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- **HUANG, Haiyong**
5656AG Eindhoven (NL)
- **LIN, Fu-Lung**
5656AG Eindhoven (NL)
- **TANG, Lijuan**
5656AG Eindhoven (NL)
- **GU, Jun**
5656AG Eindhoven (NL)
- **TAI, Chiayen**
5656AG Eindhoven (NL)

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(71) Applicant: **Koninklijke Philips N.V.**
5656 AG Eindhoven (NL)

(74) Representative: **Philips Intellectual Property & Standards**
High Tech Campus 52
5656 AG Eindhoven (NL)

(72) Inventors:
• **CHEN, Weizhong**
5656AG Eindhoven (NL)

(54) **FACE MASK**

(57) A face mask and face mask system is provided. The face mask system has a magnetic coupling means for coupling a powered fan to a filter part of the mask. The face mask further includes a holder for holding a separable magnetic portion of the coupling means in a stable position relative to the filter, for thereby locating the coupling relative to the filter. The holder for example is provided by a pocket. The pocket may further include

securement means for positionally securing the separable magnetic portion within the pocket, for example by complementary shape features of the pocket and the separable magnetic portion, for example by means of features which provide an interlock action or interlock geometry between part of or the whole of each of the pocket and the separable magnetic portion.

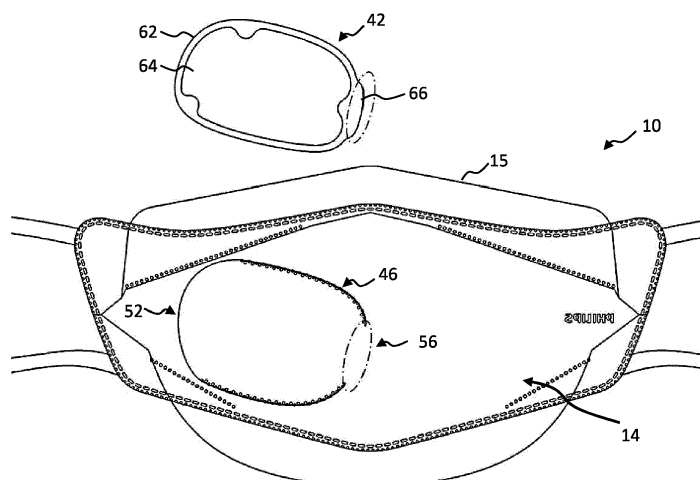


FIG. 6

Description

FIELD OF THE INVENTION

[0001] This invention relates to face masks, for providing filtering of pollutants.

BACKGROUND OF THE INVENTION

[0002] Air pollution is a worldwide concern. The World Health Organization (WHO) estimates that 4 million people die from air pollution every year. Part of this problem is the outdoor air quality in cities. Nearly 300 smog-hit cities fail to meet national air quality standards.

[0003] Official outdoor air quality standards define particle matter concentration as mass per unit volume (e.g. $\mu\text{g}/\text{m}^3$). A particular concern is pollution with particles having a diameter less than $2.5 \mu\text{m}$ (termed "PM2.5") as they are able to penetrate into the gas exchange regions of the lung (alveoli), and very small particles ($<100 \text{ nm}$) may pass through the lungs to affect other organs.

[0004] Since this problem will not improve significantly on a short time scale, a common way to deal with this problem is to wear a mask which provides cleaner air by filtration and the market for masks in China and elsewhere has seen a great surge in recent years.

[0005] Such masks may be made of material that acts as a filter of pollutant particles, or may have a filter for only part of the mask surface, and this filter may be replaceable when it becomes clogged.

[0006] However, during use, the temperature and relative humidity inside the mask increases and, combined with the pressure difference inside the mask relative to the outside, this makes breathing uncomfortable. This can be mitigated in part by providing an outlet valve or check valve which allows exhaled air to escape the mask with little resistance, but which requires inhaled air to be drawn through the filter. To improve comfort and effectiveness, a fan can be added to the mask, this fan drawing in air through the filter and/or providing assistance when breathing out.

[0007] One possible benefit to the wearer of using a fan-powered mask is that the lungs are relieved of the slight strain caused by inhalation against the resistance of the filters in a conventional non-powered mask. Furthermore, in a conventional non-powered mask, inhalation also causes a slight pressure drop within the mask which leads to leakage of the contaminants into the mask, which leakage could prove dangerous if these are toxic substances.

[0008] In one arrangement, an inlet (i.e. inhale) fan may be used to provide a continuous intake of air. In this way, the lungs are relieved of the previously mentioned slight strain caused by inhalation against the resistance of the filters in a conventional non-powered mask. A steady stream of air may then be provided to the face and may for example provide a slight positive pressure, to ensure that any leakage is outward rather than inward.

However, this gives additional resistance to breathing when exhaling.

[0009] In another arrangement, an exhaust (i.e. exhale) fan may be used to provide a continuous release of air. This instead provides breathing assistance when exhaling. An exhale fan may be combined with a series check valve so that no flow can enter the mask through the fan.

[0010] The fan again creates a continuous flow of air through the mask. Air is drawn into the mask volume through the filter by the flow induced by the fan. This improves wearer comfort.

[0011] Another alternative is to provide both inlet and exhaust fans, and to time the control of the fans in synchronism with the breathing cycle of the user. The breathing cycle may be measured based on pressure (or differential pressure) measurements. This provides improved control of temperature and humidity as well as reducing the resistance to breathing for both inhalation and exhalation.

[0012] Thus, several types of mask for preventing daily exposure to air pollutants are available, including passive masks, passive masks with an exhale valve, and masks with at least one active fan.

[0013] This invention relates in particular to active masks, having a fan. One issue is that the mask filter needs regular cleaning or changing. The fan is typically formed in such a way that a seal is formed between the fan and the mask filter. This seal needs to be released in order to separate the fan from the mask filter, because the fan (in particular its associated electrical and electronic components) is not suitable for cleaning and does not need to be replaced as regularly as the filter.

[0014] There exist known solutions for releasable coupling arrangements for releasably coupling the fan to the mask in operational position with the filter. These involve use of a mechanical connector module which provides a connection structure having grooves or members for engaging with a complementary connection structure on the mask filter. However, in the known solution, the connector module permanently fixed to the filter member 14 so that it is discarded with the filter member 14 when there is filter replacement.

[0015] This means that the known solution requires disposal and replacement of the connector module each time that the filter needs to be cleaned or replaced.

[0016] Thus, it would be of benefit to provide a connection system which allows releasable connection of the fan to the mask filter in way that does not require disposal of a physical connection member each time the filter is replaced.

SUMMARY OF THE INVENTION

[0017] The invention is defined by the claims.

[0018] According to examples in accordance with an aspect of the invention, there is provided a face mask system, comprising: a face mask, the face mask com-

prising a filter portion comprising filter material to filter air passing between an inner side of the face mask which faces toward the user's face during use, and an outer side of the face mask; a fan module for arrangement in use, when the face mask is in an assembled state, in fluidic series with the filter portion for driving air which passes through the filter portion; a magnetic coupling for releasably coupling the fan module to the filter portion in a position in fluidic series with the filter portion, wherein the magnetic coupling comprises a second magnetic part and a first magnetic part which are magnetically attractive to one another. The second magnetic part is comprised by the fan module. The first magnetic part is separate from the fan module. The face mask further comprises a holder for receiving and locating the first magnetic part relative to the filter portion.

[0019] With the first magnetic part received in the holder, magnetic attraction between the second and first magnetic parts permits magnetic coupling of the fan module to the filter portion. The fan module will be coupleable to the filter portion at a position on the mask which is defined by the position of the first magnetic part. Since the position of the first magnetic part is determined by the positioning of the holder, the holder effectively provides an alignment function of the coupling of the fan to the mask.

[0020] The use of a magnetic coupling solves the problem of providing a releasable coupling that does not require a permanently attached connection member on the filter. Instead the fan can be separated from the filter by applying a force against the magnetic attraction of the first magnetic component. However, it was realized by the inventors that a magnetic coupling might pose new problems in terms of both usability and product design since a user would be required to carefully align the first and second magnetic parts relative to one another and relative to the surface area of the filter. The user might not know the best positioning for the fan module, or might not be able to properly achieve the needed alignment, for instance so that an outer layer of the mask aligns also with the position of the fan after placement. Aligning the two portions of the magnetic couple to one another can also be a challenge.

[0021] Thus, having recognized this potential new problem, the inventors propose according to embodiments of the present invention to provide a holder, such as a flap of material, such as a pocket or band, to receive and hold the first magnetic part relative to the filter, so that the user does not need to determine the correct positioning of the first magnetic part. Such a means both holds the first magnetic part in place, and locates the first magnetic part by defining its placement on the filter. This avoids the user incorrectly placing the magnetic part and thereby coupling the fan module to an incorrect position on the filter. When the filter needs to be replaced or cleaned, the fan module can simply be pulled away from the filter, and the first magnetic part removed from the holder. Once the filter has been cleaned or a replacement filter provided, the first magnetic part can be placed back

into the holder of the cleaned filter, or put into the holder of the new filter, and the fan re-coupled, and the mask re-assembled.

[0022] It will be recognized that the inventive concept may be embodied in the face mask alone, comprising the holder for holding the first magnetic part, or in such a face mask further comprising the first magnetic part, or in a face mask system comprising the face mask and fan module. Thus, each of these may be provided as separate aspects of the invention.

[0023] In any case, in relation to the holder, this is preferably comprised by the filter portion.

[0024] The holder may be a holding structure. The holding structure may be attached to the filter portion, for example to a surface of the filter portion.

[0025] The holder may be formed by a flap attached to a surface of the filter portion, e.g. a flap of material.

[0026] In some embodiments, the holder is a pocket or band.

[0027] In some embodiments, the holder is provided on an inner side of the filter portion, and the fan module is for attachment on a position of an outer side of the filter portion corresponding to the position of the holder on the inner side of the filter portion.

[0028] The holder can alternatively be on the same (outer) side as the fan module.

[0029] In some embodiments, the holder defines an access opening at one side permitting insertion and removal of the first magnetic part.

