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(54) **FACE MASK AND METHOD OF PRODUCING A FACE MASK**

(57) A face mask for filtering airborne particles having a cover portion configured to be positioned in use over the nose, the mouth and a chin area of the face of a wearer. At least one aperture extends through the cover portion such that air can flow through the cover portion via the aperture. The face mask includes a seal for sealing around the nose, mouth and chin area. The face mask also includes a filter or filters arranged over the or each aperture, the or each filter configured to filter air. The cover portion is of a substantially transparent material, such that the face of the wearer is substantially visible through the cover portion. The or each filter is arranged on the cover portion such that the mouth of the wearer is substantially visible through the cover portion from an anterior view and from a lateral view of the face.

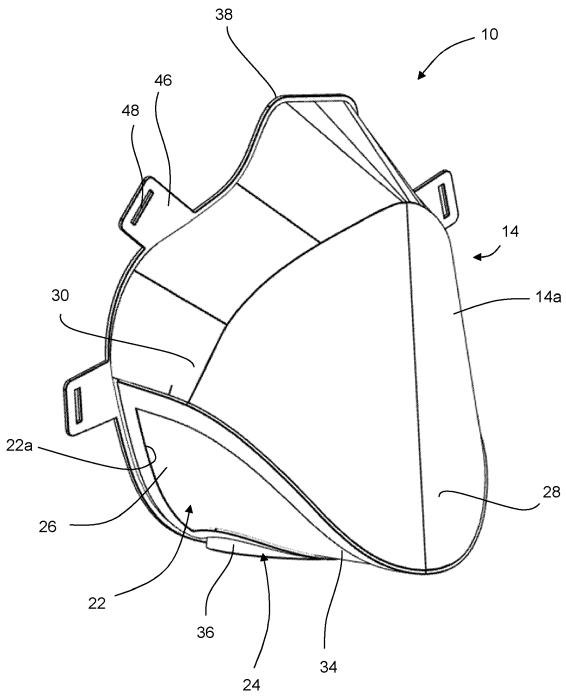

FIG. 1

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Description

FIELD

[0001] The present teaching relates to a face mask, and to a method of producing a face mask.

BACKGROUND

[0002] Filter face masks protect wearers from inhaling dust, fumes and aerosols that may be present in the atmosphere. Aerosols may carry harmful infections or viruses, and dusts and fumes may be harmful to the respiratory system.

[0003] Filter face masks are often required in particular environments, for example in workplaces where the occupational exposure limit value is exceeded (e.g. in environments with high dust, smoke or aerosol content in the breathable air). When the value is exceeded, it can be a safety requirement for a worker to wear a filter face mask. Filter face masks are commonly sealed to the face and include breathing apertures that are fitted with filters, such that air can only pass through the mask via the filters and the breathing apertures.

[0004] Filter face masks are subject to various standards and regulations. For example, the EN 149 European standard categorises filter face masks into FFP1, FFP2 and FFP3 categories. The categories are based on the aerosol filtration percentage of the filter, with FFP3 having the most effective filter. Face masks must meet numerous requirements to obtain a CE marking. The requirements define limits for inward leakage of unfiltered air (e.g. via the seal to the face, through any exhalation valves) and penetration of particles through the filter, as well as breathability requirements (i.e. reducing the resistance to breathing while wearing the mask).

[0005] Providing a mask filter that meets these regulations is commonly achieved by providing a breathing aperture and a corresponding filter with a relatively large surface area. Increasing the surface area of the breathing aperture increases the volume of air that can pass through the mask during inhalation. A filter with a larger surface area can effectively filter the increased volume of air. Many masks therefore include large filter components so as to meet the regulations.

[0006] Face masks are commonly worn in environments where communication is essential, for example in medical environments and on construction sites. Face masks are typically made from material that obstructs the view of a wearer's face, such as fabric. Wearing a face mask hinders communication between the wearer and others, as volume of speech is reduced by the presence of the mask over a mouth of a wearer. Moreover, obstruction by the mask of the wearer's face inhibits communication in that visual communication, for example reading facial expressions or lip reading, cannot be seen, or cannot be seen clearly.

[0007] It is known to form a face mask at least partially of a clear or transparent material. For example, the face mask may be substantially made of a fabric filtering material, with a portion of the fabric removed and replaced with a clear material (i.e. a clear patch). In such a mask, the fabric contacts the face, with the clear portion intended to be located over the mouth. However, such a mask does not form an effective seal to the face, and unfiltered air may leak into the mask via air gaps around the periphery of the mask. The high inward leakage means that such a mask fails to meet the EN 149 standard for an FFP2 or an FFP3 mask.

[0008] Alternatively, the face mask may be formed substantially wholly of a clear or transparent material, such as a plastics material. Such a mask can also have associated problems. Transparent materials typically fail to meet the stringent requirements for CE certification as defined in EN 149. Accordingly, it can be difficult to achieve a transparent mask at FFP2 or FFP3 standard (e.g. suitable for use in medical environments with high infection risk).

[0009] For example, many transparent materials are rigid in nature and do not fit comfortably around the face of a wearer while maintaining a seal that prevents movement of particulates through the mask via the edges (i.e. as required for FFP2 and FFP3 classification).

[0010] To meet the EN 149 standard, the face mask must include a filter. The inclusion of a filter in an otherwise transparent mask often impedes the view of a wearer's face through the transparent material, particularly as filters preferably occupy a large surface area for increased effectiveness.

[0011] Another issue arises in flammability regulations, which require the mask to not burn upon exposure to an 800°C (± 50°C) flame, or not continue to burn for more than five seconds after removal of a 800°C (± 50°C) flame. Many clear plastics burn readily, and many flame retardants are not transparent, so that using a flame retardant can affect transparency of the mask.

[0012] EN 149 also defines breathability requirements. EN 149 indicates that the mask must not inhibit inhalation/exhalation to an uncomfortable degree. The EN 149 standard provides a maximum permitted resistance to breathing value that must be adhered to. Breathability requirements are typically met with a large filter, but such a large filter can further obstruct the face and prevent clear communication between wearers of masks.

[0013] Many filter face masks also require extensive fitting procedures to ensure the mask is being correctly worn. Such extensive procedures can prevent emergency use of masks. Moreover, masks of different sizes must be provided for different people, or must be custom made to fit an individual properly.

[0014] The present teachings seek to overcome or at least mitigate one or more of the problems associated with the prior art.

SUMMARY OF THE INVENTION

[0015] In a first aspect of the invention, there is provided a face mask for filtering airborne particles, the face mask comprising: a cover portion having an inner surface and an outer surface, the cover portion configured to be positioned in use over the nose, the mouth and a chin area of the face of a wearer; at least one aperture that extends through the cover portion from the outer surface to the inner surface such that air can flow through the cover portion via the aperture (e.g. upon inhalation); a seal for sealing around the nose, mouth and chin area in use, such that air flows substantially through the aperture when inhaled and/or exhaled through the nose or mouth; a filter or filters arranged over the or each aperture, the or each filter configured to filter air so as to limit the flow of airborne particles through the aperture; wherein the cover portion is of a substantially transparent material, such that the face of the wearer is substantially visible through the cover portion, in use; and wherein the or each filter is arranged on the cover portion such that the mouth of the wearer is substantially visible through the cover portion from an anterior view and from a lateral view of the face, in use.

[0016] Filter face masks advantageously protect wearers from the inhalation of dust, fumes and aerosols that may be present in the atmosphere. Aerosols may carry harmful infections or viruses, and dusts and fumes may be harmful to the respiratory system. Wearers of such masks are protected from inhaling such substances.

[0017] The provision of a seal for sealing around the nose, mouth and chin area promotes the flow of inhaled air through the at least one aperture and the corresponding filter, rather than allowing unfiltered air to flow in around the periphery of the mask. Accordingly, the wearer is protected from inhaling harmful particles.

[0018] Masks are commonly worn in situations where clear communication is vital, such as medical environments and construction sites. Wearing a face mask inhibits communication between the wearer and others by reducing the volume of speech of the wearer. Communication is further inhibited by the increased difficulty of visual means of communication, such as reading facial expressions and lip-reading, due to the wearer's face being obscured by the mask. Advantageously, the provision of a substantially transparent mask improves visual communication by improving sight of the wearer's face.

[0019] The inclusion of a filter or filters in a face mask typically impedes the view of the wearer's face. Arranging the aperture, and so the accompanying filter, so that the wearer's mouth is substantially visible from an anterior view and a lateral view of the face reduces obstruction of the mouth and so improves visual communication.

[0020] Importantly, such a mask provides improved communication without having to alter the position of the face, and without compromising the effectiveness of the filtration aspect of the mask with regards to protecting the wearer from the inhalation of potentially hazardous particles. This is of particular use in medical environments, where staff need to communicate with patients, and for communication with children, people who are hard of hearing or people with learning difficulties, to whom visibility of the mouth and facial expressions can be critical to understanding.

[0021] In exemplary embodiments, the filter is configured to filter at least 94% of airborne particles.

[0022] The level of protection provided depends on the type of mask used. In order for a wearer to achieve a level of protection suitable for a particular environment, various standards and regulations have been developed for face masks. The face mask described is one that meets the regulatory standard of an FFP2 mask, i.e. one that filters at least 94% of airborne particles and so meets the EN 149 European standard.

[0023] In exemplary embodiments, wherein the substantially transparent material is a plastics material.

[0024] In exemplary embodiments, the plastics material is a thermoplastic polyurethane (TPU).

[0025] Advantageously, TPU has been found to have the appropriate properties with regards to elasticity, transparency, and fire retardancy to meet the regulations for face masks. A transparent cover portion that allows visibility of the face beneath the mask can thus be provided without compromising the safety standards of the mask. In addition, due to the flexible nature of TPU, the convenience and comfort of wearing the mask is improved.

[0026] In exemplary embodiments, the cover portion comprises a mouth portion configured to be located over the mouth of a wearer, wherein the or each filter is remote from the mouth portion.

[0027] Locating the filter remote from the mouth portion advantageously reduces visual obstruction of the mouth of the wearer. The arrangement is particularly beneficial at reducing obstruction of the mouth when the face is viewed from an anterior view. Such an arrangement therefore facilitates improved visibility of the mouth and thus improved communication.

