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Krespi et al.

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(45) **Date of Patent: Aug. 12, 2025**

(54) **NASAL DEVICE WITH AIR FILTER**

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(22) Filed: **Jul. 21, 2022**

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Related U.S. Application Data

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(60) Provisional application No. 62/262,699, filed on Dec. 3, 2015.

(51) **Int. Cl.**
A62B 23/06 (2006.01)

(52) **U.S. Cl.**
CPC ***A62B 23/06*** (2013.01)

(58) **Field of Classification Search**
CPC A62B 23/06; A62B 23/00; A62B 9/00; A62B 9/006; A62B 9/02; A62B 9/06; A61M 15/08; A61M 15/085; A61M 15/00
See application file for complete search history.

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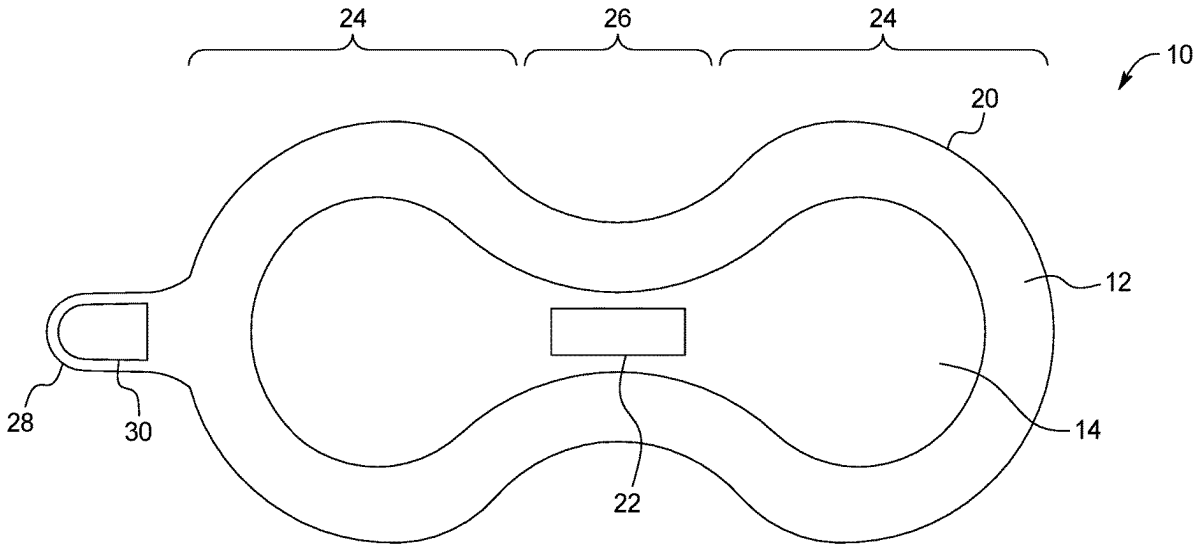
(57) **ABSTRACT**

A nasal device for filtering air breathed into a user's nose is disclosed herein. In an embodiment, a nasal device includes a body sized and shaped to be secured to at least one of a user's nostrils, and a filter positioned on the body so as to be located over at least one of the user's nasal passages when the body is secured to the user's at least one nostril, wherein the filter filters air breathed into the user's at least one nasal passage when the body is secured to the user's at least one nostril.

14 Claims, 20 Drawing Sheets



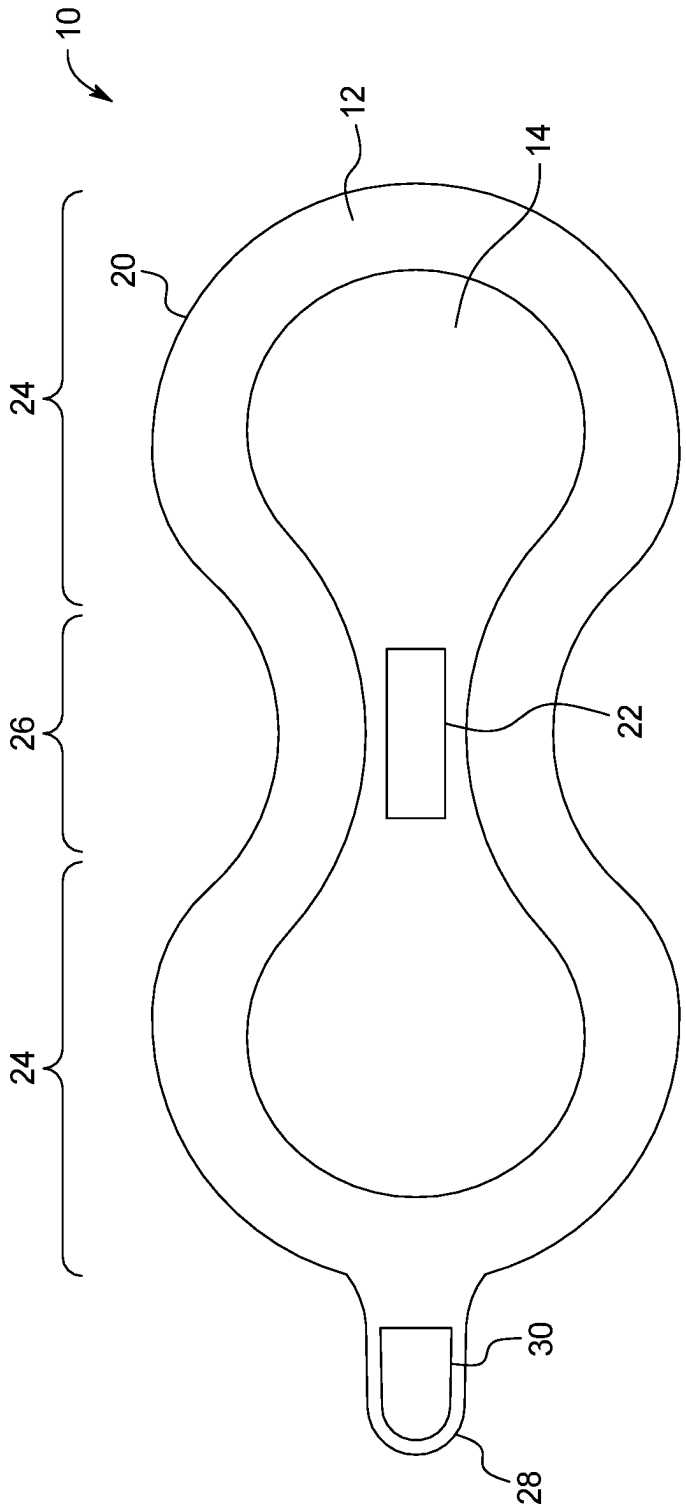


FIG. 1

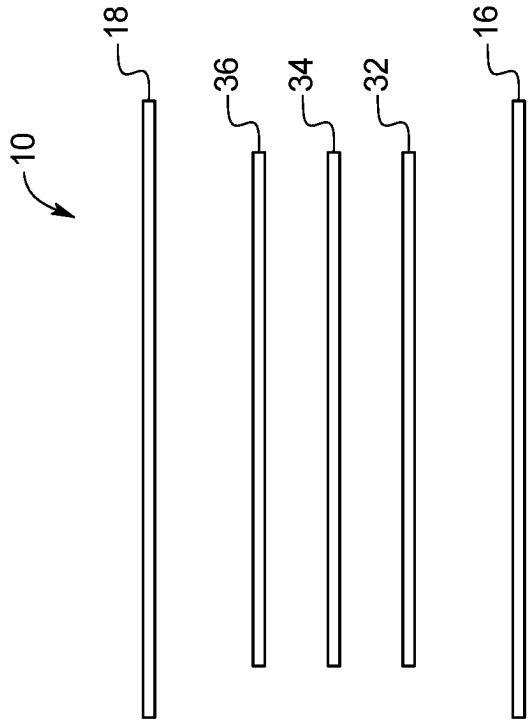


FIG. 3

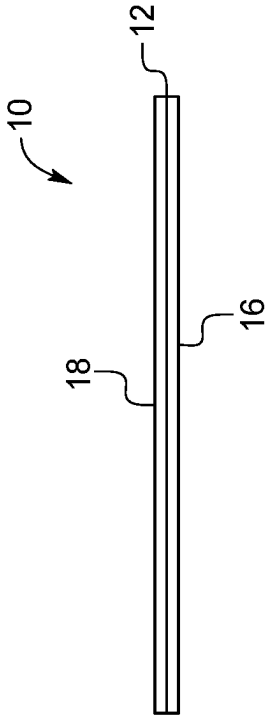


FIG. 2

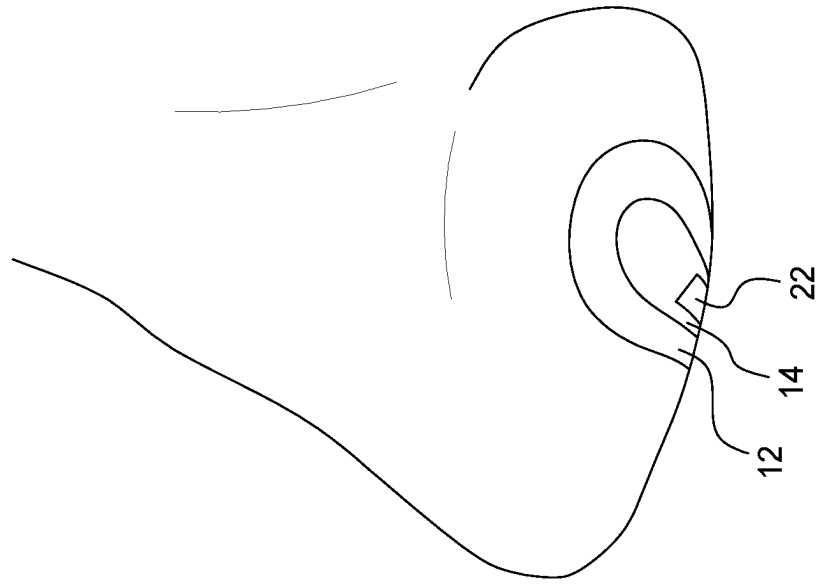


FIG. 5

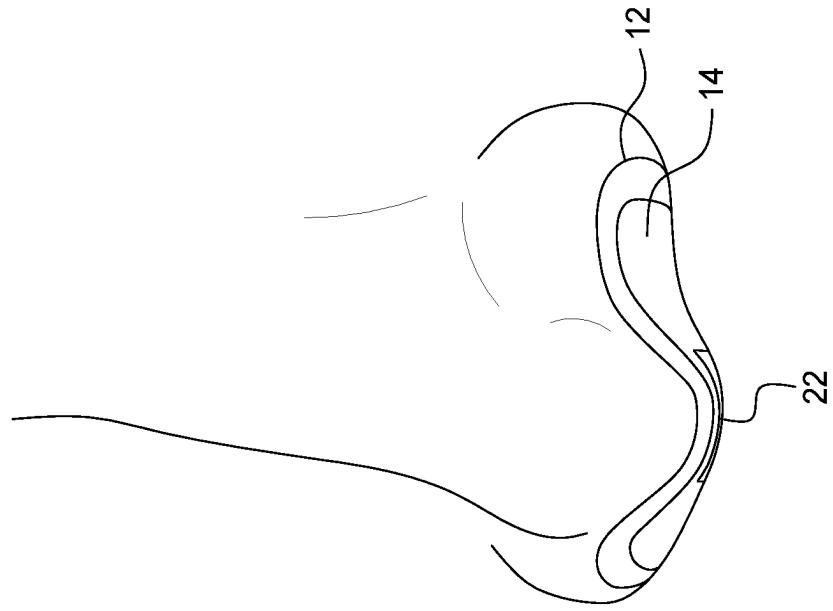


FIG. 4

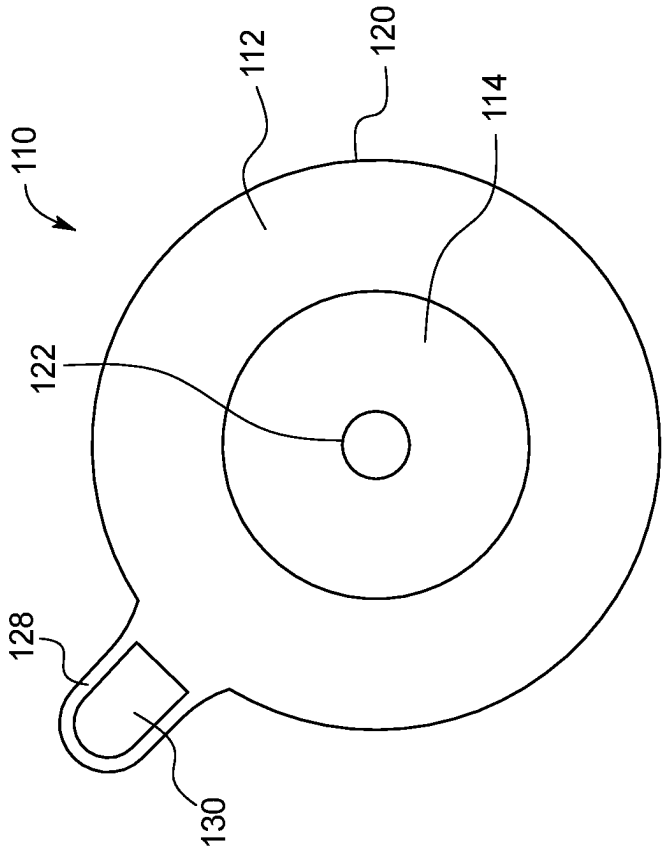
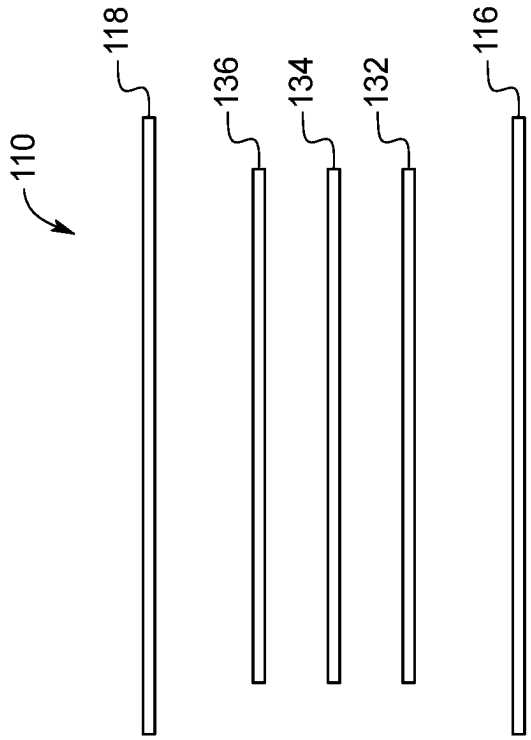


