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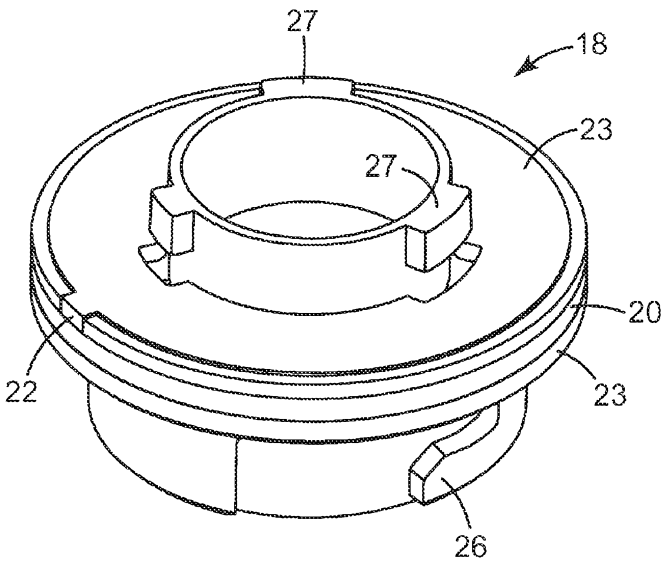

FIG. 3

(57) Abstract: Respirator attachment components are described and include a polymeric rigid respirator attachment body portion having a first surface and a second surface and a silicone sealing element chemically bonded to the first or second surface.

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RESPIRATOR ATTACHMENT COMPONENT WITH MOLDED THERMOSET ELASTOMERIC SEAL

FIELD

[01] The present disclosure relates to a respirator attachment component and particularly to a respirator attachment component with a molded thermoset elastomeric seal.

BACKGROUND

[02] Respirators provide respiratory protection from airborne substances with filtering processes and/or otherwise facilitating access to clean air. One characteristic of these devices is the seal that is formed between the user and other functional components of the respirator and the seal that is formed between the functional components and structural components of the respirator.

[03] One design consideration with these respirators is the air-tight fastening of an inhalation air source component, an exhalation component and/or speaking diaphragm to the structural component(s) of the respirator. This air-tight seal often requires a separate gasket and/or mechanical seal that adds complexity and cost to the respirator design.

It will be understood that any reference herein to prior art is not to be taken as an admission as to the common general knowledge of a person skilled in the art, or that this prior art could reasonably be expected to be ascertained, understood, or regarded as relevant by a person skilled in the art.

BRIEF SUMMARY

[04] The present disclosure relates to a respirator attachment component and particularly to a respirator attachment component with a molded thermoset elastomeric seal. This disclosure further relates to a respirator that includes a respirator attachment component with a molded thermoset elastomeric seal. This molded thermoset elastomeric seal is chemically bonded to at least one or two surfaces of the respirator attachment component. In many embodiments, the silicone seal element penetrates through at least one aperture of the body of the respirator attachment component.

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[05] In a first embodiment, a respirator attachment component includes a polymeric rigid respirator attachment body portion having a first surface and a second surface and a silicone sealing element chemically bonded to the first or second surface. In some embodiments, the silicone sealing element may be chemically bonded to at least two opposing major surfaces of the respirator attachment body portion. The silicone sealing element may in some cases also interpenetrate apertures that extend through the respirator attachment body portion.

[06] In another embodiment, a respirator attachment component includes a polymeric rigid respirator attachment body portion having a first major surface and an opposing second major surface separated by a body portion thickness and a plurality of apertures extending through the polymeric rigid respirator attachment body portion and a silicone sealing element is chemically bonded to the first major surface and second major surface and interpenetrates the apertures.

[07] In a further embodiment, a respiratory protection mask includes a polymeric rigid facepiece body portion and a compliant face contacting member attached to the polymeric rigid facepiece body portion. A respirator attachment component is fixed to the polymeric rigid facepiece body portion. The respirator attachment component includes a polymeric rigid respirator attachment body portion having an attachment surface, and a silicone sealing element chemically bonded to the attachment surface.

As used herein, except where the context requires otherwise, the term "comprise" and variations of the term, such as "comprising", "comprises" and "comprised", are not intended to exclude further additives, components, integers or steps.

BRIEF DESCRIPTION OF THE DRAWINGS

[08] The invention may be more completely understood in consideration of the following detailed description of various embodiments of the invention in connection with the accompanying drawings, in which:

[09] **FIG. 1** is a perspective view of an illustrative full face respirator;

[10] **FIG. 2** is an exploded perspective view of an illustrative full face respirator;

[11] **FIG. 3** is a perspective view of an respirator attachment component;

[12] **FIG. 4** is a cross-section perspective view of the respirator attachment component illustrated in **FIG. 3**;

[13] **FIG. 5** is a perspective view of an respirator attachment component;

[14] **FIG. 6** is a cross-section perspective view of the respirator attachment component illustrated in **FIG. 5**;

[15] **FIG. 7** is a perspective view of an respirator attachment component; and

[16] **FIG. 8** is a cross-section perspective view of the respirator attachment component illustrated in **FIG. 7.**

[17] The figures are not necessarily to scale. Like numbers used in the figures refer to like components. However, it will be understood that the use of a number to refer to a component in a given figure is not intended to limit the component in another figure labeled with the same number.

DETAILED DESCRIPTION

[18] In the following description, reference is made to the accompanying drawings that form a part hereof, and in which are shown by way of illustration several specific embodiments. It is to be understood that other embodiments are contemplated and may be made without departing from the scope or spirit of the present invention. The following detailed description, therefore, is not to be taken in a limiting sense.

