portion **21** includes a filtration medium for filtering bacteria. The filtration medium may be formed from fibers such as, for example, fiberglass, polyester, polypropylene, vinyon fibers and similar materials, used alone or in combination. Body portion **21** may also include a facing material, e.g., a nonwoven fabric, on one or both of its major surfaces.

As indicated earlier, air impervious element **30** may comprise a film of plastic material such as polyvinyl chloride, polyethylene, polypropylene and poly(ethylenevinyl acetate). Alternatively, element **30** may be a non-woven fabric or paper type material having substantially greater resistance to air flow than the filtration medium and facing material. When a material is described herein as being "air impervious" it is meant either that the material substantially completely resists the flow of air or other gas therethrough (as, for example, a film of polyethylene) or that the material has a substantially greater resistance to the flow of air than the filtration medium and facing material. It will be understood that, generally speaking, any thin flexible material that is substantially resistant to air flow can be employed in the practice of this invention. If plastic film is selected for impervious element **30**, its thickness should be from about 0.5 mil to about 5.0 mils, preferably from about 0.75 mil to about 1.5 mils. If a nonwoven fabric is used for impervious element **30**, its thickness should be approximately 3–15 mils, preferably from about 5 mil to about 10 mils.

The inner surface of the first embodiment, seen in FIG. **3**, carries bindings **23**, **24**, **25** which are merely folded-over portions of the corresponding bindings on the outer surface of the mask. The folded bindings are secured to body portion **21** by stitching, indicated by dotted lines **18** in FIGS. **2** and **3**. It will be seen that the inner surface of the first embodiment carries no impervious element. I have observed also that fogging of eyeglasses is prevented when the impervious element is disposed on the inner surface of main body portion **21**. When the impervious element **30** is on the inner surface, it is effective when it is disposed in either the preferred "flap-like" arrangement previously described, or in an arrangement wherein a great portion, or even all, of its surface area is in sealing engagement with the inner surface of main body portion **21**.

Referring to FIG. **5**, there is shown a side view, partially in section, of the mask of FIGS. **1–4** in position

on the face of the wearer. FIG. 5 shows that element 30 is secured, at its upper periphery, to binding 24 of mask 20. The remaining part of element 30, except for the side peripheries thereof, overlies noseclip 27 and the outer surface of the mask to form the flap-like arrangement already discussed.

A second embodiment of the present invention will be described with reference to FIGS. 6, 7 and 8 of the drawings. Mask 40 includes a main body portion 41, upper binding 44, lower binding 45, side bindings 43, noseclip 47, tie strings 48, and pleats 49. The outer surface of mask 40, as shown in FIG. 6, has an air impervious element 50 disposed over the upper outer surface of main body portion 41. As illustrated in FIGS. 7 and 8, impervious element 50 is folded over upper binding 44 at the uppermost edge of body portion 41 and is continued downwardly for a distance along the inner surface of the mask. Element 50 is held in position by securing it, along its side edges, to both the inner and outer side peripheries of the mask. If desired, element 50 can be further held in position by securing it along the upper periphery of the mask but this is not necessary, and preferably is not done. As illustrated in FIG. 8, when element 50 is arranged, in the manner just described, so that part thereof overlies the outer surface of the mask and part thereof overlies the inner surface of the mask, there are formed two flap-like structures. When the mask is in place, the portion of element 50 that is disposed over the inner surface of the mask contacts the face of the wearer.

As the wearer breathes, element 50, because of its flap-like structure and due to the presence of face moisture (especially in the case of plastic), stays in contact with the face of the wearer thus preventing the upward escape of moist air between the face and the mask. At the same time, the flap-like structure allows main body portion 41 to move forwardly (i.e., away from the face of the wearer) under the stress of the exhaled breath. Any moist breath which does not pass directly through the filter medium is prevented from escaping upwardly between impervious element 50 and main body portion 41 by the folded-over portion of element 50. Thus, it is seen that moist air is prevented from reaching, and subsequently fogging, the eyeglasses of the wearer.

An alternative arrangement of the air-impervious element is shown in the embodiment illustrated in FIG. 9. As seen in the enlarged portion of FIG. 9, the body portion of the mask includes a filtration medium 35 and facing material 36. An air-impervious element 37 is positioned over part of both major surfaces of filtration medium 35 and is itself covered by facing material 36. Thus, in this particular embodiment, it will be seen that the air impervious element is disposed within the body portion of the mask. Upper binding 38 overlies facing material 36 at the upper portion of the mask, and noseclip 39 is attached, in its desired position, to the facing material. Although the arrangement of FIG. 9 does not allow for the loose flap, it does adequately perform the function of preventing eyeglass fogging in a large number of instances.