FIG. 6



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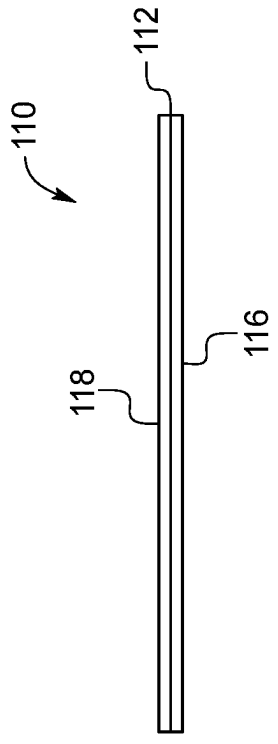

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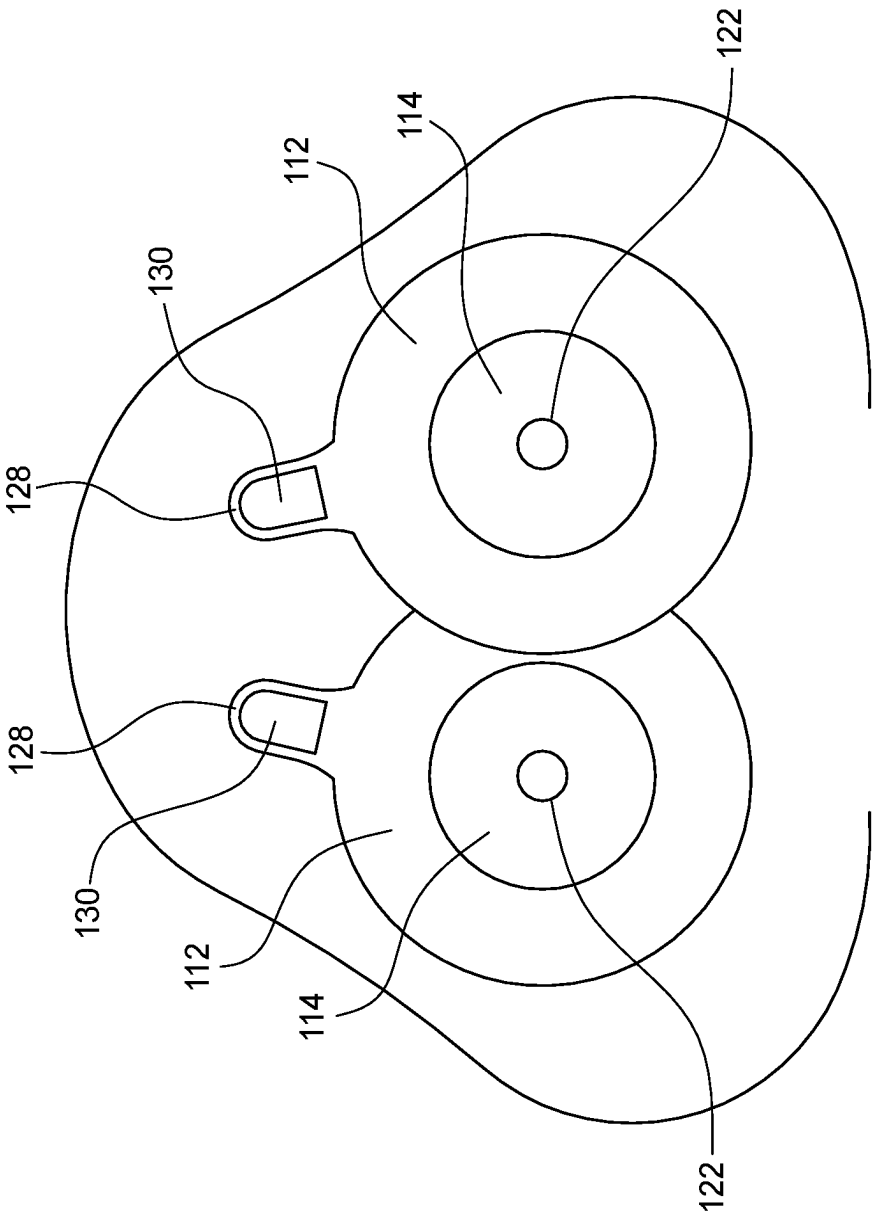

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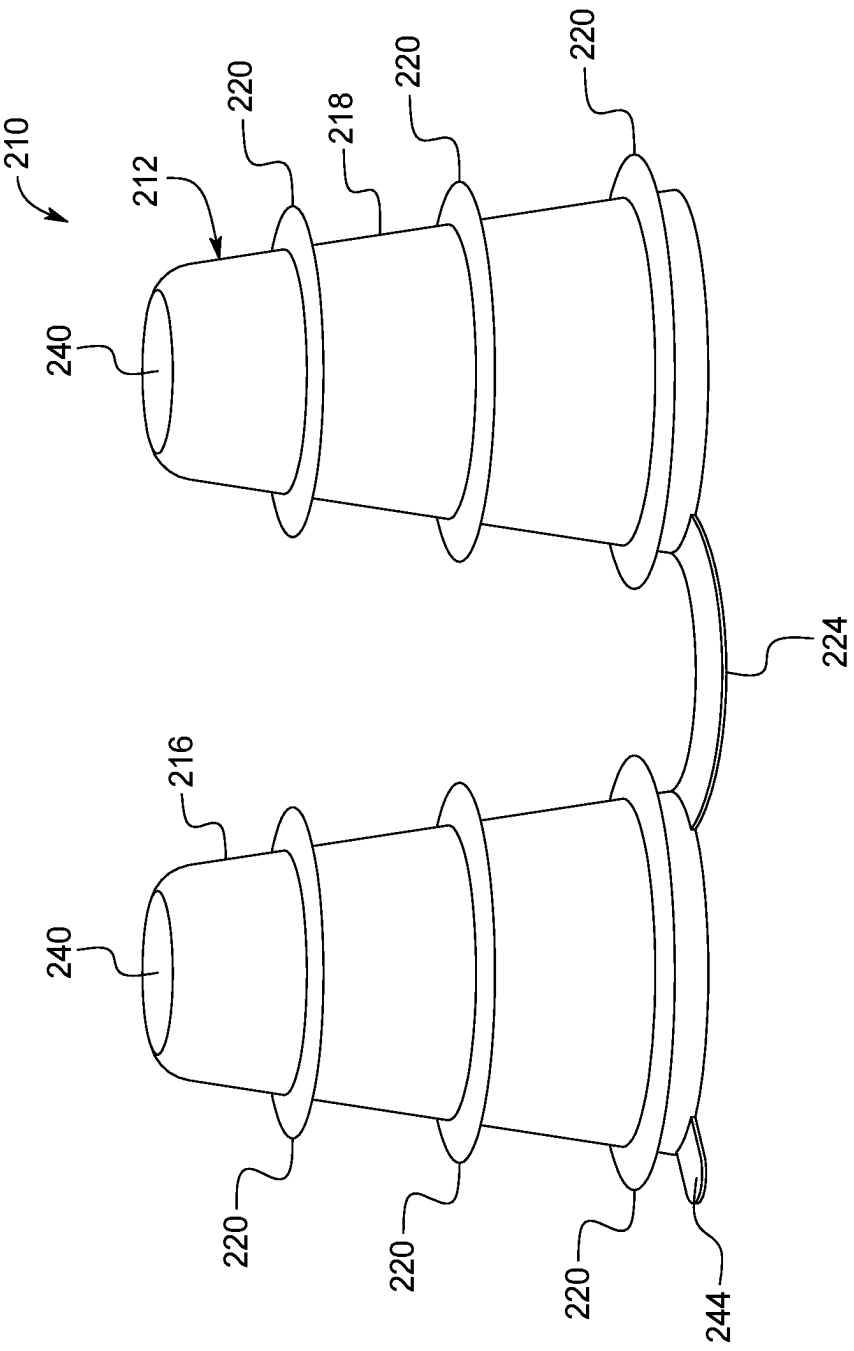

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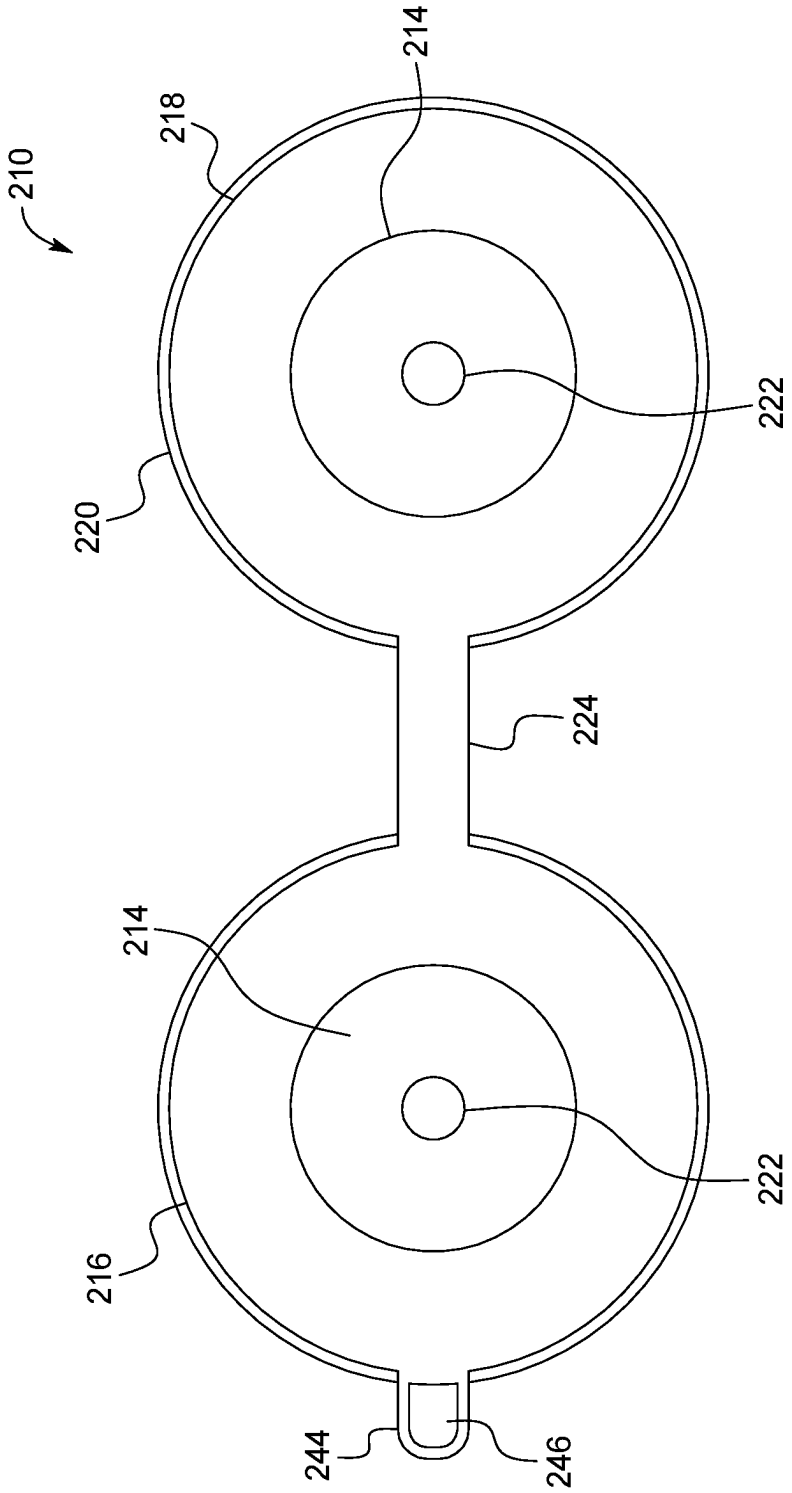

FIG. 11

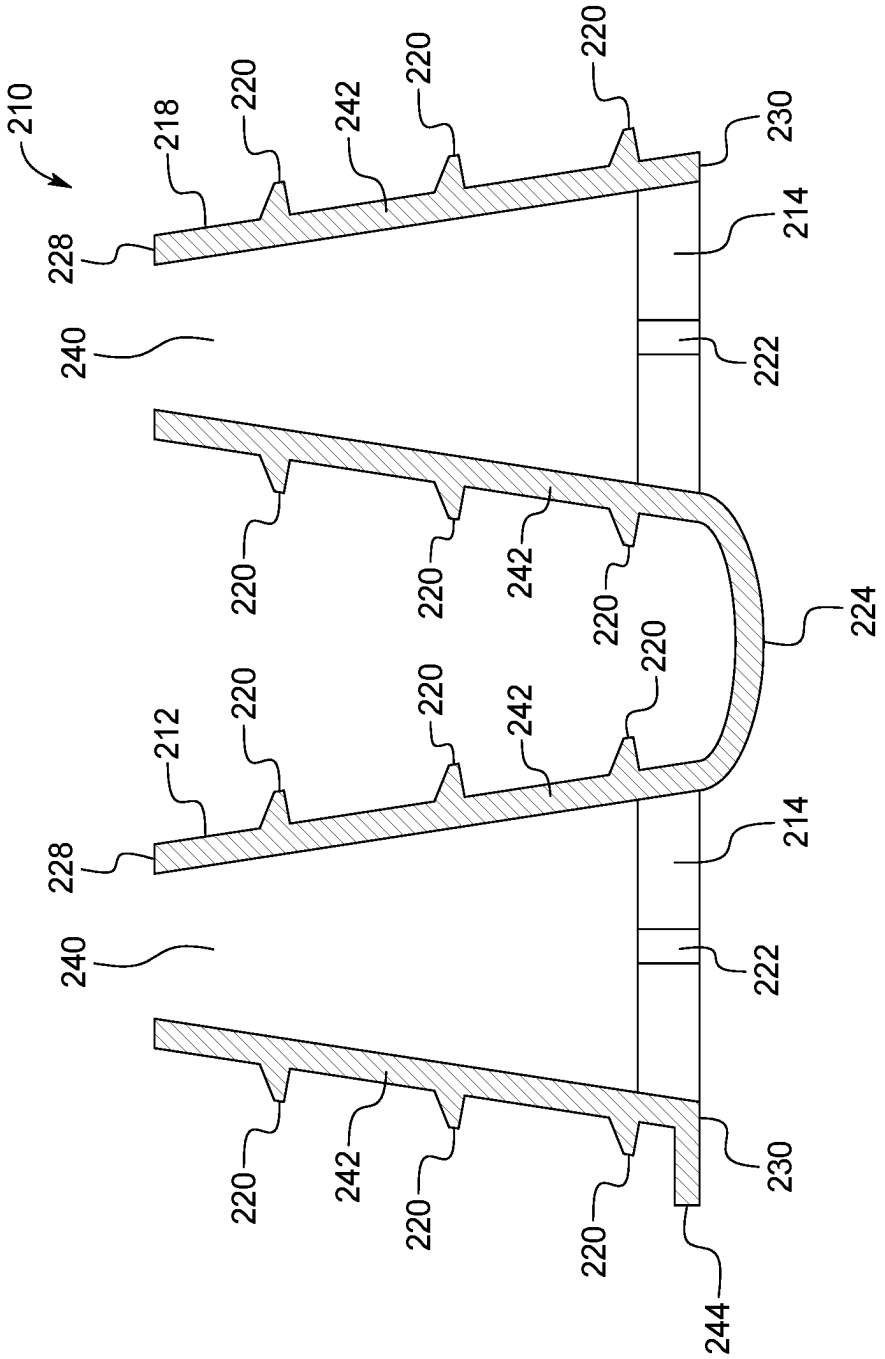
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FIG. 12