[19] All scientific and technical terms used herein have meanings commonly used in the art unless otherwise specified. The definitions provided herein are to facilitate understanding of certain terms used frequently herein and are not meant to limit the scope of the present disclosure.

[20] Unless otherwise indicated, all numbers expressing feature sizes, amounts, and physical properties used in the specification and claims are to be understood as being modified in all instances by the term "about." Accordingly, unless indicated to the contrary, the numerical parameters set forth in the foregoing specification and attached claims are approximations that can vary depending upon the desired properties sought to be obtained by those skilled in the art utilizing the teachings disclosed herein.

[21] The recitation of numerical ranges by endpoints includes all numbers subsumed within that range (e.g. 1 to 5 includes 1, 1.5, 2, 2.75, 3, 3.80, 4, and 5) and any range within that range.

[22] As used in this specification and the appended claims, the singular forms "a", "an", and "the" encompass embodiments having plural referents, unless the content clearly dictates otherwise. As used in this specification and the appended claims, the term "or" is generally employed in its sense including "and/or" unless the content clearly dictates otherwise.

[23] The term "respirator" means a personal respiratory protection device that is worn by a person to filter air before the air enters the person's respiratory system. This term includes full face respirators, half mask respirators, supplied air hoods, powered air purifying respirators, and self contained breathing apparatus.

[24] The phrase "full face respirator" means a respirator that is worn over a person's nose, mouth, and eyes.

[25] The present disclosure relates to a respirator attachment component and particularly to a respirator attachment component with a molded thermoset elastomeric seal. This disclosure further relates to a respirator that includes a respirator attachment component with a molded thermoset elastomeric seal. This molded thermoset elastomeric seal is chemically bonded to at least one or two surfaces of the attachment component. In many embodiments, the silicone seal element penetrates through the respirator attachment component body. These respirator attachment components have a robust bond between the silicone seal element and the polymeric rigid attachment component. While the present invention is not so limited, an appreciation of various aspects of the invention will be gained through a discussion of the examples provided below.

[26] The respirator attachment component overmolded thermoset elastomeric seal provides a sealing element that is integrally bonded with the attachment component body. This construction has been found to enhance the durability of the seal and prevent debris from being interposed between the attachment component body and the thermoset elastomeric seal. This integral construction also reduces the number of assembly parts and part size

variability. The overmolded thermoset elastomeric seal materials described herein also do not require that the attachment component body be primed in order for the thermoset elastomeric seal to be chemically attached to the attachment component body.

[27] **FIG. 1** is a perspective view of an illustrative full face respirator **10**. **FIG. 2** is an exploded perspective view of the illustrative full face respirator **10**. This respiratory protection mask **10** includes a polymeric rigid facepiece body **11**, face shield **11**, or lens **11** attached to a number of respirator attachment components including, for example, one or more inhalation valves **18** with an optional chemical or particulate filtration cartridge (not shown) connected to one or more of the inhalation valves **18**, one or more exhalation valves **16**, one or more speaking diaphragms **14,** and/or one or more headstraps or straps **34** configured to secure the respirator **10** to a user's head. A valve cover **8** is disposed over the exhalation valves **16** and speaking diaphragm **14**.

[28] The respirator **10** includes a compliant face contacting member **9** that is compliantly fashioned to allow the respirator body or face shield **11** to be comfortably supported over a person's nose and mouth. The illustrated respirator **10** includes two cheek openings **12** and two nasal openings **13**. **FIG. 1** illustrates two cheek openings **12** where one cheek opening does not contain a respirator attachment component and one cheek opening includes an inhalation valve **18**. **FIG. 2** illustrates an inhalation valve **18** in cheek opening **12**.

[29] Respirator attachment components **14**, **16**, and **18** are disposed within or fixed to the openings **12** and **13** by any useful method such as, for example, a bayonet attachment system. A bayonet attachment system is configured for attaching two portions together, where the two portions include elements other than mainly threads such that the two portions are attached by inserting one portion at least partially within the other portion and rotating one portion relative to the other portion so that the two portions can be joined without multiple turns.

[30] While **FIG. 1** and **FIG. 2** illustrate a respiratory protection mask **10** having one or two cheek inhalation valves **18,** and a nasal exhalation valve **16**, and a nasal speaking diaphragm **14**, any useful respiratory protection configuration is possible. For example, the respiratory protection mask **10** can have a single inhalation valve attached to a

chemical or particulate filtration cartridge or clean air supply, and one or two exhalation valves or one or more speaking diaphragms, as desired.

[31] **FIG. 3** is a perspective view of an illustrative inhalation valve **18** and **FIG. 4** is a cross-section perspective view of the illustrative inhalation valve **18** illustrated in **FIG. 3**. The inhalation valve **18** includes a polymeric rigid respirator attachment body portion **20** having a first surface **21** and a second surface **22**. A silicone sealing element **23** is chemically bonded to the first surface **21** and the second surface **22**.

[32] The silicone sealing element **23** can be formed by overmolding a thermosetting silicone material onto a thermoplastic polymeric rigid respirator attachment body portion **20**. The thermosetting silicone material chemically bonds (i.e., adhesive bonding or covalent bonding) directly onto to the thermoplastic polymeric rigid respirator attachment body portion **20** first surface **21** and the second surface **22**.