Although eyeglass fogging by exhaled breath which passes upwardly of the mask can be prevented by placing a substantially air impervious element on the upper portion of the face mask, it is also recognized that exhaled breath may "leak" around the side edges of an improperly positioned mask. To further assure prevention of such leaks, the structure shown in the mask illustrated in FIGS. 10–13 may be employed. Referring to FIG. 10, pleated face masks 60 comprises a main body portion 61, side bindings 63, an upper binding 64, a lower binding 65, a nose clip 67 and tie strings 68, corresponding to the analogous parts of the embodiments already discussed. Upper binding 64 and lower binding 65 are secured to body portion 61 by stitching (not illustrated) although a suitable adhesive or other securing means may be used if desired. Referring to FIGS. 10, 11 and 13, air impervious element 70 is disposed over the upper outer surface of body portion 61, folded over upper binding 64, and continued downwardly over the inner surface of the mask. An elongated, thin strip 76 of air impervious material is heat sealed along its lowermost edge to binding 65. At the corners of the mask, side bindings 63 overlie the ends of strip 76 and the ends of that portion of impervious element 7 which extends downwardly over the inner surface of the mask. The side bindings are secured by stitching (not illustrated) which also serves at the same time to attach air impervious element 70 to body portion 61. As best seen in FIG. 11, strips 75 of impervious material are heat sealed to side bindings 63 at the side peripheries of the mask. Since air impervious element 70 is attached to body portion 61 only by means of the stitching that holds side bindings 63 in place, air impervious element 70 is free to act as a "flap," that is, air impervious element 70 can move more or less independently of body portion 61, on both the inner and outer surfaces of the mask, as air is inhaled and exhaled by the wearer. This "flap-like" construction is illustrated in the upper part of FIG. 13 where air impervious element 70 is shown spaced away from body portion 61 on both the inner and outer surfaces of the mask. Likewise, since lower strip 76 and side strips 75 of air impervious material are attached only at the peripheries of the mask, they also are free to move more or less independently of the rest of the mask. Thus, it will be seen that on the inner surface of the mask, lower strip 76, side strips 75, and the folded over portion of air impervious element 70 are all attached to the mask in the flap like construction just described. It has been observed, especially in the case where the air impervious strips comprise a plastic such as polyethylene, that the air impervious elements on the inner surface of the mask tend to cling to the face of the wearer when he exhales. This clinging to the face by these air impervious elements forms a seal which prevents exhaled breath from escaping around the edges of the mask. Due to the "flap-like" construction, body portion 61 of the mask can move away from the wearer's face without breaking the aforementioned seal. Air impervious element 70, due to its folded over arrangement on the upper part of the mask tends to direct any exhaled breath that does not pass through the filter medium over the top edge of binding 64 and then downwardly over the outer surface of the mask so that eyeglass fogging is effectively prevented.

Although in FIGS. 12 and 13, impervious element 70 is shown as a single sheet folded over the uppermost edge of the face mask it will be understood that it is also possible to employ separate pieces of plastic on the outer and inner surfaces of the body portion of the face mask, if so desired.

As indicated in the accompanying drawings, the several impervious elements are sufficiently long to reach

from one side of the mask to the other, or from the upper edge to the lower edge thereof as the case may be. In their folded condition, most commercially available pleated face masks measure about 3¾ to 4 inches from their upper edge to their lower edge. In the embodiment illustrated in FIGS. **2-4**, I have found that impervious element **70** is most effective in preventing eye glass fogging when it extends downwardly from the top of the mask a distance of from about 1⅝ inches to about 2¾ inches. In certain circumstances, impervious element **70** may be effective to reduce or eliminate eye glass fogging when it extends less than 1¼ inches from the top edge of the mask. In the modified embodiment of FIGs. **2–4**, that is, where the impervious element is attached only to the inner surface of the upper portion of the mask, it is preferable that the impervious element extend downwardly from the top of the mask a distance of at least about three-eighths of an inch in order to effectively prevent the escape of moist air between the upper edge of the mask and the face of the wearer. Correspondingly, in the embodiment shown in FIGS. **6–8**, impervious element **50** extends downwardly on the outer surface of the mask for a distance of from about 1¼ inches to about 2½ the folded-over portion of impervious element **50** extends downwardly over the inner surface of the mask a distance of at least about three-eighths of an inch. In the embodiment shown in FIGS. **10–13**, air impervious element **70** has dimensions which correspond to those given above for impervious element **50** in the embodiment of FIGS. **6–8**. The width of impervious strips **75** and **76** should be about one-half inch although this dimension may be varied under certain circumstances.