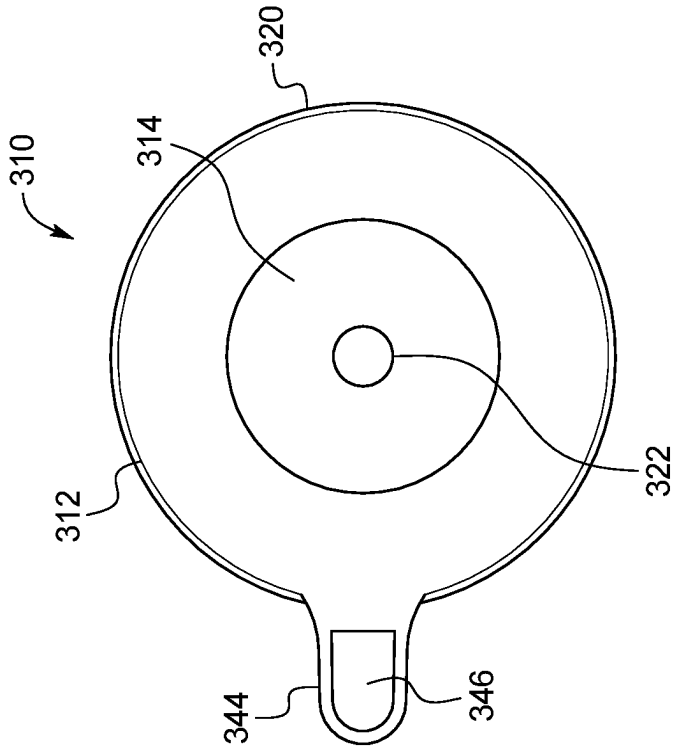
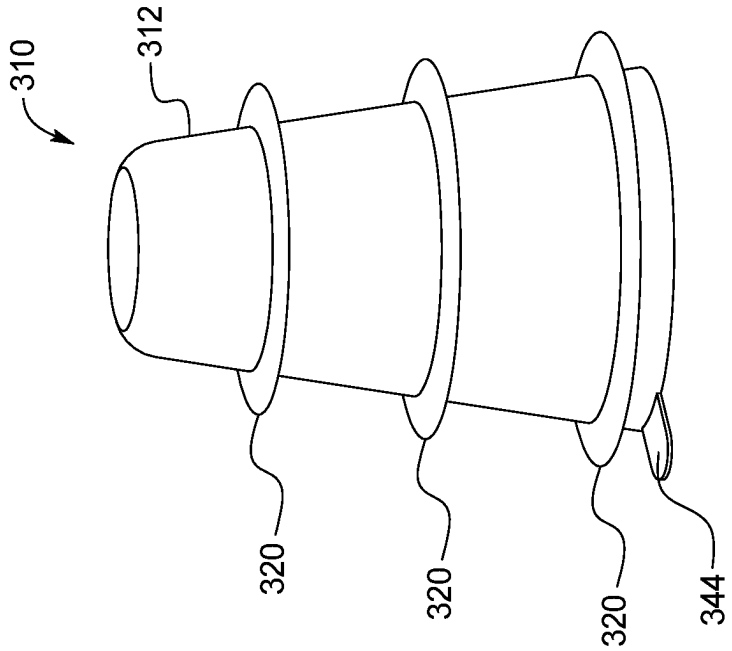


FIG. 14



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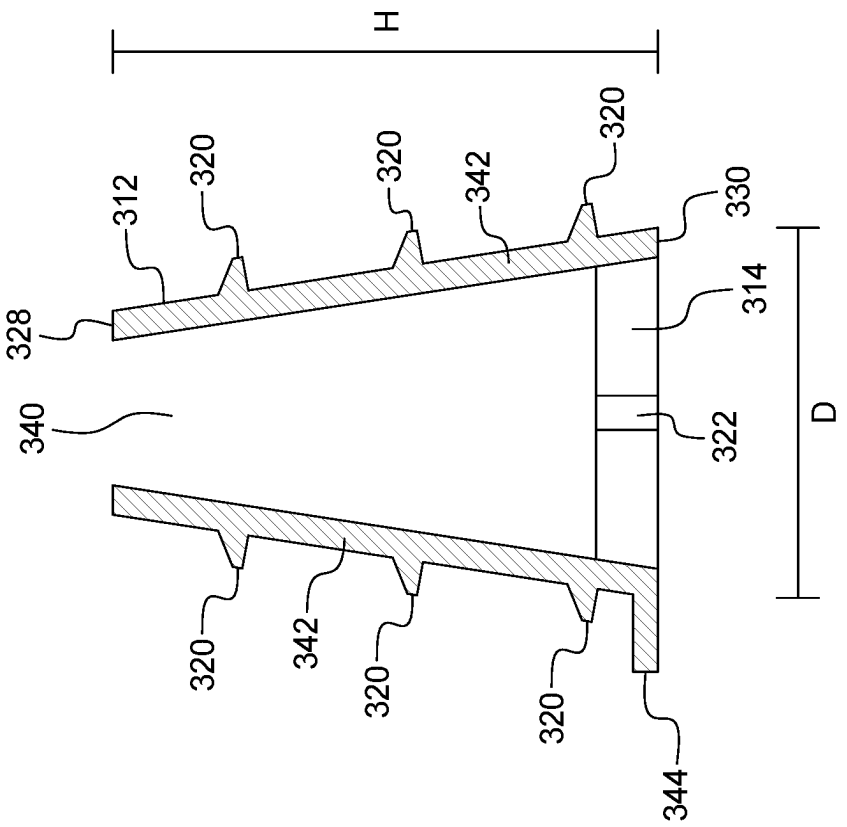

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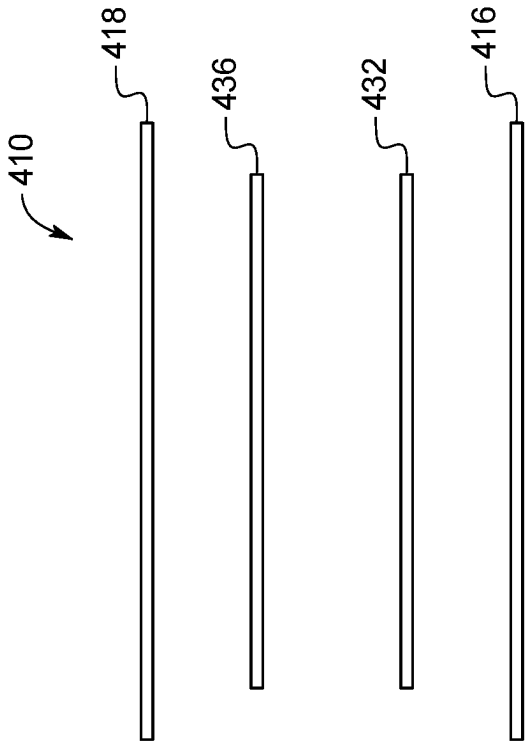


FIG. 17

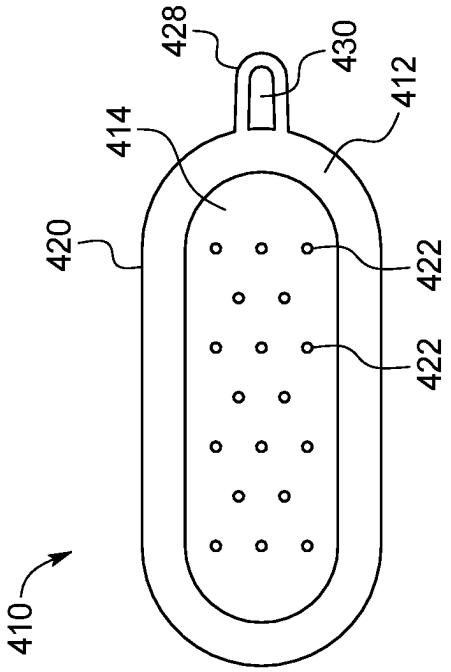


FIG. 16

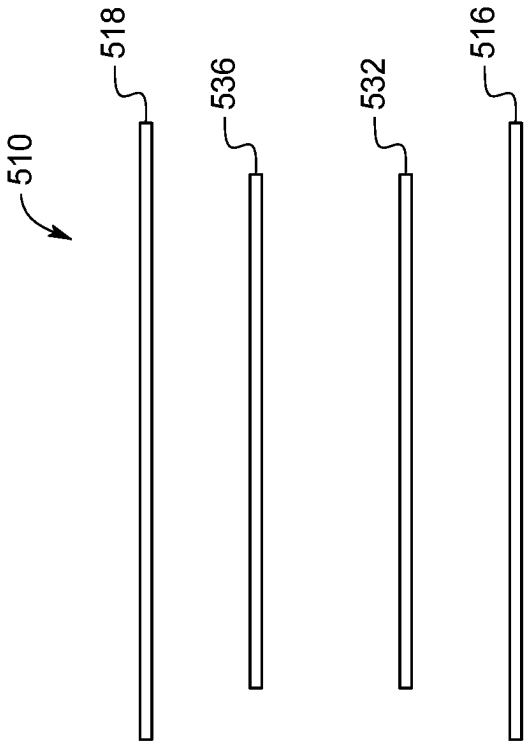


FIG. 19

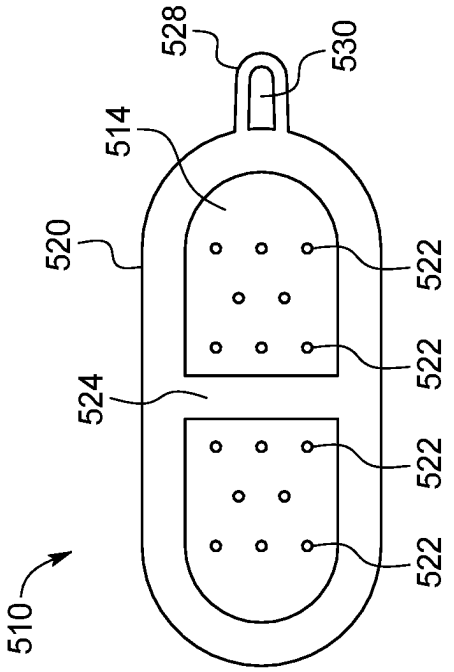


FIG. 18

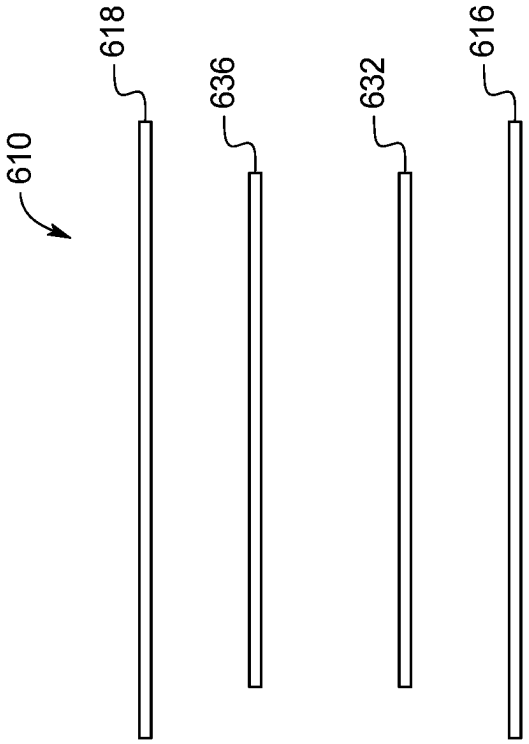


FIG. 21

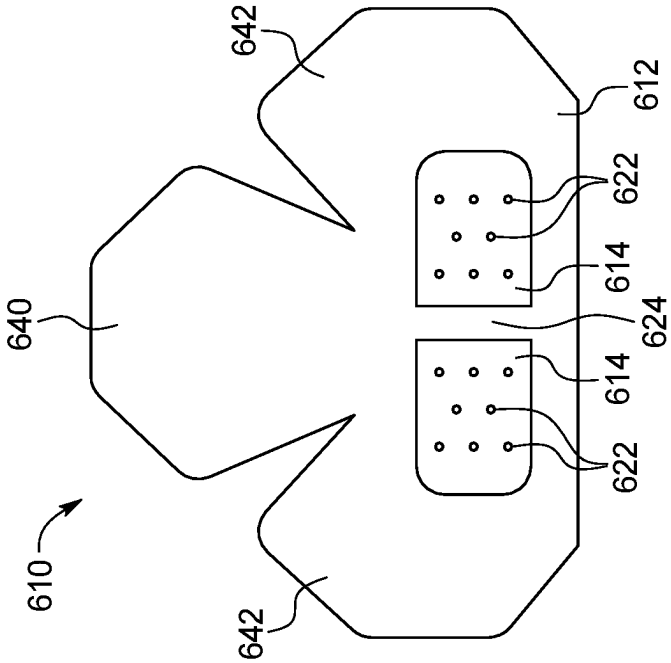
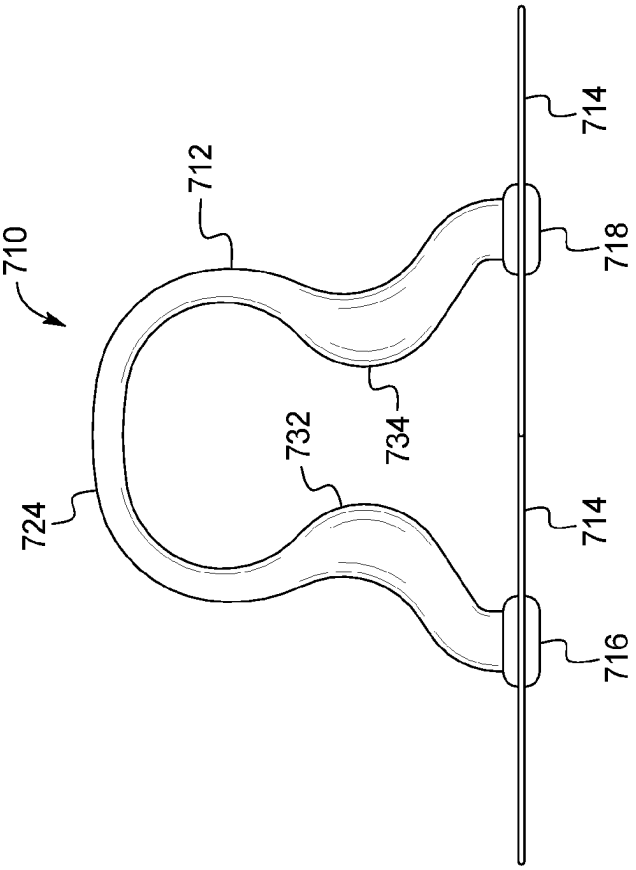