[33] The terms "chemical bonding or chemically bonded" refer to physical processes responsible for the attractive interactions between atoms and molecules and includes covalent and ionic bonds, as well as hydrogen and van der Waal's bonds and can often depend on available functional groups on the polymeric rigid respirator attachment body portion surface and their reactivity with the thermosetting silicone material. In many embodiments, the thermosetting silicone material is selected so that pretreatment of the thermoplastic polymeric rigid respirator attachment body portion is not necessary. In other words, the thermosetting silicone material is self-adhesive with the thermoplastic polymeric rigid respirator attachment body portion. The thermosetting silicone material is often heated to cure the thermosetting silicone material during the overmolding process to a temperature sufficient to cure the thermosetting silicone material but less than a glass transition temperature of the thermoplastic polymeric rigid respirator attachment body portion.

[34] As shown in the Examples below, the level of chemical bonding can be determined by the average force to failure test method. In many embodiments, the average force to failure is 25 N or greater, 50 N or greater, or 100 N or greater, or 150 N or greater, or 200 N or greater, or 300 N or greater.

[35] The thermoplastic polymeric rigid respirator attachment body portion **20** can be formed of any useful thermoplastic material. In many embodiments, the thermoplastic polymeric rigid respirator attachment body portion **20** is formed of a polyamide (e.g., nylon), a polycarbonate, polybutylene-terephthalate, polyphenyl oxide, polyphthalamide, or mixtures thereof.

[36] Any useful thermosetting liquid silicone rubber or material can be utilized to form the silicone sealing element **23**. Liquid silicone rubber is a high purity platinum cured silicone with low compression set, great stability and ability to resist extreme temperatures of heat and cold. Due to the thermosetting nature of the material, liquid silicone injection molding often requires special treatment, such as intensive distributive mixing, while maintaining the material cool before it is pushed into the heated cavity and vulcanized. Silicone rubber is a family of thermoset elastomerics that have a backbone of alternating silicone and oxygen atoms and methyl or vinyl side groups. Silicone rubbers maintain their mechanical properties over a wide range of temperatures and the presence of methyl-groups in silicone rubbers makes these materials hydrophobic.

[37] Illustrative thermosetting silicone material includes self-adhesive liquid silicone rubbers available under the trade designation: ELASTOSIL LR 3070 from Wacker-Silicones, Munich, Germany; the KE2095 or KE2009 series (such as, for example, KE2095-60, KE2095-50, KE2095-40) or X-34-1547A/B, X-34-1625A/B, X-34-1625A/B all from Shin-Etsu Chemical Co., LTD., Japan. These self-adhesive liquid silicone rubbers do not require pretreatment of certain thermoplastic surfaces for the liquid silicone rubbers to chemically bond to the thermoplastic surface.

[38] In the illustrated embodiment, the first surface **21** and second surface **22** are opposing major surfaces. One or more apertures **24** extend through the respirator attachment component body thickness defined between the opposing first surface **21** and second surface **22**. During the overmolding manufacture of the respirator attachment component, liquid silicone (that forms the silicone sealing element **23**) flows through the one or more apertures **24** and forms a mechanical interlock between the silicone sealing element **23** and the rigid respirator attachment body portion **20**.

[39] A diaphragm **25** can be fixed to the respirator attachment body portion **20**. This diaphragm **25** is biased against the respirator attachment body portion **20** to allow unidirectional air flow through the respirator attachment body portion **20**.

[40] The respirator attachment body portion **20** can also include a bayonet attachment element **26**. The bayonet attachment element **26** assists in fastening the respirator attachment body portion **20** to the cheek opening **12** of the respiratory protection mask **10**. The bayonet attachment element **26** mates with a complementary element within or adjacent to the cheek opening **12** of the respiratory protection mask **10**. This bayonet attachment system secures the illustrated inhalation valve **18** to the cheek opening **12** of the respiratory protection mask **10**.

[41] When assembled, the silicone sealing element **23** of the illustrated inhalation valve **18** is disposed between the first surface **21** and the adjacent cheek opening **12** surface, forming an air-tight seal at the sealing element surface and cheek opening surface interface. The term "air-tight seal" refers to a connection that substantially prevents unfiltered or ambient air from entering an interior portion of the respiratory protection composite facepiece **11** at the connection interface.

[42] Air-tightness is measured with a vacuum leak test. The test fixture consists of a sealed chamber with three ports. The volume of the chamber is approximately 750 cm^3. A respirator attachment component is affixed to one of the three ports by means of its bayonet attachment element. A vacuum gauge capable of measuring the pressure differential between the inside of the chamber and the ambient air (to at least 25 cm water) is attached to a second port on the fixture. A vacuum source is attached to the third port through a shut off valve. To conduct the test, the shut-off valve is opened and the vacuum source is turned on to evacuate the chamber to a pressure of 25 cm water below atmospheric pressure (as indicated by the vacuum gauge). The shut-off valve is then closed and the vacuum source is turned off. The vacuum level inside the chamber is monitored for 60 seconds. Inward leakage of air causes the pressure inside the chamber to increase, thereby reducing the vacuum level. For the current disclosure, the pressure differential between the chamber and the ambient air is greater than 15 cm of water after

60 seconds. More preferably, the pressure differential remains above 24 cm of water after 60 seconds.

[43] The silicone sealing element **23** of the illustrated inhalation valve **18** is also disposed between the second surface **22** and an attached filtered air source element (not shown). The filtered air source element can be a chemical or particulate filtration cartridge or a clean air supply source. The filtered air source element can be attached to the illustrated inhalation valve **18** via a bayonet attachment element **27** on the respirator attachment body portion **20**. This bayonet attachment element **27** mates with a complementary element on the filtered air source element. Thus, the silicone sealing element **23** of the illustrated inhalation valve **18** forms an air-tight seal at the sealing element surface and filtered air source element interface.

