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(54) Flat-folded mask forming trihedrals in an opened state

(57) The invention proposes a mask (10) having an opened state and a flat-folded store state, the mask (10) comprising a mask body (12) with: a central panel (20), having two central angles being defined by an apex (30 ; 50) and first and second edges ; two first and second lateral panels (43, 63) for which first and second apex angles can be defined, being respectively linked to one first or second edge of the two central angles; wherein for each central angle, the central panel (20), one first lateral panel (43) and one second lateral panel (63) form a trihedral (38, 58).

The invention also proposes a method for manufacturing the above mask.

The invention allows offering a high comfort for the wearer of the mask.

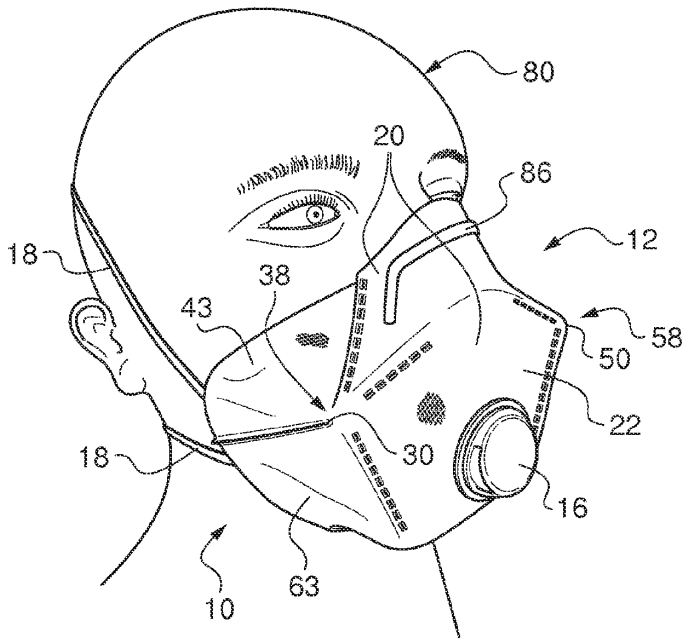

Fig.2

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Description

FIELD OF THE INVENTION

[0001] The invention relates to a mask having an opened state, capable of forming a cup-shaped air chamber over the nose and mouth of the wearer, and a store state in which the mask is substantially flat-folded. The invention also relates to a method for manufacturing such a mask.

BACKGROUND OF THE INVENTION

[0002] Masks are used in a wide variety of applications when it is desired to protect a human's respiratory system from particles suspended in the air or from unpleasant or noxious gases. Generally such face masks are of two types - a molded cup-shaped form or a flat-folded form.

[0003] One example of mask with a flat-folded form is disclosed in EP-A-0 814 871. Using a mask with a flat-folded form implies to unfold it in a opened state to put the mask in the correct disposition over the nose and mouth. However the fold of the mask may render the setting up very inconvenient for the wearer of the mask. Besides, in order to set the mask in the correct disposition, the unfolding of a flat-folded mask often requires that the wearer inserts his fingers in the internal side of the mask. This may cause contamination issues for the mask when the hands and fingers of the wearer are dirty prior to the unfolding and to the setting up of the mask by the wearer. Depending on the technical field, the dirtiness of the wearer's hands may be organic, chemical or biological.

[0004] Moreover, due to their simple conception, flat-folded masks propose low volume chamber for the wearer which induces a low comfort e.g. while speaking or even breathing with the mask set up on the wearer.

[0005] Further, known masks of both types present common inconvenients. For example, masks are mass produced in a limited number of sizes and have consequently difficulties to fit the largest range of different morphologies of wearer. The unfitting of the mask on a particular morphology of a wearer causes bad airtightness between the mask and the wearer which may decrease the protection of the wearer.

SUMMARY OF THE INVENTION

[0006] The object of the present invention is to alleviate at least partly the above mentioned drawbacks.

[0007] More particularly, the invention aims to offer a greater volume chamber to provide a better comfort for the wearer.

[0008] This object is achieved with a mask having an opened state, capable of forming a cup-shaped air chamber over the nose and mouth of a wearer, and a store state in which the mask is substantially flat-folded comprising a mask body with:

- a central panel flat in the store state, having at least two central angles opposite one another, each central angle being defined by an apex and first and second edges,
- two first lateral panels flat in opened state for which first apex angles can be defined, being respectively linked to one first edge of the two central angles through a fold-line, seam, weld or bond,
- two second lateral panels flat in opened state for which second apex angles can be defined, being respectively linked to one second edge of the two central angles through a fold-line, seam, weld or bond,wherein the first apex and second apex angles are arranged so that for each central angle, the central panel, one first lateral panel and one second lateral panel form a trihedral.

[0009] Preferred embodiments are defined in the dependent claims. The invention further proposes that :

- the first and second edges are straight edges ;
- for each central angle, the sum of the value of both apex angles is substantially equal to the value of the central angle : Central angle = value of the first apex angle + value of the second apex angle ;
- the value of each central angle is comprised between 120° and 150° ;
- the first and the second lateral panels of the same central angle are welded together ;
- the central panel has a polygonal form, preferably a hexagonal one ;
- the central panel comprises an upper portion in contact with the nose of the wearer, when the mask is used, the upper portion being reinforced of the wearer by reinforcing parts ;
- the widths of the first and second lateral panels are greater than the half of the central panel ;
- in the store state, the first and second lateral panels are folded on the central panel by covering the whole internal side of the central panel;
- the central panel comprises an upper portion and an intermediate portion which are integral, the upper portion being

in contact with the nose of the wearer and wherein the intermediate portion comprises an additional stiffener arranged so that in the store state, the central panel is substantially flat and in the open state, the upper portion and the intermediate portion are separated by a fold line ;

- the stiffener is reinforced on the links with lateral panels ;
- the stiffener covers at least the whole intermediate portion ;
- the stiffener is an additional layer ;

[0010] The invention also proposes a method for manufacturing a mask comprising:

- cutting a mask body in a bidimensional sheet being an assembly of different layers including at least one filtering layer ,
- forming the mask by ultrasound welding layers of the mask body in three dimensions by using a holder with the desired form for the mask.

[0011] Preferred method embodiments are defined in the dependent claims, in which :

- the mask body has a central panel, the holder has the form of the central panel, the central panel being on the holder when the welding step is achieved ;
- the mask body is the mask body of the above mask, and wherein at the cutting step, the part of the assembly comprised in the angular areas between the edges of the first and second apex angles which are opposite to the edges defining the corresponding central angles is removed ;
- the mask body is the mask body of the above mask, wherein at the welding step, the edges of the first and second apex angles which are opposite to the edges defining the corresponding central angles are welded together.

[0012] Further features and advantages of the invention will appear from the following description of embodiments of the invention, given as non-limiting examples, with reference to the accompanying drawings listed hereunder.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

Fig. 1 shows a perspective view of an embodiment of a mask set up in an opened state on a human face;
Fig. 2 shows another perspective view of an improved embodiment of the mask according to figure 1, the mask being set up in an opened state on a human face;
Fig. 3 shows a plane view of the mask according to figure 2 in the store state;
Fig. 4 shows a plane view of the plane pattern for manufacturing a mask body of the mask according to figure 1 or figure 2;
Fig. 5A shows a perspective view of another embodiment of a mask in the opened state;
Fig. 5B and 5C show perspective views of the holder used to obtain the mask in the opened state according to figure 5A;
Fig. 6A and 6B show different steps of the manufacturing of the mask according to figure 5A starting from a plane tape;
Fig. 7 shows another embodiment of the mask in the same step of the manufacturing as in figure 6B;
Fig. 8A shows an inside view of the mask according to figure 1 in the opened state;
Fig. 8B shows an enlargement of the figure 8A on the lower part of the mask;
Fig. 8C shows a schematic cross-sectional view of the lower part of the mask on a pleat of the material of the mask body of figure 8A;
Fig. 9A and 9B show same masks set up in an opened state on human faces with different morphologies : large or small;
Fig. 10A and 10B show schematic representations of various embodiments of a nose clip;
Fig.11A, 11B and 11C show different views of a first embodiment of the attachment device;
Fig. 12 shows a variant for the fastener of the attachment devices shown in figures 11A, 11B and 11C;
Fig.13A, 13B and 13C show different views of a second embodiment of the attachment device.

DETAILED DESCRIPTION OF THE INVENTION

[0014] The invention proposes a mask. The mask has an opened state in which the mask is capable of forming a cup-shaped air chamber over the nose and mouth of the wearer. The mask further has a store state in which the mask is substantially flat-folded. In this document, the store state is said substantially flat when the mask in the store state corresponds to a substantially plane object.

[0015] The mask comprises a mask body. The mask body includes a central panel that is flat in the store state. This central panel has at least two angles which are opposite one another. In the following, each angle of the central panel is called a central angle, and the expressions "at least two central angles" and "two central angles" are used indifferently. Each central angle of the two angles is defined by an apex and first and second edges.

[0016] The mask body further includes two lateral panels of a first kind. In the description, a lateral panel of the mask body belonging to the first kind of lateral panel are called first lateral panel, and the expressions "at least two first lateral panels" and "two first lateral panels" are used indifferently. The two first lateral panels are flat in the opened state. For each first lateral panel a first apex angle can be defined. Besides, each first lateral panel is respectively linked to a first edge of one of the two central angles. Each link between a first lateral panel and the first edge of one of the two central angles is made through a fold-line, seam, weld or bond.