FIG. 20



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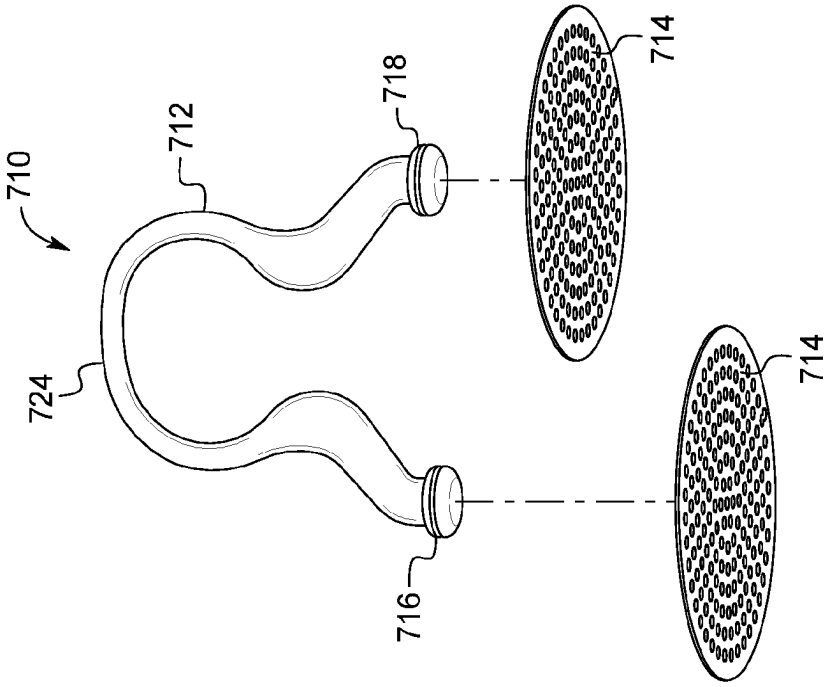