[0030] In some embodiments, the holder is a pocket and the pocket includes a fastening means for reversibly fastening the access opening into a closed state for preventing escape of the magnetic part when so closed.

[0031] In some embodiments, the holder includes means for positionally securing the first magnetic part within the holder, for example for rotationally securing the first magnetic part within the holder. The holder may be a pocket. The means may include means for providing an interlock geometry or interlock action between at least a portion of the first magnetic part and at least a portion of the pocket. The said means for positionally securing the first magnetic part may be referred to as a fixation structure which is configured to rotationally locate the first magnetic part.

[0032] In some embodiments, the means for positionally securing the first magnetic part within the holder is provided by complementary shape features of the first magnetic part and the holder. These features could be a complementary outer shape and inner shape of the first magnetic part and the holder respectively. These could be complementary male/female mating portions of the first magnetic part and the holder respectively.

[0033] More explicitly, in some embodiments, the holder (e.g. pocket) has an (inner) shape and/or size which is complementary with an outer shape and/or size of the first magnetic part, such that the boundaries of the holder act to hold the first magnetic part in a fixed/stable position when received inside the holder for thereby locating the

first magnetic part relative to the filter portion. Thus, this provides an example of a means for positionally securing the first magnetic part in the holder which makes use of complementary shape features of the first magnetic part and the holder. The complementary fitting shapes provide an interlock geometry.

[0034] Additionally or alternatively, in some embodiments, the first magnetic part comprises a tab protruding from one edge for use in rotationally securing or locating the first magnetic part within the holder. The holder may be a pocket. The tab may extend in-plane with a plane defined by the first magnetic part. For example, the first magnetic part might be annular in shape and wherein the tab extends in-plane with the plane defined by the annulus of the first magnetic part.

[0035] In some embodiments, the holder is a pocket and comprises a tab-receiving opening (through a wall of the pocket) in one side arranged to permit protrusion of the tab therethrough when the first magnetic part is received in the pocket. The opening may have a shape and size which is complementary with the tab, for thereby rotationally locating or securing the first magnetic part within the pocket when the tab is received through the opening. To express this in other words, the previously mentioned fixation structure comprised by the holder may take the form of a second opening of the holder, and wherein the first magnetic part is configured with a tab corresponding to the position of said second opening.

[0036] Thus, this provides another example of a means for positionally securing the first magnetic part in the pocket which makes use of complementary shape features of the first magnetic part and the pocket. The complementary shapes of the tab and the tab-receiving opening provide an interlock geometry.

[0037] In some embodiments, at least the first magnetic part defines an annular shape which delimits a central open area. In some embodiments, the second magnetic part additionally or alternatively defines an annular shape which delimits a central open area. For example, the first magnetic part may have the form of a ring which delimits a central open area. For example the ring may be a flat ring shape.

[0038] In some embodiments, the central open area may have a first portion and a second portion, wherein the holder covers the first portion of the central open area, whereby the flow resistance of the second portion is lower than the flow resistance of the first portion of the central open area.

[0039] In some embodiments, the first and second magnetic parts are configured such that when magnetically coupled to one another, at least an air input/output area of the fan module is aligned with said central open area delimited by the first magnetic part.

[0040] In some embodiments, with the mask system in an assembled state, the holder is disposed on a reverse side of the filter portion compared to the fan module.

[0041] In some embodiments, the mask further com-

prises an upper panel and a lower panel disposed on the same side of the filter portion to which the holder is attached, wherein the upper panel comprises a flap which is foldable along a lower edge and the lower panel comprises a flap which is foldable along an upper edge, and wherein the upper and lower panels are foldable to cover or uncover said holder, for thereby covering or uncovering the magnetic part when received in the holder.

[0042] In some embodiments, the mask further comprises an upper panel and/or a lower panel, wherein a lower edge of the upper panel connects to the filter portion, and an upper edge of the lower panel connects to the filter portion, and wherein the holder is in a position relative to the upper edge of lower panel and/or the lower edge of the upper panel to secure the magnetic part together with the holder when the mask is in use.

[0043] By way of example, in some embodiments, the upper panel and the lower panel could be formed by the filter portion or may be formed by a different element/component. If formed by the filter portion, the filter portion could fold on the upper side to form an upper panel and/or the filter portion could fold on the lower side to form a lower panel. In some embodiments, where the holder includes a fixation structure in the form of a second opening (as mentioned previously), then the lower panel and/or the upper panel may be configured to fold toward the second opening to hold the first magnetic part.

[0044] In some embodiments, the mask (e.g. a facial portion of the mask) has a bending line in a substantially vertical direction when the mask is in use. The holder may be in a position relative to the bending line such that the bending line acts to retain/secure the magnetic part in the holder to prevent the magnetic part from detaching when the mask is in use. For example, the holder may be a position relative to the bending line such that the bending line acts to block/interrupt lateral motion of the magnetic part out of the holder, to thereby act to in part retain the magnetic part in the holder, i.e. to help prevent the magnetic part from detaching when the mask is in use.

[0045] For example, in some embodiments, the mask (e.g. the filter portion of the mask) may have a facial portion, wherein, when the mask is in use, the facial portion has a bending line substantially in the vertical direction, and wherein the bending line engages to said first opening to secure/retain the first magnetic device in the holder, i.e. to prevent the first magnetic part from detaching when the mask is in use.

[0046] In some embodiments, when the mask is in use, the mask (e.g. the filter portion of the mask) may have a bending line in a substantially vertical direction, and wherein the bending line engages to said first opening to secure/retain the first magnetic device to prevent the first magnetic part from detaching when the mask is in use.

[0047] In some embodiments, at least the first magnetic part defines an annular shape which delimits a central open area, the central open area having a first portion and a second portion, wherein, when the first magnetic

part is received in the holder, said holder covers the first portion of the central open area, and the second portion of the first magnet part is exposed on a surface of the inner side or the outer side of the filter portion, whereby a flow resistance of the first portion is higher than the flow resistance of the second portion.

[0048] As mentioned previously, an aspect of this invention is a face mask system which includes the face mask with the holder for the first magnetic part of the magnetic coupling, in combination with the magnetic coupling, and in combination with the fan. Another aspect of the invention is the face mask alone, with the holder. A further embodiment of this aspect of the invention is the face mask in combination with the first part of the magnetic coupling, for being received in the holder. Another embodiment of this aspect of the invention is the face mask in combination with both parts of the magnetic coupling.

[0049] The inventive concept can also be embodied in the form of a kit of parts comprising the various separable components of the above-discussed face mask or face mask system, but in a nonassembled state. For example the kit may comprise the mask, the filter portion, the fan module, and/or the first magnetic part of the magnetic coupling.

[0050] Any of the options, features or embodiments described above in relation to the face mask system aspect of the invention can be incorporated as embodiments of any of the other aspects of the invention. For example features pertaining to the configuration or structure of the holder can be incorporated as part of embodiments of the face mask aspect of the invention.

[0051] By way of more explicit outline, an aspect of the invention provides a face mask. The face mask may be for use in a face mask system comprising the face mask and a fan module releasably coupleable to the face mask. The face mask according to at least one set of embodiments comprises: a filter portion comprising filter material to filter air passing between an inner side of the face mask which faces toward the user's face during use, and an outer side of the face mask. The face mask further comprises a holder configured on the inner side or the outer side of the filter portion. The holder may be for holding a magnetic part of a magnetic coupling on the inner side or the outer side of the filter portion. This may be for use in magnetically coupling a fan module to the filter portion. For example, it may be for use in magnetically coupling a fan module to the filter portion, wherein the fan module comprises a second magnetic part of the magnetic coupling, wherein the first magnetic part and second magnetic part are magnetically attractive to one another.

[0052] By way of example, the face mask may be for use in a face mask system comprising the face mask and a fan module releasably coupleable to the face mask and further comprising a magnetic coupling for releasably coupling the fan module to the filter portion in a position in fluidic series with the filter portion, wherein the mag-

netic coupling comprises a first magnetic part and a second magnetic part which are magnetically attractive to one another.

[0053] Optionally, the holder may be formed by a flap of material attached to the filter portion, for example the flap of material forming a pocket or band.

[0054] The holder may have an access opening configured to receive the magnetic part in said holder.

[0055] In some embodiments, the holder is for holding a magnetic part which has the form of an annular member, e.g. a ring which delimits a central open area. The ring may be a flat ring shape, e.g. an annular disc shape.

[0056] In some embodiments, the holder is for holding/supporting the magnetic part against the force of gravity when received in the holder when the mask is oriented for normal use.

[0057] In some embodiments, the holder is attached to the filter portion by at least an upper joining edge and a lower joining edge, with said flap of material extending between the upper joining edge and lower joining edge.

[0058] In some embodiments, the mask further comprises an upper and lower panel disposed on the same side of the filter portion to which the holder is attached, wherein the upper panel comprises a flap which is foldable along a lower edge and the lower panel comprises a flap which is foldable along an upper edge, and wherein the upper and lower panels are foldable to cover or uncover said holder, for thereby covering or uncovering the magnetic part when received in the holder. This further helps in retaining the magnetic part in the holder.

[0059] For example, in some embodiments, a portion of the mask, (e.g. the filter portion) may fold on the upper side to form an upper panel and/or fold on the lower side to form a lower panel. In some embodiments, where the holder includes a fixation structure in the form of a second opening (as mentioned previously), then the lower panel and/or the upper panel may be configured to fold toward the second opening to hold the first magnetic part.

[0060] For example, the upper and lower panels might be flaps of material which are open at their lower edge and which are sized and shaped so as to sit over the top of the holder in normal use to further help keep the magnetic part in place.

[0061] In some embodiments, the face mask further comprises said magnetic part of the magnetic coupling for being held by the holder.

[0062] In some embodiments, the holder is a pocket and the pocket defines an access opening at one side permitting insertion and removal of the magnetic part.

[0063] In some embodiments, the holder comprises an access opening at one side permitting insertion and removal of the magnetic part, and a second opening at an opposite side of a smaller size than the access opening. The second opening may be for use in positionally (e.g. rotationally) locating the magnetic part, for example by receiving a tab of the second magnetic part.