[0017] The mask body also includes two lateral panels of a second kind. In the description, a lateral panel of the mask body belonging to the second kind of lateral panel are called second lateral panel, and the expressions "at least two second lateral panels" and "two second lateral panels" are used indifferently. The two second lateral panels are flat in the opened state. For each second lateral panel a second apex angle can be defined. Besides, each second lateral panel is respectively linked to a second edge of one of the two central angles. Each link between a second lateral panel and the second edge of one of the two central angles is made through a fold-line, seam, weld or bond.

[0018] Further, the first apex and second apex angles are arranged so that for each central angle the central panel, one first lateral panel and one second lateral panel form a trihedral. The formation of at least two trihedrals in the opened state creates additional volumes inside the mask in the area of the apex. Such additional volumes allow to have a high volume chamber for the mask's wearer, which high volume chamber implies a better comfort for the wearer when speaking, moving or breathing.

[0019] Consequently the mask in the opened state achieves the aim of offering a high comfort for the wearer of the mask.

[0020] Figures 1 and 2 show masks 10 including the above-mentioned features. Both of these figures show a perspective view of the masks 10 in an opened state on a human face of a wearer 80. On the left side of the figures, a trihedral 38 is formed by the central panel 20, the first panel 43 and the second panel 63. On the right side of the figures, a trihedral 58 is formed by the central panel 20, the other first panel and the other second panel (not shown). The formation of the two trihedrals 38 and 58 permits to have a substantially flat portion 22 of the central panel 20 in front of and kept far from the mouth and nose of the wearer 80. The trihedrals 38 and 58 stiffen the substantially flat portion so that the substantially flat portion is not collapsible when used. The formation of the trihedrals 38 and 58, by permitting the portion 22 to be flat in the opened state, allows to position a valve 16 in the air flow of the wearer 80 breathing with the mask 10 set up, as illustrated by figure 2.

[0021] Due to its substantially flat-folded store state, the mask 10 belongs to the type of mask with a flat-folded form. This substantially flat-folded store state presents the advantage that it can be carried in a wearer's pocket until needed and re-folded flat to keep the inside of the mask clean between uses. This substantially flat-folded store state also presents the benefit of a less cumbersome warehousing or transportation.

[0022] Figure 3 shows a plane view of the mask 10 in the store state. Figure 3 shows the outer or external side of the central panel 20 with the valve 16 in the portion 22 adapted to be substantially flat in the opened state.

[0023] The invention also proposes a method for manufacturing a mask. The proposed method first comprises a step of cutting a mask body in a bidimensional sheet. The bidimensional sheet is an assembly of different layers. Among these different layers at least one is a filtering layer. After this step of cutting the mask body from the bidimensional sheet, a plane pattern of the mask is obtained. Figure 4 shows a plane view of such a plane pattern for the manufacturing of the mask body 12 of the mask.

[0024] The proposed method then comprises a step of forming the mask in three dimensions. The three dimensional form of the mask is imposed by ultrasound welding of the assembly on a holder with the desired form for the mask. Figure 5A shows an example of three dimensional form of the mask that could be obtained with a mask body 12 made from the previous plane pattern. Figure 5B shows a perspective view of the holder 100. The holder 100 has a three-dimensional form corresponding to the three-dimensional form of the mask 10 in the opened state as shown in figure 5A. Each portion of the mask body 12 corresponds to at least one face of the holder 100, each face of the holder 100 being referenced by the reference number of the corresponding portion of the mask body 12 preceded by a '1', unless explicitly mentioned otherwise in the following description. According to the proposed method, the mask body 12 is placed on the three-dimensional holder 100 so as to form the mask in three-dimensions by welding.

[0025] The placement on the three-dimensional holder 100 could be performed by clamping the mask body 12 on the mask holder 100 with the help of a clamping device. Figure 5B shows the clamping device 200 in a state before the clamping of the mask body 12 on the holder 100. Figure 5C shows the clamping device 200 in a state wherein the mask body 12 is clamped on the holder 100. The clamping device 200 could comprise clamping plates to clamp corresponding portions of the mask body 20 on the holder 100. Then, each portion of the mask body 12 may correspond to at least one clamping plate of the clamping device 200. Each plate of the clamping device 200 is referenced by the reference number of the corresponding portion of the mask body 12 preceded by a '2', unless explicitly mentioned otherwise in

the following description. Each clamping plate may be actuated by any appropriate means. The use of separated plates for clamping the mask body 12 on the holder 100 allows having a welding space between each plate in the clamped position.

[0026] The performing of this three-dimensional welding during the manufacturing allows to have a very precise form of the opened state for the manufactured mask 10. Furthermore, this three-dimensional welding during the manufacturing allows also to precisely arranging various component on the mask body, such as a chin strap, a nose clip or an attachment device for attachment to the face of the wearer. However, alternatively, the three-dimensional form of the opened state for the manufactured mask 10 may also be obtained with steps of welding the mask on a two-dimensional support and of cutting the excess of material for the mask body. These steps of two-dimensional welding and cutting may be performed in both orders.

[0027] The mask 10 shown in figure 5A also corresponds to an embodiment of the above-described mask with the two trihedrals 38 and 58. Then, the proposed mask with the two trihedrals 38 and 58 may be advantageously obtained by the proposed method of manufacturing. Therefore figures 4 and 5A previously used to describe the method of manufacturing show the same reference signs of the proposed mask described in reference to figures 1, 2 and 3.

[0028] When the proposed mask is manufactured by the proposed method, the ultrasound welding of the plane pattern may be used to enhance lines 28 separating the portion 22 from another portion 82 of the central portion 20.

[0029] Furthermore the ultrasound welding may also be used to enhance the first and second lines 24 and 26 of the mask 10 as shown in figure 4. These first and second edges 24 and 26 are fold-line of the mask. Each of these enhancing of the lines 28 and of the edges 24 and 26 contributes to the substantially flatness of the portion 22 in the opened state.

[0030] Figure 6A shows the bidimensional sheet in the form of a plane tape from which the mask may be manufactured. The plane tape may comprise at least a set of layers 90 comprising the filtering layer in the form of a tape and at least one additional layer 92. The plane tape then corresponds to the above-mentioned assembly of different layers. Figure 6B shows the bidimensional sheet in the form of a plane tape after the ultrasound welding.

[0031] In a general way, according to the various aspect of the invention, the assembly of layers forming the mask body 12 could be made of different layers in the following order : an internal layer, the additional layer 92, the filtering layer and an external layer. The internal and external layers protect the whole assembly of layers against degradation, notably the internal and external layer protect the filtering layer. The internal and external layers are then protecting layers. Further, the external layer may also serve as a supporting layer. The supporting layer has a higher tensile strength than the filtering layer, so that the filtering layer may be manipulated with limited tear of the filtering layer. The supporting layer may also be a layer distinct from the other layers of the assembly. The supporting layer is then positioned between the other layers in the vicinity of the filtering layer. The internal layer, the external layer, the filtering layer and, if necessary the supporting layer may constitute the layers of the set of layers 90 shown in figure 6A. The different layers may all be made of non-woven material. The filtering layer is for example made of melt blown non-woven material whereas others layers of the assembly could be made of spun bond non-woven materials. Thus, the external layer and the internal layer could be made of polypropylene non woven. Further, the external layer could have a higher basis weight than the internal layer.

[0032] According to an aspect of the invention, illustrated by figures 6A and 6B, the at least one additional layer 92 due its form may be used as an additional stiffener of the intermediate portion 22, *i.e.* the second layer may be additional to the supporting layer already supporting the filtering layer. The additional layer 92 is a layer more rigid than the others layers of the set of layers 90, then the additional layer 92 rigidifies the mask body 12 in order to avoid that the mask body collapse during use.

[0033] As shown the additional layer 92 covers the whole intermediate portion 22. The additional layer 92 having the boundary 98 is then of the desired form to enhance the lines 28 which, in the opened state of the mask 10, would separate the flat portion 22 from the other portion 82 of the central panel 20. Then the additional layer 92 may also introduce a difference of stiffening allowing the formation of a fold between the lines 28 when the mask 10 is unfolded by opening from the store state to the opened state. The fold line advantageously allows to keep the intermediate portion 22 substantially flat at the opened state. In general, the intermediate portion 22 may comprise any additional stiffener arranged so that at the store state, the central panel 22 is substantially flat and that at the open state, the upper portion 82 and the intermediate portion 22 is separated by a fold line.

[0034] Similarly, this additional layer 92 as an additional stiffener may also contribute to the enhancing of the first and second lines 24 and 26 of the mask 10. Indeed, the boundary 94 and 96 of the additional layer 92 shown in figure 6A may correspond to the welding enhancing the first and second edges 24 and 26 shown in figure 6B. More generally, the additional stiffener may be reinforcing the mask body 12 on the links with lateral panels, i.e. on the area of the central panel 20 that are proximate to the lateral panels 43, 45, 63 and 65. In this embodiment the additional stiffener includes strips 84. Such an embodiment may be combined with the embodiment having an additional stiffener covering the whole intermediate portion 22 as illustrated in figures 6A and 6B. The strips 84 are then on the area of the central panel 20 that are proximate to the lateral panels 43 and 45. Alternatively to the embodiment having an additional stiffener covering the whole intermediate portion 22, the additional stiffener may only be reinforcing the mask body 12 on the links with

lateral panels 43, 45, 63 and 65, the additional stiffener having then only the form of the strips 84.