FIG. 22

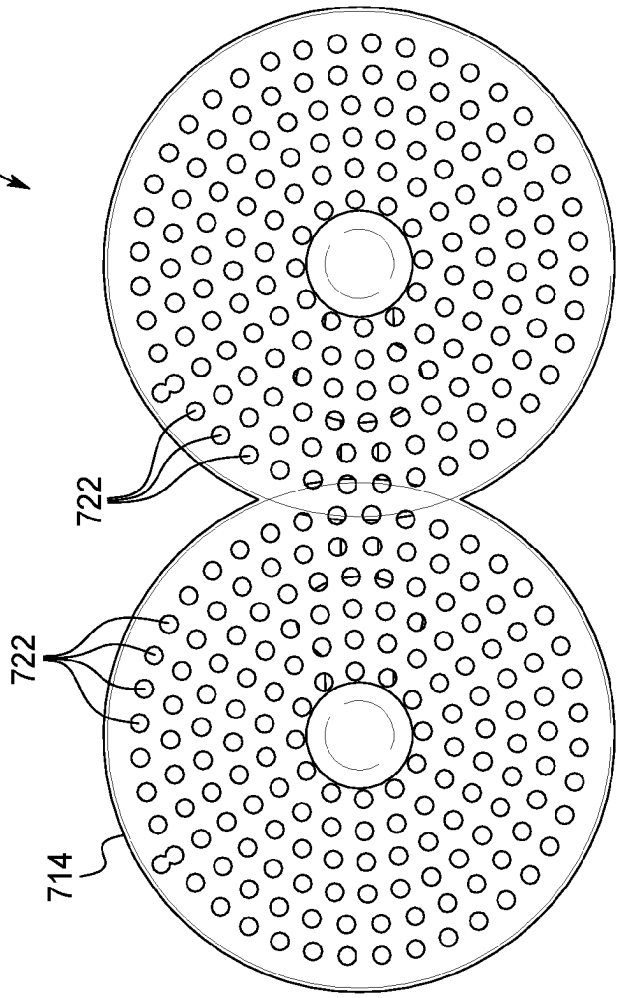

FIG. 25

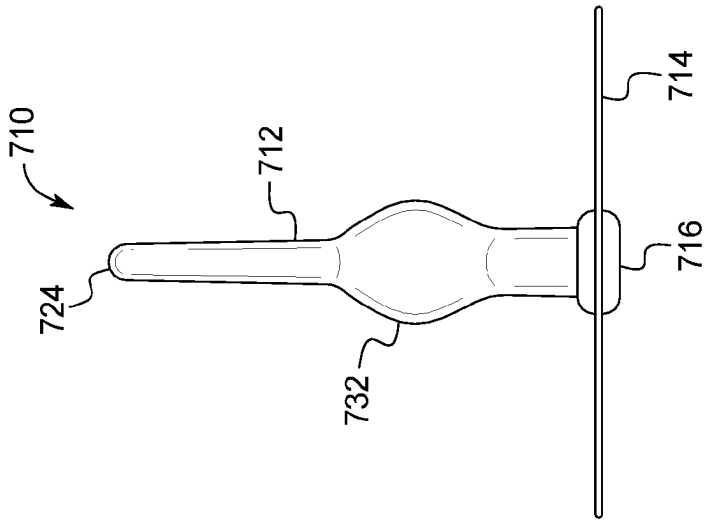

FIG. 24

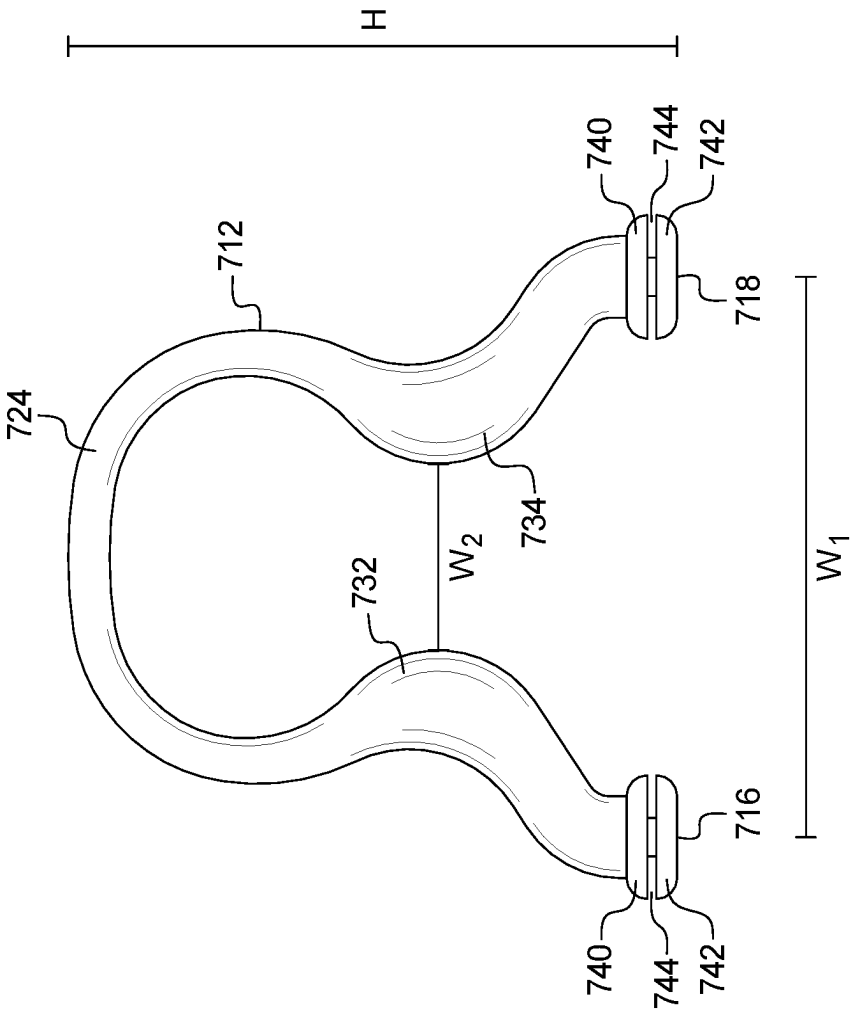

FIG. 26

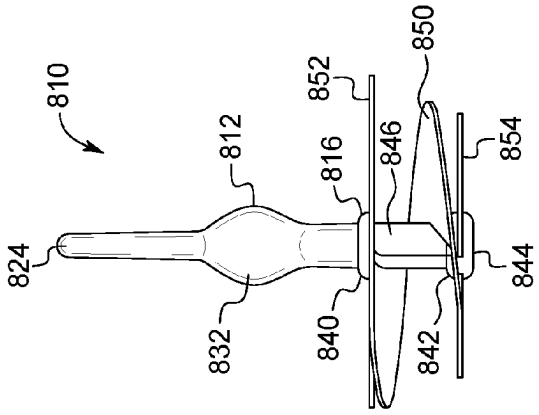

FIG. 28

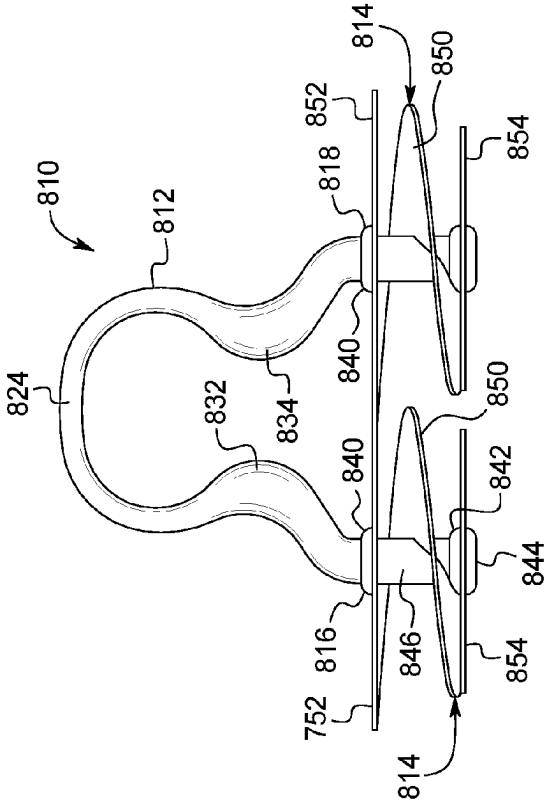

FIG. 27

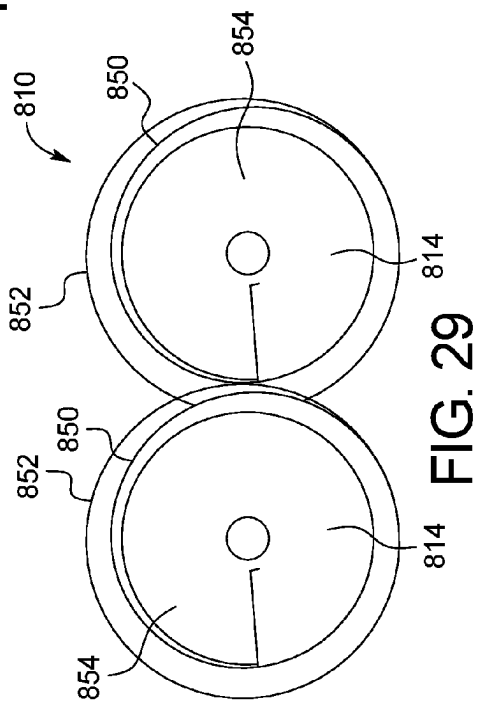

FIG. 29

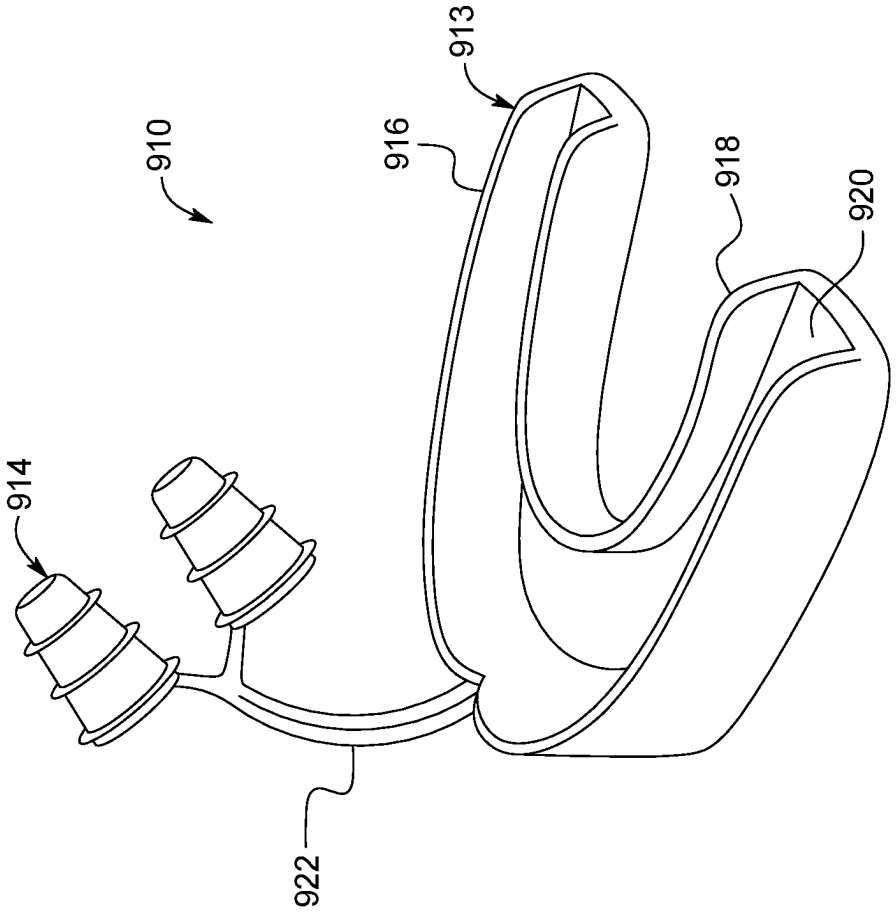

FIG. 30

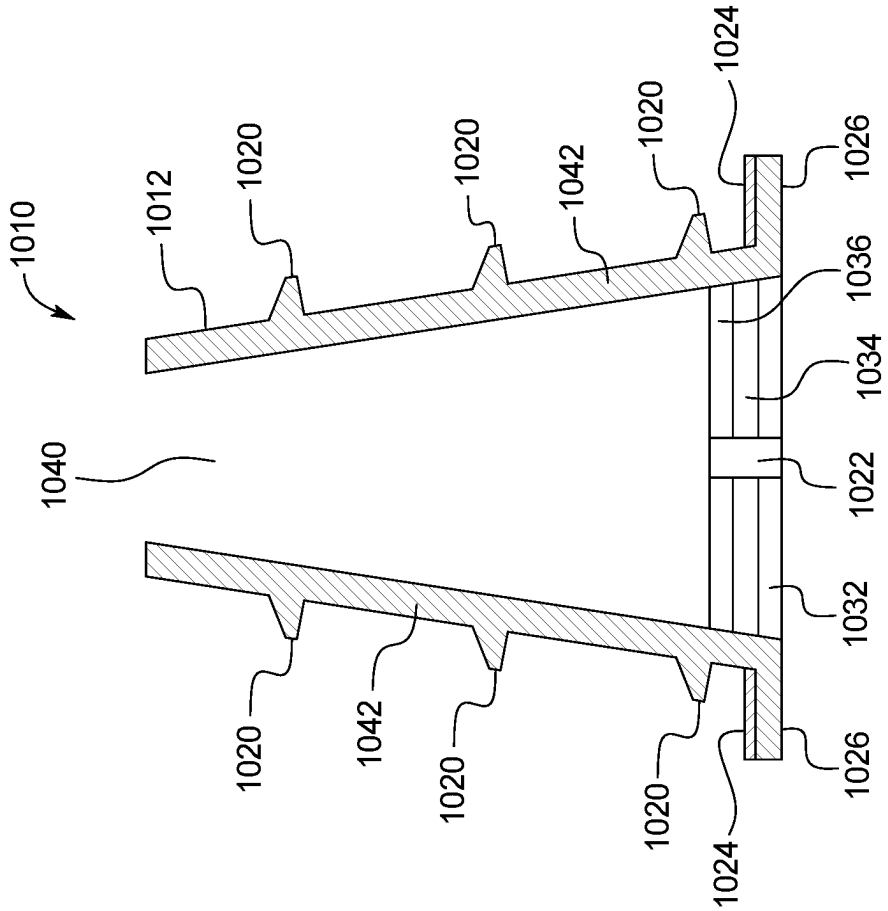
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FIG. 31

NASAL DEVICE WITH AIR FILTER

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a divisional application, claiming benefit of and priority to U.S. Non-Provisional application Ser. No. 15/367,806 filed on Dec. 2, 2016, which claims benefit of and priority to U.S. Provisional patent application Ser. No. 62/262,699 filed on Dec. 3, 2015, each of which are incorporated by reference herein in their entirety.

FIELD OF THE INVENTION

The present disclosure relates generally to a filter that is placed over or into a user's nose to filter air breathed in by the user, and more specifically to a nasal device including the filter that can be attached to the user's nose.

BACKGROUND

Respiratory face masks are worn for a variety of professions. Industrial workers wear respirator masks to filter dust, small particles, pollutants, chemical agents and dangerous gases from the air. Medical workers wear respirator masks as protection against the contraction of infectious diseases.

SUMMARY

The present disclosure is directed to methods and apparatuses that filter air breathed into a user's nose. In a general example embodiment, a nasal device includes a body sized and shaped to be secured to at least one of a user's nostrils, and a filter positioned on the body so as to be located over at least one of the user's nasal passages when the body is secured to the user's at least one nostril, wherein the filter filters air breathed into the user's at least one nasal passage when the body is secured to the user's at least one nostril.

In another example embodiment, the nasal device includes an adhesive to secure the body to the user's at least one nostril.

In another example embodiment, the body pinches the user's septal cartilage to secure the body to the user's at least one nostril.

In another example embodiment, the body is sized and shaped to be secured to both of the user's nostrils.

In another example embodiment, the body includes a narrow portion with opposite bulbous portions on each side, the narrow portion configured to be located over the user's septal cartilage when the bulbous portions are secured to the user's nostrils.

In another example embodiment, the filter is located to cover both of the user's nasal passages when the body is secured to the user's nostrils.

In another example embodiment, the nasal device includes a valve that allows unfiltered air to be breathed out of the user's at least one nasal passage.

In another example embodiment, the filter includes copper or a copper alloy.

In another example embodiment, the body is secured to the user's at least one nostril by being placed within the at least one nasal cavity.

In another example embodiment, the body includes at least one of: (i) a nose tab configured to fold up over the tip of the user's nose when the body is secured to at least one of a user's nostrils; and (ii) a nostril tab configured to fold up over a side of the user's nostril when the body is secured to at least one of a user's nostrils.

In another example embodiment, the nasal device includes a contamination indicator configured to indicate when the filter has been contaminated.

In another example embodiment, the contamination indicator is configured to change color when the filter has been contaminated.

In another general example embodiment, a nasal device includes a body configured to adhere to skin on at least one of a user's nostrils around at least one of the user's nasal passages, and a filter positioned on the body to be located over the user's at least one nasal passage when the body is secured to the user's at least one nostril, wherein the filter filters air breathed into the user's at least one nasal passage when the body is secured to the user's at least one nostril.

In another example embodiment, the nasal device includes a valve that allows unfiltered air to be breathed out of the user's at least one nasal passage.

In another example embodiment, the nasal device includes an adhesive to adhere the body to the user's at least one nostril.

In another example embodiment, the body is configured to adhere to skin on both of the user's nostrils.

In another example embodiment, the body includes a narrow portion with opposite bulbous portions on each side, the narrow portion configured to be located over the user's septal cartilage when the bulbous portions are adhered to skin on the user's nostrils.

In another example embodiment, the filter is located to cover both of the user's nasal passages when the body is adhered to skin on the user's nostrils.

In another example embodiment, the body includes at least one of: (i) a nose tab configured to fold up over the tip of the user's nose when the body is secured to at least one of a user's nostrils; and (ii) a nostril tab configured to fold up over a side of the user's nostril when the body is secured to at least one of a user's nostrils.

In another general example embodiment, a nasal device includes a body configured to pinch a user's septal cartilage, a first filter positioned on the body so as to be located within one of the user's nasal passages when the body pinches the user's septal cartilage, and a second filter positioned on the body so as to be located within the other of the user's nasal passages when the body pinches the user's septal cartilage, wherein the first and second filters filter air breathed into the user's nasal passages when the body pinches the user's septal cartilage.

In another example embodiment, the nasal device includes a valve that allows unfiltered air to be breathed out of the user's at least one nasal passage

In another example embodiment, the first filter overlaps the second filter before the body pinches the user's septal cartilage.

In another example embodiment, the body includes a bridge with opposite bulbous portions on each side, the bulbous portions configured to pinch the user's septal cartilage.

In another example embodiment, the first and second filters each include a top portion, a bottom portion, and a middle portion spiraling around the body from the top portion to the bottom portion

In another example embodiment, the nasal device includes a contamination indicator configured to indicate when the filter has been contaminated.

In another example embodiment, the contamination indicator is configured to change color when the filter has been contaminated.

In another general example embodiment, a nasal device includes an upper body sized and shaped to be secured to at least one of the user's nostrils, the upper body including a filter configured to filter air breathed into the user's at least one nostril when the body is secured to the user's at least one nostril, and a lower body attached to the upper body, the lower body configured to be placed in the user's mouth while the upper body is secured to the user's at least one nostril.

In another general example embodiment, a kit for filtering a user's breathing includes a first nasal device sized and shaped to be placed into one of the user's nasal passages, the first nasal device including a first filter to filter air breathed into the one of the user's nasal passages, and a second nasal device sized and shaped to be placed into one of the user's nasal passages, the second nasal device including a second filter to filter air breathed into the other of the user's nasal passages, wherein the first nasal device and the second nasal device differ in at least one of (i) a size of the first and second nasal devices; (ii) a shape of the first and second nasal devices; (iii) a material of the first and second nasal devices; (iv) a size of the first and second filters; (v) a shape of the first and second filters; and (vi) a material of the first and second filters.

In another example embodiment, the first and second nasal devices differ in height.

In another example embodiment, the first and second nasal devices differ in diameter.

In another example embodiment, the first and second nasal devices differ in shape.

In another example embodiment, a body of the first nasal device is formed from a different material than a body of the second nasal device.

In another example embodiment, the first and second filters differ in size.

In another example embodiment, the first and second filters differ in shape.

In another example embodiment, the first and second filters differ in at least one material.

BRIEF DESCRIPTION OF THE FIGURES

Embodiments of the present disclosure will now be explained in further detail by way of example only with reference to the accompanying figures, in which:

FIG. **1** shows a front elevational view of an example embodiment of a nasal device according to the present disclosure;

FIG. **2** shows a side elevational view of the nasal device of FIG. **1**;

FIG. **3** shows an exploded view of the nasal device of FIG. **1**;

FIG. **4** shows a front perspective view of a user using the nasal device of FIG. **1** to filter air breathed in by the user;

FIG. **5** shows a side perspective view of a user using the nasal device of FIG. **1** to filter air breathed in by the user;

FIG. **6** shows a front elevational view of an example embodiment of a nasal device according to the present disclosure;

FIG. **7** shows a side elevational view of the nasal device of FIG. **6**;

FIG. **8** shows an exploded view of the nasal device of FIG. **6**;

FIG. **9** shows a bottom view of a user using the nasal device of FIG. **6** to filter air breathed in by the user;

FIG. **10** shows a front perspective view of an example embodiment of a nasal device according to the present disclosure;

FIG. **11** shows a bottom plan view of the nasal device of FIG. **10**;

FIG. **12** shows a front cross-sectional view of the nasal device of FIG. **10**;

FIG. **13** shows a front perspective view of an example embodiment of a nasal device according to the present disclosure;

FIG. **14** shows a bottom plan view of the nasal device of FIG. **13**;

FIG. **15** shows a front cross-sectional view of the nasal device of FIG. **13**;

FIG. **16** shows a front elevational view of an example embodiment of a nasal device according to the present disclosure;

FIG. **17** shows an exploded view of the nasal device of FIG. **16**;

FIG. **18** shows a front elevational view of an example embodiment of a nasal device according to the present disclosure;

FIG. **19** shows an exploded view of the nasal device of FIG. **18**;

FIG. **20** shows a front elevational view of an example embodiment of a nasal device according to the present disclosure;

FIG. **21** shows an exploded view of the nasal device of FIG. **20**;

FIG. **22** shows an exploded perspective view of an example embodiment of a nasal device according to the present disclosure;

FIG. **23** shows a front elevational view of the nasal device of FIG. **22**;

FIG. **24** shows a side elevational view of the nasal device of FIG. **22**;

FIG. **25** shows a bottom plan view of the nasal device of FIG. **22**;

FIG. **26** shows a front elevational view of the body of the nasal device of FIG. **22**;

FIG. **27** shows a front elevational view of an example embodiment of a nasal device according to the present disclosure;

FIG. **28** shows a side elevational view of the nasal device of FIG. **27**;

FIG. **29** shows a bottom plan view of the nasal device of FIG. **27**;

FIG. **30** shows a front perspective view of an example embodiment of a nasal device according to the present disclosure; and

FIG. **31** shows a front cross-sectional view of an example embodiment of a nasal device according to the present disclosure.

DETAILED DESCRIPTION

Before the disclosure is described, it is to be understood that this disclosure is not limited to the particular apparatuses and methods described. It is also to be understood that the terminology used herein is for the purpose of describing particular embodiments only, and is not intended to be limiting, since the scope of the present disclosure will be limited only to the appended claims.

As used in this disclosure and the appended claims, the singular forms "a," "an" and "the" include plural referents

unless the context clearly dictates otherwise. The methods and apparatuses disclosed herein may lack any element that is not specifically disclosed herein. Thus, "comprising," as used herein, includes "consisting essentially of" and "consisting of."

FIGS. **1** to **3** illustrate an example embodiment of a nasal device **10** according to the present disclosure. In the illustrated embodiment, nasal device **10** includes a body **12** that can be secured over a user's nasal passages and a filter **14** that filters air breathed into the user's nose.

Body **12** is a thin, flexible, preferably elastic material that can be bent or adjusted to fit a variety of differently shaped nostrils. As explained in more detail below, air breathed in by a user of nasal device **10** should only pass through filter **14**, so body **12** must be formed of an airtight material. Suitable materials include, for example, paper, plastic such as PVC, polyethylene or polyurethane, woven or nonwoven fabrics, or latex. Those of ordinary skill in the art will recognize other suitable materials that can be used for body **12**.

In the illustrated embodiment, body **12** includes an adhesive surface **16** and an outer surface **18**. The adhesive surface **16** is configured adhere to the skin on the user's nostrils around the user's nasal passages to align filter **14** over the user's nasal passages. The outer surface **18** is configured to face outward from the user's skin when nasal device **10** is being used. The adhesive surface **16** can either be an adhesive applied to the outer surface **18**, or a layer of material separate from the outer surface **18** that contains adhesive and is attached to the outer surface **18**. In a preferred embodiment, the adhesive surface **16** is a soft foam surface with adhesive applied to the soft foam. Suitable materials for the adhesive include, for example, acrylate or vinyl resins such as methacrylates or epoxy diacrylates. Those of ordinary skill in the art will recognize other suitable materials that can be used for adhesive surface **16**.

In the embodiment illustrated in FIG. **1**, body **12** has an outer contour **20** in the shape of a figure-eight, with two opposite bulbous portions **24** separated by a thinner central portion **26**. The purpose of the outer contour **20** of body **12** is to closely match the contour of a user's nostrils on the bottom of the user's nose, with central portion **26** positioned over the user's septal cartilage when placed on the user's nose. Since air breathed in by the user should only pass through filter **14**, the outer contour **20** of body **12** should be sized and shaped to press against the skin on the user's nostrils around the user's nasal passages, so that air cannot be breathed in through the user's nostrils without the air passing through filter **14**. Those of ordinary skill in the art will understand that other sizes and shapes can also be used for body **12**.

Filter **14** can include, for example, an air-permeable, mesh or grid-like, porous structure that can be breathed through by the wearer and that is configured to filter dust, small particles, pollutants, chemical agents, dangerous gases and/or microorganisms from the air breathed by the wearer. In an embodiment, filter **14** can include copper or a copper alloy. It has been determined that copper and copper alloys are effective in inactivating certain viruses, for example, human coronavirus. In a preferred embodiment, filter **14** therefore includes at least one layer of a copper mesh material. In an embodiment, filter **14** can include at least one layer of copper oxide-impregnated polypropylene fibers. Filter **14** can also include at least one layer of a woven or non-woven material that itself acts as a filter or is treated to filter dust, small particles, pollutants, chemical agents, dangerous gases and/or microorganisms from the air breathed by the wearer. In an embodiment, filter **14** can be treated with an antimicrobial material. Those of ordinary skill in the art will recognize other materials that can be used for filter **14** besides those described herein. In alternative embodiments, filter **14** can include or exclude one or more of a ferrous metal, a non-ferrous metal, a noble metal, a heavy metal and a metal alloy. For example, filter **14** can include metals such as aluminum, iron, nickel, cobalt, silver and/or the like.