[0028] In exemplary embodiments, the cover portion comprises two cheek portions each configured to be located over a respective cheek of the wearer, wherein the or each filter is arranged so as to be remote from the cheek portions, such that the mouth of the wearer is substantially visible through the cover portion from a lateral view of the face.

[0029] Advantageously, locating the filter remote from the cheek portions reduces obstruction caused by the filter to the visibility of the mouth of the wearer. The arrangement is particularly beneficial at reducing obstruction of the mouth when the face is viewed from a lateral view. Such an arrangement reduces the need for a wearer to change their orientation during communication and therefore the convenience of communicating while wearing the mask is improved.

[0030] In exemplary embodiments, the cover portion comprises a chin portion configured to be located over

the chin area of a wearer, and wherein the or each filter is located at the chin portion.

[0031] Advantageously, arranging the filter on the chin portion utilises an area of high surface area that is remote from the mouth for location of the filter and the aperture. Making use of an area of higher surface area for the aperture allows optimisation of air flow rate into the mask for inhalation by the wearer. The required air flow rate standard can therefore be met. Moreover, as is known in the art, increasing the surface area of a filter can increase its effectiveness and throughput. An increased amount of air can be effectively filtered without compromising visibility of the mouth of the wearer.

[0032] In exemplary embodiments, the chin portion is configured to extend to an underside of the jaw of the wearer, and wherein the or each filter is substantially arranged so as to be located over the underside of the jaw in use.

[0033] Making use of the space on the underside of the jaw to locate the filter allows an increase of the size of the filter and aperture, thus increasing the air flow into the mask as well as the filter performance. Locating the filter on the underside of the jaw further reduces the obstruction to the mouth caused by the filter.

[0034] In exemplary embodiments, the or each filter is arranged exclusively on the chin portion.

[0035] Location of the filter only at the chin portion greatly reduces the potential for obstructing a view of the mouth of the wearer, and increases the range of angles from which the mouth is visible.

[0036] In exemplary embodiments, the or each filter is arranged so as to be located exclusively over the underside of the jaw in use.

[0037] Locating the face mask exclusively over the underside of the jaw has been found to increase the filter performance and air flow rate of the mask, while also entirely removing the obstruction caused by the filter to the visibility of the face of the wearer. Accordingly, the mouth of the wearer is clearly visible through the mask from a range of angles when worn, including from below, which is particularly important in medical settings where healthcare workers may be communicating with patients in bed (i.e. where the patient is looking up at the mask wearer).

[0038] In exemplary embodiments, the at least one aperture is an inlet aperture, and wherein the face mask further comprises: at least one outlet aperture that extends through the cover portion from the inner surface to the outer surface such that air can flow through the cover portion via the outlet aperture (e.g. upon exhalation); and a valve or valves arranged over the or each outlet aperture, the or each valve configured to permit the flow of air from the inner surface to the outer surface upon exhalation by a wearer; and to inhibit the flow of air from the outer surface to the inner surface upon inhalation by the wearer.

[0039] It is well known in the art that air flow rate during exhalation is higher than that of inhalation. The size available to the filter may not be large enough to manage exhaled air as well as inhaled air. Accordingly, outlet apertures provide an alternative path for the removal of exhaled air from the mask, reducing discomfort to the wearer and enabling the mask to meet the required air flow rate standard. The provision of the valve or valves prevents or inhibits air from flowing through the mask on inhalation, thus reducing the risk of unfiltered air passing through the mask and carrying harmful particles to the respiratory system of the wearer.

[0040] In exemplary embodiments, the cover portion comprises a mouth portion configured to be located over the mouth of a wearer, wherein the or each valve is remote from the mouth portion.

[0041] Arranging the valves such that they are remote from the mouth prevents visual obstruction of the mouth of the wearer, thereby facilitating improved visual communication.

[0042] In exemplary embodiments, the cover portion comprises a chin portion configured to be located over the chin area of a wearer and configured to extend to an underside of a jaw of the wearer, and wherein the or each valve is substantially arranged so as to be located over the underside of the jaw in use.

[0043] Locating the valve on the underside of the jaw further limits visual obstruction of the mouth of the wearer.

[0044] In exemplary embodiments, the or each filter is configured to sealingly engage with the cover portion; preferably wherein the or each filter is configured to extend fully over a respective aperture.

[0045] Sealingly engaging the or each filter with the cover portion reduces the presence of air gaps between the filter and the cover portion. Without the sealing engagement, unfiltered air may enter the mask via said gaps. This arrangement therefore advantageously promotes the flow of air through the filter and reduces the risk of the wearer inhaling unfiltered air and potentially harmful airborne particles. Sealing engagement also provides a secure fit between the filter and the cover portion, thereby reducing the likelihood of the filter detaching from the cover portion of the mask and generating gaps for unfiltered air.

[0046] In exemplary embodiments, the seal comprises a sealing surface coupled to an outer perimeter of the cover portion; preferably wherein the sealing surface is configured to sealingly engage the face of the wearer such that the cover portion defines a chamber between the face of the wearer and the cover portion.

[0047] The arrangement of the cover portion into a chamber has been found to improve the comfort associated with wearing the mask, as contact between the cover portion and/or filter and the wearer's face is reduced. This is of particular importance in workplace settings, where the mask may be worn for several hours.

[0048] Advantageously, sealing around the outer perimeter of the mask reduces the likelihood of unfiltered air passing through the mask via the interface between the face and the mask. Therefore, the risk of unfiltered

air entering the chamber (i.e. air that has not passed through the filter first) is reduced.

[0049] In exemplary embodiments, the sealing surface is of substantially transparent material.

[0050] The sealing surface being of a transparent material has been found to further improve the visibility of the mouth from various angles relative to the face when the mask is worn, as the sealing surface does not cause a visual obstruction.

[0051] In exemplary embodiments, the mask is configured such that the seal is generated during inhalation by the wearer.

[0052] Generation of a seal upon inhalation by the wearer reduces the complexity of wearing and removing the mask. Such is particularly important in emergency scenarios where a face mask is needed quickly. Generating a seal through the act of inhalation is intuitive for a wearer, and ensures the mask will always seal to the face, thus ensuring the mask is protecting the wearer from airborne particles from the moment the wearer inhales.

[0053] In exemplary embodiments, the cover portion is configured to mould around the face of the wearer during inhalation.

[0054] Unlike conventional fabric masks that typically crease, the mask moulds to the wearer's face, thereby ensuring a comfortable and effective fit without the need for special fitments or a fitting procedure to ensure the wearer is wearing the mask correctly. Instead, the mask described adapts to the face of the wearer, thus increasing the convenience of use, and the range of potential wearers for a mask of a particular size.

[0055] In exemplary embodiments, the mask is configured such that the mask does not instantly combust when exposed to temperatures of 800°C (± 50°C) or greater.

[0056] Mask standards require a high degree of flame retardancy. The mask described has been found to meet the flame retardancy standards, while still maintaining its transparency and thus the advantages associated with increased visibility of the face.

[0057] In exemplary embodiments, the mask further comprises a securing means coupled to the cover portion and configured to secure the cover portion to the face of a wearer (e.g. via a head strap).

[0058] The provision of a securing means has been found to improve the fit of the mask around a wearer's face, therefore improving the convenience of using the mask and reducing the need to reposition the mask once it is on the face. Moreover, the securing means assists in the generation of a seal around the face of the wearer, thus reducing the risk of unfiltered air entering the chamber and potentially harming the wearer.

[0059] In exemplary embodiments, the securing means is configured so as to be user-adjustable.

[0060] Advantageously, an adjustable securing means allows the mask to be securely fitted to a wide range of wearers with differently sized faces and heads, reducing the need for individually sized masks with substantial fitting procedures.

[0061] In exemplary embodiments, the securing means is of a substantially transparent material.

[0062] Forming the securing means from a transparent material will reduce the likelihood that the securing means visually obstructs the face, thereby further promoting visibility of the face for improved communication.

[0063] In exemplary embodiments, the securing means is elastic.

[0064] In exemplary embodiments, the cover portion is configured to have anti-fog properties.

[0065] Reducing the likelihood of fogging inhibits a reduction in visibility of the mouth of the wearer. In addition, the chances of the wearer moving or removing the mask for de-fogging are reduced, so reducing the risk of exposure of the wearer to unfiltered air while the mask is moved or removed.

[0066] In exemplary embodiments, the or each filter is welded to the cover portion.

[0067] Advantageously, welding the filter to the cover portion removes the need for any other material to perform a sealed connection between the filter and the cover portion, thus preventing further obstruction caused by such a material. Moreover, welding the filter has been found to provide a secure connection between the filter and the cover portion, thus substantially preventing the flow of air through the aperture around the periphery of the filter, and promoting the flow of air through the filter prior to flowing through the aperture.

[0068] In exemplary embodiments, the or each filter is a first filter, and wherein the face mask is configured such that the first filter is removeable from the at least one aperture after use and is replaceable with a second filter for subsequent use.

[0069] Facilitating replacement of the filter improves the lifetime of the mask and renders the mask reusable. Such a feature advantageously reduces the waste generated by the use of the mask, and reduces cost.

[0070] In exemplary embodiments, the filter is configured to filter at least 99% of airborne particles.

[0071] Due to the potential risks of exposure to such particles, numerous standards and regulations have been developed to ensure face masks are capable of suitable protection. The face mask described has been found to meet the regulatory standards of an FFP3 mask (i.e. filters at least 99% of airborne particles) and offer suitable protection for the wearer.

[0072] In a second aspect of the invention, there is provided a method of producing the face mask of the first aspect, the method comprising the steps of: forming the cover portion by a first processing operation; and securing the or each filter over the or each aperture by a second processing operation.

[0073] In exemplary embodiments, the cover portion is a plastics material, preferably a thermoplastic polyurethane (TPU).

[0074] In exemplary embodiments, the first processing operation is injection moulding.

[0075] In exemplary embodiments, the second processing operation is welding.

[0076] In exemplary embodiments, the step of forming the cover portion includes applying an antifog spray or antifog coating to the cover portion.

[0077] In exemplary embodiments, the step of forming the cover portion includes introducing a flame retardant powder to the cover portion.