[0064] As mentioned above, in some embodiments, the holding of the first magnetic part may be for use in

magnetically coupling a fan module to the filter portion. For example, it may be for use in magnetically coupling a fan module to the filter portion, wherein the fan module comprises a second magnetic part of the magnetic coupling, wherein the first magnetic part and second magnetic part are magnetically attractive to one another.

[0065] In some embodiments, the face mask may further include the first magnetic part, attachable to the inner side or the outer side by the holder.

[0066] In some embodiments, the face mask includes a fixation structure which is configured to rotationally locate the first magnetic part.

[0067] In some embodiments, the fixation structure is a second opening, and the first magnetic part is configured with a tab corresponding to the position of said second opening.

[0068] In some embodiments, at least the first magnetic part defines an annular shape which delimits a central open area, the central open area having a first portion and a second portion, wherein, when the first magnetic part is received in the holder, said holder covers the first portion of the central open area, and the second portion of the first magnet part is exposed on a surface of the inner side or the outer side of the filter portion, whereby a flow resistance of the first portion is higher than the flow resistance of the second portion.

[0069] Features or options recited in relation to one aspect or embodiment of the invention may be combined or incorporated into any other aspect of embodiment of the invention.

[0070] These and other aspects of the invention will be apparent from and elucidated with reference to the embodiment(s) described hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0071] For a better understanding of the invention, and to show more clearly how it may be carried into effect, reference will now be made, by way of example only, to the accompanying drawings, in which:

Figs. 1-3 show views of a prior art face mask having a fixed coupling between a filter member and a fan module;

Fig. 4 shows an illustration of the parts of the magnetic coupling provided in accordance with one or more embodiments of the present invention;

Fig. 5 shows a view of an inner side of an example face mask according to one or more embodiments of the invention, illustrating a holder in the form of a pocket for receiving a part of a magnetic coupling; Fig. 6 shows a view of an inner side of a further example face mask according to one or more embodiments of the invention, illustrating a holder in the form of a pocket for receiving a part of a magnetic coupling;

Fig. 7 shows a view of a filter portion of a face mask according to one or more embodiments of the inven-

tion, having a holder in the form of a pocket for receiving a part of a magnetic coupling;

Fig. 8 shows a view of a filter portion of a face mask according to a further one or more embodiments of the invention, having a holder in the form of a pocket for receiving a part of a magnetic coupling;

Fig. 9 shows an exploded view of an outer side of the mask, schematically illustrating how the fan module aligns with a first magnetic coupling part;

Fig. 10 shows a view of a face mask according to a further one or more embodiments of the invention, having a holder in the form of a band, for receiving a part of a magnetic coupling;

Fig. 11 shows a view of a face mask according to a further one or more embodiments of the invention, having a holder in the form of a band;

Fig. 12 shows a view of a filter portion of the face mask of Fig. 11, including the holder; and

Fig. 13 shows a view of a filter portion of a face mask according to a further one or more embodiments of the invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0072] The invention will be described with reference to the Figures.

[0073] It should be understood that the detailed description and specific examples, while indicating exemplary embodiments of the apparatus, systems and methods, are intended for purposes of illustration only and are not intended to limit the scope of the invention. These and other features, aspects, and advantages of the apparatus, systems and methods of the present invention will become better understood from the following description, appended claims, and accompanying drawings. It should be understood that the Figures are merely schematic and are not drawn to scale. It should also be understood that the same reference numerals are used throughout the Figures to indicate the same or similar parts.

[0074] The invention provides a face mask system and face mask. The face mask system includes a magnetic coupling means for coupling a powered fan to a filter part of the mask, wherein the mask further includes a holding means for holding a separable magnetic portion (referred to later as 'first magnetic part') of the coupling means in a stable position relative to the filter, for thereby locating the coupling relative to the filter. The holding means for example is provided by a pocket or a band. The pocket may further include securement means for positionally securing the separable magnetic portion within the pocket, for example by complementary shape features of the pocket and the separable magnetic portion, for example by means of features which provide an interlock action or interlock geometry between part of or the whole of each of the pocket and the separable magnetic portion.

[0075] According to at least one set of embodiments, a provided face mask system may include: a face mask

with a mask filter, and a fan module comprising a fan component for driving air. The fan module is attachable to the filter through a magnetic coupling comprising a pair of magnetically mutually attractive elements, for example a pair of magnets or one magnet and one accepting part comprising a magnetic material for being attracted to the magnet. The face mask can be provided alone according to further embodiments, or may be provided in combination with at least one of the magnetic parts of the magnetic coupling but without the fan module. A cover portion may optionally extend over the filter portion and optionally may delimit a hole or opening with which the fan module can align to permit coupling of the fan module to the filter portion.

[0076] There is a holder such as a holding structure on the filter to accommodate/house one of the magnetically attractive parts. The holder can for example comprise a flap attached to a surface of the filter portion. The holder can for example be in the form of a pocket or band. In a preferred embodiment, a holding structure can be designed in a shape complementary to a shape of the magnetic part which it receives, to guide placement of the magnetic part in a defined position and orientation in the holding structure, to thereby ensure a fool proof design. The holder can be on either side of the filter. Where the holder is a pocket, the pocket can be of any shape. Optionally the holder includes means for positionally securing or locating the first magnetic part within the holder. For example, the holder may include a fixation structure which is configured to positionally locate the first magnetic part, for example to rotationally locate the first magnetic part. For example, optionally, there is a hole on the pocket, and there is a designated convex tab on the magnetic component that can fit in the hole on the pocket. By doing this, it ensures the user can easily align the magnetic pair in the right orientation.

[0077] Optionally, the holder is only attached to the inner layer of the filter.

[0078] To provide context for embodiments of this invention, and also to clarify features to be described later, Figs. 1-3 show an example of a prior art mask design of which embodiments of the present invention represent an inventive development. The mask 10 is shown in exploded view and comprises an outer casing 12 and an inner filter member 14. The outer casing is rigid or semi-rigid with ear straps 13, whereas the filter member 14 is formed of a fabric and thus easily deforms such that an outer edge can match the shape of a wearer's face.

[0079] The outer casing 12 is porous so that air can flow through the outer casing.

[0080] The inner filter member 14 is sealed around a connection area 16. The connection area 16 provides an area for connecting fluidly and mechanically to a fan module 20. In this particular example, the connection area 16 encompasses a passive check valve. The connection area and the fan module may be connected together and disconnected manually.

[0081] A control unit 22 is further provided and com-

prises for example a battery and control circuitry for controlling the fan module. This may include sensors. It may be mechanically attached to the fan module. In the illustrated example for instance, the control module 18 is coupled to the outside of the filter member 14 and the control module includes both the fan module 20 and also the control unit 22. Note that the control circuitry may instead be integrally comprised by the fan module. Thus, the various additional circuitry elements and battery may be divided between the fan module and a dedicated control unit in different ways.

[0082] In the illustrated example, the connection area includes a physical connector module 16 which is permanently fixed to the filter member 14 so that it is discarded with the filter member 14 when there is filter replacement. The fan module 20 is reusable and includes (at least) the fan drive circuitry and fan impeller.

[0083] The outer casing 12 has an opening 24 in which the fan module 20 is received. An inner surface of the outer casing may also have a receiving dock area for the control unit 22, or else there may be a receiving dock area 26 on the outer surface of the filter member for locating the control unit 22.

[0084] An electrical connector bridge 28 provides electrical connection between the control unit 22 and the fan module 20 of the fan assembly, for transfer of power and control signals.

[0085] The fan module 20 and the control unit 22 are at opposite lateral sides of the mask, i.e. one on each side of the nose of the wearer. This provides a balanced weight distribution. By having two modules, the weight of each individual part is reduced, so that the loading at any one location is reduced.

[0086] In this example, the fan is an exhaust fan. In a most simple design, it operates continuously to provide a continuous supply of air to the face (using air drawn through the mask filter). This provides temperature and humidity control. However, it may be operated in synchronism with the breathing of the wearer (with suitable breath sensing), and it may be controlled bi-directionally.

[0087] Fig. 2 shows the design of Fig. 1 in an assembled state from one front side and Fig. 3 shows the design of Fig. 1 in an assembled state from an opposite front side.

[0088] Figs. 4-6 schematically illustrate an example face mask and face mask system in accordance with one or more embodiments of the present invention.

[0089] Fig. 4 illustrates parts of a magnetic coupling for use with a provided face mask or face mask system.

[0090] Fig. 5 shows an inside view of a provided face mask, including a holder in the form of a pocket for retaining one of the parts of the magnetic coupling of Fig. 4.

[0091] Fig. 6 illustrates an inside view of a variation of the face mask of Fig. 5, which includes a locating tab on the magnetic part to be received in the pocket.

[0092] Referring to Fig. 5, the face mask 10 comprises a filter portion 14 comprising filter material to filter air passing between an inner side of the face mask (which

faces toward the user's face during use), and an outer side of the face mask (which faces away from the user during use). Fig. 5 and Fig. 6 both show a view of the inner side of the face mask. The filter portion 14 may be formed by a filter layer or filter member. The filter portion may be covered on an outer side of the face mask by a cover portion. The cover portion may be porous to permit passage of air through it.

[0093] A face mask system may be provided which includes the face mask 10 and further comprises a fan module 20, shown in Fig. 4 but omitted from Figs. 5 and 6. The fan module is configured for arrangement in use, when the face mask system is in an assembled state, in fluidic series with the filter portion 14 for driving air which passes through the filter portion. The fan module includes a fan component for driving air, and electronics for driving the fan. The fan component can be an inhaling fan or exhaling fan, or both. The fan module 20 may be disposed in operation on an outer side of the mask coupled to an area of the filter portion of the mask (for example an area of the filter portion exposed by an opening in the optional cover portion) to permit driving of air from the outer side to the inner side of the mask, or vice versa, or both.