In an embodiment, filter **14** can include a textile or another material and be treated with particles or a chemical such as a liquid microbial. For example, filter **14** can include one ore more layer of spunbond polypropylene with impregnated copper oxide particles or meltblown polypropylene with impregnated copper oxide particles. Particles from other metals such as aluminum, iron, nickel, cobalt, silver and/or the like can also be used. The particles can be, for example, microparticles or nanoparticles. In alternative embodiments, the particles can be embedded in a textile or other material via a chemical treatment process, a sonochemical process or an acoustic cavitation process. For example, the particles can be embedded in a textile or other material via ultrasound.

In an embodiment, filter **14** can include one or more layers **32**, **34**, **36**. FIG. **3** shows an example embodiment of filter **14** being formed with three layers between adhesive surface **16** and outer surface **18**. As illustrated, first layer **32**, second layer **34** and third layer **36** can be surrounded by adhesive layer **16** and outer layer **18** to form the configuration shown in FIG. **2**. Those of ordinary skill in the art will recognize other suitable shapes, sizes and materials that can be used to design a nasal device **10** according to the present disclosure.

In different embodiments, each of one or more layers **32**, **34**, **36** can be a fabric layer such as a woven or nonwoven fabric or can be a hardened liquid material. In an embodiment, one layer **32**, **34**, **36** can for example include copper or a copper allow, while another layer **32**, **34**, **36** can be for example a woven or nonwoven material treated with a microbial or another composition. In another embodiment, one layer **32**, **34**, **36** can for example be made of a woven or nonwoven material, while another layer **32**, **34**, **36** can be a hardened liquid layer of a microbial or another treatment composition. In another embodiment, the middle layer **34** can for example be made of a woven or nonwoven material, while one or more outer layers **32**, **36** can be hardened liquid layers of a microbial or another treatment composition. Those of ordinary skill in the art will recognize other ways to arrange multiple layers **32**, **34**, **36**.

Body **12** can further include a tab **28** protruding from the outer contour **20**. In the illustrated embodiment, tab **28** includes a contamination indicator/sensor **30**. In an embodiment, contamination indicator **30** includes a specialized color-changing ink which changes color in the presence of known viruses and airborne bacteria. Upon contamination of nasal device **10**, contamination indicator **30** changes color to indicate that the nasal device **10** needs to be replaced, changed, and/or properly disposed. Contamination indicator **30** can also change to different colors to indicate the level of microbial contamination or pollution. In an embodiment, contamination sensor **30** can be printed or stamped onto tab **28** or another external surface of nasal device **10**. Tab **28** can also be used by a user to more easily remove nasal device **10** from the user's nose after use.

In an embodiment, the user of nasal device **10** can take a picture of his or her own face while wearing nasal device **10**, and a computer-based application associated with the camera can perform a color analysis of the contamination indicator **30** to alert the user if nasal device **10** needs to be

replaced. The camera application is advantageous, for example, because it allows the user to analyze nasal device **10**/color indicator **30** without having to touch and potentially contaminate nasal device **10**. In an embodiment, the application can indicate the level of contamination of nasal device **10** (e.g., 25%, 75%). In an embodiment, the application is a cellular phone application.

As illustrated in FIG. **1**, nasal device **10** can also optionally include a microvalve **22** that permits unfiltered air to be breathed out by the user. In an embodiment, microvalve **22** is a one-way valve, wherein air can be exhaled through microvalve **22**, but cannot be inhaled through microvalve **22**. That is, air can flow through microvalve **22** in the direction from adhesive surface **16** towards outer surface **18**, but not in the direction from outer surface **18** towards adhesive surface **16**. Microvalve **22** is advantageous because it allows air to escape the user's nose more freely than if the air were to pass through filter **14**, which provides a more normal breathing experience for the user when the purpose of filter **14** is only to filter air inhaled by the user.

FIGS. **4** and **5** shows nasal device **10** after it has been placed underneath a user's nose. As illustrated, nasal device **10** has been adhered to the bottom of the user's nose so that central portion **24** is positioned over the user's septal cartilage, and so that bulbous portions **22** adhere to the skin on the user's nostrils around the user's nasal passages. The positioning shown in FIGS. **4** and **5** positions filter **14** over the user's nasal passages so that the user can breathe through filter **14**.

FIGS. **6** to **8** illustrate an alternative embodiment of a nasal device **110** according to the present disclosure. In the illustrated embodiment, nasal device **110** includes a body **112** that can be secured over a user's nasal passage and a filter **114** that filters air breathed into the user's nose. Nasal device **110** may also optionally include a microvalve **122** that permits unfiltered air to be breathed out by the user. In an embodiment, microvalve **122** is a one-way valve, wherein air can be exhaled through microvalve **122**, but cannot be inhaled through microvalve **122**.

Body **112** is a thin, flexible, preferably elastic material that can be bent or adjusted to fit a variety of differently shaped nostrils. Since air should only pass through filter **114** of nasal device **110** when the user is breathing in, body **112** must be formed of an airtight material. Suitable materials include, for example, paper, plastic such as PVC, polyethylene or polyurethane, woven or nonwoven fabrics, or latex. Those of ordinary skill in the art will recognize other suitable materials that can be used for body **112**.

In the illustrated embodiment, body **112** includes an adhesive surface **116** and an outer surface **118**. The adhesive surface **116** is configured adhere to the skin on the user's nostril around the user's nasal passage to align filter **114** over the user's nasal passage. The outer surface **118** is configured to face outward from the user's skin when nasal device **110** is being used. The adhesive surface **116** can either be an adhesive applied to the outer surface **116**, or a layer of material separate from the outer surface **118** that contains adhesive and is attached to the outer surface **118**. In a preferred embodiment, the adhesive surface **116** is a soft foam surface with adhesive applied to the soft foam. Suitable materials for the adhesive include, for example, acrylate or vinyl resins such as methacrylates or epoxy diacrylates. Those of ordinary skill in the art will recognize other suitable materials that can be used for adhesive surface **116**.

In the embodiment illustrated in FIG. **6**, the outer contour **120** of body **112** has a circular shape. The purpose of the circular shape is to closely match one of the user's nostrils, so that filter **114** can be positioned over one of the user's nasal cavities and completely cover the nasal cavity. In use, two of the nasal devices **110** are used by the user at the same time, with the user placing one nasal device **110** over each nostril such that the nasal devices **110** overlap at the user's septal cartilage. Those of ordinary skill in the art will understand that other sizes and shapes can be used for body **112**.

Body **112** can further include a tab **128** protruding from the outer contour **20**. In the illustrated embodiment, tab **128** includes a contamination indicator/sensor **130**. In an embodiment, contamination indicator **130** includes a specialized color-changing ink which changes color in the presence of known viruses and airborne bacteria. Upon contamination of nasal device **110**, contamination indicator **130** changes color to indicate that the nasal device **110** to be replaced, changed, and/or properly disposed. Contamination indicator **130** can also change to different colors to indicate the level of microbial contamination or pollution. In an embodiment, contamination sensor **130** can be printed or stamped onto tab **128** or another external surface of nasal device **110**. Contamination indicator **130** can also be associated with a computer-based application as described above. Tab **128** can also be used by a user to more easily remove nasal device **110** from the user's nose after use.

Filter **114** can be formed as described above for filter **14**. Like with nasal device **10**, filter **114** of each nasal device **110** can include, for example, an air-permeable, mesh or grid-like, porous structure that can be breathed through by the wearer and that is configured to filter dust, small particles, pollutants, chemical agents, dangerous gases and/or microorganisms from the air breathed by the wearer. In an embodiment, filter **114** can include copper or a copper alloy or another material as described above. Those of ordinary skill in the art will recognize other materials that can be used. In alternative embodiments, filter **114** can include or exclude one or more of a ferrous metal, a non-ferrous metal, a noble metal, a heavy metal and a metal alloy. For example, filter **114** can include metals such as aluminum, iron, nickel, cobalt, silver and/or the like. Filter **114** can also be formed of one or more layers **132**, **134**, **136** as described above with respect to filter **14**.

FIG. **9** shows two nasal devices positioned on a user's nose, such that the two nasal devices **110** overlap at the user's septal cartilage. As illustrated, each nasal device **110** covers one of the user's nasal passages by adhering to the skin of the user's nostril around the nasal passage. The use of two nasal devices **110**, as compared to one nasal device **10** described above, can be advantageous because it allows users with irregularly shaped nostrils to position the two nasal devices **110** in a preferred manner. The user could also use different sized or shaped nasal devices **110** to cover different sized and shaped nostrils on the same nose. In an embodiment, a kit could be prepared for a user with a variety of nasal devices **110** of different shapes and sizes, and the user could determine which of the nasal devices **110** to use. The variety of different shapes and sizes can include, for example, different diameters for outer contour **120** and/or different shapes for outer contour **120**. Different nasal devices **110** could also have different filter types (different shapes, sizes, materials, etc.) so that the user could use different types of filters in different settings.

FIGS. **10** to **12** illustrate an alternative embodiment of a nasal device **210** according to the present disclosure. In the illustrated embodiment, nasal device **210** includes a body **212** that can be placed into the user's nasal passages and a filter **214** that filters air breathed into the user's nose. When

body **212** is placed into the user's nasal passages, body **212** provides an airtight seal of the user's nasal passages such that all air breathed in by the user must pass through filter **214**

In the illustrated embodiment, body **212** includes a first nostril plug **216** and a second nostril plug **218**, which are cone-shaped in FIG. **10**. In use, the first nostril plug **216** is placed into the user's left nasal passage, and the second nostril plug **218** is placed into the user's right nasal passage, or vice versa. The first and second nostril plugs **216**, **218** are connected by a bridge **224** that that is located over the user's septal cartilage when nasal device **210** is being used. Bridge **224** helps hold the first and second nostril plugs **216**, **218** in place when placed in the user's nasal passages.

The first and second nostril plugs **216**, **218** can be secured to the user's nostrils in a variety of ways to provide an airtight seal of the user's nasal passages such that all air breathed in by the user must pass through filter **214**. In the illustrated embodiment, each of the first and second nostril plugs **216**, **218** includes a plurality of flexible ribs **220** that conform to the inside of the user's nasal passages as the nostril plugs **216**, **218** are inserted into the nasal passages, so as to anchor nasal device **210** within the user's nasal passages. In an embodiment, the ribs **220** can form a continuous spiral around a nostril plug **216**, **218**. In another embodiment, the first and second nostril plugs **216**, **218** can be made of a flexible material such as a foam material that is capable of conforming to the inside of the user's nasal passages when inserted into the user's nostrils, and then returning to an original shape when removed from the user's nostrils. Suitable foam materials include, for example, plastic, urethane, polyurethane and other similar materials. Those of ordinary skill in the art will recognize other suitable materials that can be used.

Filter **214** can be formed as described above for filter **14**. Like with nasal device **10**, filter **214** can include, for example, an air-permeable, mesh or grid-like, porous structure that can be breathed through by the wearer and that is configured to filter dust, small particles, pollutants, chemical agents, dangerous gases and/or microorganisms from the air breathed by the wearer. In an embodiment, filter **214** can include copper or a copper alloy or another material as described above. Those of ordinary skill in the art will recognize other materials that can be used. In alternative embodiments, filter **214** can include or exclude one or more of a ferrous metal, a non-ferrous metal, a noble metal, a heavy metal and a metal alloy. For example, filter **214** can include metals such as aluminum, iron, nickel, cobalt, silver and/or the like. Filter **214** can also be formed of one or more layers as described above with respect to filter **14**.

In the illustrated embodiment, filter **214** is located at the base **230** of each of first nostril plug **216** and second nostril plug **218** so that any air that passes through internal cavity **240** must pass through filter **214**. Locating filter **214** at the base **230** of the first and second nostril plugs **216**, **218** advantageously allows filter **214** to be a larger size than if it were located at an intermediate location or at the top of internal cavity **240**, which allows more air to pass through filter **214**. Those of ordinary skill in the art will recognize, however, that filter **214** can be located anywhere within internal cavity **240** and still serve its purpose to filter air breathed in by the user.

Nasal device **210** can also optionally include a microvalve **222** that permits unfiltered air to be breathed out by the user. In an embodiment, microvalve **222** is a one-way valve, wherein air can be exhaled through microvalve **222**, but cannot be inhaled through microvalve **222**. That is, air can flow through microvalve **222** in the direction from top surface **228** towards base **230**, but not in the direction from base **230** towards top surface **228**. In the illustrated embodiment, microvalve **222** is located in the center of filter **214**, but microvalve **222** can also be located in other locations, for example, along a sidewall **242** of the first and second nostril plugs **216**, **218**.

In an embodiment, body **212** can further include a tab **244** including a contamination indicator/sensor **246**. In an embodiment, contamination indicator **246** includes a specialized color-changing ink which changes color in the presence of known viruses and airborne bacteria. Upon contamination of nasal device **210**, contamination indicator **246** changes color to indicate that the nasal device **210** needs to be replaced, changed, and/or properly disposed. Contamination indicator **246** can also change to different colors to indicate the level of microbial contamination or pollution. In an embodiment, contamination sensor **246** can be printed or stamped onto tab **244**, or can be printed or stamped on another external surface of nasal device **210**. Contamination indicator **230** can also be associated with a computer-based application as described above.

FIGS. **13** to **15** illustrate an alternative embodiment of a nasal device **310** according to the present disclosure. In the illustrated embodiment, nasal device **310** includes a body **312** that can be placed into one of the user's nasal passages and a filter **314** that filters air breathed into the user's nasal passage. When body **312** is placed into the user's nasal passage, body **312** provides an airtight seal of the nasal passage such that all air breathed in by the user must pass through filter **314**. In use, two of the nasal devices **310** are used by the user at the same time, with the user placing one nasal device **310** in each nasal passage such that the user cannot breathe in through his or her nose unless the air passes through a filter **314**.

Nasal device **310** can be secured to the user's nostril in a variety of ways. In the illustrated embodiment, body **312** is cone-shaped and includes a plurality of flexible ribs **320** that conform to the inside of the user's nasal passage as nasal device **310** is inserted into the nasal passage, so as to anchor nasal device **310** within the nasal passage. In an embodiment, the ribs **320** can form a continuous spiral around body **312**. In another embodiment, body **312** can be made of a flexible material such as a foam material that is capable of conforming to the inside of the user's nasal passage when inserted into the user's nostril, and then returning to an original shape when removed from the user's nostril. Suitable foam materials include, for example, plastic, urethane, polyurethane and other similar materials. Those of ordinary skill in the art will recognize other suitable materials that can be used for body **312**.