[0035] Every enhancing of lines 24, 26 or 28 contributes to reinforce the "pop up" effect of the mask 10, i.e. contributes keeping the flat portion 22 far from the mouth of the wearer 80 in the opened state. Thereby, it allows the formation a greater volume for the cup-shaped air chamber for the mask 10 in the opened state.

[0036] The edges 24 and 26 delimit the central panel 22, and the lines 28 are the boundary between the portion 22 and the other portion 82 of the central panel. In the opened state, when the mask is set up on the human face of the wearer 80, the other portion 82 of the central panel 22 is on the upper side of the mask, i.e. in contact with the nose of the wearer 80. Consequently in the followings, the other portion 82 of the central portion 20 is called the upper portion 82 whereas the portion 22 is called the intermediate portion 22. In order to limit the number of operations during the manufacturing of the mask 10, the upper portion 82 and the intermediate portion 22 may be integral, e.g. the two portions may be coming together from the same bidimensional sheet as illustrated by figure 6B.

[0037] The upper portion 82 may be reinforced in the nose of the wearer by further reinforcing parts. Figure 7 shows another embodiment of the mask in the same step of the manufacturing as in figure 6B. In this embodiment the additional layer 92 comprises reinforcing parts 88 on the strips 84 in the area proximate to the lateral panels 43 and 45. The reinforcing parts 88 may be symmetrical with relation of the nose of the wearer. The reinforcing parts 88 may also have a form substantially semicircular. These reinforcing parts 88 allow to have a better contact with the nose of the wearer 80 and to improve the airtightness of the mask 10 in the area of the nose of the wearer 80. The better contact with the nose of the wearer 80 induces a better comfort for the wearer 80.

[0038] In a general way, the invention relates also to the manufacturing of mask from a bidimensional sheet having different layers including an additional layer or additional stiffener of the desired form, as described above, in order to induce desired fold-lines in the opened state of the mask.

[0039] The invention also proposes a mask body having at least one portion formed of an assembly of bounded layers including at least one non-pleated layer. The at least one non-pleated layer comprises the filtering layer. In this document the wording "non-pleated" relative to a layer means that there is no intrinsic pleat of the layer when the mask including the mask body is in the opened state. In such a case, in the opened state's three-dimensional form of the mask, there is no pleat for the various layers forming the mask panels that are due to the intrinsic strength of the material of the non-pleated layer(s). In other words, a non-pleated layer may present pleats, but the only pleats that it presents are maintained by means external to the material of the non-pleated layer.

[0040] The proposed assembly of bounded layers comprises a stretchable layer. This stretchable layer has an elongation at break higher than the filtering layer which is non-pleated. The elongation at break of the stretchable layer permits to pleat the at least one non-pleated layer. In this document, the term "stretchable layer" refers to a layer having an elongation at break which could be equal or superior to 100%, or at least be equal or superior to 200%. It is however preferable than the elongation at break should be comprised within 300% and 500%. In comparison, the filtering layer has an elongation at break fewer than 100%, more usually fewer than 60%. Besides the stretchable layer is preferably more elastic than the at least one non-pleated layer, i.e. the stretchable layer has preferably a lower Young's Modulus than all of the at least one non-pleated layer.

[0041] In the following, the expressions "at least one non-pleated layer" and "the set of non-pleated layer" are used indifferently and both corresponds to a set including one filtering layer which is non-pleated as above defined and, optionally, including other layer(s) non-pleated as above defined. Indeed the set of non-pleated layer may also correspond to the different layers above-described : internal layer, additional layer, filtering layer, external layer. The set of non-pleated layer may also include the above described supporting layer to support the filtering layer.

[0042] Due to its high stretchability, the stretchable layer may form pleat which could serves as supplementary material for the mask body 12, this supplementary material being able to be unfolded when required by the specific morphology of a wearer. When putted up on a wearer face, the specific morphology of the wearer exerts a specific strain on the stretchable layer which unfolds the pleat accordingly. In other words, the use of the stretchable layer to pleat the mask 10 permits that the pleat may be unfolded automatically by putting the mask up on the wearer's face. It induces that the panels forming the mask may not be fixed in term of dimensions.

[0043] Consequently the proposed mask body 12 and mask 10 with a set of non-pleated layer and a stretchable layer allows fitting with a large range of different morphologies of wearer.

[0044] This fitting with a large range of different morphologies ensures a good airtightness for every wearer, notably thanks to the pressure made by the stretchable layer. The good airtightness maintains the quality of protection of the wearer.

[0045] Figure 8A shows an inside view of such a mask 10 with a non-pleated layer. This mask 10 also corresponds to an embodiment of the above-described mask with one central panel 20, two first lateral panels 43 and 45 and two second lateral panels 53 and 56 forming two trihedrals 38 and 58. Then the patterns shown in figures 4, 6A and 6B also correspond to a mask having a non-pleated layer and a stretchable layer. Figure 8A is a view of the inside of the mask 10 in the opened state. In the lower part of the mask 10, a panel 70 is provided to be put under the chin of the wearer 80 of the mask 10 when in the opened state. The panel 70 may correspond to a face 170 of the holder 100 when the

mask is obtained by three dimensional welding. Figure 8B shows an enlargement of the figure 8A on the lower part of the mask 10.

[0046] The lower panel 70 comprises side portions 76 which are parts of pleats together with respective lower portions 78 of the lateral panels 63 and 65. The pleats are induced by the above-described stretchable layer 72 in the form of an elastic strip.

[0047] Figure 8C shows a schematic cross sectional view of a portion of the mask 10 on the pleat formed between the lower panel 70 and the lateral panel 63. In this document the term "pleat" corresponds to a folding being in the form of a double overlapping of the material on its self, i.e. a folding in the form of an 'S' or a 'Z' as illustrated in figure 8C.

[0048] Standing on figure 8C, the stretchable layer 72 is linked on the at least one non-pleated layer of the mask 10 by using adhesive 74. The stretchable layer 72 may also be ultrasonically welded or seamed on the mask body 12. The ultrasound welding is preferred in that it limits the provision of supplementary material. Besides avoiding the use of adhesive means permits to have a mask body 12 clean of adhesive waste.

[0049] As illustrated in figures 8A and 8B, the elastic strip may be placed externally to the mask 10 when the mask 10 is used. This feature permits to facilitate the conception of the mask 10, notably when the mask 10 is obtained by the use of the tri-dimensional holder 100. However the stretchable layer 72 may also be placed on the internal side of the mask body 12. When the stretchable layer 72 is either on the internal side or the external side of the mask body, the stretchable layer is positioned out of the layer(s) of the set of non-pleated layer. Alternatively, when the set of non-pleated layer includes at least two layers, the stretchable layer may be positioned between the non-pleated layers (embodiment not shown).

[0050] In the above illustrated embodiment, the portion of the mask body 12 formed of the proposed assembly of the set of non-pleated layer and of the stretchable layer 72 corresponds to the chin part of the mask 10. In other words, the stretchable layer 72 in the form of the elastic strip is adapted to be placed on the chin part of the wearer 80 when the mask is used. Indeed the stretchable layer 72 is superimposed on the lateral panel 63, on the lateral panel 65, and preferably on the lower panel 70. Then the proposed formation of the pleat near the lower panel 70 allows fitting with the chin of the wearer 80 even when speaking or moving, thereby inducing a better comfort for the wearer 80. As illustrations, Figure 9A and 9B show masks of the same size set up in an opened state on human faces with different morphologies : large or small respectively. The formation of the pleats accommodates both of these morphologies. For a fitting with a larger range of morphologies, the proposed mask 10 may be provided in two sizes.

[0051] Apart from the fitting with a large range of different morphologies, the proposed formation of pleat for the mask body may contribute to the tri-dimensional form of the mask 10 in the opened state. Indeed, even when the set of non-pleated layer and the stretchable layer are plane layers, the pleating may fold the mask body in a tri-dimensional form as illustrated in figure 8A. Then according to an aspect of the invention, the tri-dimensional form of the mask 10 may be exclusively induced by the assembly of layers forming the mask body 12, the assembly including the set of non-pleated layer and the stretchable layer pleating the set of non-pleated layer.

[0052] The invention also proposes methods for manufacturing the proposed mask with a set of non-pleated layer and a stretchable layer. Different methods of manufacturing ensure that the stretchable layer pleats the set of non-pleated layer. One method for manufacturing the proposed mask may comprise a step of pleating the at least one non-pleated layer prior to the bounding with the stretchable layer. The stretchable layer maintains the pleat after the bounding. According to this method of manufacturing and in reference to figure 8C, the step of pleating of the non-pleated layer is followed by the superimposing of the elastic strip on layers of the mask 10 to maintain the pleat. Another method for manufacturing the proposed mask may comprise straining the stretchable layer prior to the bounding with one layer of the set of non-pleated layer. According to this method of manufacturing and in reference to figure 8C, the straining of the elastic strip is followed by superimposing the strained elastic strip on one layer of the set of non-pleated layer of the mask 10 so as to pleat the set of non-pleated layer of the mask 10.