[0094] The provided mask 10 or mask system further comprises a magnetic coupling for releasably coupling the fan module 20 to the filter portion 14 in a position in fluidic series with the filter portion. The magnetic coupling comprises a second magnetic part 44 and a first magnetic part 42 which are magnetically attractive to one another. The second magnetic part 44 is comprised by the fan module 20, while the first magnetic part 42 is separate from the fan module. The second magnetic part is not directly visible in Figs. 4-6, but is integrated in a housing of the fan module 20, for instance at or adjacent to a face of the fan module 20 which faces inward toward the face of the user when the mask is assembled, as indicated in Fig. 4.

[0095] The face mask further comprises a holder 46 for receiving and locating the first magnetic part 42 of the magnetic coupling relative to the filter portion 14. In the illustrated embodiments, the holder is in the form of a pocket 46. However, in other embodiments, it could take a different form such as a flap or band or other structure to receive and locate the first magnetic part. In the illustrated embodiments, the pocket is provided on the filter portion itself, in particular by a flap attached to an inner side of the filter portion which faces toward the face of the user during use.

[0096] In general, the holder 46 may be at least partially formed by a flap of material attached to the filter portion 14, the flap of material for example forming a pocket or band. In general, the holder may be attached to the filter portion by at least an upper joining edge and a lower joining edge, and wherein said flap of material extends between the upper joining edge and lower joining edge. The upper and lower joining edges may be connected by at least one side edge as shown in Fig. 5 to form a pocket, or the sides might be open, to form a band or loop.

[0097] The holder 46 provides a function of locating the first magnetic part 42 relative to the filter portion 14, so that, with the first magnetic part received in the holder 46, magnetic attraction between the second 44 and first 42 magnetic parts permits magnetic coupling of the fan module 20 to the mask, for example to the filter portion 14. In particular, it is anticipated that the fan module would be coupled to the outer side of the mask, for example to an outer side of the filter portion.

[0098] The holder 46 may be positioned, as illustrated in Fig. 5 and 6, on an inner side of the filter portion 14, while the fan module 20, in the assembled state of the mask, is coupled at an outer side of the filter portion. However, in other embodiments, it is also possible to provide the holder on the same (outer) side of the filter portion.

[0099] The holder 46 may in general have an access opening configured to receive the first magnetic part in said holder.

[0100] The holder 46 in general may be for the purpose of holding or supporting the first magnetic part 42 against the force of gravity when received in the holder, when the mask is oriented for normal use.

[0101] As previously mentioned, optionally a cover portion 15 is provided covering an outer side of the filter portion (the side on the reverse of the (inner) side shown in Fig. 5 and Fig. 6). The cover portion may delimit an opening (not shown) which exposes an area of the filter portion underneath. The opening may be sized and shaped in complementarity with the size and shape of the fan module 20 and positioned aligned with the holder 46, so that the fan module 20 can align with the opening to permit at least an air input/output area of the fan module 20 to couple with an area of the filter portion underneath the cover portion exposed by the opening in the cover portion.

[0102] As illustrated in Fig. 4 and Fig. 6, the first magnetic part 42 preferably has an annular shape, i.e. a ring shape, with magnetic element(s) incorporated in the outer annular rim 62. It may have a flat and/or disc-like form. Delimited by the annular rim is a large central open area 64. This configuration permits, as illustrated in Fig. 4, for the first magnetic part to marry up with a face of the fan module 20 in such a way that an air input/output area of the fan module aligns with the central open area 64 in the middle of the first magnetic part. Thus, the first magnetic part can couple with the fan module without impeding the flow of air from the fan through into the mask, or from the mask out via the fan. By way of example, the second magnetic part 44 of the magnetic coupling might have a complementary ring shape to the first magnetic part 42, for example extending around an outer periphery of the face of the fan module 44 which faces toward the user in the assembled position.

[0103] The second and first magnetic parts may each include one or more magnets, wherein the magnet(s) of the second part are magnetically attracted to the magnets of the first part. Alternatively, one of the second and first

magnetic parts may include one or more magnets, and the other may include magnetic material attractive to the magnet(s) of the other part. With regards to the magnets, a plurality of magnetic elements may be included in one or both of the magnetic parts of the coupling, or just one. One or more magnetic strips might be used in some examples.

[0104] As illustrated in Fig. 5 and Fig. 6, the holder 46 defines an access opening 52 at one side permitting insertion and removal of the first magnetic part 42. For example, the holder may be in the form of a pocket with an access opening 52 at one side. Optionally the holder further includes a fastening means for reversibly fastening the access opening into a closed state for preventing escape of the magnetic part when so closed. Any suitable fastening means could be used, for example a releasable popper, a tongue and groove sealing, hook and loop fastening, and so on.

[0105] In a preferred set of embodiments, the holder 46 further comprises securement or locating means for the first magnetic part 42 within the pocket. In particular, preferably means is provided for holding the first magnetic part in a fixed or stable position within the holder 46, or at least for at least partially resisting motion of the first magnetic part within the holder 46. This means may provide means for rotationally securing or locating the first magnetic part within the holder. For example, the holder may include a fixation structure which is configured to positionally locate the first magnetic part (e.g. rotationally locating the first magnetic part).

[0106] By way of example, and as illustrated in Fig. 6 and Fig. 7, the holder 46 may be provided having a shape and/or size which is complementary with an outer shape and/or size of the first magnetic part, such that the boundaries of the holder act to hold the first magnetic part in a fixed/stable position when received inside the pocket for thereby locating the first magnetic part relative to the filter portion. For example, as illustrated in Fig. 5 and Fig. 6, the first magnetic part has a round shape, for example an oval shape. The holder 46 is in the form of a pocket and the pocket has a matching round shape, for example a matching oval shape. This provides a snug or flush fit of the first magnetic part inside the pocket 46. In other words, the complementary outer/inner shapes of the first magnetic part 42 and the pocket respectively provide could be said to provide an interlock geometry.

[0107] Additionally or alternatively, and as illustrated in Fig. 4 and Fig. 6, in a preferred set of embodiments, the first magnetic part 42 comprises a protruding member, such as a tab 66, protruding from one edge. The tab in the illustrated example extends in-plane with a plane defined by the first magnetic part 42, in particular a plane defined by an annular shape of the first magnetic part. This provides assistance in securing the first magnetic part in the holder 46 in a particular spatial arrangement. For example, in the illustrated example, the holder 46 is in the form of a pocket which includes a tab-receiving opening 56 in one side arranged to permit protrusion of

the tab therethrough when the first magnetic part is received in the pocket, and having a shape and size which is complementary with the tab, for thereby rotationally locating/securing the first magnetic part within the pocket when the tab is received through the opening. Thus, the opening 56, in combination with the tab 66, provides a function of rotationally aligning the first magnetic part 42 within the pocket 46. For example, the tab-receiving opening may be sized and shaped such as to at least partially restrict lateral (e.g. rotational) movement of the tab 66 when protruding through the opening, for thereby rotationally locating the first magnetic part within the pocket. In other words, the complementary shapes of the tab and the tab-receiving opening can be said to provide an interlock geometry.

[0108] Thus, in this example, the holder 46 comprises a fixation structure which is configured to rotationally locate the first magnetic part 42, and wherein the fixation structure is said tab-receiving opening 56 in the holder 46, and wherein the first magnetic part is configured with a tab 66 corresponding to the position of said opening 56 in the holder. Furthermore, the tab-receiving opening is a second opening of the holder 46, provided in addition to a first (access) opening 52 which permits the first magnetic part 42 to be received in the holder.

[0109] As a more general principle, it is advantageous to provide means for positionally securing the first magnetic part within the holder 46.

[0110] Furthermore, it can be recognized from the above-described examples that, as a general principle, it is possible to provide such means through complementary shape features of the first magnetic part and the holder 46 themselves, either complementary outer/inner shapes of the magnetic part / holder or by complementary morphology of engaging mating parts such as tabs and openings. The means may include means for providing an interlock geometry or interlock action between at least a portion of the first magnetic part and at least a portion of the holder.

[0111] Fig. 7 and Fig. 8 show further views of an inner side of the filter portion 14 with the holder 46. In these examples also the holder takes the form of a pocket 46. The first magnetic part 42 of the magnetic coupling is housed in the pocket. Each of Fig. 7 and Fig. 8 show a perspective view of a respective embodiment of the invention, showing an inner side of the filter (which would face the user in an assembled state of the mask). Fig. 7 and Fig. 8 show respectively different possible example configurations for a pocket.

[0112] Fig. 7 shows an example in which the pocket 46 has an opening for receiving the first magnetic part 42 at one lateral side of the pocket, extending from top to bottom of the pocket. In this example, the pocket is arranged to receive substantially the whole of the first magnetic part. In other words, when the first magnetic part is received in the pocket, the pocket covers substantially the whole of the area of the first magnetic part.

[0113] Fig. 8 shows an example in which the pocket

46 has an opening for receiving the first magnetic part 42 across a top of the pocket. The opening extends from one lateral side to the other lateral side. In this example, the pocket is arranged to receive only a portion of first magnetic part. In other words, when the first magnetic part is received in the pocket, the pocket covers only a portion of the area of the first magnetic part. In particular, in this example, the pocket covers approximately half of the area of the first magnetic part.

[0114] Indeed, in further examples, it is possible to provide a holder comprising a flap which covers even less of the area of the first magnetic part, so long as the holder receives and holds the first magnetic part in position. In other words, the holder may provide an enclosure configured to accommodate the first magnetic part and to secure the first magnetic part in position. For example, the holder could take the form of a band having openings on both sides and which is arranged to accommodate the first magnetic part and to hold it in position.

[0115] In general, the configuration may conform with the following. The first magnetic part 42 may define an annular shape which delimits a central open area, the central open area having a first portion and a second portion, wherein, when the first magnetic part is received in the holder 46, said holder covers the first portion of the central open area, and the second portion of the first magnetic part is exposed on a surface of the inner side or the outer side of the filter portion 14, whereby a flow resistance of the first portion is higher than the flow resistance of the second portion.

[0116] Fig. 9 shows an exploded view of an outer side of the mask, schematically illustrating how the fan module 20 aligns with a first magnetic coupling part. Fig. 9 schematically illustrates the positioning of the first magnetic part 42 received in the holder 46. In this example, the holder takes the form of a band structure 46.