The present invention may also be employed in a preformed surgical face mask as illustrated in FIGS. **14–16**. In FIG. **14**, preformed, contoured mask **85** has a main body **80** which is usually formed from a thermoplastic fibrous material, such as polyester, Vinyon (copolymers of vinyl chloride and vinyl acetate) or suitable blends of these fibers with rayon, into its desired preformed, contoured shape. Mask **85** has an elastic tie string **81** which is used to secure the mask over the nose and mouth of the wearer. The upper portion of the mask carries a nose clip **82**. The upper, outer surface of the mask has disposed thereover a strip **83** of an air-impervious material which is cut in such fashion that it will substantially conform to the upper surface of the mask. Strip **83** acts in the manner already described to prevent exhaled breath from flowing across the surface of the mask toward the eyeglasses of the wearer. The mask will be effective in preventing fogging of eyeglasses if the entire surface area of strip **83** is adhered to the main body of the mask. Preferably, however, strip **83** is secured at the peripheral edges of the mask in order to provide a flap-like construction analogous to that discussed for the flat face masks. Either of the above described methods for securing strip **83** to main body **80** will provide a face mask that will effectively reduce or even eliminate eyeglass fogging.

In an alternative embodiment illustrated in FIGS. **15** and **16**, contoured mask **95** has a body portion **90**, a nose clip **92**, and an air impervious element **93**, corresponding respectively to parts **80**, **82**, and **83** of the mask shown in FIG. **14**. Mask **95** also has a strip **96** of impervious material along the edge of its inner surface as seen in FIG. **15**. The entire surface area of strip **96** may be bonded to the inner surface of main body **90**, for example, by the use of a suitable adhesive. Preferably, however, strip **96** is secured by heat sealing, stitching, or gluing the edges thereof to the inner surface of the mask as indicated by dotted line **98** of FIG. **15**, to provide a flap-like arrangement analogous to that shown in the upper portion of FIG. **16**. The presence of strip **96** on the inner surface of the mask substantially eliminates the escape of moist air along the area where the mask contacts the face of the wearer and reduces even further the possibility of eyeglass fogging. Impervious strip **96** should be about one-half inch in width.

It will be understood by those skilled in the art that the principles of the present invention may be applied not only to the pleated face masks illustrated in FIGS. **1-13** and to the contoured face masks of FIGS. **14-16**, but also to other face masks such as unpleated face masks and to what are known in the art as "pouch" or "pocket" type face masks. Other variations and modifications can be made without departing from the spirit and scope of the invention.

What is claimed is:

1. A surgical face mask comprising:

a. a body portion having an upper part, a lower part, an upper edge, a lower edge and a pair of side edges and comprising a filtration medium for filtering bacteria;

b. means for securing the mask over the mouth and nose of the wearer; and

c. a sheet of air impervious material having an upper edge, a lower edge, and a pair of side edges, the upper edge of said air impervious material being secured to the upper part of said body portion, the lower edge of said air impervious material lying between said upper and lower edges of said body portion and being substantially free from attachment to said body portion, said sheet of air impervious material extending substantially from side to side of said body portion whereby, when the mask is worn, exhaled breath is directed downwardly from the upper part of the mask and away from the eyes of the wearer.

2. A face mask according to claim **1** wherein said sheet of air impervious material is attached to the outer surface of said body portion.

3. A face mask according to claim **2** wherein said sheet of air impervious material is folded over the uppermost edge of the mask and is continued downwardly for a relatively short distance along the inner surface of the mask.

4. A face mask according to claim **2** wherein a second sheet of air impervious material is attached to the upper inner surface of said body portion.

5. A face mask according to claim **1** wherein said sheet of air impervious material is disposed within said body portion.

6. A face mask according to claim **3** wherein said sheet of air impervious material is attached to the upper inner surface of said body portion.

7. A face mask according to claim **4** wherein elongated narrow strips of air impervious material are secured to the side and bottom edges of the inner surface of the mask.

8. A face mask according to claim **1** wherein said sheet of air impervious material is a plastic film.

9. A face mask according to claim **1** wherein said sheet of air impervious material is a nonwoven fabric.

10. A face mask according to claim **1** wherein said sheet of air impervious material is paper.

11. A face mask according to claim **1** wherein said body portion is contoured.

12. A face mask according to claim **1** wherein said body portion further comprises an air pervious facing material.

13. A face mask according to claim **1** further comprising a noseclip.

14. A face mask according to claim **13** wherein said body portion includes a facing material overlying both major surfaces of said filtration medium.

15. A surgical face mask comprising:

a. a body portion having an upper part, a lower part, an upper edge, a lower edge and a pair of side edges and comprising a filtration medium for filtering bacteria;

b. means for securing the mask over the mouth and nose of the wearer; and

c. a sheet of air impervious material having a lower edge and a pair of side edges, said air impervious material being secured to the upper part of said body portion, the lower edge of said air impervious material lying between said upper and lower edges of said body portion and being substantially free from attachment to said body portion, said sheet of air impervious material being folded over the uppermost edge of the mask and continued downwardly for a relatively short distance along the inner surface of the mask whereby, when the mask is worn, exhaled breath is directed downwardly from the upper part of the mask and away from the eyes of the wearer.

16. A surgical mask according to claim **15** further comprising elongated strips of air impervious material secured to the side and bottom edges of the inner surface of aaid body portion.

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