[0078] In exemplary embodiments, the step of forming the cover portion includes applying a flame retardant spray to the cover portion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0079]

Figure 1 is an isometric view of a face mask according to an embodiment of the present teachings;
Figure 2 is a front view of the face mask of Figure 1;
Figure 3 is an underside view of the face mask of Figure 1;
Figure 4 is a rear view of the face mask of Figure 1;
Figure 5 is a side view of the face mask of Figure 1;
Figure 6 is a front or anterior view of a wearer of the face mask of Figure 1; and
Figure 7 is a side or lateral view of a wearer of the face mask of Figure 1.

DETAILED DESCRIPTION OF EMBODIMENTS

[0080] Referring to Figures 1 to 7, a face mask is indicated generally at 10.

[0081] The face mask 10 includes a cover portion 14. The cover portion 14 has an outer surface 14a and an inner surface 14b. The cover portion 14 is intended to be positioned on the face 12 of a wearer. The cover portion 14 is configured to be positioned over a nose 16, a mouth 18 and a chin area 20 of the face of a wearer.

[0082] The mouth 18 may refer to the mouth of the wearer, but may also include an area around the mouth 18. The nose 16 may refer to the entire nose, or to just a portion of nose.

[0083] Specifically, the cover portion 14 is intended to be positioned over those parts of the face through which inhalation and/or exhalation take place, and so through which harmful particles may be inhaled, i.e. the mouth and the nostrils. In some embodiments, the cover portion 14 positioned not over the entire nose, but only over the nostrils.

[0084] The chin area 20 refers to an area below the mouth, i.e. an area that incorporates the jaw/mandible. In some embodiments, the chin area 20 does not include the entirety of the mandible.

[0085] The cover portion defines one or more apertures 22, 24 that extend fully through the cover portion 14 from the outer surface 14a to the inner surface 14b. The apertures 22, 24 permit the flow of air through the cover portion 14. Air can flow between the outer surface 14a and the inner surface 14b via the apertures 22, 24. For example, air flows to or from the nose 16 or mouth 18 of a wearer through the apertures 22, 24 upon inhalation or exhalation.

[0086] In some embodiments, a single aperture 22, 24 extends through the cover portion 14. However, in some embodiments multiple apertures that extend through the cover portion 14 are included, so as to improve the breathability of the mask 10. In some embodiments, the apertures 22, 24 are located proximate one another or can be distributed across the cover portion 14.

[0087] The face mask 10 includes a seal 38. The seal is for sealing around the nose 16, mouth 18 and chin area 20 when the mask 10 is worn. The seal facilitates the flow of air substantially through the apertures 22, 24 when inhaled/exhaled through the nose 16 or mouth 18 by preventing inhalation and exhalation of air around the perimeter of the mask 10.

[0088] The face mask 10 includes a filter 26 for filtering air inhaled through the mask 10. In the illustrated embodiment, the filter 26 is arranged over the aperture 22. As discussed in more detail below, the filter 26 extends over the aperture 22, but does not extend over the aperture 24. In alternative embodiments, the filter 26 extends over all of the apertures.

[0089] In this embodiment, the aperture 22 is defined by an edge 22a located between the aperture 22 and the cover portion 14. The edge 22a defines the outer perimeter of the aperture 22. The filter 26 wholly covers the aperture 22. In this embodiment, the shape of the filter 26 corresponds to the shape of the aperture 22.

[0090] In this embodiment, the aperture 22 is substantially U-shaped, and thus the filter 26 is also substantially U-shaped. It should be appreciated that the aperture 22 may be any shape. The filter 26 may not be the same shape as the aperture 22 in some embodiment.

[0091] In exemplary embodiments, the filter 26 is sized to extend beyond the edge 22a of the aperture 22 in the present embodiment, to facilitate securing the filter 26 to the cover portion 14, as will be discussed in more detail below. In an alternative embodiment, the filter 26 may be sized to terminate at the edge 22a of the aperture 22.

[0092] In some embodiments, a single filter is located over multiple apertures. In alternative embodiments, multiple filters are provided. In one embodiment, each filter is arranged over a respective aperture. In another embodiment, each filter is arranged over multiple apertures.

[0093] In this embodiment, the filter 26 is capable of filtering at least 94% of airborne particles. The filter 26 can thus protect the wearer from negative health impacts linked with inhaling harmful particles.

[0094] The filter 26 meets the regulatory standard of an FFP2 mask, i.e. filters at least 94% of airborne particles and so meets the EN 149 European standard and the standard for CE marking. The mask also meets the standard of a KF94 mask, meeting the Korean regulatory standard.

[0095] In an alternative embodiment, the filter 26 is ca-

pable of filtering at least 95% of airborne particles, so as to meet the regulatory standard of an NP95 and a KN95 mask, i.e. meeting the US and Chinese regulatory standards.

[0096] The filter 26 is in an alternative embodiment capable of filtering at least 99% of airborne particles. The filter 26 thus meets the regulatory standard of an FFP3 mask, i.e. filters at least 99% of airborne particles and so meets the EN 149 European standard.

[0097] More specifically, the EN 149 standard requires that the penetration of the filter does not exceed 6% for an FFP2 classification, and 1% for an FFP3 classification. The filter meets the standard of an FFP2 mask. In an alternative embodiment, the filter meets the standard for an FFP3 classification.

[0098] In exemplary embodiments, the aperture 22 has a surface area of at least 2000 mm^2. In some embodiments, the aperture 22 has a surface area of at least 3000 mm^2. In some embodiments, the aperture 22 has a surface area of at least 4000 mm^2. In some embodiments, the aperture 22 has a surface area of at least 5000 mm^2. In some embodiments, the aperture 22 has a surface area of at least 6000 mm^2. In some embodiments, the aperture 22 has a surface area of at least 7000 mm^2.

[0099] The combination of the seal 38 and the filter 26 reduces the concentration of harmful particulates from air that moves between the outer surface 14a and the inner surface 14b of the cover portion 14 (e.g. during inhalation), thereby reducing the concentration of harmful particulates that may enter the respiratory system of the wearer. The seal promotes the flow of inhaled air through the filter and reduces the flow of unfiltered air into the respiratory system. The filter 26 facilitates the inhalation of air that contains minimal harmful particles.

[0100] As can be seen best in Figures 6 and 7, the cover portion 14 is of a substantially transparent material. The face 12 of the wearer is substantially visible through the cover portion 14 when the mask 10 is in use. The transparent material assists in communication when wearing a mask, as facial expressions can be observed, and words can be lipread.

[0101] Figure 6 indicates the face 12 of a wearer of the mask 10 from an anterior perspective (i.e. from a substantially straight-on front view). Figure 7 indicates the face 12 of a wearer of the mask 10 from a lateral perspective (i.e. from a side view or profile view, where the head of the wearer is viewed in profile so that the side of the wearer's face is viewed).

[0102] As can be seen in Figures 6 and 7, the filter 26 is arranged on the cover portion 14 such that the mouth 18 of the wearer is substantially visible through the cover portion 14. That is to say, the filter 26 does not impede the view of the face 12 of a wearer when viewed from an anterior perspective and from a lateral perspective.

[0103] Put another way, the aperture 22 and the associated filter 26 are arranged on the cover portion 14 such that a line of sight extending toward the face 12 is unobstructed by the cover portion 14 and the filter 26 so that the mouth 18 of the wearer is substantially visible through the cover portion 14 along said line of sight.

[0104] As shown in the figures, the aperture 22 and the accompanying filter 26 are positioned so as to remove obstruction to the face 12. Such an arrangement, when combined with the transparent cover portion 14, provides a clear, unobstructed view of the face 12 from multiple angles. Such a mask facilitates improved communication without having to alter the position of the face 12, and without compromising the effectiveness of the filter with regards to protecting the wearer from inhaling hazardous particles.

[0105] A clear view of the face 12 is crucial in workplace environments where communication is essential. This is of particular value in medical environments, where communication with patients is key, and/or for communication with children, people who are hard of hearing, or people with learning difficulties, to whom visibility of the mouth 18 and facial expressions can be critical to understanding.

[0106] The cover portion 14 includes a mouth portion 28 that is provided to be located over the mouth 18 of the wearer. In exemplary embodiments, the filter 26 is arranged so as to be remote from the mouth portion 28. Positioning the filter remote from the mouth portion 28 reduces obstruction caused by the filter 26 to the mouth 18 when the face 12 of the wearer is viewed from an anterior view.

[0107] The cover portion 14 includes two cheek portions 30 that are provided to be located over a respective cheek 32 of a wearer. In exemplary embodiments, the filter 26 is arranged so as to be remote from the cheek portions 30. Locating the filter remote from the cheek portions reduces obstruction caused by the filter 26 to the mouth 18 when the face 12 of the wearer is viewed from a lateral view.

[0108] The cover portion 14 includes a chin portion 34 that is provided to be located over the chin area 20 of the wearer. As can be seen in the figures, the filter 26 is located at the chin portion 34. The chin area 20 of the wearer is an area of relatively large surface area, therefore the chin portion 34 of the cover portion 14 is an area of relatively large surface area. Arranging the filter 26 on the chin portion 34 makes use of the area of large surface area for an increased aperture area so as to optimise air flow through the mask 10 for inhalation, thus allowing the breathability standard (as discussed below) to be met. Moreover, the chin portion 34 is remote from the mouth 18, and thus the filter 26 can be positioned so as to reduce obstruction to the view of the mouth 18.

[0109] Breathability requirements defined in EN 149 require that the mask 10 does not inhibit inhalation and exhalation to an uncomfortable degree. Specifically, the maximum permitted resistance for inhalation at 30 l min^{-1} is 0.7 mbar for an FFP2 mask, and 1 mbar for an FFP3 mask. The maximum permitted resistance for inhalation at 95 l min^{-1} is 2.4 mbar for an FFP2 mask and 3 mbar

for an FFP3 mask. The maximum permitted resistance for exhalation is larger than for inhalation. At 160 l min^{-1}, the maximum permitted resistance for exhalation is 3 mbar for an FFP2 and an FFP3 mask. The mask 10 of this embodiment meets the standard for at least an FFP2 mask. In alternative embodiments, the mask meets the standard for at least an FFP3 mask.

[0110] In some embodiments, the filter 26 extends across numerous portions of the cover portion 14. Alternatively or additionally, multiple filters can be arranged on the cover portion 14. In the present embodiment, the filter 26 is arranged exclusively on the chin portion 34. Such an arrangement increases the range of angles from which the mouth 18 is visible through the cover portion 14.