[44] **FIG. 5** is a perspective view of an illustrative exhalation valve **16** without showing the diaphragm **35** (shown in **FIG. 2**). **FIG. 6** is a cross-section perspective view of the exhalation valve **16** illustrated in **FIG. 5**. The exhalation valve **16** includes a polymeric rigid respirator attachment body portion **30** having a first surface **31** and a second surface **32**. A silicone sealing element **33** is chemically bonded to the first surface **31**.

[45] The silicone sealing element **33** can be formed by overmolding a thermosetting silicone material onto a thermoplastic polymeric rigid respirator attachment body portion **30**. The thermosetting silicone material chemically bonds (i.e., adhesive bonding or covalent bonding) directly onto to the thermoplastic polymeric rigid respirator attachment body portion **30** first surface **31**. The terms "chemical bonding or chemically bonded" are described above.

[46] The thermoplastic polymeric rigid respirator attachment body portion **30** can be formed of any useful thermoplastic material, as described above. Any useful thermosetting liquid silicone rubber or material can be utilized to form the silicone sealing element **33**, as described above.

[47] In the illustrated embodiment, the first surface **31** and second surface **32** are opposing major surfaces. In some embodiments, one or more apertures (not shown) extend through the respirator attachment component body thickness defined between the opposing first

surface **31** and second surface **32**. During the overmolding manufacture of the respirator attachment component, liquid silicone (that forms the silicone sealing element) flows through the one or more apertures and forms a mechanical interlock between the silicone sealing element and the rigid respirator attachment body portion.

[48] A diaphragm **35** can be fixed to the respirator attachment body portion **30** (see **FIG. 2**). This diaphragm **35** is biased against the respirator attachment body portion **30** to allow unidirectional air flow through the respirator attachment body portion **30**.

[49] The respirator attachment body portion **30** can also include a bayonet attachment element **36**. The bayonet attachment element **36** assists in fastening the respirator attachment body portion **30** to the nasal opening **13** of the respiratory protection mask **10**. The bayonet attachment element **36** mates with a complementary element within or adjacent to the nasal opening **13** of the respiratory protection mask **10**. This bayonet attachment system secures the illustrated exhalation valve **16** to the nasal opening **13** of the respiratory protection mask **10**.

[50] When assembled, the silicone sealing element **33** of the illustrated exhalation valve **16** is disposed between the first surface **31** and the adjacent nasal opening **13** surface, forming an air-tight seal at the sealing element surface and nasal opening surface interface. The term "air-tight seal" is defined above.

[51] **FIG. 7** is a perspective view of an illustrative speaking diaphragm **14**, and **FIG. 8** is a cross-section perspective view of the speaking diaphragm **14** illustrated in **FIG. 7.** The speaking diaphragm **14** includes a polymeric rigid respirator attachment body portion **40** having a first surface **41** and a second surface **42**. A silicone sealing element **43** is chemically bonded to the first surface **41**. A diaphragm **45** is fixed to the polymeric rigid respirator attachment body portion **40**. The diaphragm **45** assists in the transmission of sound from a user of the respirator **10** to another person.

[52] The silicone sealing element **43** can be formed by overmolding a thermosetting silicone material onto a thermoplastic polymeric rigid respirator attachment body portion **40**. The thermosetting silicone material chemically bonds (i.e., adhesive bonding or covalent bonding) directly onto to the thermoplastic polymeric rigid respirator attachment body

portion **40** first surface **41**. The terms "chemical bonding or chemically bonded" are described above.

[53] The thermoplastic polymeric rigid respirator attachment body portion **40** can be formed of any useful thermoplastic material, as described above. Any useful thermosetting liquid silicone rubber or material can be utilized to form the silicone sealing element **43**, as described above.

[54] In the illustrated embodiment, the first surface **41** and second surface **42** are opposing major surfaces. In some embodiments, one or more apertures (not shown) extend through the respirator attachment component body thickness defined between the opposing first surface **41** and second surface **42**. During the overmolding manufacture of the respirator attachment component, liquid silicone (that forms the silicone sealing element) flows through the one or more apertures and forms a mechanical interlock between the silicone sealing element and the rigid respirator attachment body portion.

[55] The respirator attachment body portion **40** can also include a bayonet attachment element **46**. The bayonet attachment element **46** assists in fastening the respirator attachment body portion **40** to the nasal opening **13** of the respiratory protection mask **10**. The bayonet attachment element **46** mates with a complementary element within or adjacent to the nasal opening **13** of the respiratory protection mask **10**. This bayonet attachment system secures the illustrated speaking diaphragm **14** to the nasal opening **13** of the respiratory protection mask **10**.

[56] When assembled, the silicone sealing element **43** of the illustrated speaking diaphragm **14** is disposed between the first surface **41** and the adjacent nasal opening **13** surface, forming an air-tight seal at the sealing element surface and nasal opening surface interface. The term "air-tight seal" is defined above.

EXAMPLES

[57] Several tests were used to identify suitable combinations of silicone rubbers and thermoplastic materials. Of particular interest is the strength of the bond between the silicone rubber and thermoplastic material, which affects the durability of the air-tight seal.

[58] A surrogate test strip was developed to permit measurement of the bond strength. The test strip is prepared by molding a rigid, flat substrate piece 51 mm long, 25 mm wide, and 2 mm thick with thermoplastic material. The substrate is then clamped into a second mold such that 6 mm of one end of the substrate protrudes into the cavity of the second mold. The cavity of the second mold is 27 mm wide and 49 mm long. The depth of the mold is 2 mm, expanding to 4 mm in the immediate vicinity of the protruding substrate end, such that when silicone is injected into the mold cavity it forms a layer 1 mm thick on all sides of the protruding substrate end. The resulting test strip is thus 94 mm long, with a rigid thermoplastic substrate piece on one end and silicone rubber on the other end.