[0117] Although Fig. 9 shows the first magnetic part secured on the outer side of the filter portion 14, it more preferably may be secured on an inner side of the filter portion, facing toward the user during use. The fan module 20 includes the second magnetic part 44 for coupling with the first magnetic part 42. The two magnetic parts have substantially matching annular shapes. Furthermore, the fan module has an outer shape which substantially matches the outer shape of the first magnetic part. The fan component 21 of the fan module, for driving air, is shown in Fig. 9.

[0118] Optionally, the mask can include an outer cover portion 15 which is layered atop the filter portion 14, for protection. For example, the outer cover portion may be rigid or semi-rigid with ear straps 13, whereas the filter member 14 may be formed of a fabric and thus easily deforms such that an outer edge can match the shape of a wearer's face. More preferably however, the mask comprises the filter portion without such an outer covering, to minimize resistance against the breathing of the user. Ear bands may be attached to the filter portion to permit wearing of the face mask in the usual way. The

filter portion comprises a filter material. Different grades of filtration are possible.

[0119] Where an outer cover portion 15 is provided, the fan module can be coupled directly to the outer cover portion, via the magnetic attraction with the first magnetic part 42 which is arranged in the holder in the filter portion, where the holder is preferably on the inner side of the filter, but can also be on the outer side of the filter. Alternatively, the outer cover portion may delimit an opening having a complementary size and shape to at least an air input/output area the fan module 20, and positioned in alignment with the holder 46 on (e.g. the reverse side of) the filter portion such that, when the fan module is magnetically coupled with the first magnetic part 42 received in the holder, the fan module 20 is aligned with the opening in the outer cover portion to permit the fan to be coupled to the area of the filter portion exposed by the opening in the cover portion.

[0120] With regards to the fan module as illustrated in Fig. 4 and Fig. 9, this is preferably a self-contained modular unit which contains a fan component 21 (fan impeller) for driving air, a battery, and control electronics for driving the fan. The control circuitry may further include sensors.

[0121] The fan module may be an inward fan. In a most simple design, it operates continuously to provide a continuous supply of air to the face (using air drawn through the mask filter). This provides temperature and humidity control. However, it may alternatively be operated in synchronism with the breathing of the wearer (with suitable breath sensing), and it may be controlled bi-directionally.

[0122] For example, when breathing in, air is drawn through the filter portion 14. The fan may be operating during this time, providing an airflow, or it may be turned off to save power. When breathing out, the fan may operate to create outward flow, and there may also be outward flow through the inner filter portion. Breathing comfort is improved particularly because the fan removes the exhaled air from the mask cavity and therefore prevents re-breathing (recycling) of previously exhaled and hence un-fresh air.

[0123] Fig. 10 illustrates a further example face mask according to one or more embodiments which comprises a filter portion 14 and a holder 46 for holding a first magnetic part 42 of a magnetic coupling, for use in coupling a fan module comprising a second magnetic part to the filter portion 14. As illustrated, in this example, the holder 46 takes the form of a pocket or band formed by a flap of material. The holder is attached to the filter portion 14 by an upper and lower joining edge. The holder 46 includes an access opening at one side for permitting insertion and removal of the first magnetic part 42. As illustrated, this example also includes, in common with the embodiment of Fig. 6, a second opening 56, and wherein the first magnetic part is configured with a tab 66 corresponding to the position of the second opening.

[0124] Fig. 11 illustrates a further example face mask according to one or more embodiments which comprises a filter portion 14 and a holder 46 for holding a first mag-

netic part 42 of a magnetic coupling, for use in coupling a fan module comprising a second magnetic part to the filter portion 14. As illustrated, in this example, the holder 46 takes the form of a band formed by a flap of material which is attached to the filter portion 14 by an upper and lower joining edge. The lower joining edge may be longer than the upper joining edge in this example.

[0125] Fig. 12 shows a view of a filter portion 14 of an example face mask according to one or more embodiments. The configuration of the holder 46 in this example is the same as in the example face mask shown in Fig. 11. This view further shows that the filter portion comprises an upper panel 82 and lower panel 84 which are foldable to cover or uncover the holder 46 (and the first magnetic part 42 when it is received in the holder). More particularly, the upper panel 82 comprises a flap which is foldable along a lower edge 92 and the lower panel 84 comprises a flap which is foldable along an upper edge 94. Fig. 12 shows a view in which the upper and lower panel are folded up to reveal the holder 46 (and the first magnetic part 42). This permits the first magnetic part 42 to be inserted and removed from the holder. The upper and lower panels are foldable down toward the holder, to at least partially cover the holder. For example, the filter portion may fold on the upper side to form the upper panel and/or the filter portion folds on the lower side to form the lower panel, and wherein the lower panel and/or the upper panel folds toward the second opening 56 of the holder 46 to hold the first magnetic part. This further assists in holding first magnetic part 42 in the holder when the mask is being worn.

[0126] Furthermore, it can be seen that a lower edge of the upper panel connects to the filter portion, and an upper edge of the lower panel connects to the filter portion.

[0127] The holder is in a position relative to the upper edge of lower panel and/or the lower edge of the upper panel to secure the magnetic part together with the holder when the mask is in use.

[0128] Additionally, Fig. 12 shows that the filter portion may comprise a bending line 86 in a substantially vertical direction on a facial portion of the filter portion when the mask is in use being worn by a user.

[0129] The holder 46 is in a position relative to the bending line 86 such that the bending line acts to block/interrupt lateral motion of the first magnetic part 42 out of the holder, to thereby help retain/secure the first magnetic part in the holder, to prevent the magnetic part from detaching when the mask is in use.

[0130] The holder 46 in particular is in a position, so that the bending line 86 may engage to the first (access) opening 52 of the holder 46 to secure/retain the first magnetic part in the holder 46, to prevent the first magnetic part from detaching when the mask is in use.

[0131] Fig. 13 shows a view of a further example filter portion 14 of an example face mask according to one or more embodiments. This example is the same as that of Fig. 12 except for the shape of the holder 46. In this ex-

ample, the holder 46 comprises a pocket with an access opening 52 at one side for receiving the first magnetic part 42 and comprising a second opening 56 at a second side for receiving a tab 66 comprised by the first magnetic part for positionally locating the first magnetic part 42. In this example, the holder covers approximately half of the area delimited by the first magnetic part, as compared with the example of Fig. 12 where the holder is in the form of a band which covers less of the area delimited by the first magnetic part 42.

[0132] Variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality.

[0133] A single processor or other unit may fulfill the functions of several items recited in the claims.

[0134] The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

[0135] A computer program may be stored/distributed on a suitable medium, such as an optical storage medium or a solid-state medium supplied together with or as part of other hardware, but may also be distributed in other forms, such as via the Internet or other wired or wireless telecommunication systems.

[0136] If the term "adapted to" is used in the claims or description, it is noted the term "adapted to" is intended to be equivalent to the term "configured to".

[0137] Any reference signs in the claims should not be construed as limiting the scope.

Claims

1. A face mask system, comprising:

- a face mask, the face mask comprising a filter portion comprising filter material to filter air passing between an inner side of the face mask which faces toward the user's face during use, and an outer side of the face mask;
- a fan module for arrangement in use, when the face mask system is in an assembled state, in fluidic series with the filter portion for driving air which passes through the filter portion;
- a magnetic coupling for releasably coupling the fan module to the filter portion in a position in fluidic series with the filter portion, wherein the magnetic coupling comprises a first magnetic part and a second magnetic part which are magnetically attractive to one another;
- wherein the second magnetic part is comprised by the fan module;
- wherein the first magnetic part is separate from

- the fan module;
 wherein the face mask further comprises a holder for receiving and locating the first magnetic part relative to the filter portion;
 whereby with the first magnetic part received in the holder, magnetic attraction between the first and second magnetic parts permits magnetic coupling of the fan module to the filter portion.
2. The face mask system of claim 1, wherein the holder comprises a pocket or a band.
 3. The face mask system of claim 1 or 2, wherein the holder is comprised by the filter portion.
 4. The face mask system of any of claims 1-3, wherein the holder is formed by a flap attached to a surface of the filter portion.
 5. The face mask system of any of claims 1-4, wherein the holder is provided on an inner side of the filter portion, and the fan module is for attachment at a position on an outer side of the filter portion corresponding to the position of the holder on the inner side of the filter portion.
 6. The face mask system of any of claims 1-5, wherein the holder is a pocket and the pocket defines an access opening at one side permitting insertion and removal of the first magnetic part.
 7. The face mask system of any of claims 1-6, wherein the holder includes means for positionally securing the first magnetic part within the holder.
 8. The face mask system of claim 7, wherein the means for positionally securing the first magnetic part within the holder is provided by complementary shape features of the first magnetic part and the holder.
 9. The face mask system of any of claims 1-8, wherein the holder is a pocket and the pocket has a shape and/or size which is complementary with an outer shape and/or size of the first magnetic part, such that the boundaries of the pocket act to hold the first magnetic part in a fixed/stable position when received inside the pocket for thereby locating the first magnetic part relative to the filter portion.
 10. The face mask system of any of claims 1-9, wherein the holder is a pocket, and wherein the first magnetic part comprises a tab protruding from one edge for use in rotationally securing the first magnetic part on the pocket, and preferably wherein the tab extends in-plane with a plane defined by the first magnetic part.
 11. The face mask system of claim 10, wherein the pocket comprises a tab-receiving opening in one side arranged to permit protrusion of the tab therethrough when the first magnetic part is received in the pocket, and having a shape and size which is complementary with the tab, for thereby rotationally locating the first magnetic part within the pocket when the tab is received through the tab-receiving opening.
 12. The face mask system of any of claims 1-11, wherein at least the first magnetic part defines an annular shape which delimits a central open area, the central open area having a first portion and a second portion, wherein the holder covers the first portion of the central open area, whereby the flow resistance of the second portion is lower than the flow resistance of the first portion of the central open area.
 13. The face mask system of claim 12, wherein the first and second magnetic parts are configured such that, when magnetically coupled to one another, an air input/output area of the fan module is aligned with said central open area delimited by the first magnetic part.
 14. A face mask for use in a face mask system comprising the face mask and a fan module releasably coupleable to the face mask, the face mask comprising:
 - a filter portion comprising filter material to filter air passing between an inner side of the face mask which faces toward the user's face during use, and an outer side of the face mask;
 - a holder configured on the inner side or the outer side of the filter portion for holding a magnetic part of a magnetic coupling on the inner side or the outer side of the filter portion for use in magnetically coupling a fan module to the filter portion.
 15. The face mask of claim 14, wherein the holder is formed by a flap of material attached to the filter portion, the flap of material forming a pocket or band.
 16. The face mask of claim 14 or 15, wherein the holder is for holding a magnetic part which has the form of a ring which delimits a central open area.
 17. The face mask of any of claims 14-16, wherein the holder is provided on an inner side of the filter portion, and the filter portion having an attachment area on a position of an outer side of the filter portion corresponding to the position of the holder on the inner side of the filter portion.
 18. The face mask of any of claims 14-17, wherein the holder is attached to the filter portion by at least an upper joining edge and a lower joining edge, with said flap of material extending between the upper

joining edge and lower joining edge.