[0111] As can be seen in the figures, the chin portion 34 includes the area beneath the mouth portion 28, but also extends to an underside of the jaw 44 of the wearer. In exemplary embodiments of the kind illustrated, the filter 26 is substantially arranged so as to be located over the underside of the jaw 44 of the wearer.

[0112] As can be seen in Figure 7, a substantial surface area of the mask is provided over the underside of the jaw 44. There is thus more space for the aperture 22 and the filter 26 at the underside of the jaw 44 than when compared with other areas of the mask (e.g. the cheek portion 30). Arranging the filter 26 as such therefore facilitates the implantation of a larger filter, or more filters, and so increases the filter performance and the air flow to the wearer.

[0113] As can be seen in Figures 1 to 5, the aperture 22 and the filter 26 are arranged exclusively over the underside of the jaw 44 of the wearer. The positioning of the filter 26 as indicated entirely removes the obstruction caused by the filter 26 to the visibility of the face 12 of the wearer. The mouth 18 of the wearer is thus visible from a range of angles when worn, including from below. A clear view of the mouth 18 from below is particularly important in medical environments where healthcare workers may be communicating with supine patients in beds.

[0114] It should be appreciated that the aperture 22 and corresponding filter 26 can be located anywhere on the cover portion 14 so as to prevent obstruction to the mouth 18 of the wearer from an anterior and a lateral view.

[0115] It should be appreciated that although the figures and discussion only refer to one aperture 22 associated with the filter, in alternative embodiments, multiple filters or multiple apertures can be provided.

[0116] The filter 26 is configured to sealingly engage with the cover portion 14. Sealingly engaging the filter 26 with the cover portion 14 reduces the presence of air gaps between the filter 26 and cover portion 14, so as to reduce the likelihood of unfiltered air passing through the mask 10.

[0117] Filters 26 are generally single use, in that they are only suitable for a single shift. The filter 26 may not effectively filter the air if used beyond a single shift. Typically, filter masks are only single use, as once the filter has been used, the mask no longer meets the required standard and is no longer suitable for use.

[0118] In the present embodiment, the filter 26 is fixedly secured to the cover portion 14. The filter 26 sealingly engages the cover portion 14 so as to inhibit the presence of air gaps between the filter 26 and the cover portion 14, and reduce the risk of a wearer inhaling unfiltered air.

[0119] In one embodiment, the filter 26 is secured to the cover portion 14 by welding. In an embodiment, the filter 26 is secured to the cover portion 14 by heat/thermal welding. Alternatively, the filter 26 is ultrasonically welded to the cover portion.

[0120] In the illustrated embodiment, the cover portion 14 includes a recess (not shown) around the edge 22a of the aperture 22. The recess is configured to receive the outer edge of the filter 26, which is then welded or otherwise secured into the cover portion 14. Such an arrangement would also be suitable in embodiments having multiple apertures 22 that each have a corresponding filter 26.

[0121] Put another way, the cover portion 14 may include two layers. The filter 26 is sized such that a portion of the filter extend beyond the edge 22a of the aperture 22. The portion of the filter 26 that extends beyond the edge 22a is positioned between the two layers (i.e. the filter 26 is sandwiched between an upper and a lower layer of the cover portion 14). The portion of the filter 26 is then welded (or secured by other means) in place between the two layers.

[0122] In some embodiments, one layer forms the outer surface 14a of the cover portion 14, and the other layer forms the inner surface 14b of the cover portion 14. Alternatively, the cover portion 14 is generally formed of a single layer, but is divided into two layers in the areas intended to receive the filter 26 (e.g. proximate the edge 22a of the aperture 22 to be covered). In other embodiments, the cover portion 14 includes multiple layers, for example, the filter 26 may be sandwiched between two upper layers and two lower layers, or more.

[0123] Alternatively, the cover portion 14 includes a recess around a periphery of the chin portion 34, or around some other suitable part of the cover portion, e.g. some other part of the chin portion. The recess is configured to receive the outer edge of the filter 26, which is then welded (or secured by other means) into the cover portion 14. Such an arrangement facilitates the positioning of the filter 26 over multiple apertures 22.

[0124] In some embodiments, the filter 26 is fitted to the cover portion 14 via a clamping arrangement. For example, the cover portion 14 includes an upper and a lower layer (as described above), with the filter intended to extend therebetween. Clamps (not shown) can then be arranged to clamp the upper and lower layers together and secure the filter 26 to the cover portion 14. As discussed above, multiple upper and lower layers may be provided.

[0125] In some embodiments, a plurality of clamps are provided to secure the filter 26 to the cover portion 14. It

should be appreciated that any number of clamps may be suitable.

[0126] In an alternative embodiment, the filter 26 is glued to the cover portion 14 using a suitable adhesive.

[0127] In some embodiments, the filter 26 is replaceable. In such an arrangement, the filter 26 can be removed and replaced from the mask 10 without having to replace the entire mask 10. For example, the filter 26 is a first filter, and the mask 10 is configured such that the first filter is removeable from the mask 10 after use and is replaceable with a second filter for subsequent use. Such an arrangement increases the lifetime of the mask 10 and reduces waste.

[0128] In embodiments where the filter 26 is replaceable, the clamping arrangement described above can be utilised. The clamping arrangement in such an embodiment is releasable, such that a user can release the clamp or clamps, remove the used filter 26, introduce a new filter, and reapply the clamp or clamps for continued use of the mask 10. It should be appreciated that numerous means may be employed to replace the filter 26, for example a clipping system.

[0129] In this embodiment, the mask cover portion 14 is formed from a flexible material. In some embodiments, the flexible material is an elastic material and/or a mouldable material.

[0130] In exemplary embodiments, the mask 10 is configured such that a seal is generated around the nose 16, mouth 18 and chin area 20 when the user inhales.

[0131] The cover portion 14 is configured to mould around the face of the wearer upon inhalation. Specifically, when the mask 10 is appropriately positioned, the wearer is merely required to inhale such that mask adjusts to fit the wearer's face 12. The mask 10 does not require fitting procedures, but instead adapts to the shape and size of a wearer's face.

[0132] In this embodiment, the substantially transparent material of which the cover portion 14 is formed is a plastics material. In this embodiment, the substantially transparent material is a thermoplastic polyurethane (TPU). In this embodiment, the TPU is a flexible TPU. In alternative embodiments, an alternative suitable material, such as an alternative TPU, is used. It should be appreciated that any suitable clear material could be used.

[0133] TPU has been found to provide a balance of rigidity and clarity, such that the mask 10 can maintain its general shape, while also providing a view of a wearer's face. Moreover, TPU can flex around the face 12 of a wearer, thus increasing the ease of fitting the mask 10 and the comfort of wearing the mask 10. The flexibility of TPU means that a seal to the face 12 of a wearer can be formed.

[0134] TPU also meets the required EN149 standard with regards to flammability. Specifically, forming the cover portion 14 from TPU prevents the cover portion 14 from instantly combusting when exposed to temperatures of 800°C (± 50°C) or greater.

[0135] In alternative embodiments, the mask 10 is configured to meet the flammability standard (e.g. through the application of a flame retardant). For example, flame retardant powders may be added to the material during manufacture of the mask 10, or a flame retardant spray may be applied to the outer surface 14a of the cover portion 14.

[0136] In exemplary embodiments, the cover portion 14 is configured to have anti-fog properties. In the present embodiment, an anti-fog spray is applied to the inner surface 14a of the cover portion 14. Reducing the likelihood of fogging reduces decreased visibility of the wearer, and reduces the chance of the wearer removing the mask in a hazardous environment to de-fog.

[0137] In alternative embodiments, an anti-fog coating or coatings is applied. In an alternative embodiment, the material of the cover portion has integral anti-fog properties.

[0138] In the figures, two apertures are provided through the cover portion 14. It should be appreciated that any number of apertures may be provided. In some embodiments, inhaled air flows through the apertures (via a filter 26) and exhaled air flows through the same apertures (also via the filter 26).

[0139] In the present embodiment, one aperture is an inlet aperture 22, and one aperture is an outlet aperture 24. The inlet and outlet apertures 22, 24 extend through the cover portion 14 from the outer surface 14a to the inner surface 14b such that air can flow through the cover portions 14 via the apertures (e.g. upon inhalation or exhalation).

[0140] Any suitable number of inlet and outlet apertures may be provided in an alternative embodiment.

[0141] The filter 26 is located over the inlet aperture 22 such that air that passes through the apertures 22 is filtered before inhalation. The filter 26 is arranged so as to extend around a periphery of the outlet aperture 24 without covering the outlet aperture 24. More specifically, the filter 26 extends over the cover portion 14 around the entire underside of the jaw 44, besides the area occupied by the outlet aperture 24.

[0142] In alternative embodiments, the filter 26 is located over the inlet and the outlet apertures 22, 24.

[0143] The mask 10 includes a valve 36 that is arranged over the outlet aperture 24. In some embodiments, where multiple outlet apertures 24 are provided, a single valve 36 is located over multiple outlet apertures 24, or multiple valves 36 is located over a respective outlet aperture 24.

[0144] The valve 36 is provided such that air is permitted to flow from the inner surface 14b to the outer surface 14a (i.e. out of the mask upon exhalation), and air is inhibited from flowing from the outer surface 14a to the inner surface 14b (i.e. into the mask upon inhalation).

[0145] The provision of a separate aperture 24 for exhaled air provides an alternative flow path for exhaled air that is not restricted by the filter 26. The separate aperture 24 assists the mask 10 in meeting the standard for breathability, which is higher for exhaled air when compared

with inhaled air, as noted above.

[0146] The valve 36 facilitates flow in one direction (i.e. out of the mask 10), and inhibits flow into the mask 10. The valve 36 therefore reduces the risk of unfiltered air passing through the outlet aperture 24 upon inhalation and entering the respiratory system of the wearer.

[0147] As can be seen in Figure 4, the outlet aperture 24 of the illustrated embodiment is divided into segments by dividing parts of the cover portion. Such an arrangement has been found to provide structural support to the cover portion 14, and to support the valve 36. The valve 36 is arranged over all of the segments of the aperture 24.

[0148] The figures indicate one inlet aperture 22 and one outlet aperture 24 although it should be appreciated that any number of each aperture may be provided. In some embodiments, the apertures serve as an inlet and an outlet for air flow. In some embodiments, the outlet apertures are associated with filters for filtering exhaled air before it flows through the cover portion 14 via the outlet aperture 24.