[59] The strength of the bond between the substrate material and silicone is measured by gripping the two ends of the test strip in the jaws of a mechanical tester such as an MTS Model 858 Material Test System (MTS Systems Corporation, Eden Prairie, MN), stretching it until the test strip breaks apart, and recording the force at which failure occurs. Examples of the force to failure are shown in Table 1. Examples 1 through 4 show that bond strengths greater than 300 N can be achieved with the appropriate combination of materials. For Comparative Examples C1 and C2, the silicone did not bond to the thermoplastic material.

Example	Silicone	Thermoplastic Substrate	Average Force to Failure (N)
1	Shin-Etsu KE2095-60	RTP Nylon 6/6	136
2	Wacker 3070-60	RTP Nylon 6/6	303
3	Dow LC-70-2004	Zytel PA	174
4	Wacker 3070-60	Zytel PA	166
C1	Dow LC-70-2004	RTP Nylon 6/6	No bonding
C2	Shin-Etsu KE2095-60	Zytel PA	No bonding

[60] Dow LC-70-2004 silicone is produced by Dow Corning Corporation, Midland MI; RTP Nylon 6/6 is a polyamide produced by RTP Company, Winona, MN; Zytel PA is a polyamide produced by E.I. du Pont de Nemours, Wilmington, DE.

[61] Thus, embodiments of the RESPIRATOR ATTACHMENT COMPONENT WITH MOLDED THERMOSET ELASTOMERIC SEAL are disclosed. One skilled in the art will appreciate that the present invention can be practiced with embodiments other than

those disclosed. The disclosed embodiments are presented for purposes of illustration and not limitation, and the present invention is limited only by the claims that follow.

What is claimed is:

1. A respirator attachment component comprising:

a polymeric rigid respirator attachment body portion having a first surface and a second surface; and

a silicone sealing element chemically bonded to the first or second surface.

2. A respirator attachment component according to claim 1, wherein the silicone sealing element is chemically bonded to the first surface and the second surface.

3. A respirator attachment component according to claim 1, wherein the first surface and the second surface are opposing major surfaces separated by a body portion thickness.

4. A respirator attachment component according to claim 1, wherein the polymeric rigid respirator attachment body portion comprises at least one aperture extending through the polymeric rigid respirator attachment body portion and the silicone sealing element interpenetrates the aperture.

5. A respirator attachment component according to claim 1, wherein the polymeric rigid respirator attachment body portion comprises a plurality of apertures extending through the polymeric rigid respirator attachment body portion and the silicone sealing element interpenetrates the apertures and is chemically bonded to the first surface and the second surface.

6. A respirator attachment component according to claim 1, wherein the polymeric rigid respirator attachment body portion comprises a port extending through the body portion and a plurality of apertures extend through the body portion and disposed about the port, and the silicone sealing element is disposed about the port and interpenetrates the plurality of apertures.

7. A respirator attachment component according to claim 1, further comprising a diaphragm attached to the polymeric rigid respirator attachment body portion and forming an inhalation valve, an exhalation valve, or a speaking diaphragm.

8. A respirator attachment component according to claim 1, wherein the polymeric rigid respirator attachment body portion comprises a thermoplastic polymer and the silicone sealing element is a thermoset polymer and the thermoset polymer chemically bonds directly onto the thermoplastic polymer.

9. A respirator attachment component according to claim 6, further comprising a chemical or particulate filtration cartridge attached to the respirator attachment component.

10. A respirator attachment component comprising:

a polymeric rigid respirator attachment body portion having a first major surface and an opposing second major surface separated by a body portion thickness and a plurality of apertures extending through the polymeric rigid respirator attachment body portion; and

a silicone sealing element chemically bonded to the first major surface and second major surface and interpenetrates the apertures.

11. A respirator attachment component according to claim 10, further comprising a diaphragm attached to the polymeric rigid respirator attachment body portion and forming an inhalation valve.

12. A respiratory protection mask comprising:

a polymeric rigid facepiece body portion; and

a compliant face contacting member attached to the polymeric rigid facepiece body portion; and

respirator attachment component fixed to the polymeric rigid facepiece body portion the respirator attachment component comprising:

a polymeric rigid respirator attachment body portion having an attachment surface; and

a silicone sealing element chemically bonded to the attachment surface.

13. A respiratory protection mask according to claim 12, wherein the respirator attachment component is removably attached to the polymeric rigid facepiece body portion.

14. A respiratory protection mask according to claim 12, wherein the respirator attachment component further comprises a second surface opposing the attachment surface and the silicone sealing element is chemically bonded to both the attachment surface and the second surface.

15. A respiratory protection mask according to claim 12, wherein the attachment surface and the second surface are opposing major surfaces separated by a body portion thickness.

16. A respiratory protection mask according to claim 12, wherein the polymeric rigid respirator attachment body portion comprises at least one aperture extending through the polymeric rigid respirator attachment body portion and the silicone sealing element interpenetrates the aperture.

17. A respiratory protection mask according to claim 12, wherein the polymeric rigid respirator attachment body portion comprises a plurality of apertures extending through the polymeric rigid respirator attachment body portion and the silicone sealing element interpenetrates the apertures.

18. A respiratory protection mask according to claim 12, wherein the polymeric rigid respirator attachment body portion comprises a port extending through the body portion and a plurality of apertures extend through the body portion and disposed about the port, and the silicone sealing element is disposed about the port and interpenetrates the plurality of apertures and a diaphragm is attached to the respirator attachment body portion.

19. A respiratory protection mask according to claim 12, further comprising a chemical or particulate filtration cartridge attached to the polymeric rigid respirator attachment body portion.