- 19.** The face mask of any of claims 14-18, further comprising an upper panel and a lower panel disposed on the same side of the filter portion to which the holder is attached, 5

wherein the upper panel comprises a flap which is foldable along a lower edge and the lower panel comprises a flap which is foldable along an upper edge; 10
and wherein the upper and lower panels are foldable to cover or uncover said holder, for thereby covering or uncovering the magnetic part when received in the holder. 15

- 20.** The face mask of any of claims 14-19, further comprising an upper panel and/or a lower panel, wherein a lower edge of the upper panel connects to the filter portion, and wherein an upper edge of the lower panel connects to the filter portion, 20
wherein the holder is in a position relative to the upper edge of the lower panel and/or the lower edge of the upper panel to secure the magnetic part together with the holder when the mask is in use. 25

- 21.** The face mask of any of claims 14-20, wherein,
the mask has a bending line in a substantially vertical direction when the mask is in use, and 30
the holder is in a position relative to the bending line such that the bending line acts to block or interrupt lateral motion of the magnetic part out of the holder, to thereby prevent the magnetic part from detaching when the mask is in use. 35

- 22.** The face mask of any of claims 14-21, further comprising said magnetic part of the magnetic coupling for being held by the holder. 40

- 23.** The face mask of any of claims 14-22, wherein the holder is a pocket and the pocket defines an access opening at one side permitting insertion and removal of the magnetic part. 45

- 24.** The face mask of any of claims 14-23, wherein the holder is a pocket and the pocket has a shape and/or size which is complementary with an outer shape and/or size of the magnetic part, such that the boundaries of the pocket act to hold the magnetic part in a fixed/stable position when received inside the pocket for thereby locating the magnetic part relative to the filter portion. 50