[0149] The valve 36 can cause an obstruction to the view of the face 12 through the mask. The valve 36 and the outlet aperture 24 are remote from the mouth portion 28. Such an arrangement prevents obstruction of the mouth 18 of the wearer in an anterior view caused by the valve 36

[0150] The valve 36 is arranged so as to be remote from the cheek portion 30 to prevent obstruction to the mouth from a lateral view in exemplary embodiments.

[0151] As can be best seen in Figure 3, the valve 36 is arranged to be located over the underside of the jaw 44 of the wearer. Such an arrangement further limits visual obstruction of the mouth 18. In exemplary embodiments, the valve 36 is arranged exclusively over the underside of the jaw 44 of the wearer.

[0152] The valve 36 and the outlet aperture 24 are omitted from Figure 7 for purposes of clarity.

[0153] The valve 36 and outlet aperture 24 are arranged over the same area of the cover portion 14 as the filter 26 and the inlet apertures 22. Such an arrangement prevents obstruction caused by the means of inhaling and by the means of exhaling.

[0154] More specifically, as can be seen most clearly in Figure 3, the inlet aperture 22 and the filter 26 are substantially U-shaped. The outlet aperture 24 occupies a central area in between opposing sides of the U-shaped aperture 22 and filter 26. Such an arrangement maximises the utilisation of space available for the apertures 22, 24 and filter 26 to improve breathability and filter effectiveness, without causing obstruction to the mouth 18.

[0155] In alternative embodiments, the valve 36 and outlet aperture 24 are arranged over a different area of the cover portion 14 to the filter 26 and inlet apertures 22.

[0156] The seal includes a sealing surface 38. The sealing surface 38 sealingly engages the face 12 of the wearer. In the figures, the sealing surface 38 is coupled to an outer perimeter of the cover portion 14. The sealing surface 38 extends about the entire outer perimeter of the cover portion 14 so as to provide a complete seal. However, in alternative embodiments, the sealing surface 38 only extends around a portion of the outer perimeter, or includes multiple sealing surfaces that are located periodically around the outer perimeter.

[0157] As can be seen in Figure 4, the sealing surface 38 is in the form of a flat projection that extends from an edge of the cover portion 14. The flat projection is intended to contact the face of the wearer around the outer perimeter of the cover portion 14.

[0158] The seal 38 prevents, or substantially restricts, flow of air between the outer surface 14a and the inner surface 14b of the cover portion 14 via the edge of the cover portion 14. Instead, the flow of air is directed through the apertures 22, 24.

[0159] The sealing surface 38 sealingly engages the face 12 of the wearer such that the cover portion 14 defines a chamber 40 between the face 12 of the wearer and the internal surface 14b of the cover portion 14. Configuring the cover portion 14 to define a chamber 40 reduces contact between the mask 10 and the face 12, as a large portion of the cover surface 14 is spaced away from the face 12. Such an arrangement has been found to reduce the discomfort of wearing a mask, particularly when the mask is worn for long periods of time.

[0160] The sealing surface 38 is of a substantially transparent material. In exemplary embodiments, the substantially transparent material is a plastics material. In exemplary embodiment, the substantially transparent material is a thermoplastic polyurethane (TPU). The TPU may be a flexible TPU.

[0161] In some embodiments, the mask 10 is produced such that the sealing surface 38 is integrally formed with the cover portion 14. In alternative embodiments, the sealing surface 38 is formed separately and fixedly secured to the cover portion 14, e.g. via welding.

[0162] The mask 10 includes fixture points 46 for receiving a means of securing the mask 10 to the face 12 of a wearer. The fixture points 46 extend beyond the sealing surface 38 in the illustrated embodiment. As can be seen, the fixture points 46 are extensions of the sealing surface 38 at various positions about the periphery of the cover portion 14. In this way, the fixture points 46 can also substantially seal to the face of the user.

[0163] The fixture points include apertures 48 for receiving a means of securing the mask 10 to the face 12, e.g. a strap.

[0164] As illustrated in Figures 6 and 7, a securing means 42 is provided to secure the cover portion 14 to the face 12 of the wearer. The securing means 42 is intended to be received in the apertures 48 and secured to the fixture points 46.

[0165] In alternative embodiments, the fixture points 46 do not extend beyond the sealing surface 38, but are integral with the cover portion 14. In this way, the securing means 42 is coupled directly to the cover portion 14 (i.e. via the integral fixture points 46).

[0166] In the figures, the securing means 42 is in the

form of a head strap that extends from a respective fixture point 46 and is intended to extend around a back of a head of the wearer. The securing means 42 is fixedly secured at both ends to a fixture point 46.

[0167] In the figures, four fixture points 46 are provided. Such an arrangement facilitates the receipt of two securing means 42, i.e. one that extends between a first pair of fixture points 46, and another that extends between a second pair of fixture points 46. However, only one securing means 42 may be necessary to secure the mask 10 to the face 12.

[0168] It should be appreciated that any number of fixture points 46 and securing means 42 may be provided.

[0169] Only one securing means 42 is shown in Figure 6 and 7 for purposes of clarity.

[0170] In some embodiments, the securing means 42 includes a horizontal portion and a vertical portion. The vertical portion extends between an upper end of the cover portion 14 (e.g. from the part of the cover portion 14 that is to be located over the nose 16, or from the cheek portion/portions) and the horizontal portion 42a so as to provide further security. The mask 10 only includes a horizontal portion in some embodiments.

[0171] In exemplary embodiments, the securing means 42 is configured to be useradjustable (e.g. through the use of the apertures 48 in the fixture points 46), for example, to allow the user to loosen or tighten the securing means 42. Additionally/alternatively, the securing means 42 is elasticated such that the securing means adjusts depending on the size of the head of the wearer.

[0172] In exemplary embodiments, the securing means 42 is of a substantially transparent material. In exemplary embodiments, the fixture points 46 are of a substantially transparent material.

[0173] In exemplary embodiments, the substantially transparent material is a plastics material. The substantially transparent material can be a thermoplastic polyurethane (TPU). The TPU can be a flexible TPU.

[0174] In some embodiments, the mask 10 is produced such that the securing means 42 and/or the fixture points 46 are integrally formed with the cover portion 14. In alternative embodiments, the securing means 42 and/or the fixture points 46 are fixedly secured to the cover portion 14, e.g. via welding.

[0175] A method of producing the mask 10 will now be described.

[0176] The cover portion 14 is formed via a first processing operation. In exemplary embodiments, the cover portion 14 is formed via a moulding operation, e.g. via injection moulding.

[0177] The first processing operation is a 3D printing operation in alternative embodiments.

[0178] As described above, the cover portion 14 is formed from a transparent material. The cover portion 14 is formed of a plastics material, e.g. a thermoplastic polyurethane, in exemplary embodiments. It may be preferable for the transparent material to be of a colour for aesthetic or branding purposes (i.e. transparent but tinted a chosen colour).

[0179] The first processing operation may include an optional embossment/indentation step, wherein logos or certifications can be embossed/indented onto the cover portion 14.

[0180] In some embodiments, the sealing surface 38 and/or the securing means 42 and/or the fixture points 46 are formed with the cover portion 14 in the first processing operation. Alternatively, the sealing surface 38 and/or the securing means 42 and/or the fixture points 46 are formed via separate operations and then fixedly secured to the cover portion 14.

[0181] The cover portion 14 produced in the first processing operation includes at least one aperture 22.

[0182] The filter 26 is secured over the aperture 22 via a second processing operation. The second processing operation includes a simple clamping operation in some embodiments, such that the filter 26 is removeable and replaceable. Alternatively, the second processing operation is a welding operation, e.g. sonic welding. The second processing operation is any suitable operation for securing the filter 26 to the cover portion 14.

[0183] The mask 10 can be provided in various sizes. That is to say, the cover portion 14 can be appropriately sized for differently sized faces. For example, the mask 10 may be provided in a range of three sizes appropriate for a child, for a smaller adult and for a larger adult.

[0184] It should be understood that any reference to the mask 10 being in use, or on a wearer, refers to scenarios where the mask 10 is properly fitted to the face 12 such that inbound air passes through the cover portion 14 through the apertures 22 and the filter 26, rather than entering around the edges of the mask 10.

[0185] It should be appreciated that, in exemplary embodiments, the mask 10 is configured so as to meet at least FFP2 standard as set forth in EN 149. While the entirety of the EN 149 standard have not been discussed in detail, any reference to an FFP2 mask should be understood to mean that the mask 10 meets all of the requirements for FFP2 classification as set forth in EN 149.

[0186] In some embodiments, the mask meets all of the requirements for FFP3 classification as set forth in EN 149.

[0187] In some embodiments, the mask meets all of the requirements for an NP95 and a KN95 mask. It should be understood that the mask can meet all international standards equivalent to an FFP2 or an FFP3 mask in exemplary embodiments.

[0188] Although the teachings have been described above with reference to one or more preferred embodiments, it will be appreciated that various changes or modifications may be made without departing from the scope as defined in the appended claims.

Claims

1. A face mask for filtering airborne particles, the face mask comprising:

   a cover portion having an inner surface and an outer surface, the cover portion configured to be positioned in use over the nose, the mouth and a chin area of the face of a wearer;
   at least one aperture that extends through the cover portion from the outer surface to the inner surface such that air can flow through the cover portion via the aperture (e.g. upon inhalation);
   a seal for sealing around the nose, mouth and chin area in use, such that air flows substantially through the aperture when inhaled and/or exhaled through the nose or mouth;
   a filter or filters arranged over the or each aperture, the or each filter configured to filter air so as to limit the flow of airborne particles through the aperture;
   wherein the cover portion is of a substantially transparent material, such that the face of the wearer is substantially visible through the cover portion, in use; and
   wherein the or each filter is arranged on the cover portion such that the mouth of the wearer is substantially visible through the cover portion from an anterior view and from a lateral view of the face, in use.

2. The face mask of claim 1, wherein the filter is configured to filter at least 94% of airborne particles; optionally, wherein the filter is configured to filter at least 99% of airborne particles.

3. The face mask of claim 1 or claim 2, wherein the substantially transparent material is a plastics material; optionally, wherein the substantially transparent material is a thermoplastic polyurethane (TPU).