20. A respiratory protection mask according to claim 12, wherein the respiratory protection mask further comprises a speaking diaphragm attached to the polymeric rigid facepiece body portion.

21. A respirator attachment component substantially as hereinbefore described with reference to the accompanying drawings.

22. A respiratory protection mask substantially as hereinbefore described with reference to the accompanying drawings.

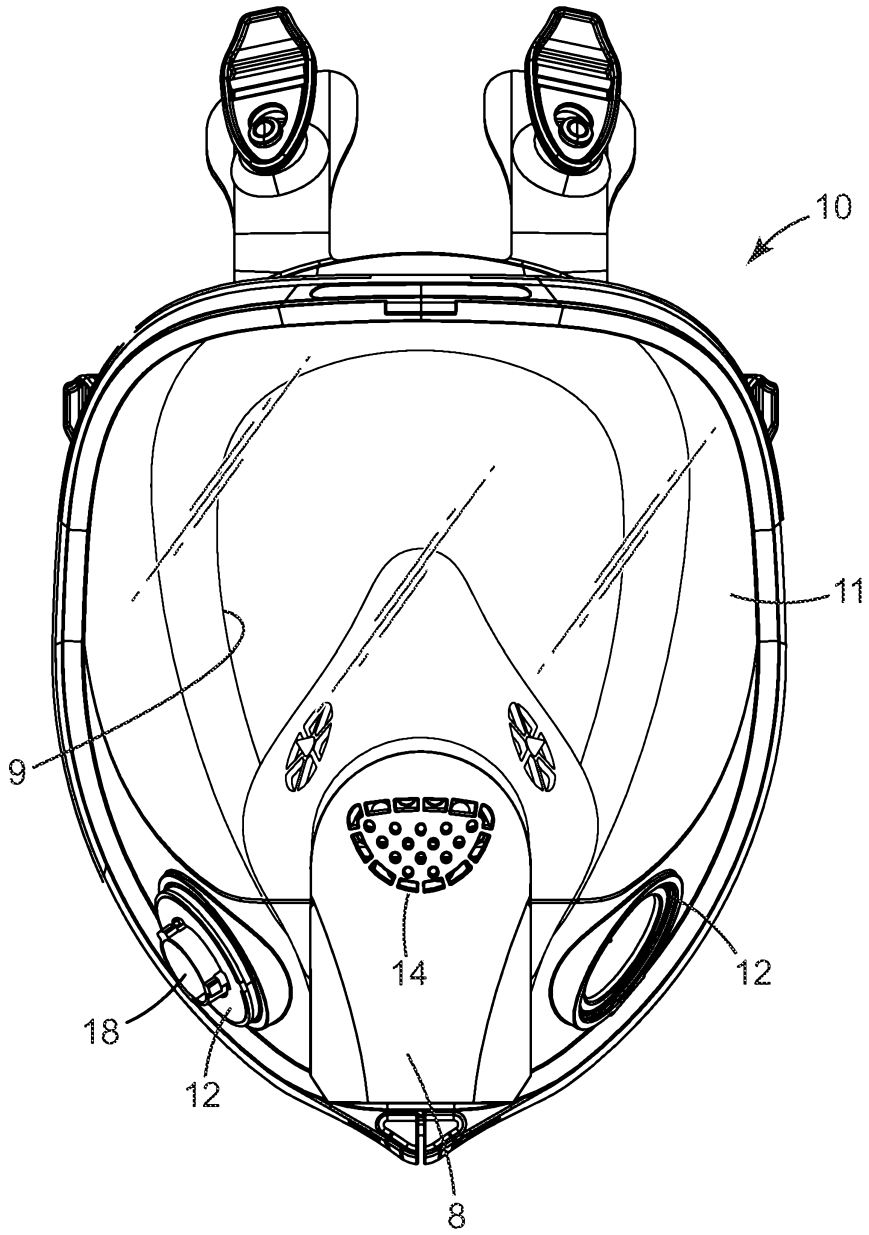

FIG. 1

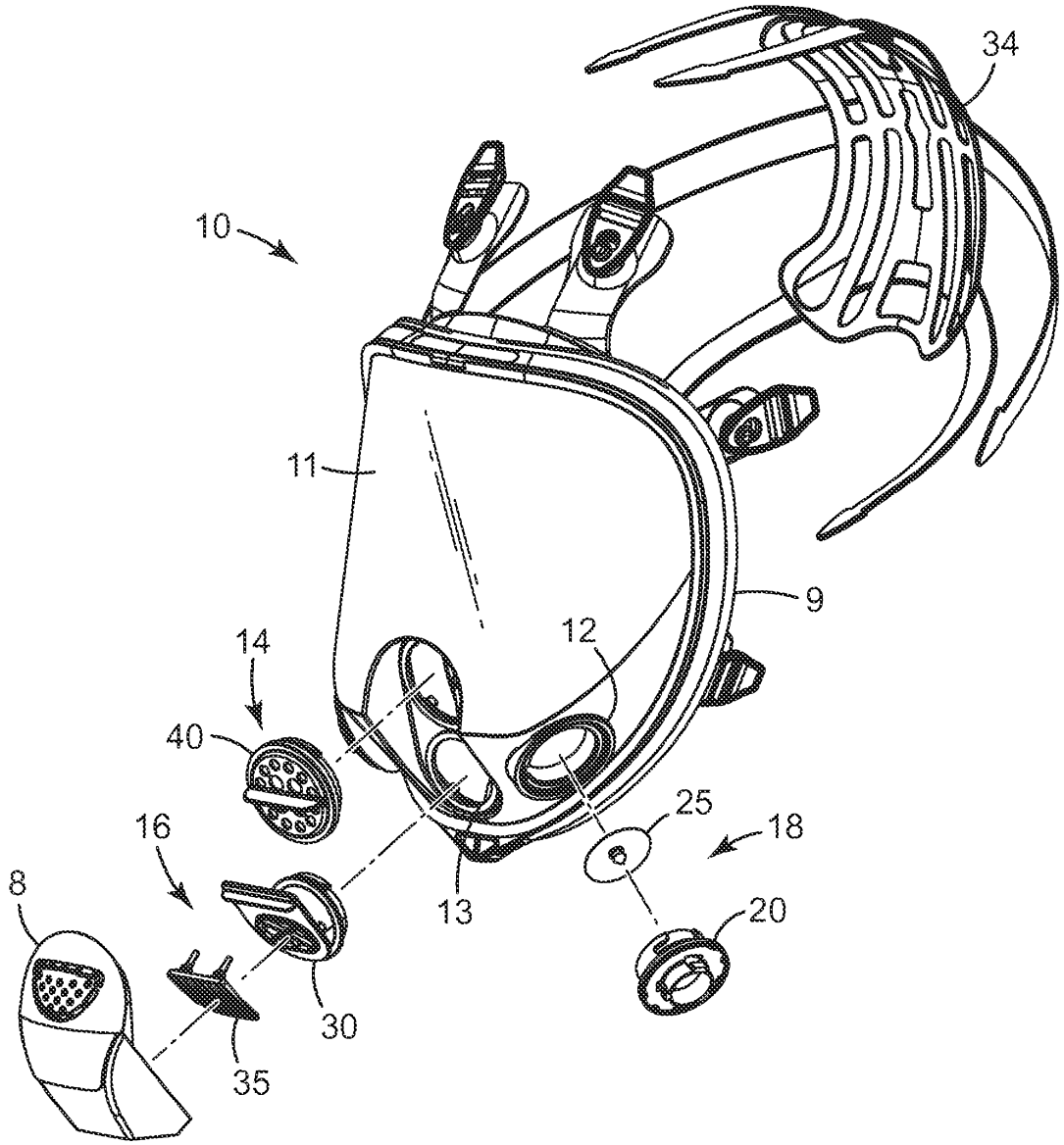

FIG. 2