Filter **314** can be formed as described above for filter **14**. Like with nasal device **10**, filter **314** can include, for example, an air-permeable, mesh or grid-like, porous structure that can be breathed through by the wearer and that is configured to filter dust, small particles, pollutants, chemical agents, dangerous gases and/or microorganisms from the air breathed by the wearer. In an embodiment, filter **314** can include copper or a copper alloy or another material as described above. Those of ordinary skill in the art will recognize other materials that can be used. In alternative embodiments, filter **314** can include or exclude one or more of a ferrous metal, a non-ferrous metal, a noble metal, a heavy metal and a metal alloy. For example, filter **314** can include or metals such as aluminum, iron, nickel, cobalt, silver and/or the like. Filter **314** can also be formed of one or more layers as described above with respect to filter **14**.

In the illustrated embodiment, filter **314** is located at the base of body **312** so that any air that passes through internal cavity **340** must pass through filter **314**. Locating filter **314** at the base of body **312** advantageously allows filter **314** to be a larger size than if it were located at an intermediate location or at the top of internal cavity **340**, which allows more air to pass through filter **314**. Those of ordinary skill in the art will recognize, however, that filter **314** can be located anywhere within internal cavity **340** and still serve its purpose to filter air breathed by the user.

Nasal device **310** can also optionally include a microvalve **322** that permits unfiltered air to be breathed out by the user. In an embodiment, microvalve **322** is a one-way valve, wherein air can be exhaled through microvalve **322**, but cannot be inhaled through microvalve **322**. That is, air can flow through microvalve **322** in the direction from top surface **328** towards base **330**, but not in the direction from base **330** towards top surface **328**. In the illustrated embodiment, microvalve **322** is located in the center of filter **314**, but microvalve **322** can also be located in other locations, for example, along a sidewall **342** of body **312**.

In an embodiment, body **312** can further include a tab **344** including a contamination indicator/sensor **346**. In an embodiment, contamination indicator **346** includes a specialized color-changing ink which changes color in the presence of known viruses and airborne bacteria. Upon contamination of nasal device **310**, contamination indicator **346** changes color to indicate that the nasal device **310** needs to be replaced, changed, and/or properly disposed. Contamination indicator **346** can also change to different colors to indicate the level of microbial contamination or pollution. In an embodiment, contamination sensor **346** can be printed or stamped onto tab **344**, or can be printed or stamped on another external surface of nasal device **310**. Contamination indicator **346** can also be associated with a computer-based application as described above.

As discussed above, two of the nasal devices **310** are used by the user at the same time, with the user placing one nasal device **310** in each nasal passage such that the user cannot breath in through his or her nose unless the air passes through a filter **314**. The use of two nasal devices **310**, as compared to one nasal device **210** described above, can be advantageous because it allows users with irregularly shaped nostrils to position the two nasal devices **310** in a preferred manner. The user could also use different sized or shaped nasal devices to cover different sized and shaped nostrils in the same nose. In an embodiment, a kit could be prepared for a user with a variety of nasal devices **310** of different shapes and sizes, and the user could determine which of the nasal devices to use. The variety of different shapes and sizes can include, for example, different heights H for each body **312**, different diameters D for each body **312**, different angles for cone-shaped body **312** from base **330** to top surface **328**, different sizes for the plurality of ribs **320**, different materials for each body **312**, and/or different shapes for base **330** and/or top surface **328** of body **312**. Different nasal devices **310** could also have different filter types (different shapes, sizes, materials, etc.) so that the user could use different types of filters in different settings.

FIGS. **16** and **17** illustrate an alternative embodiment of a nasal device **410** according to the present disclosure. Similar to nasal device **10**, nasal device **410** includes a body **412** that can be secured over a user's nasal passages and a filter **414** that filters air breathed into the user's nose.

Body **412** is a thin, flexible, preferably elastic material that can be bent or adjusted to fit a variety of differently shaped nostrils. Since air should only pass through filter **414** of nasal device **410** when the user is breathing in, body **412** must be formed of an airtight material. Suitable materials include, for example, paper, plastic such as PVC, polyethylene or polyurethane, woven or nonwoven fabrics, or latex. Those of ordinary skill in the art will recognize other suitable materials that can be used for body **412**.

In the illustrated embodiment, body **412** includes an adhesive surface **416** and an outer surface **418**. The adhesive surface **416** is configured adhere to the skin on the user's nostrils around the user's nasal passages to align filter **414** over the user's nasal passages. The outer surface **418** is configured to face outward from the user's skin when nasal device **410** is being used. The adhesive surface **416** can either be an adhesive applied to the outer surface **416**, or a layer of material separate from the outer surface **418** that contains adhesive and is attached to the outer surface **418**. In a preferred embodiment, the adhesive surface **416** is a soft foam surface with adhesive applied to the soft foam. Suitable materials for the adhesive include, for example, acrylate or vinyl resins such as methacrylates or epoxy diacrylates. Those of ordinary skill in the art will recognize other suitable materials that can be used for adhesive surface **116**.

In the illustrated embodiment, the outer contour **420** of body **412** is shaped to cover both of the user's nostrils and the user's septal cartilage when placed on the user's nose. Since air breathed in by the user should only pass through filter **414**, the outer contour **420** of body **412** should be sized and shaped to press against the skin on the user's nostrils around the user's nasal passages, so that air cannot be breathed in through the user's nostrils without the air passing through filter **14**. Those of ordinary skill in the art will understand that other sizes and shapes can be used for body **412**.

Filter **414** can be formed as described above for filter **14**. Like the filters in the previous embodiments, filter **414** includes a plurality of apertures **422** and is located in a central portion of body **412** so that filter **414** is located over one or both of the user's nasal passages when body **412** is fitted to the user's nose. Like with nasal device **10**, filter **414** can include, for example, an air-permeable, mesh or grid-like, porous structure that can be breathed through by the wearer and that is configured to filter dust, small particles, pollutants, chemical agents, dangerous gases and/or microorganisms from the air breathed by the wearer. In an embodiment, filter **414** can include copper or a copper alloy or another material as described above. Those of ordinary skill in the art will recognize other materials that can be used. In alternative embodiments, filter **414** can include or exclude one or more of a ferrous metal, a non-ferrous metal, a noble metal, a heavy metal and a metal alloy. For example, filter **414** can include metals such as aluminum, iron, nickel, cobalt, silver and/or the like. Filter **414** can also be formed of one or more layers **432**, **436** as described above with respect to filter **14**.

Body **412** can further include a tab **428** protruding from the outer contour **420**. In the illustrated embodiment, tab **428** includes a contamination indicator/sensor **430**. In an embodiment, contamination indicator **430** includes a specialized color-changing ink which changes color in the presence of known viruses and airborne bacteria. Upon contamination of nasal device **410**, contamination indicator **430** changes color to indicate that the nasal device **410** to be replaced, changed, and/or properly disposed. Contamination indicator **430** can also change to different colors to indicate the level of microbial contamination or pollution. In an embodiment, contamination sensor **430** can be printed or stamped onto tab **428** or another external surface of nasal

device **410**. Contamination indicator **430** can also be associated with a computer-based application as described above. Tab **428** can also be used by a user to more easily remove nasal device **410** from the user's nose after use.

FIGS. **18** and **19** illustrate an alternative embodiment of a nasal device **510** according to the present disclosure. Similar to nasal device **10**, nasal device **510** includes a body **512** that can be secured over a user's nasal passages and a filter **514** that filters air breathed into the user's nose.

Body **512** is a thin, flexible, preferably elastic material that can be bent or adjusted to fit a variety of differently shaped nostrils. Since air should only pass through filter **514** of nasal device **510** when the user is breathing in, body **512** must be formed of an airtight material. Suitable materials include, for example, paper, plastic such as PVC, polyethylene or polyurethane, woven or nonwoven fabrics, or latex. Those of ordinary skill in the art will recognize other suitable materials that can be used for body **512**.

In the illustrated embodiment, body **512** includes an adhesive surface **516** and an outer surface **518**. The adhesive surface **516** is configured adhere to the skin on the user's nostrils around the user's nasal passages to align filter **514** over the user's nasal passages. The outer surface **518** is configured to face outward from the user's skin when nasal device **510** is being used. The adhesive surface **516** can either be an adhesive applied to the outer surface **516**, or a layer of material separate from the outer surface **518** that contains adhesive and is attached to the outer surface **518**. In a preferred embodiment, the adhesive surface **516** is a soft foam surface with adhesive applied to the soft foam. Suitable materials for the adhesive include, for example, acrylate or vinyl resins such as methacrylates or epoxy diacrylates. Those of ordinary skill in the art will recognize other suitable materials that can be used for adhesive surface **516**.

In the illustrated embodiment, the outer contour **520** of body **412** is shaped to cover both of the user's nostrils and the user's septal cartilage when placed on the user's nose. Adhesive surface **516** further includes a center portion **524** that is configured to adhere to the user's septal cartilage. Since air breathed in by the user should only pass through filter **514**, the outer contour **520** of body **512** should be sized and shaped to press against the skin on the user's nostrils around the user's nasal passages, so that air cannot be breathed in through the user's nostrils without the air passing through filter **514**. Those of ordinary skill in the art will understand that other sizes and shapes can be used for body **512**.

Filter **514** can be formed as described above for filter **14**. Like the filters in the previous embodiments, filter **514** includes a plurality of apertures **522** and is located over the user's nasal passages when body **512** is fitted to the user's nose. Like with nasal device **10**, filter **514** can include, for example, an air-permeable, mesh or grid-like, porous structure that can be breathed through by the wearer and that is configured to filter dust, small particles, pollutants, chemical agents, dangerous gases and/or microorganisms from the air breathed by the wearer. In an embodiment, filter **514** can include copper or a copper alloy or another material as described above. Those of ordinary skill in the art will recognize other materials that can be used. In alternative embodiments, filter **514** can include or exclude one or more of a ferrous metal, a non-ferrous metal, a noble metal, a heavy metal and a metal alloy. For example, filter **514** can include metals such as aluminum, iron, nickel, cobalt, silver and/or the like. Filter **414** can also be formed of one or more layers **532**, **536** as described above with respect to filter **14**.

Body **512** can further include a tab **528** protruding from the outer contour **520**. In the illustrated embodiment, tab **528** includes a contamination indicator/sensor **530**. In an embodiment, contamination indicator **530** includes a specialized color-changing ink which changes color in the presence of known viruses and airborne bacteria. Upon contamination of nasal device **510**, contamination indicator **530** changes color to indicate that the nasal device **510** to be replaced, changed, and/or properly disposed. Contamination indicator **530** can also change to different colors to indicate the level of microbial contamination or pollution. In an embodiment, contamination sensor **530** can be printed or stamped onto tab **528** or another external surface of nasal device **510**. Contamination indicator **530** can also be associated with a computer-based application as described above. Tab **528** can also be used by a user to more easily remove nasal device **510** from the user's nose after use.

FIGS. **20** and **21** illustrate an alternative embodiment of a nasal device **610** according to the present disclosure. Similar to nasal device **10**, nasal device **610** includes a body **612** that can be secured over a user's nasal passages and a filter **614** that filters air breathed into the user's nose.

Body **612** is a thin, flexible, preferably elastic material that can be bent or adjusted to fit a variety of differently shaped nostrils. Since air should only pass through filter **614** of nasal device **610** when the user is breathing in, body **612** must be formed of an airtight material. Suitable materials include, for example, paper, plastic such as PVC, polyethylene or polyurethane, woven or nonwoven fabrics, or latex. Those of ordinary skill in the art will recognize other suitable materials that can be used for body **612**.

In the illustrated embodiment, body **612** includes an adhesive surface **616** and an outer surface **618**. The adhesive surface **616** is configured adhere to the skin on the user's nostril around the user's nasal passage to align filter **614** over the user's nasal passage. The outer surface **618** is configured to face outward from the user's skin when nasal device **610** is being used. The adhesive surface **616** can either be an adhesive applied to the outer surface **616**, or a layer of material separate from the outer surface **618** that contains adhesive and is attached to the outer surface **618**. In a preferred embodiment, the adhesive surface **616** is a soft foam surface with adhesive applied to the soft foam. Suitable materials for the adhesive include, for example, acrylate or vinyl resins such as methacrylates or epoxy diacrylates. Those of ordinary skill in the art will recognize other suitable materials that can be used for adhesive surface **616**.

In the illustrated embodiment, body **612** is shaped to cover both of the user's nostrils and the user's septal cartilage when placed on the user's nose. Body **612** includes a nose tab **640** and two nostril tabs **642**. Nose tab **640** is configured to fold up over the tip of the user's nose, and the nostril tabs **642** are configured to fold up over the sides of each of the user's nostrils. Nose tab **640** and nostril tabs **642** serve to more securely adhere nasal device **610** to the user's nose, which also helps ensure that no air passes into the user's nose without passing through filter **614**. Adhesive surface **616** further includes a center portion **624** that is configured to adhere to the user's septal cartilage. In a preferred embodiment, the width of body **612** from one nostril tab **642** to the other is about 7 to 8 cm, and the height of body **612** from the bottom edge in FIG. **21** to the top of nose tab **640** is about 4.5 to 6 cm. Those of ordinary skill in the art will understand that other sizes and shapes can be used for nose tab **640** and/or nostril tabs **642**, and that one or more of nose tab **640** and/or nostril tabs **642** can be added to any nasal device described herein.

Like the filters in the previous embodiments, filter **614** includes a plurality of apertures **622** and is located over the user's nasal passages when body **612** is fitted to the user's nose. Like with nasal device **10**, filter **614** can include, for example, an air-permeable, mesh or grid-like, porous structure that can be breathed through by the wearer and that is configured to filter dust, small particles, pollutants, chemical agents, dangerous gases and/or microorganisms from the air breathed by the wearer. In an embodiment, filter **614** can include copper or a copper alloy or another material as described above. Those of ordinary skill in the art will recognize other materials that can be used. In alternative embodiments, filter **614** can include or exclude one or more of a ferrous metal, a non-ferrous metal, a noble metal, a heavy metal and a metal alloy. For example, filter **614** can include metals such as aluminum, iron, nickel, cobalt, silver and/or the like. Filter **614** can also be formed of one or more layers **632**, **636** as described above with respect to filter **14**.

FIGS. **22** to **25** illustrate an alternative embodiment of a nasal device **710** according to the present disclosure. In the illustrated embodiment, nasal device **710** includes a body **712** that can be placed into the user's nasal passages and filters **714** that filter air breathed into the user's nose. When body **712** is placed into the user's nasal passages, substantially all air breathed in by the user must pass through filters **714**.

In the illustrated embodiment, body **712** includes a first nostril plug **716** and a second nostril plug **718**. In use, the first nostril plug **716** is placed into the user's left nasal passage, and the second nostril plug **718** is placed into the user's right nasal passage, or vice versa. The first and second nostril plugs **716**, **718** are connected by a bridge **724** that that is located over the user's septal cartilage when nasal device **710** is being used. Bridge **724** helps hold the first and second nostril plugs **716**, **718** in place when placed in the user's nasal passages.