[0053] According to one aspect of the invention, the proposed mask 10 offers a vertical opening contrary to the horizontal opening of the masks proposed by the prior art. A horizontal opening of a mask corresponds to the manipulation of mask's panels by the wearer around substantially horizontal fold lines of the mask. In other words, a mask with a horizontal opening is putted on the wearer's face by moving away mask panels along a vertical axis so that an upper panel of such a mask could be put on the nose and that a lower panel of such a mask could be put on the chin. On the contrary a vertical opening of the mask corresponds to the manipulation of mask's panels by the wearer around substantially vertical fold lines of the mask. Then the proposed mask 10 may be putted on the wearer's face by moving away mask lateral panels 43, 45, 63 and 65 around the substantially vertical lines formed by the first and second edges 24 and 26. In other words, the proposed mask is set up on the wearer's face by moving away mask panels along a horizontal axis. Such a vertical opening of the mask induces a more intuitive setting up for the wearer.

[0054] The formation of trihedrals 38 and 58 as described above contributes also to an intuitive setting up of the mask 10 on the wearer 80.

[0055] Back to the figure 8A, the proposed mask is vertically opened by pulling the lateral panels along the arrows T. These pullings along the arrows T induce the rotation of the lateral panels around the edges 24 and 26 as shown by

arrows R.

[0056] In reference to figures 1, 2, 8A, 8B, 9A and 9B, the proposed mask 10 may comprise an attachment device made of elastic headband 18 fixed to the lateral panels. The attachment device is known to facilitate the setting up of the mask on the head of the wearer 80. In the proposed embodiment of the mask 10, the attachment device in the form of headband 18 further contributes to the vertical opening of the mask. In reference to figure 8A, to set up the mask, the wearer can then pull the portions of headband 18 along the arrows T. This method of setting up such a mask avoids the insertion of the fingers of the wearer in the internal side of the mask. The use of the headband 18 then lets the inside of the mask uncontaminated.

[0057] Besides, the plane pattern used to obtain the above described mask 10 may comprise extensions 46 and 64 as shown in figure 4. These extensions 46 and 64 may be welded together so as to form the mask in three dimensions as shown in figure 8A. The welding of the extensions 46 and 64 corresponds to the welding by overlapping of the first and second lateral panels on each side of the mask 20. The vertical opening of the mask 10 for the setting up could be made by pulling these extensions 46 and 64 along the arrows T. As shown in figure 4, the extensions 46 and 64 may be made of the assembly of different layers located in angular areas between the edges of the first and second apex angles 34, 36, 54 and 56 which are opposite to the edges 24 and 26 defining the corresponding central angles 32 and 52. In a variant embodiment not shown, all the assembly of different layers located in such angular areas may be welded together, forming advantageously greater extensions and avoiding cut waste. Alternatively, the assembly of different layers comprised in the angular areas between the edges of the first and second apex angles which are opposite to the edges defining the corresponding central angles may be removed in the proposed method.

[0058] The feature of vertical opening could be obtained with a specific form of the mask 10. For example in reference to figure 4, the mask may be designed to present for each central angle 32 and 52, a sum of the value of both apex angles, 34 and 36, or 54 and 56 respectively, being substantially equal to the value of the central angle 32 or 52 respectively. Then central angle 32 obeys to the below formula :

$$\textit{Central angle 32} = \textit{value of the first apex angle 34} + \textit{value of the second apex angle 36};$$

and the central angle 52 obeys to the below formula :

$$\textit{Central angle 52} = \textit{value of the first apex angle 54} + \textit{value of the second apex angle 56.}$$

[0059] This feature may contribute to the folding of the mask 10 in the store state. Indeed back to figure 3, the mask may be flat-folded with a superposition of the lower panel 70 on the inside of the central panel 20, the lateral panels 43 and 63 of one of the central angle 32 being folded on the lower panel 70. In such a store state the lateral panels 45 and 65 from the other of the central angle 52 are folded on the lateral panels 43 and 63. Alternatively, in the flat-folded state of the mask 10, the position of the lateral panels 43 and 63 with respect to the lateral panels 45 and 65 may be reversed. For the masks 10 with the above described flat-folded state, the feature of central angles being the sum of the value of both apex angles facilitates the flat-folding. The folding on the central panel 20 of the lower panel 70, of the lateral panels 43 and 63, and of the lateral panels 45 and 65 preferably covers the whole surface of the internal side of the central panel 20. Then the folding of the mask in the store state allows to protect the internal side of the mask body 12 from external dirtiness. The compliance to this covering feature induces that the set of lateral panels 43 and 63, the set of the lateral panels 45 and 65, or the lower panel alone each covers at least the half, preferably at least the two thirds, of the surface of the internal side of the central panel 20. Consequently, the widths of the laterals panels 43, 45, 63, 65 are preferably greater than the half of the width of the central panel 22. This feature of the widths of the laterals panels further contributes that the flat portion 22 is kept far form the mouth of the wearer 80 in the opened state. Thereby, it allows the formation a greater volume for the cup-shaped air chamber for the mask 10 in the opened state.

[0060] According to a preferred embodiment, the value of each central angle 32 or 52 is comprised between 120° and 150°. Such an angle may correspond to a central panel 20 having a hexagonal form. In a general way, the central panel 20 may have any other polygonal form. In a more general way, the first and second edges 24 and 26 may be straight edges to simplify the conception of the mask 20. However, the first and second edges 24 may be bound together by a radius of curvature as shown in figure 4. The radius of curvature may be chosen between 5 and 15 mm and is preferably equal to 8,5 mm.

[0061] According to another aspect of the invention, the upper portion 82 is reinforced on the nose of the wearer 80 by a nose clip. In reference to figures 1, 2, 5A, 9A and 9B the nose clip 86 may be provided on the outside of the mask 10. The nose clip 86 may be made of material having a sufficient plasticity property so as to allow the wearer to adjust

the upper portion 70 on its nose. The nose clip 86 may then be made of aluminum or aluminum coated with polypropylene. The coating of polypropylene allows the nose clip 86 to be welded on the mask body 12 when the exterior layer of the mask body 12 is also made of polypropylene. Without specific coating, the nose clip may be bound to the mask body 12 by adhesive means.

[0062] According to an aspect of the invention the nose clip 86 may have the form of a 'U' to provide a better airtightness to the mask 10 around the nose when the nose clip 86 is clamped. Figures 10A and 10B show such nose clips 86 with a 'U' shape. This 'U' shape may be obtained by folding of a straight bar on its both ends as illustrated by figure 10A. The 'U' shape may also be obtained by roll bending a straight bar as illustrated by figure 10B. In this method of manufacturing the nose clip 86, the radius of curvature Rc for the roll bending could be chosen around 15mm, *i.e.* for example between 10mm and 20mm. Each folded or bended ends of the bar presents an angle α with the central unfolded or unbended portion of the bar. The central portion of the 'U' shape is preferably straight. The angle α is preferably comprised between 90° and 120° so as to fit with the hexagonal form of the central panel 20. More preferably, the angle α is chosen around 104,7° with an allowance of more or less 5°.

[0063] Back to figure 5A, the airtightness of the mask 10 in the nose area, may be improved by the provision of a nose seal 14 on the inside of the mask on the upper portion 82 of the mask body 12. More generally, the airtightness between the mask 10 and the face of the wearer 80 may be improved by the provision of seals (not shown) on the whole periphery of the mask body 12.

[0064] Standing to figure 5A and according to a further aspect of the invention, the attachment device of the mask 10 may comprise independent elastic headbands 18 on each side of the mask 10. The independence of the elastic headbands 18 on each side of the mask 10 means that the elastic headbands 18 of each side may be separated from the elastic headband 18 of the other side before the placement of the mask on the face of the wearer 80. This independence of the elastic allows to pull the right elastic headband 18 on the rightward direction and to pull the left elastic headband 18 on the leftward direction. In other words, back to figure 8A, the independence of the elastic headbands 18 facilitates the vertical opening of the mask 10 by pulling along arrows T prior to the setting up of the mask on the face of the wearer 80. After the setting up of the mask 10 on the face of the wearer 80, the independent elastic headbands 18 of each side may then be fastened to the independent elastic headband 18 of the other side of the mask 10 with the help of a fastener. The fastening of the elastic headband of the right side together with the elastic headband 18 of the left side allows closing the attachment device around the head of the wearer 80.

[0065] The above described attachment device may have various variants for its fastener. Figure 11A shows a front view of the attachment device with the fastener being in the form of mirror hooks 102 which cooperate one with another. In figure 11A, the mask 10 is represented with a molded cup-shaped form, but the following description also applies to above described masks 10 with an opened state forming trihedrals and/or with at least a non pleated layer being pleated by a stretchable layer. Figure 11B shows a back view of the attachment device with another fastener being in the form of a "fish bone" 106. The fish bone is a plate 106 linked to one of the elastic headband 18. The plate 106 has several hook portions to provide an adjustably fastening with the other elastic headband 18. Figure 11C shows a back view of the attachment device with another fastener being in the form of open buckles 108. Each open buckle 108 is linked to one of the elastic headband 18. The open buckles 108 further fasten one to another as the mirror hooks 102. Figure 12 shows a variant for the above fastener. The fastener here corresponds to bands 104 of hook-and-loop fastener, commonly known under the term "Velcro bands", each band being linked to one of the elastic headbands 18.