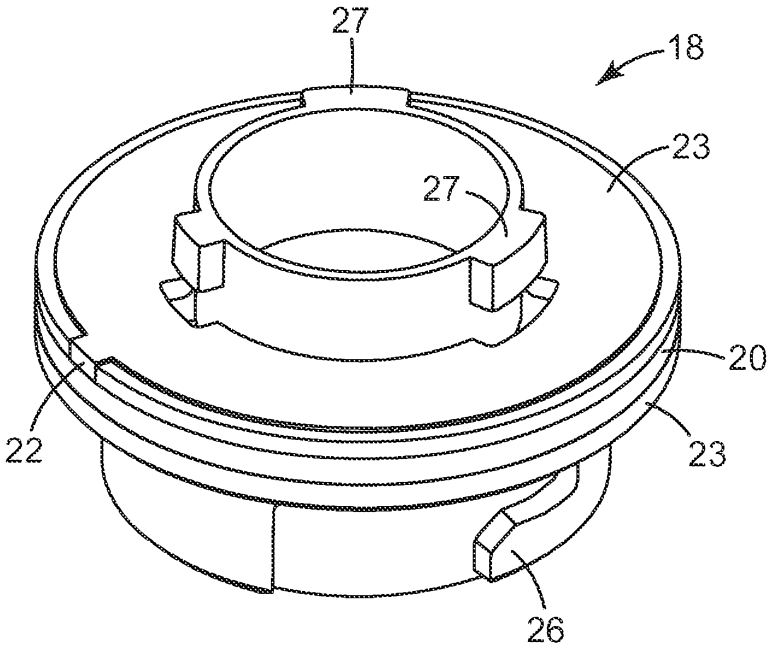

FIG. 3

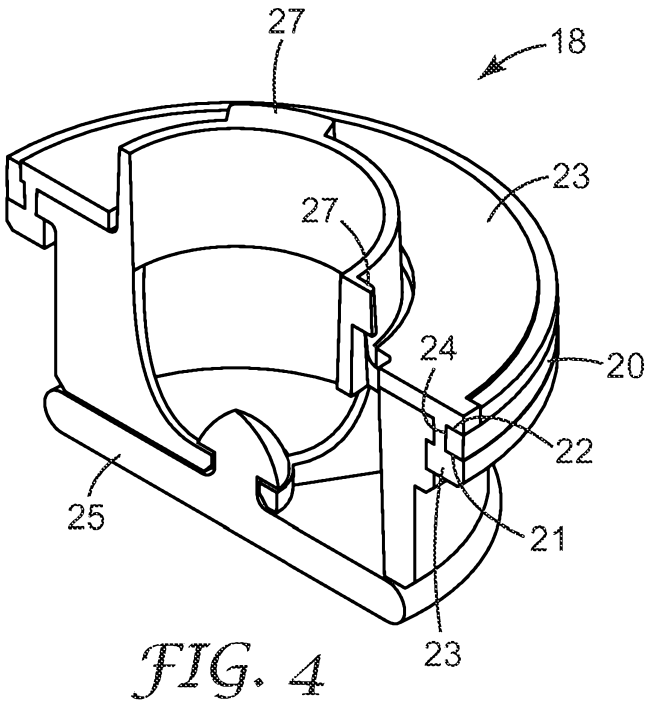

FIG. 4

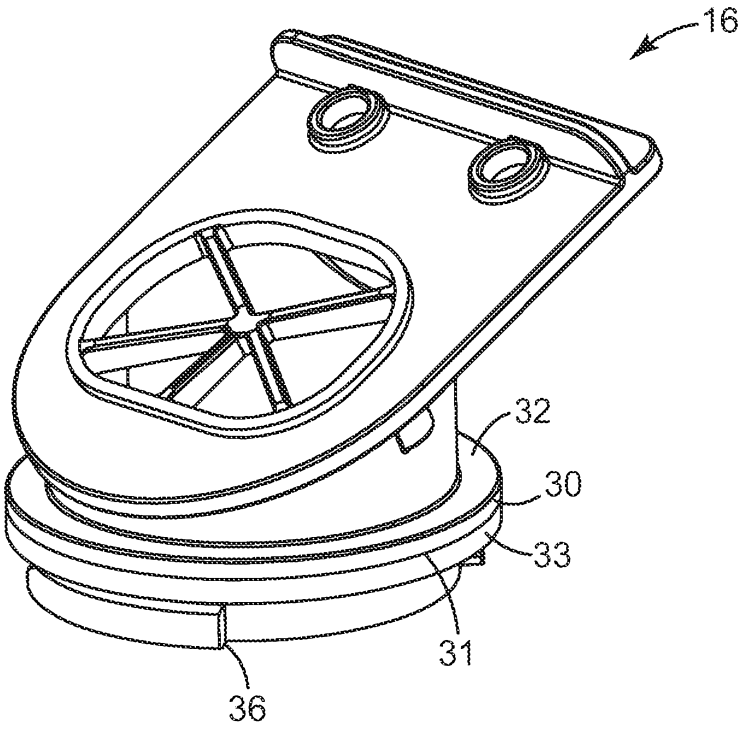

FIG. 5

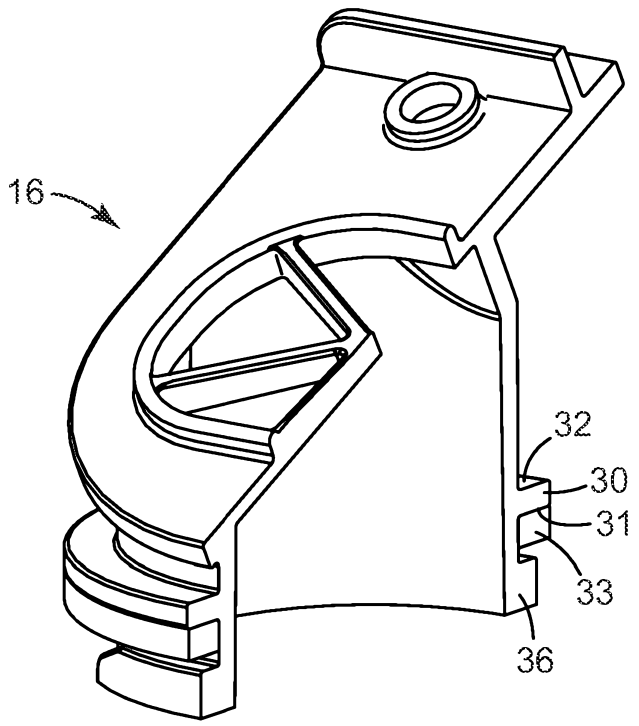

FIG. 6

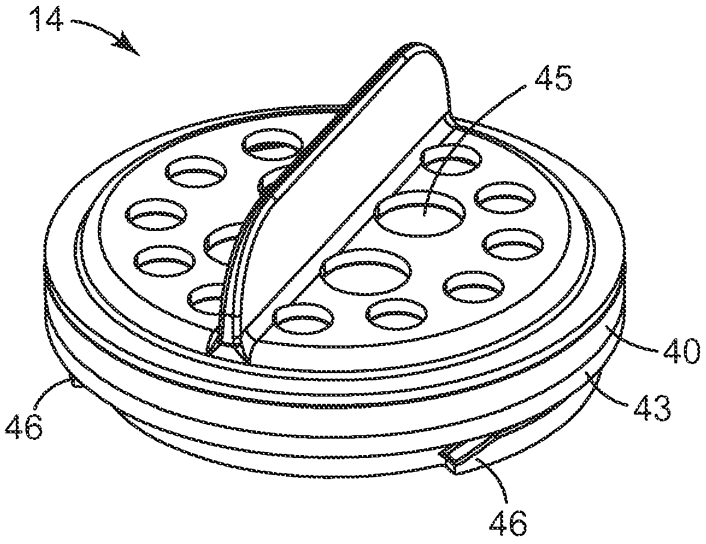

FIG. 7

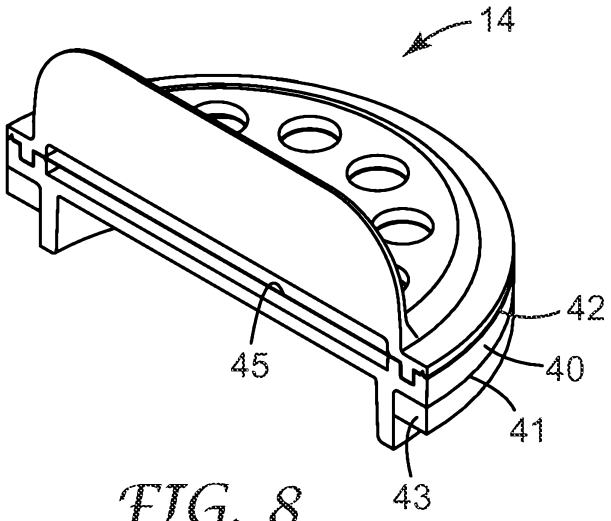

FIG. 8