4. The face mask of any preceding claim, wherein the cover portion comprises a mouth portion configured to be located over the mouth of a wearer, wherein the or each filter is remote from the mouth portion; and/or wherein the cover portion comprises two cheek portions each configured to be located over a respective cheek of the wearer, wherein the or each filter is arranged so as to be remote from the cheek portions, such that the mouth of the wearer is substantially visible through the cover portion from a lateral view of the face; and/or wherein the cover portion comprises a chin portion configured to be located over the chin area of a wearer, and wherein the or each filter is located at the chin portion; optionally, wherein the or each filter is arranged exclusively on the chin portion.

5. The face mask of any preceding claim, wherein the cover portion comprises a chin portion that is configured to extend to an underside of the jaw of the wearer, and wherein the or each filter is substantially arranged so as to be located over the underside of the jaw in use; optionally, wherein the or each filter is arranged so as to be located exclusively over the underside of the jaw in use.

6. The face mask of any preceding claim, wherein the at least one aperture is an inlet aperture, and wherein the face mask further comprises: at least one outlet aperture that extends through the cover portion from the inner surface to the outer surface such that air can flow through the cover portion via the outlet aperture (e.g. upon exhalation); and

   a valve or valves arranged over the or each outlet aperture, the or each valve configured to permit the flow of air from the inner surface to the outer surface upon exhalation by a wearer; and to inhibit the flow of air from the outer surface to the inner surface upon inhalation by the wearer; optionally, wherein the cover portion comprises a mouth portion configured to be located over the mouth of a wearer, wherein the or each valve is remote from the mouth portion; optionally, wherein the cover portion comprises a chin portion configured to be located over the chin area of a wearer and configured to extend to an underside of a jaw of the wearer, and wherein the or each valve is substantially arranged so as to be located over the underside of the jaw in use.

7. The face mask of any preceding claim, wherein the or each filter is configured to sealingly engage with the cover portion; preferably wherein the or each filter is configured to extend fully over a respective aperture; optionally, wherein the filter is welded to the cover portion.

8. The face mask of any preceding claim, wherein the seal comprises a sealing surface coupled to an outer perimeter of the cover portion; preferably wherein the sealing surface is configured to sealingly engage the face of the wearer such that the cover portion defines a chamber between the face of the wearer and the cover portion; optionally, wherein the sealing surface is of substantially transparent material.

9. The face mask of any preceding claim, wherein the mask is configured such that the seal is generated during inhalation by the wearer; optionally, wherein the cover portion is configured to mould around the face of the wearer during inhalation; optionally, wherein the cover portion is configured to have anti-fog properties; optionally, wherein the mask is configured such that the mask does not instantly com-

bust when exposed to temperatures of 800°C (± 50°C) or greater.

10. The mask of any preceding claim, wherein the mask further comprises a securing means coupled to the cover portion and configured to secure the cover portion to the face of a wearer (e.g. via a head strap); optionally, wherein the securing means is configured so as to be useradjustable; optionally, wherein the securing means is of a substantially transparent material; optionally, wherein the securing means is elastic.

11. The face mask of any preceding claim, wherein the or each filter is a first filter, and wherein the face mask is configured such that the first filter is removeable from the at least one aperture after use and is replaceable with a second filter for subsequent use.

12. A method of producing the face mask of any preceding claim, the method comprising the steps of:

forming the cover portion in a first processing operation; and
securing the or each filter over the or each aperture in a second processing operation.

13. The method of claim 12, wherein the first processing operation is injection moulding.

14. The method of claim 12 or claim 13, wherein the second processing operation is welding.

15. The method of any of claims 12 to 14, wherein the step of forming the cover portion includes applying an antifog spray or antifog coating to the cover portion.