[0066] According to another aspect, the attachment device of the mask 10 may comprise a single elastic headband 18. An attachment device with a single elastic headband provides easy manufacturability. Figure 13A shows an example of such an attachment device. The single elastic headband 18 differs from the independent elastic headbands 18 in that the single elastic headband forms a closed loop from the right side of the mask 10 to the left side of the mask 10. However the headband 18 also forms an additional loop able to be open and closed around the head of the wearer 80. As illustrated in figure 13B, the elastic headband 18 then presents two free ends having hooks 110 which can be fasten together so as to be able to open or close the additional behind the head of the wearer 80. The hooks 110 may correspond to the open buckles 108 of figure 11C. The size of the closed loop can be adjusted by the sliding of the single elastic headband into two gliding channel 180 formed on the left and right sides of the mask 10. The mask 10 may then be positioned on the wearer 80 by passing the enlarged loop around the head. After the positioning of the closed loop around the head of the wearer, the enlargement of the closed loop offers enough liberty to open vertically the mask as above described by pulling the elastic headband 18 according to both the rightward and leftwards directions. After the vertical opening of the mask 10, the mask can be set up on the face of the wearer and the additional loop may be closed. After the closing of the additional loop, the length of this additional loop may be adjusted by the use of clamping tongues 118 on the plastic parts that forms the hooks as shown in figure 11C. Figure 13C shows a side view of the mask with the above described attachment device adjusted on the wearer 80. This embodiment of the attachment device is fastened by a back neck operation which is easier than a back head operation. Alternatively the closed loop may be positioned around the neck of the wearer 80, and the closing of the additional loop may be performed by a back head operation.

[0067] In both the above embodiments of the attachment device, the mask 10 is held on the face of the wearer 80 by

four portions of elastic headband which provides better seal between the wearer's face and the mask 10.

[0068] The invention has been described with reference to preferred embodiments. Every various described aspect of the invention may be implemented in a mask independently or simultaneously one to another. Further, many variations are possible within the scope of the invention. For instance, the lateral panels, 43 and 63, or, 45 and 65, of each central angle 32 or 52 may be integral, i.e. formed of a single continuous panel (not shown). In other words the lateral panels 43 and 63, 45 and 65 respectively, may not be separated by a fold-line, seam, weld or bond. According to this embodiment or independently from it, the tri-dimensional form of the mask body 12 may be obtained by thermoforming an assembly of different layers on the holder 100 above described, then allowing to have an integral mask body 12. The thermoforming of the assembly into the mask body 12 on the holder 100 is facilitated by the provision of a thermosetting or thermofusible layer in the assembly of different layer. The additional layer is then advantageously made of thermosetting or thermofusible material.

Claims

1. A mask (10) having an opened state, capable of forming a cup-shaped air chamber over the nose and mouth of a wearer (80), and a store state in which the mask (10) is substantially flat-folded comprising a mask body (12) with:

   - a central panel (20) flat in the store state, having at least two central angles (32, 52) opposite one another, each central angle (32 ; 52) being defined by an apex (30 ; 50) and first and second edges (24, 26),
   - two first lateral panels (43, 45) flat in opened state for which first apex angles (34, 54) can be defined, being respectively linked to one first edge (24) of the two central angles (32 ; 52) through a fold-line, seam, weld or bond,
   - two second lateral panels (63, 65) flat in opened state for which second apex angles (36, 56) can be defined, being respectively linked to one second edge (26) of the two central angles (32 ; 52) through a fold-line, seam, weld or bond,

   wherein the first apex and second apex angles (34, 54 ; 36, 56) are arranged so that for each central angle (32 ; 52), the central panel (20), one first lateral panel (43 ; 45) and one second lateral panel (63 ; 65) form a trihedral (38, 58).

2. The mask according to claim 1, wherein the first and second edges (24, 26) are straight edges.

3. The mask according to claims 1 or 2, wherein for each central angle (32 ; 52), the sum of the value of both apex angles (34, 54 ; 36, 56) is substantially equal to the value of the central angle (32 ; 52) :

   Central angle (32 ; 52) = value of the first apex angle (34 ; 54) + value of the second apex angle (36 ; 56).

4. The mask according to any one of claims 1 to 3, wherein the value of each central angle (32 ; 52) is comprised between 120° and 150°.

5. The mask according to any one of claims 1 to 4, wherein the first and the second lateral panels (43, 63 ; 45, 65) of the same central angle (32 ; 52) are welded together.

6. The mask according to any one of claims 1 to 5, wherein the central panel (20) has a polygonal form, preferably a hexagonal one.

7. The mask according to any one of claims 1 to 6, wherein the central panel (20) comprises an upper portion (82) in contact with the nose of the wearer (80), when the mask is used, the upper portion (82) being reinforced of the wearer (80) by reinforcing parts (88).

8. The mask according to any one of the claims 1 to 7, wherein the widths of the first and second lateral panels (43, 45, 63, 65) are greater than the half of the central panel.

9. The mask according to claim 8, wherein, in the store state, the first and second lateral panels (43, 45, 63, 65) are folded on the central panel (20) by covering the whole internal side of the central panel (20).

10. The mask according to any one of claims 1 to 9, wherein the central panel (20) comprises an upper portion (82)

and an intermediate portion (22) which are integral, the upper portion (82) being in contact with the nose of the wearer (80) and wherein the intermediate portion (22) comprises an additional stiffener (92) arranged so that in the store state, the central panel (20) is substantially flat and in the open state, the upper portion (82) and the intermediate portion (22) are separated by a fold line.

11. The mask according to claim 10, wherein the stiffener (92) is reinforced on the links with lateral panels (43, 45, 63, 65).

12. The mask according to claims 10 or 11, wherein the stiffener (92) covers at least the whole intermediate portion (22).

13. The mask according to any one of claims 10 to 12, wherein the stiffener (92) is an additional layer (92).

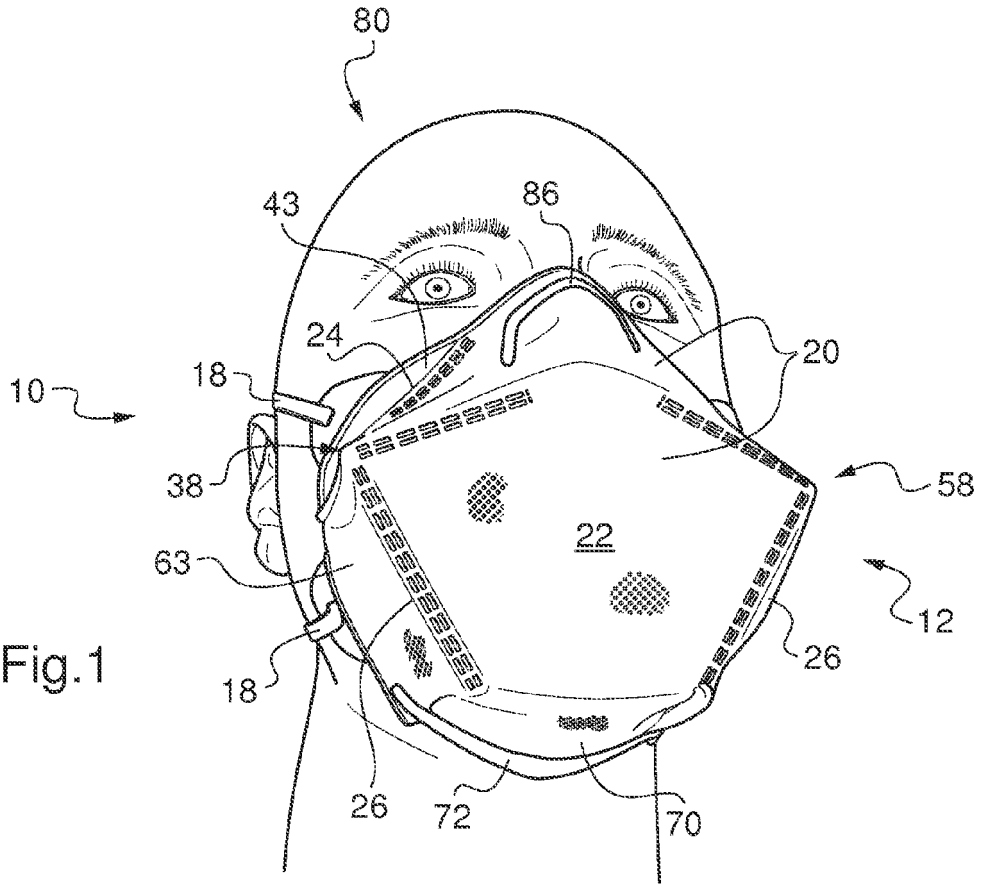
14. A method for manufacturing a mask comprising:

- cutting a mask body (12) in a bidimensional sheet being an assembly of different layers (90, 92) including at least one filtering layer ,
- forming the mask (10) by ultrasound welding layers (90, 92) of the mask body (12) in three dimensions by using a holder with the desired form for the mask (10).

15. The method according to claim 14, wherein the mask body (12) has a central panel (20), the holder has the form of the central panel (20), the central panel (20) being on the holder when the welding step is achieved.