As illustrated, body **712** has a winding shape, with two bulbous portions **732**, **734** located between the respective first and second nostril plugs **716**, **718** and bridge **724**. The bulbous portions **732**, **734** pinch the user's septal cartilage as the first and second nostril plugs **716**, **718** are inserted into the user's nostrils. In an embodiment, body **712** can be formed of a bendable material that allows the user to push bulbous portions **732**, **734** towards each other as first and second nostril plugs **716**, **718** are inserted into the user's nostrils to cause the bulbous portions **832**, **834** to pinch the septal cartilage. In another embodiment, body **712** can be formed of a resilient material that is biased towards the pinching position and automatically pushes bulbous portions **732**, **734** towards each other as first and second nostril plugs **716**, **718** are inserted into the user's nostrils.

As illustrated, nasal device **710** includes two filters **714**, with one filter **714** being attached to body **712** at nostril plug **716** and the other filter **714** being attached to body **712** at nostril plug **718**. As illustrated in the example embodiment of FIG. **26**, each nostril plug **716**, **718** can include a first portion **740**, a second portion **742** and a gap **744** between the first portion and the second portion, so that a filter **714** can be inserted into the gap **744** and held in place on body **712** between first portion **740** and second portion **742**. In an embodiment, the filters **714** can be made of a stretchable material and can include a central aperture that can be stretched over second portion **742** to locate the filter **714** between first portion **740** and second portion **742**.

Filter **714** can be formed as described above for filter **14**. Like the filters in the previous embodiments, each filter **714** includes a plurality of apertures **722** and is located over the user's nasal passages when body **712** is fitted to the user's nose. Like with nasal device **10**, filter **714** can include, for example, an air-permeable, mesh or grid-like, porous structure that can be breathed through by the wearer that is configured to filter dust, small particles, pollutants, chemical agents, dangerous gases and/or microorganisms from the air breathed by the wearer. In an embodiment, filter **714** can include copper or a copper alloy or another material as described above. Those of ordinary skill in the art will recognize other materials that can be used. In alternative embodiments, filter **714** can include or exclude one or more of a ferrous metal, a non-ferrous metal, a noble metal, a heavy metal and a metal alloy. For example, filter **714** can include metals such as aluminum, iron, nickel, cobalt, silver and/or the like. Filter **714** can also be formed of one or more layers as described above with respect to filter **14**.

As illustrated in FIGS. **22** and **25**, the filter **714** of nostril plug **716** overlaps with the filter **714** of nostril plug **718**. In the illustrated embodiment, the filters **714** are bendable, so they conform to the user's nasal passages as the nostril plugs **716**, **718** are inserted into the nasal passages. The filters **714** are also sized to be larger than the user's nasal passages, so that they each bend within the nasal passage to form a cone shape that contacts the sides of each nasal passage and causes substantially all air breathed in by the user to pass therethrough. In alternative embodiments, filter **714** can be formed of different shapes or sizes or formed so as not to overlap.

As set forth above, body **712** is shaped with a round bridge **724**, which is connected to inwardly converging bulbous portions **732**, **734**, which are then each connected to an outwardly converging portion including a nostril plug **716**, **718**. In the illustrated embodiment, body **712** has a height H of about 14.6 mm, a width W1 of about 13.5 mm between nostril plug **716** and nostril plug **718**, and a width W2 of about 4.5 mm between bulbous portion **732** and bulbous portion **743**. In the illustrated embodiment, each filter **714** has a diameter of about 14.7 mm and a thickness of about 0.2 mm. Those of ordinary skill in the art will recognize that other dimensions can be used.

In an embodiment, nasal device **710** can include an optional microvalve that permits unfiltered air to be breathed out by the user. The microvalve can be formed as described above. In another embodiment, nasal device **710** can include a contamination indicator/sensor as described above, which can for example include a specialized color-changing ink which changes color in the presence of known viruses and airborne bacteria. In an embodiment, the contamination indicator can be printed or stamped onto bridge **724** or another portion of nasal device **710**.

FIGS. **27** to **29** illustrate an alternative embodiment of a nasal device **810** according to the present disclosure. In the illustrated embodiment, nasal device **810** includes a body **812** that can be placed into the user's nasal passages and filters **814** that filter air breathed into the user's nose. When body **812** is placed into the user's nasal passages, substantially all air breathed in by the user must pass through filters **814**.

In the illustrated embodiment, body **812** includes a first nostril plug **816** and a second nostril plug **818**. In use, the first nostril plug **816** is placed into the user's left nasal passage, and the second nostril plug **818** is placed into the user's right nasal passage, or vice versa. The first and second nostril plugs **816**, **818** are connected by a bridge **824** that that is located over the user's septal cartilage when nasal device

810 is being used. Bridge **824** helps hold the first and second nostril plugs **816**, **818** in place when placed in the user's nasal passages.

As illustrated, body **812** has a winding shape, with two bulbous portions **832**, **834** located between the respective first and second nostril plugs **816**, **818** and bridge **824**. The bulbous portions **832**, **834** pinch the user's septal cartilage as the first and second nostril plugs **816**, **818** are inserted into the user's nostrils. In an embodiment, body **812** can be formed of a bendable material that allows the user to push the bulbous portions **832**, **834** towards each other as first and second nostril plugs **816**, **818** are inserted into the user's nostrils to cause the bulbous portions **832**, **834** to pinch the septal cartilage. In another embodiment, body **812** can be formed of a resilient material that is biased towards the pinching position and automatically pushes bulbous portions **832**, **834** towards each other as first and second nostril plugs **816**, **818** are inserted into the user's nostrils.

As illustrated, nasal device **810** includes two filters **814**, with one filter being attached to body **812** at nostril plug **816** and the other filter being attached to body **812** at nostril plug **818**. In the illustrated embodiment, each filter **814** has a spiral shape in which a middle portion **850** spirals around a nostril plug **816**, **818** from its top portion **852** to its bottom portion **854**.

As illustrated, each nostril plug **816**, **818** can include a first portion **840**, a second portion **842** and a third portion **844**, with a rod **846** connecting the first portion **840** to the second portion **842**, the rod **846** having a smaller diameter than first portion **840** and second portion **842**. Filter **814** can then be aligned on a nostril plug **816**, **818** by securing bottom portion **854** of filter **814** within a gap between second portion **842** and third portion **844** as described above with respect to gap **744**, while top portion **852** of filter **814** can be placed against or attached to first portion **840**, so that middle portion **850** of filter **814** spirals around rod **846** continuously from top portion **852** to bottom portion **854**.

Filter **814** can be formed as described above for filter **14**. Like the filters in the previous embodiments, each filter **814** includes a plurality of apertures and is located over the user's nasal passages when body **812** is fitted to the user's nose. Like with nasal device **10**, filter **814** can include, for example, an air-permeable, mesh or grid-like, porous structure that can be breathed through by the wearer and that is configured to filter dust, small particles, pollutants, chemical agents, dangerous gases and/or microorganisms from the air breathed by the wearer. In an embodiment, filter **814** can include copper or a copper alloy or another material as described above. Those of ordinary skill in the art will recognize other materials that can be used. In alternative embodiments, filter **814** can include or exclude one or more of a ferrous metal, a non-ferrous metal, a noble metal, a heavy metal and a metal alloy. For example, filter **814** can include metals such as aluminum, iron, nickel, cobalt, silver and/or the like. Filter **814** can also be formed of one or more layers as described above with respect to filter **14**.

As illustrated in FIG. **29**, the filter **814** of nostril plug **816** overlaps with the filter **814** of nostril plug **718**. In the illustrated embodiment, the filters **814** are bendable, so they conform to the user's nasal passages as the nostril plugs **816**, **718** are inserted into the nasal passages. The filters **814** are also sized to be larger than the user's nasal passages, so that they bend within the nasal passages to seal the outer edges of the nasal passages and cause substantially all air breathed in by the user to pass therethrough. In alternative embodiments, filter **814** can be formed of different shapes or sizes or formed so as not to overlap.

As set forth above, body **812** is shaped with a round bridge **824**, which is connected to inwardly converging bulbous portions **832**, **834**, which are then each connected to an outwardly converging portion including a nostril plug **816**, **818**. The dimensions of body **812** can be similar to the dimensions of body **712** described above. In an embodiment, the diameter of the top portion **852** of each filter **814** can be about 15 mm, while the diameter of the bottom portion **854** of each filter **814** can be about 10 mm to 12 mm, with the middle portion **850** decreasing in diameter from the top portion **852** to the bottom portion **854**. By forming the bottom portion **854** to be smaller than the top portion **852**, filter **814** can form a cone shape configured to be easily insertable into a user's nostrils. Those of ordinary skill in the art will recognize that other dimensions can be used.

In an embodiment, nasal device **810** can include an optional microvalve that permits unfiltered air to be breathed out by the user. The microvalve can be formed as described above. In another embodiment, nasal device **810** can include a contamination indicator/sensor as described above, which can for example include a specialized color-changing ink which changes color in the presence of known viruses and airborne bacteria. In an embodiment, the contamination indicator can be printed or stamped onto bridge **724** or another portion of nasal device **810**.

FIG. **30** illustrates an alternative embodiment of a nasal device **910** according to the present disclosure. In the illustrated embodiment, nasal device **910** includes an upper body **912** that can be placed into the user's nasal passages, and a lower body **913** that can be placed in the user's mouth. In the illustrated embodiment, upper body **912** is the same as body **912** discussed above, with a filter located in an internal passage therein so as to filter any air breathed in by the user.

Lower body **913** can be placed in the user's mouth to help secure upper body **912** in place in the user's nasal passages. In the illustrated embodiment, lower body **913** includes an outer wall **916**, an inner wall **918**, and a biting surface **920**. In use, a user bites down on biting surface **920** to hold lower body **913** within the user's mouth, which not only holds nasal device **910** in place on the user's face due to the bridge **922** that holds upper body **912** and lower body **913** together, but also ensures that the user keeps his or her mouth closed and only breathes through the filter in upper body **912**. Lower body **913** is preferably formed of a soft material that will not damage the user's teeth when the user bites into lower body **713**. Soft materials for lower body **913** can include, for example, any suitable material for a mouth guard such as plastic, urethane, polyurethane and other similar materials. Those of ordinary skill in the art will recognize other suitable materials that can be used for lower body **913**.

Although the lower surface of lower body **913** is not shown, the lower surface can be formed similar to the upper surface, with a biting surface for the user to bite into with the user's bottom teeth. The lower biting surface can also be surrounded by an outer wall and inner wall as described above. In an embodiment, the lower surface of lower body **913** is the mirror image of the upper surface shown in FIG. **30**.

In an alternative embodiment, lower body **913** can include a filter in outer wall **916** so that the user can breathe through his or her mouth as well as his or her nose. In an embodiment, lower body **913** includes an accordion-like filter that unfolds when the user opens his or her mouth, so that the user can breathe through the accordion-like filter when the user breathes through his or her mouth. When the user's

mouth is closed, the accordion-like filter is compressed and the user breathes through his or her nose.

It should be understood that any and all of the features of nasal devices **10**, **110**, **210**, **310**, **410**, **510**, **610**, **710**, **810** and **910** can be combined. FIG. **31** illustrates an example embodiment of a nasal device **1010** according to the present disclosure. Nasal device **1010** incorporates elements from each of nasal devices **10**, **110**, **210**, **310**, **410**, **510**, **610**, **710**, **810** and **910**. Specifically, nasal device **1010** includes a cone-shaped body **1012** with a plurality of ribs **1020** along the sidewall **1042**, and also includes an adhesive **1024** on lower lip **1026** of body **1012** that is configured to adhere to the skin on the user's nostrils around the user's nasal passages. Nasal device **1010** therefore includes multiple mechanisms for securing nasal device **1010** within a user's nostrils in an airtight manner so that all of the air breathed by the user through internal passage **1040** must pass through the first electrode **1032**, insulator mesh **1034** and second electrode **1036**, except that air breathed out by the user can pass through one-way microvalve **1022**.

Modifications in addition to those described above may be made to the structures and techniques described herein without departing from the spirit and scope of the disclosure. Accordingly, although specific embodiments have been described, these are examples only and are not limiting on the scope of the disclosure.

What is claimed is:

1. A nasal device comprising:

a body configured to pinch a user's septal cartilage;

a first filter positioned so as to be located within one of the user's nasal passages when the body pinches the user's septal cartilage; and

a second filter positioned so as to be located within the other of the user's nasal passages when the body pinches the user's septal cartilage,

said first and said second filters each have a thickness, and said thickness is in the range of 0.1-1 mm;

said first and said second filters include a material selected from the group consisting of copper or a copper alloy, a ferrous metal, a non-ferrous metal, a noble metal, a heavy metal, and a metal alloy;

a contamination indicator configured to indicate when the first or second filter has been contaminated; said contamination indicator includes an indication for contamination by known viruses or airborne bacteria;

wherein the first and second filters filter air breathed into the user's nasal passages when the body pinches the user's septal cartilage.

2. The nasal device of claim **1**, where the body is U-shaped, with a round bridge that is connected to inwardly converging bulbous portions, which are then connected to outwardly bending portions ending in a nostril plug.

3. The nasal device of claim **1**, wherein the first and second filters are located on opposite nostril plugs.

4. The nasal device of claim **1**, wherein the body has a height, and the height is in the range of 13.5 to 15.5 mm.

5. The nasal device of claim **1**, wherein the body has a width, and the width is in the range of 13 to 15 mm.

6. The nasal device of claim **1**, wherein the first and second filters have a diameter, and the diameter is in the range of 14 to 15.5 mm.

7. The nasal device of claim **1**, wherein the first filter overlaps the second filter before the body pinches the user's septal cartilage.

8. The nasal device of claim **1**, wherein the body includes a bridge with bulbous portions on opposite sides of said bridge, the bulbous portions configured to pinch the user's septal cartilage.

9. The nasal device of claim **1**, wherein the first and second filters are spiral shaped, formed by the first and second filters having a top portion, a bottom portion, and a middle portion which spirals around the body from the top portion to the bottom portion.

10. The nasal device of claim **1**, wherein the first and second filters are bendable so as to conform to the inside of a user's nasal passages.

11. The nasal device of claim **1**, wherein the first and second filters include copper or a copper alloy.

12. The nasal device of claim **1**, wherein the first and second filters are a porous, grid-like material configured to filter material selected from the group consisting of dust, small particles, pollutants, chemical agents, dangerous gases and/or microorganisms from the air breathed by the wearer.

13. The nasal device of claim **1**, wherein the first and second filter are configured to filter coronavirus particles from the air breathed by the user.

14. The nasal device of claim **1**, wherein the contamination indicator is printed or stamped onto a bridge or onto another portion of the nasal device.

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