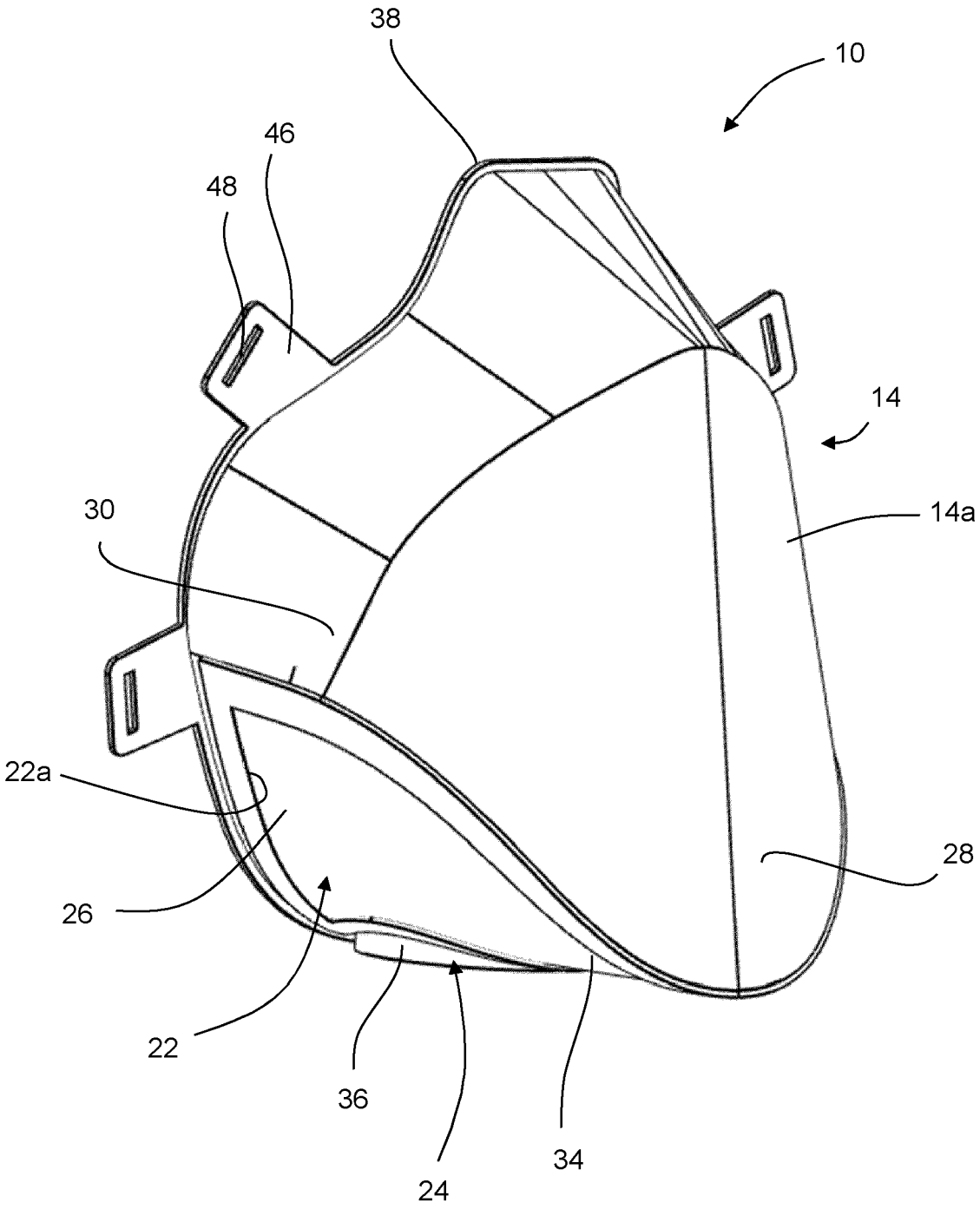

FIG. 1

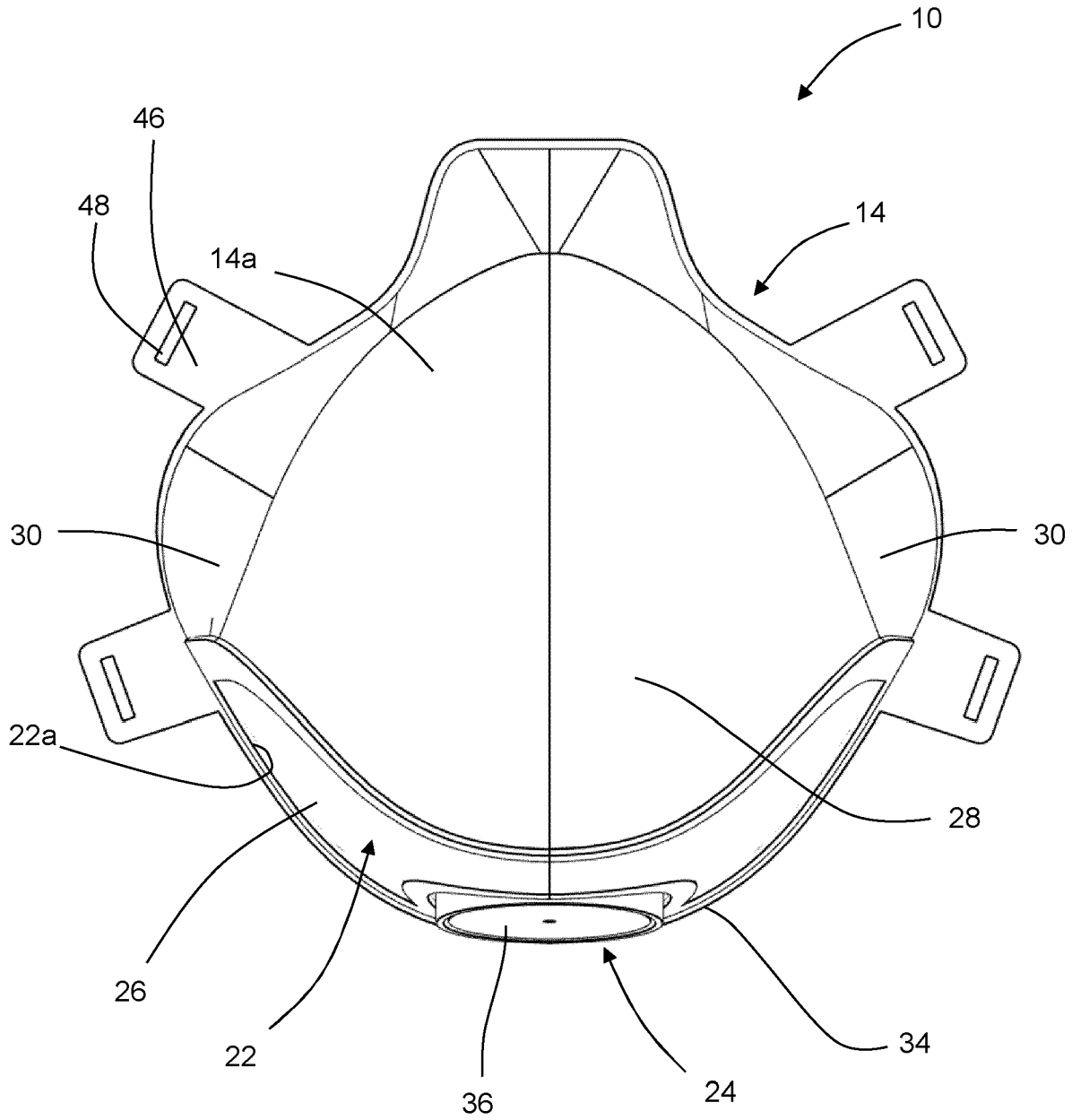

FIG. 2

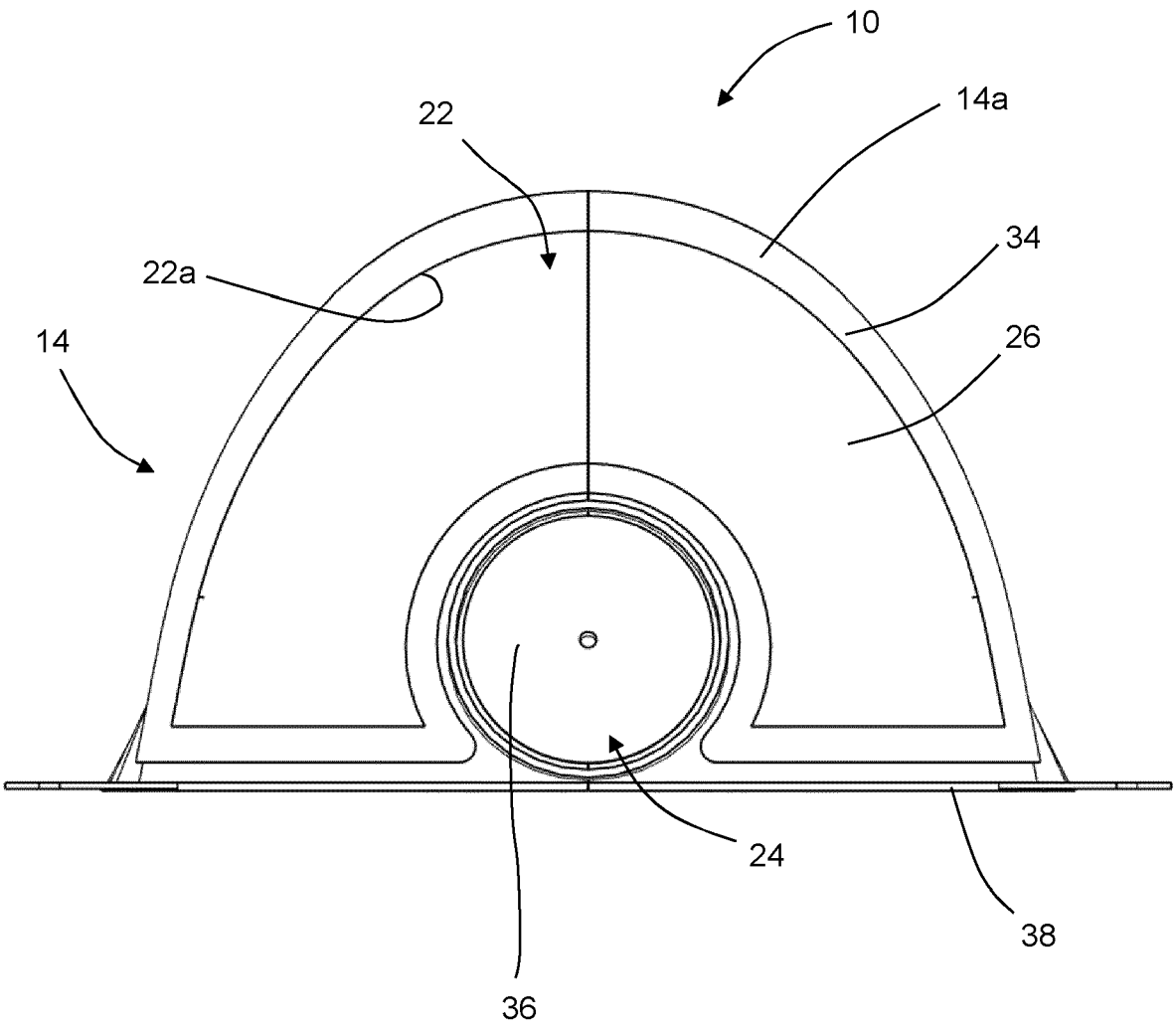

FIG. 3

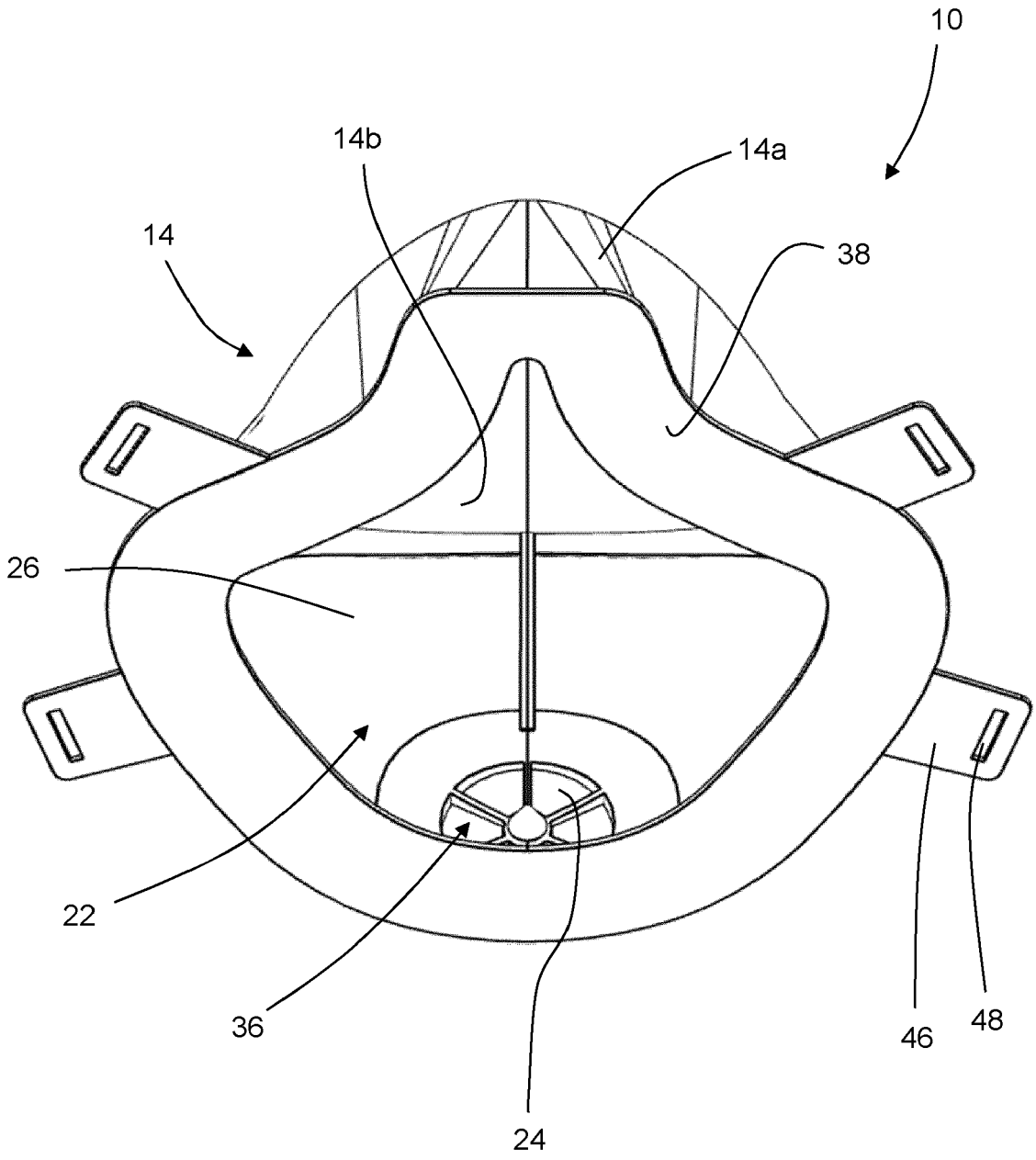

FIG. 4

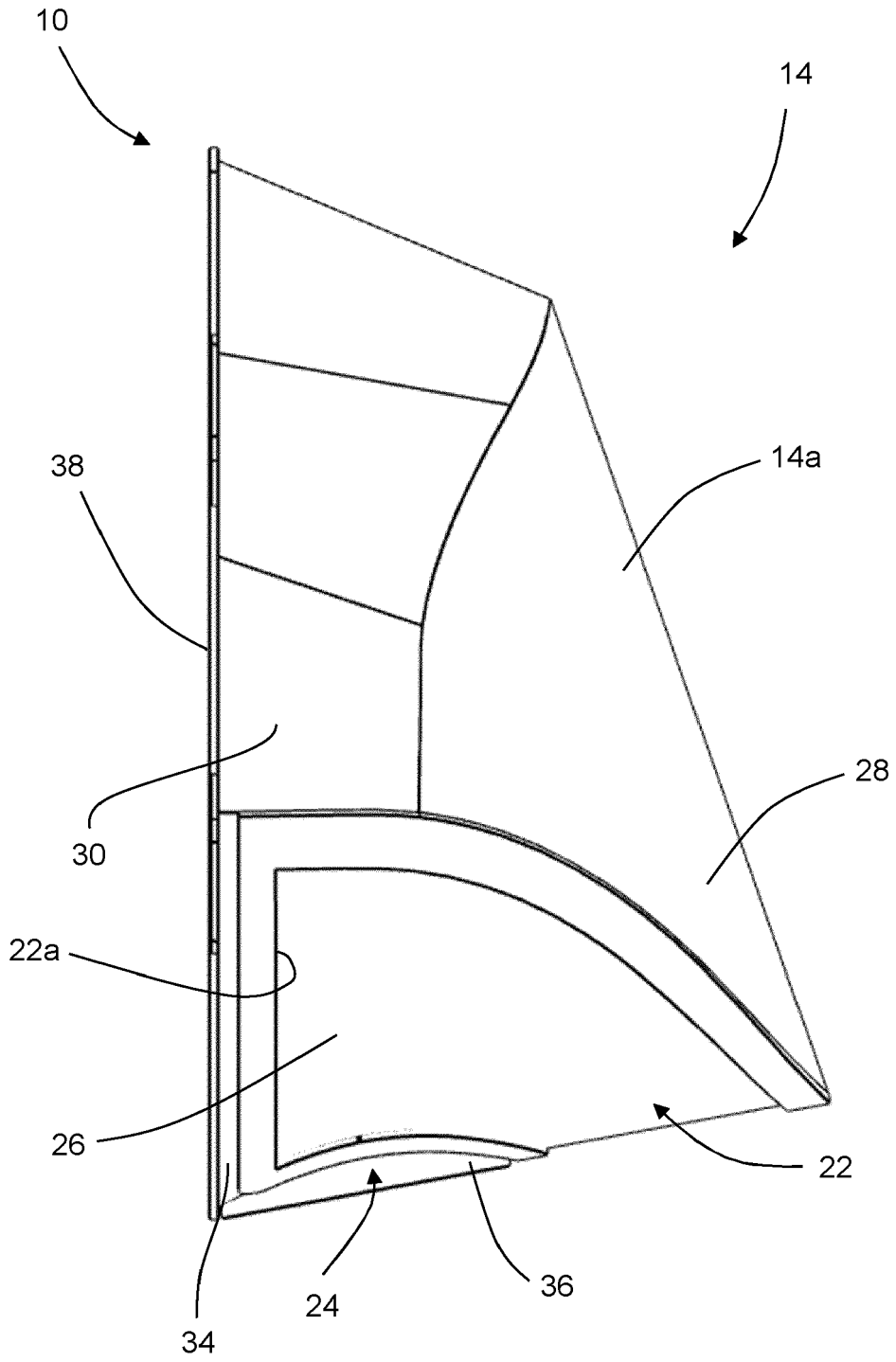

FIG. 5

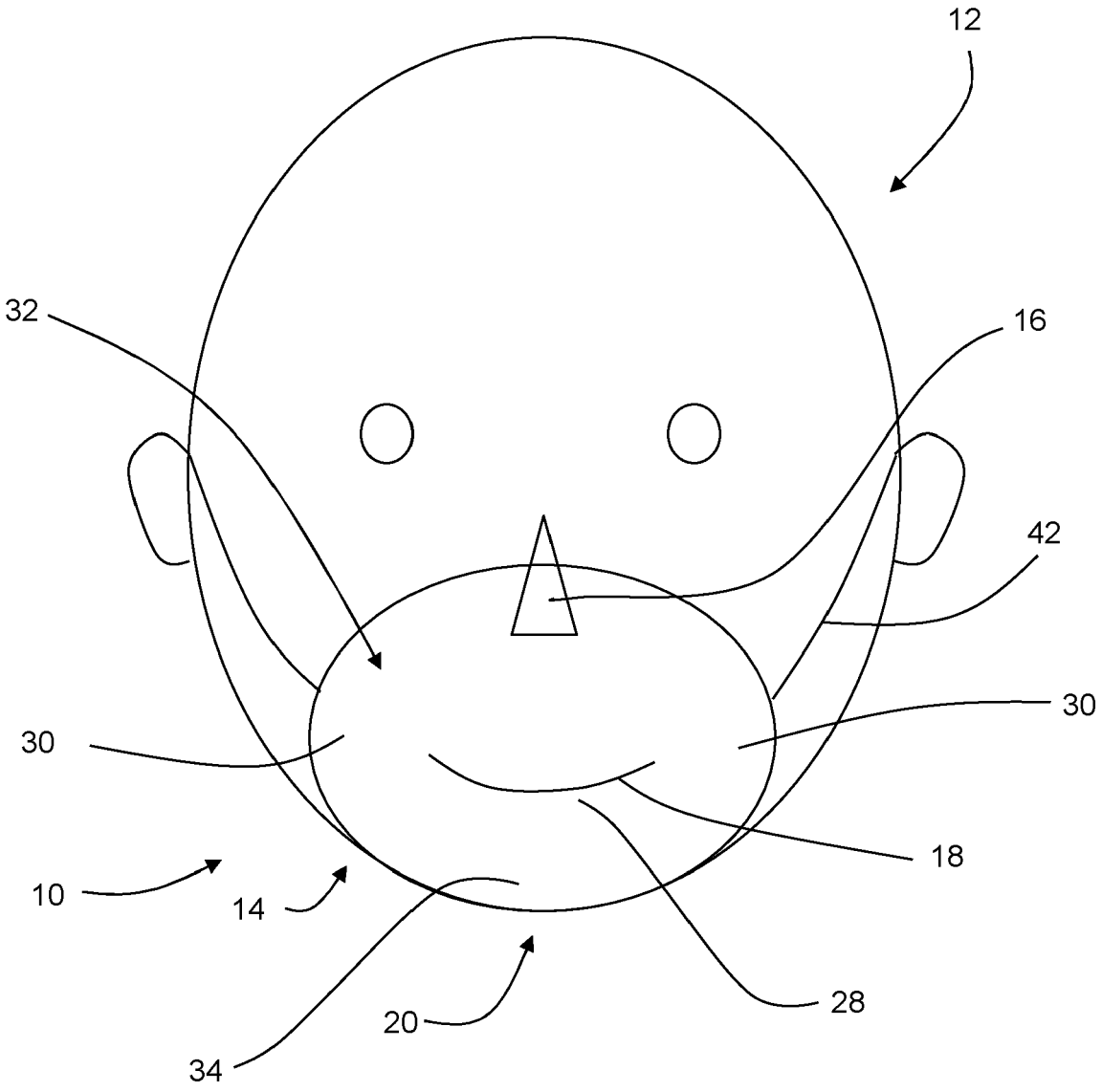

FIG. 6

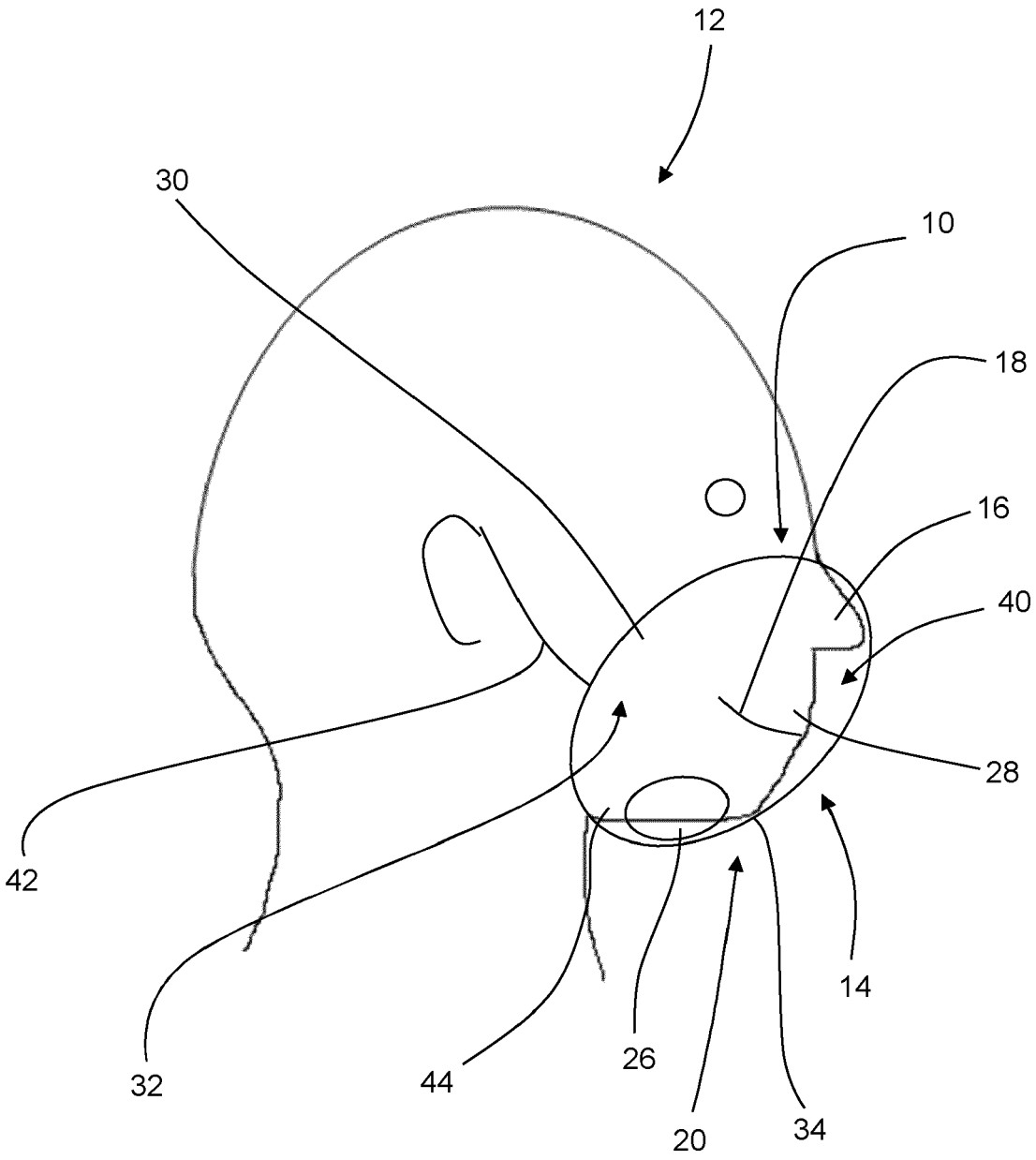

FIG. 7

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 21 21 2371

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	KR 102 260 020 B1 (AN PAL YONG [KR]) 3 June 2021 (2021-06-03) * paragraphs [0006] - [0009] * * paragraphs [0013] - [0031] * * figures 1-3 *	1-15	INV. A62B18/02 A62B18/08 A41D13/11
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	19 May 2022	Zupancic, Gregor

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