16. The method according to claims 14 or 15, wherein the mask body (12) is the mask body (12) of the mask (10) according to any one of claims 1 to 13, and wherein at the cutting step, the part of the assembly comprised in the angular areas between the edges of the first and second apex angles (34, 36, 54, 56) which are opposite to the edges (24, 26) defining the corresponding central angles (32, 52) is removed.

17. The method according to any one of claims 14 to 16, wherein the mask body (12) is the mask body (12) of the mask (10) according to any one of claims 1 to 13, wherein at the welding step, the edges of the first and second apex angles (34, 36, 54, 56) which are opposite to the edges (24, 26) defining the corresponding central angles (32, 52) are welded together.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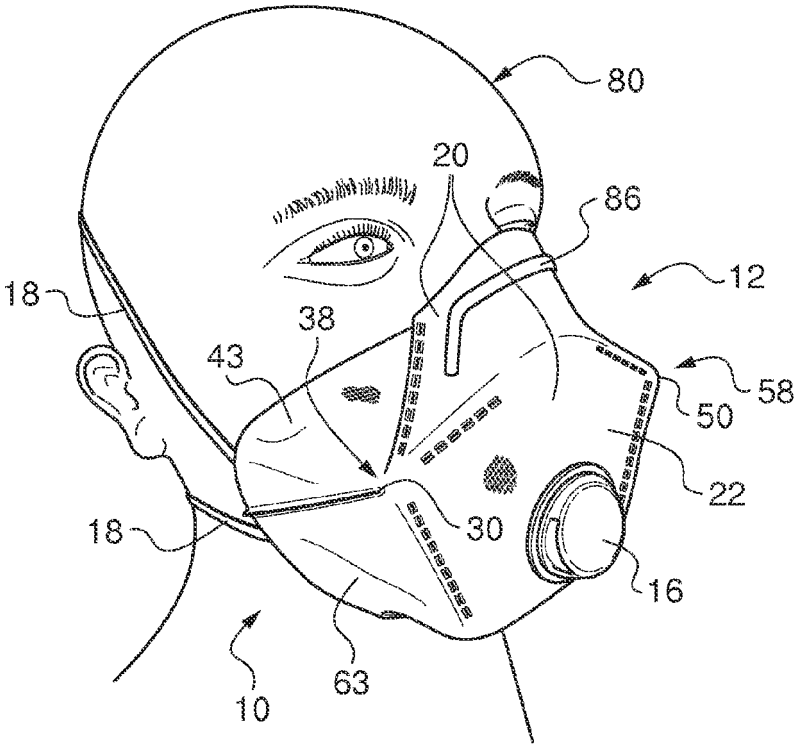
26
72
70

Fig.1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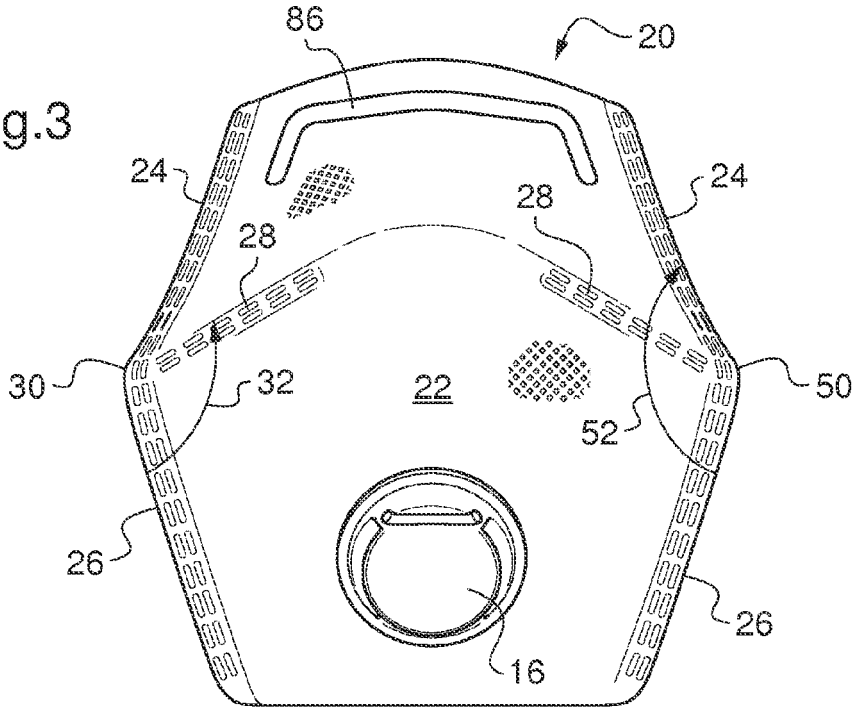
16
10
63

Fig.2

Fig.3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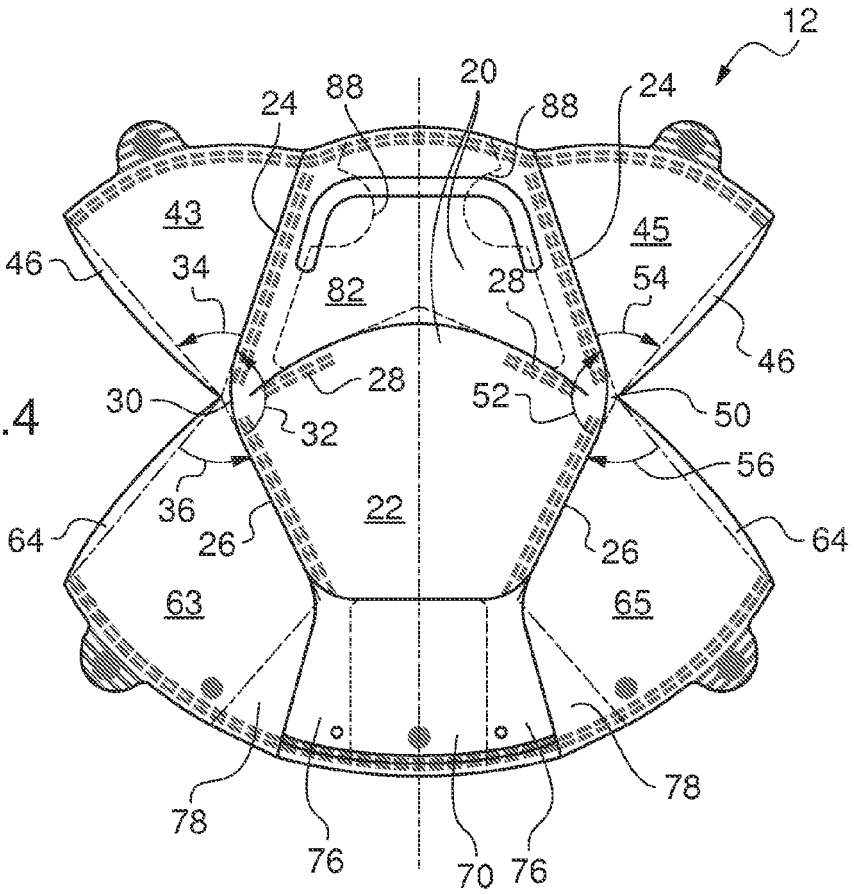
50
52
26
26
16

Fig.4


12
24
88
20
88
24
43
45
46
34
82
28
54
46
28
30
52
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32
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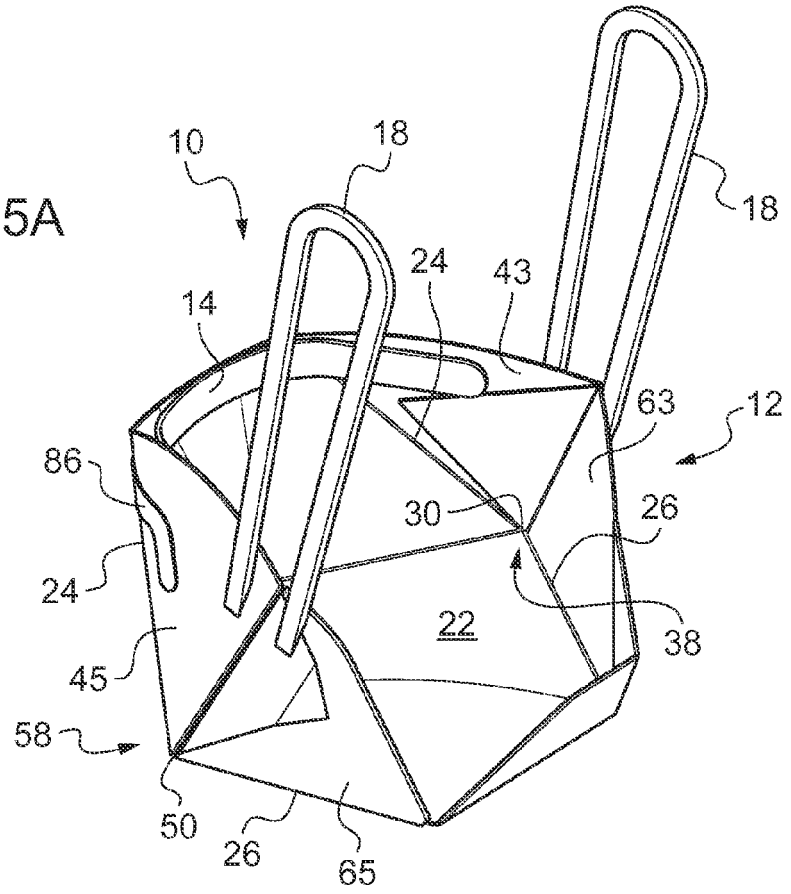
64
63
65
78
78
76
70
76