55

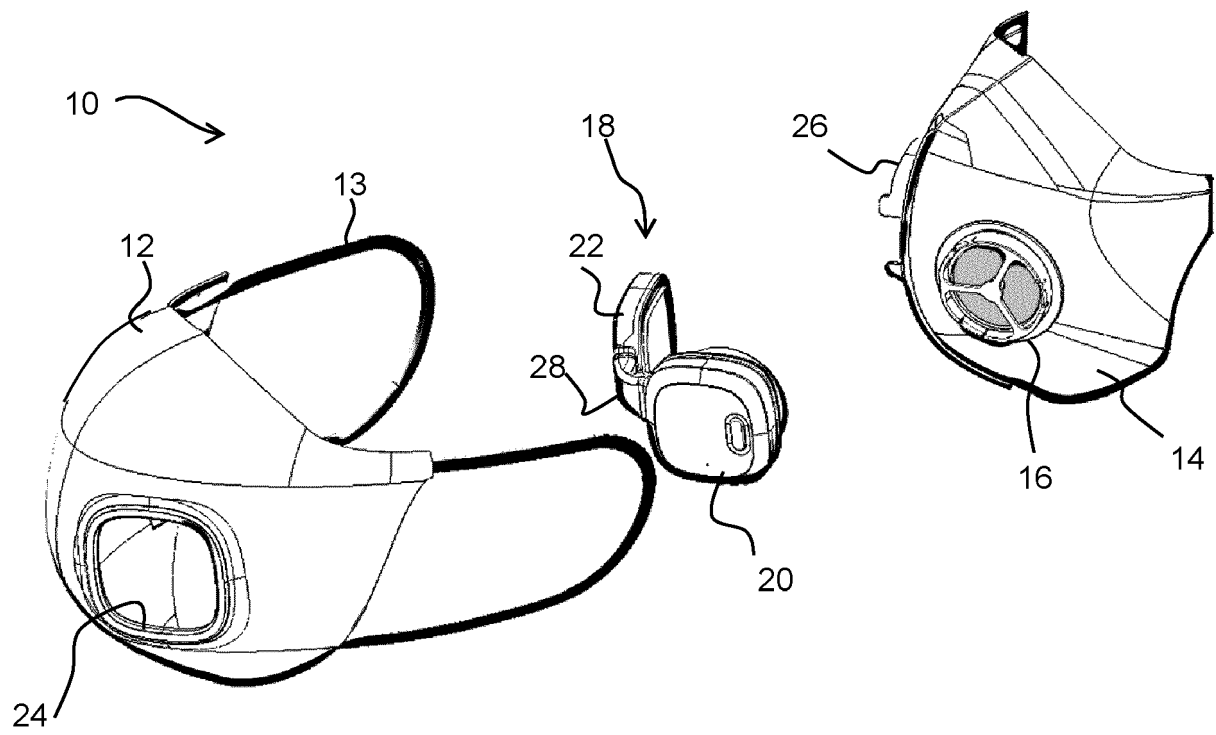


FIG. 1

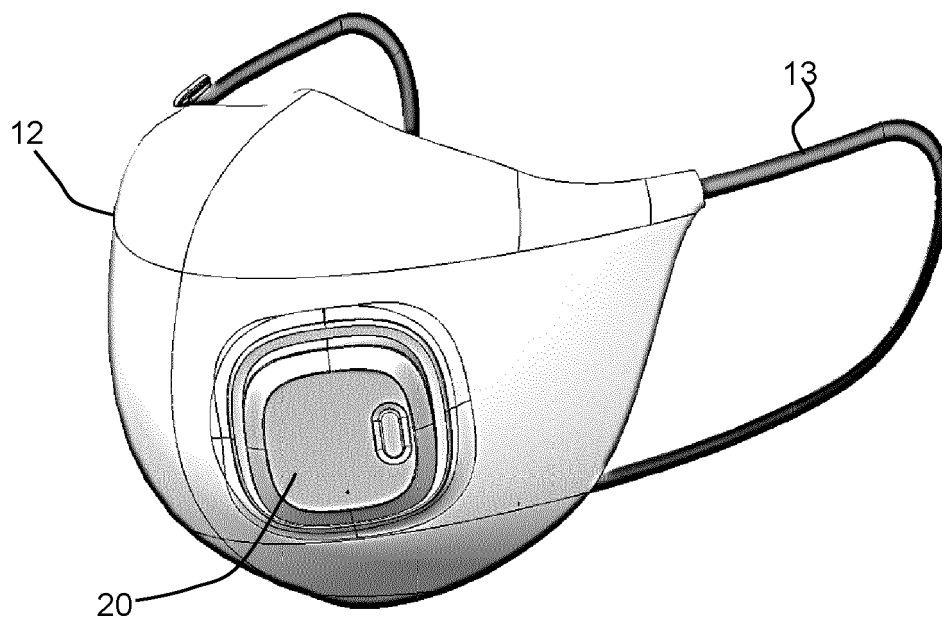


FIG. 2

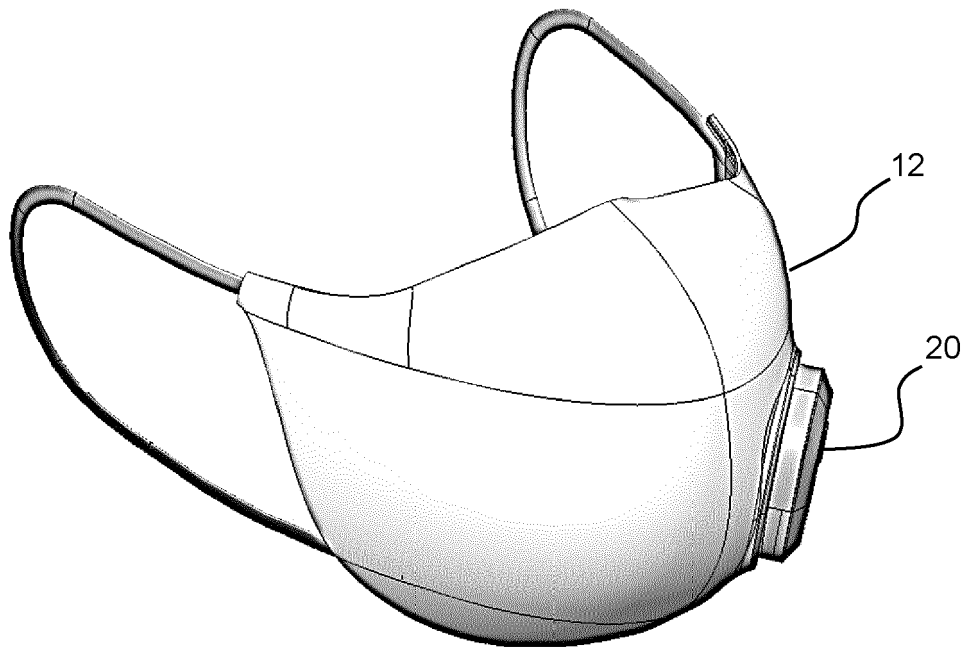


FIG. 3

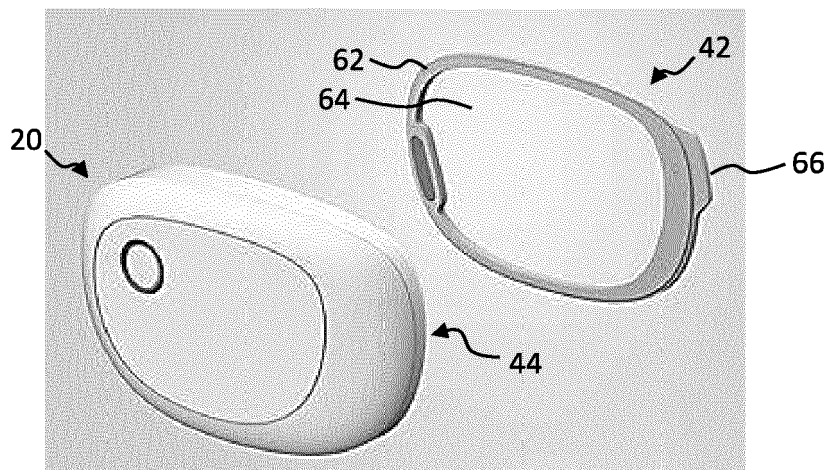


FIG. 4

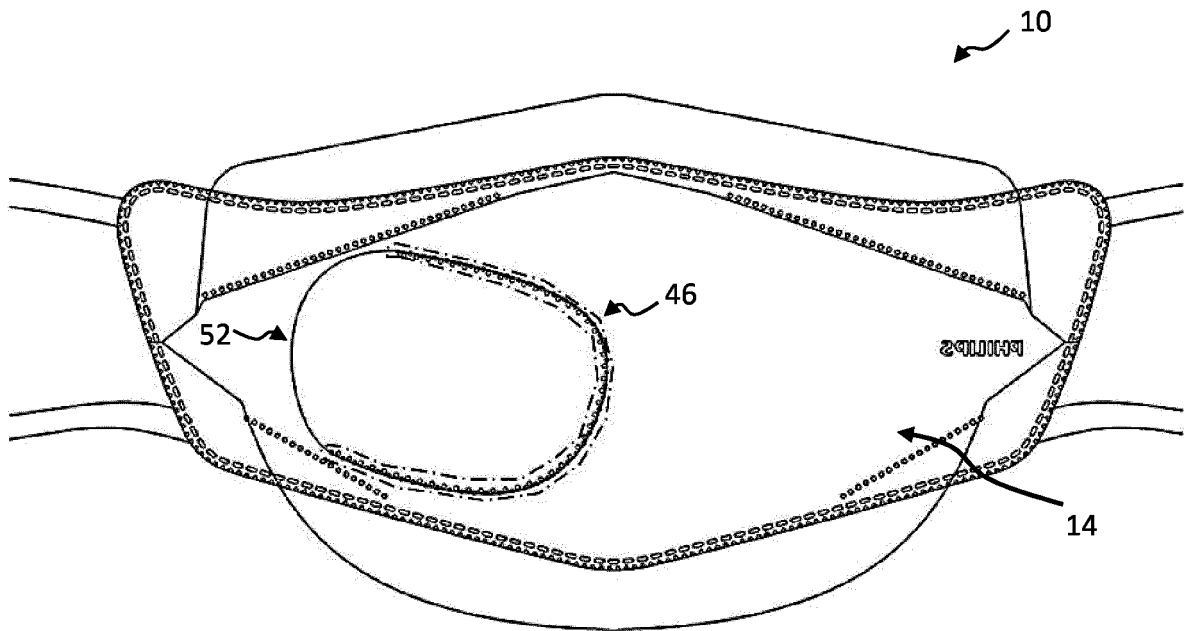


FIG. 5

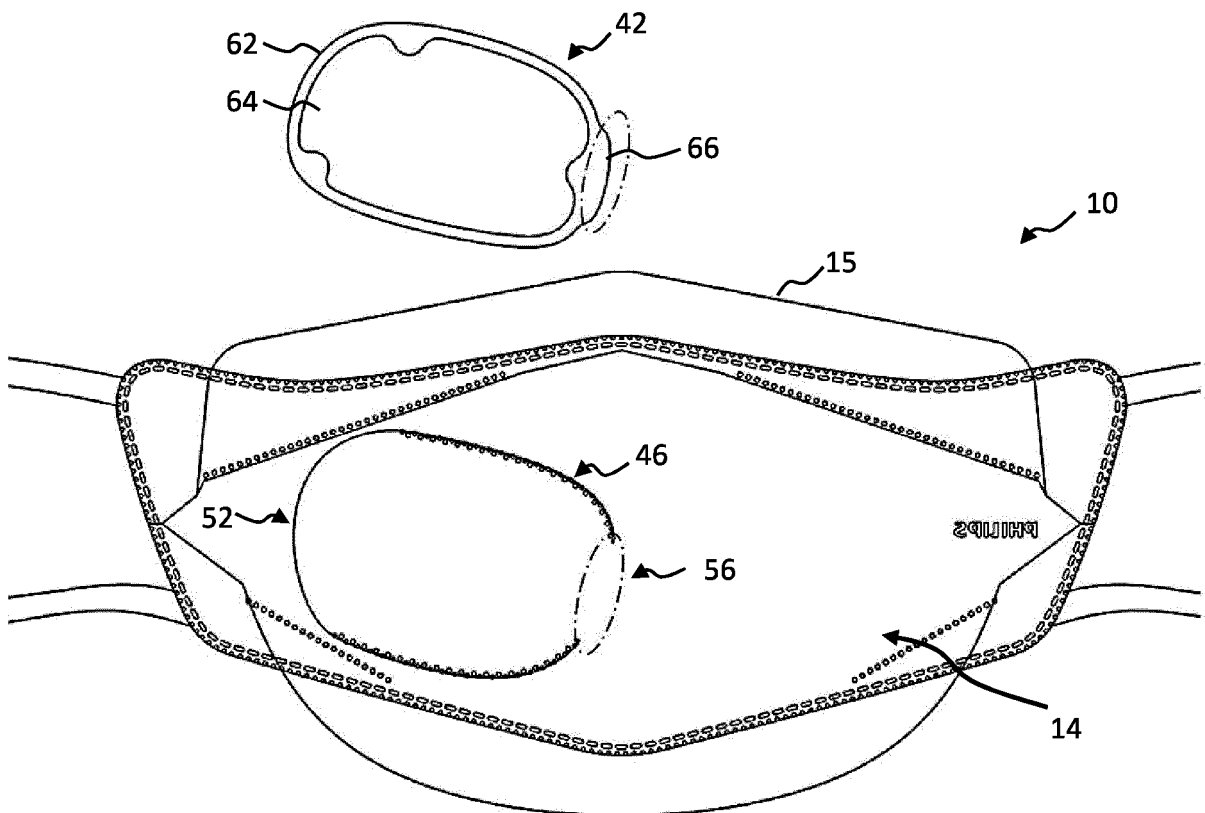


FIG. 6

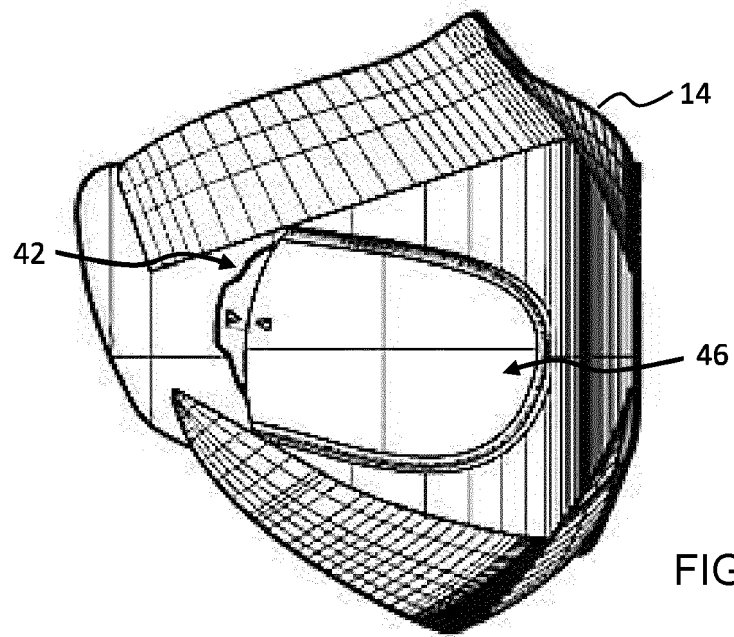


FIG. 7

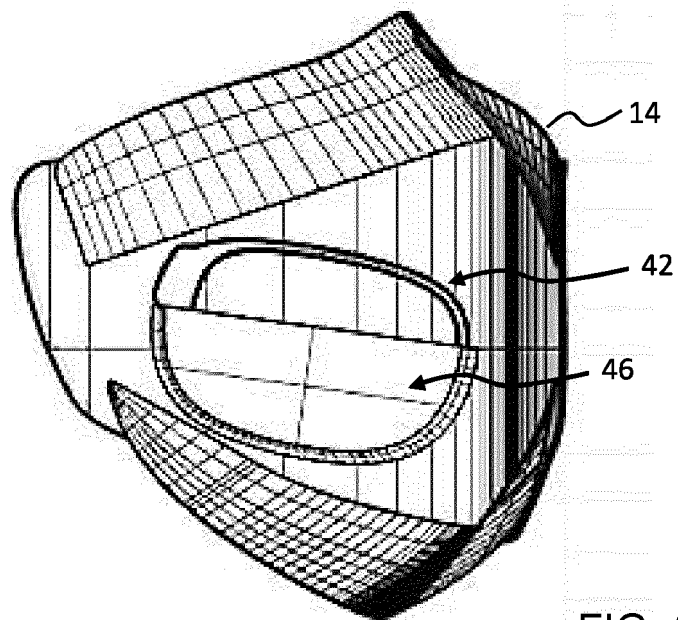


FIG. 8

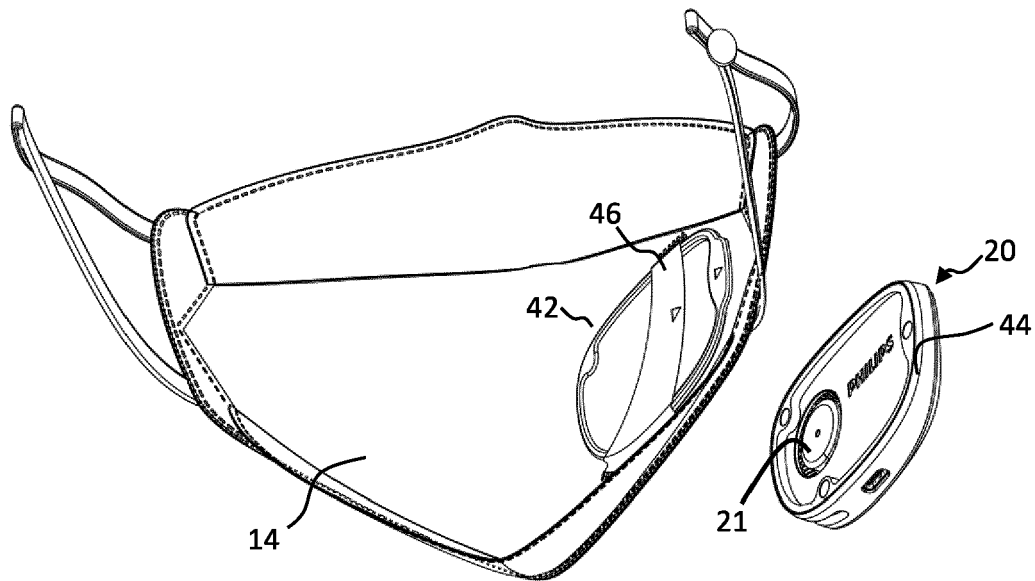