Fig.5A



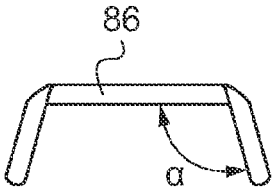


Fig.10A

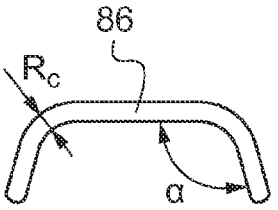
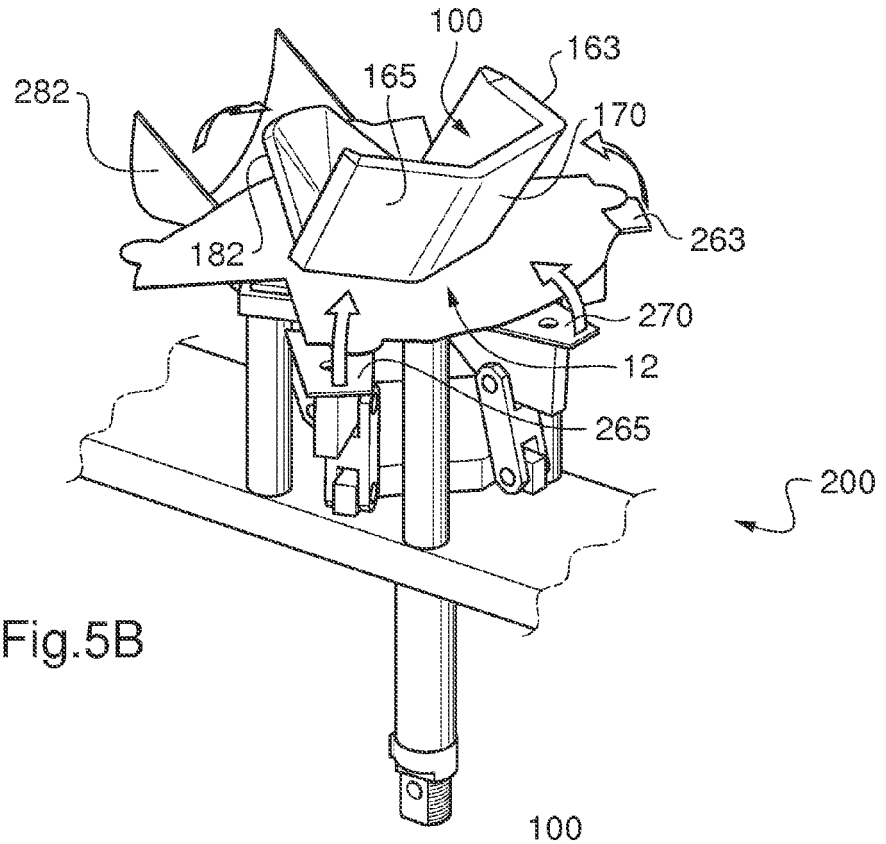


Fig.10B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163
165
282
170
263
182
270
12
265
200