FIG. 9

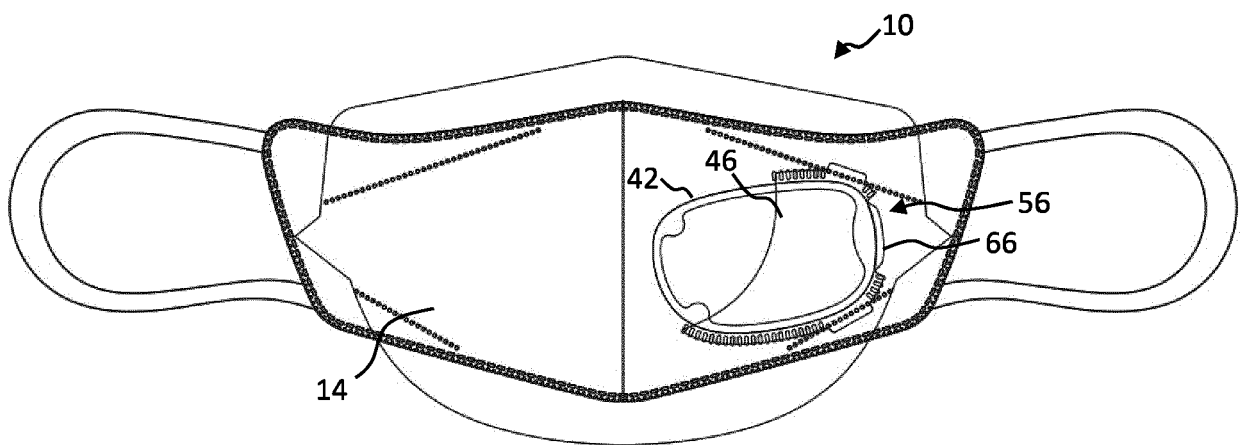


FIG. 10

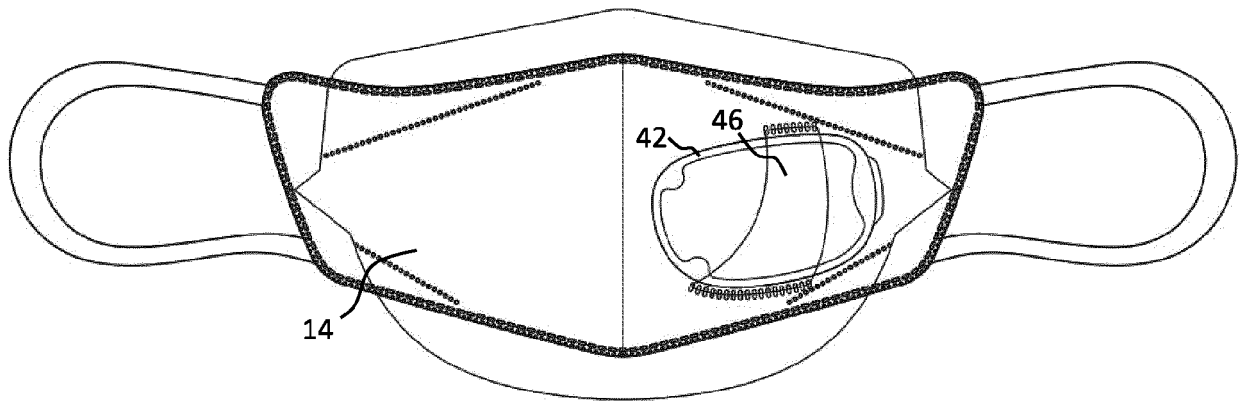


FIG. 11

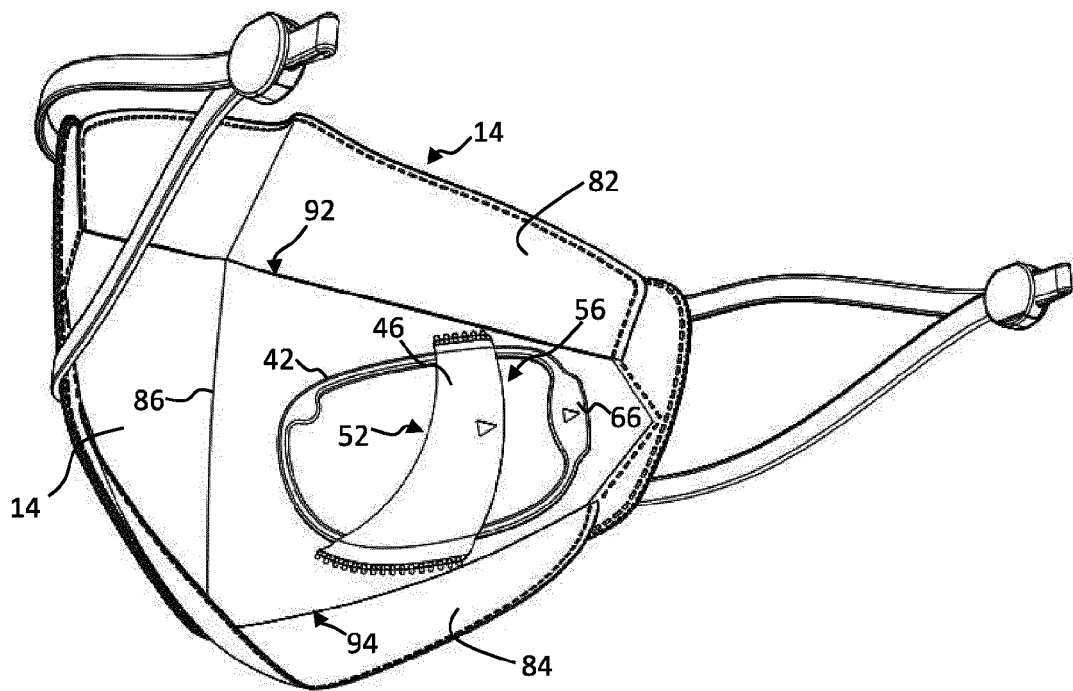


FIG. 12

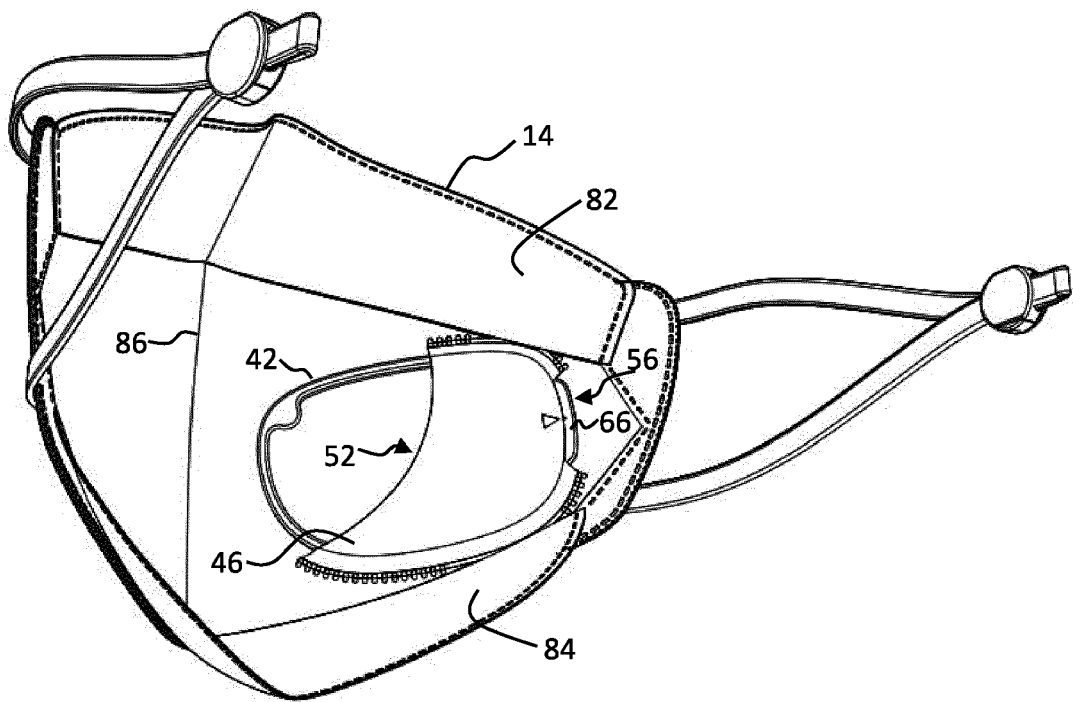


FIG. 13



EUROPEAN SEARCH REPORT

Application Number

EP 23 15 1933

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Y	* paragraphs [0002], [0037] - [0041] *	5, 17	
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