Fig.5B

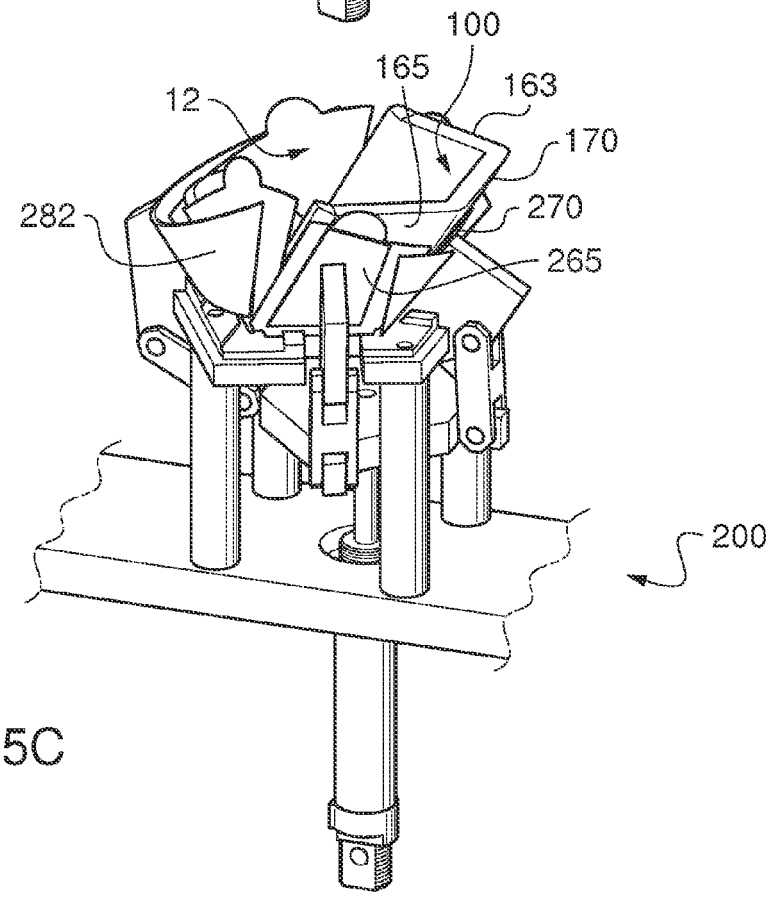

100
165
163
12
170
270
282
265
200

Fig.5C

Fig.6A

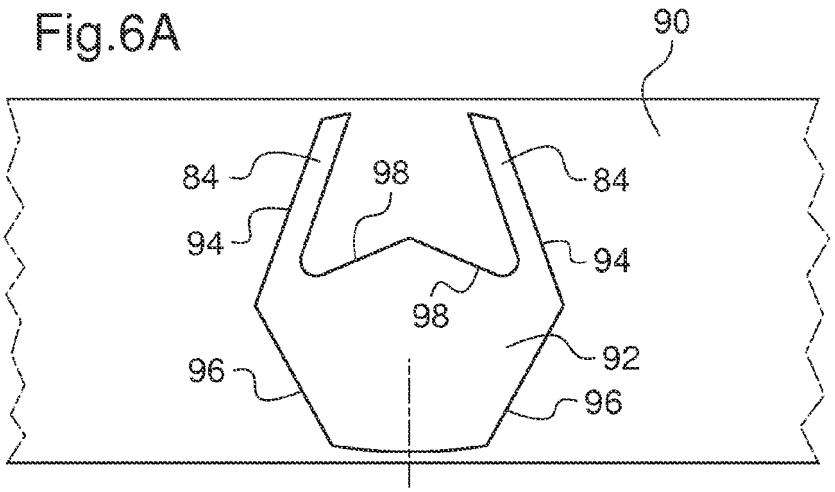


Fig.6B

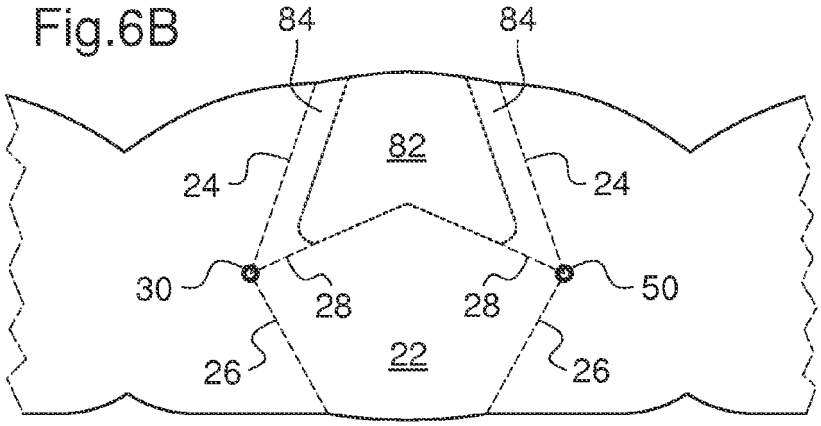


Fig.7

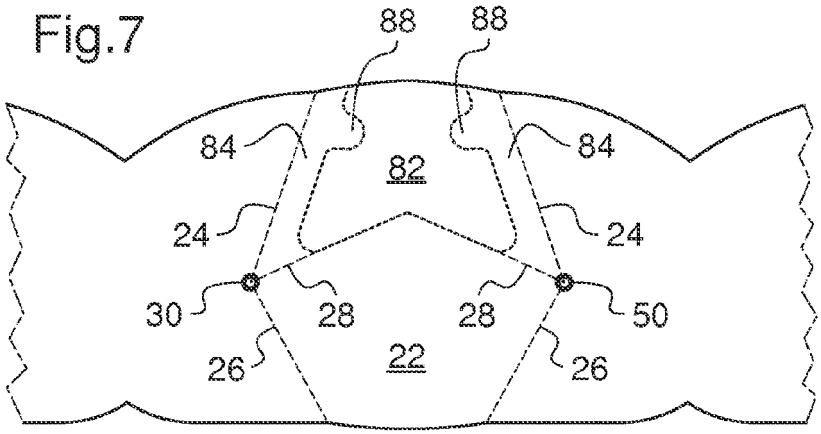
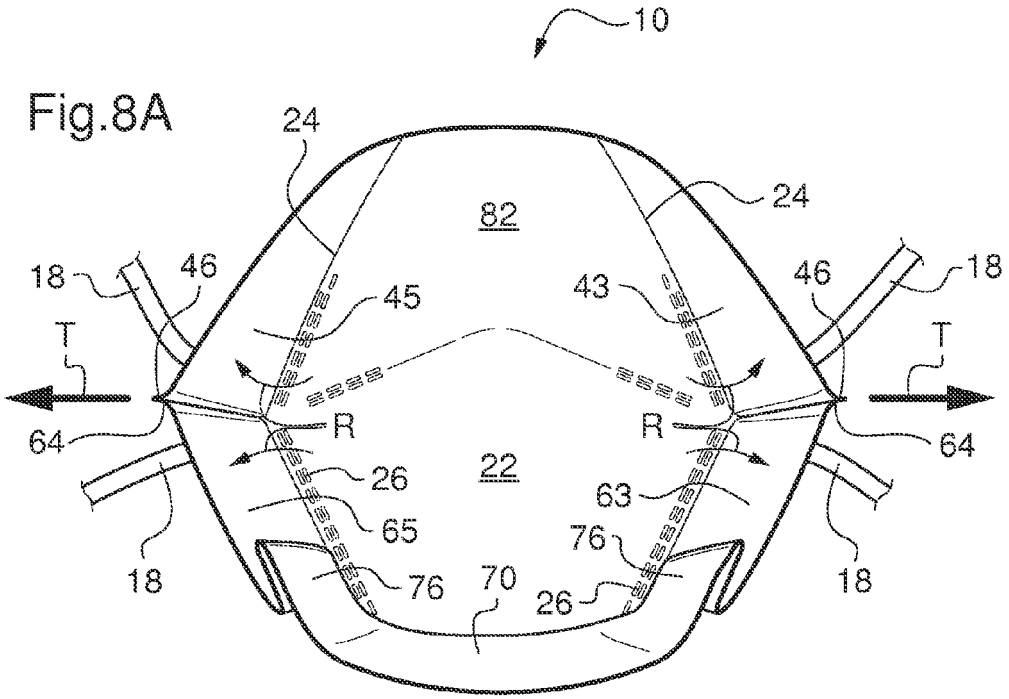


Fig.8A



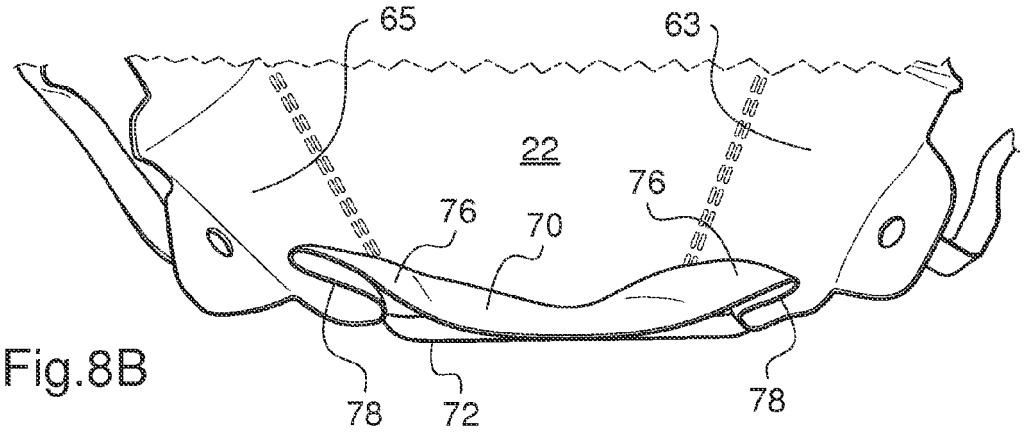


Fig.8B

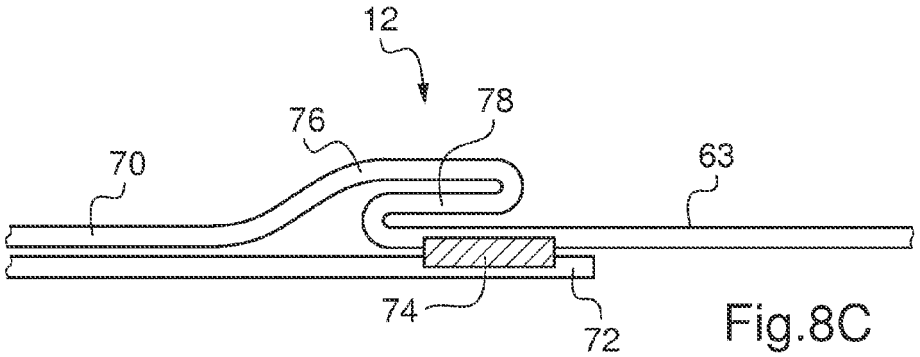


Fig.8C

Fig.9A

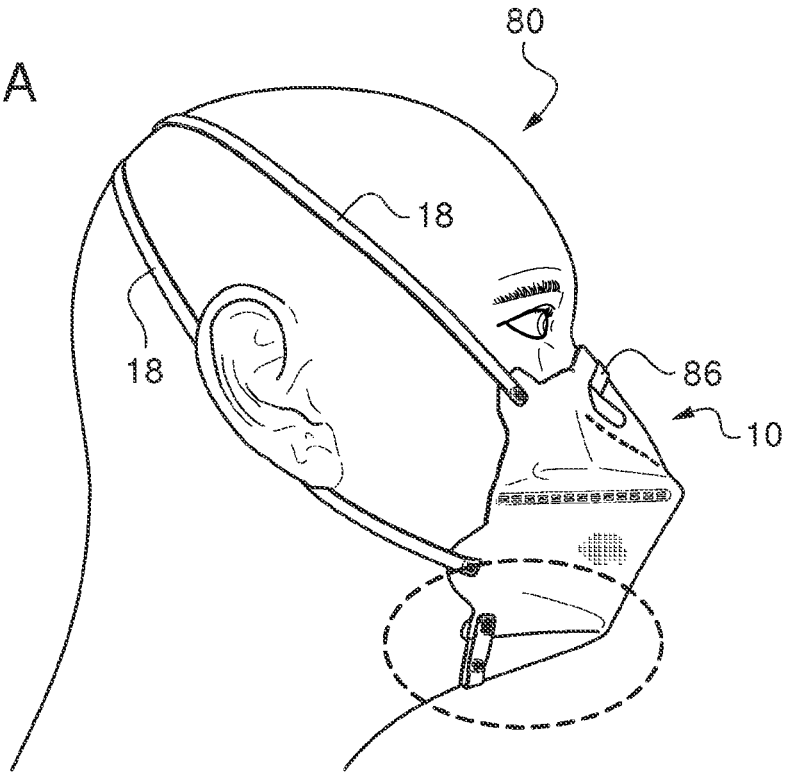


Fig.9B

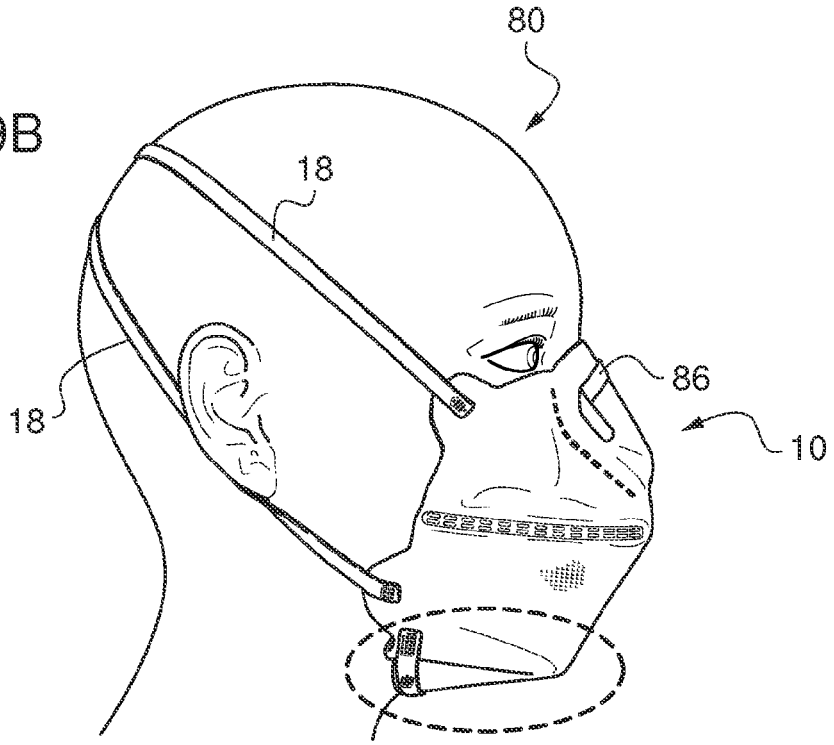


Fig.11A

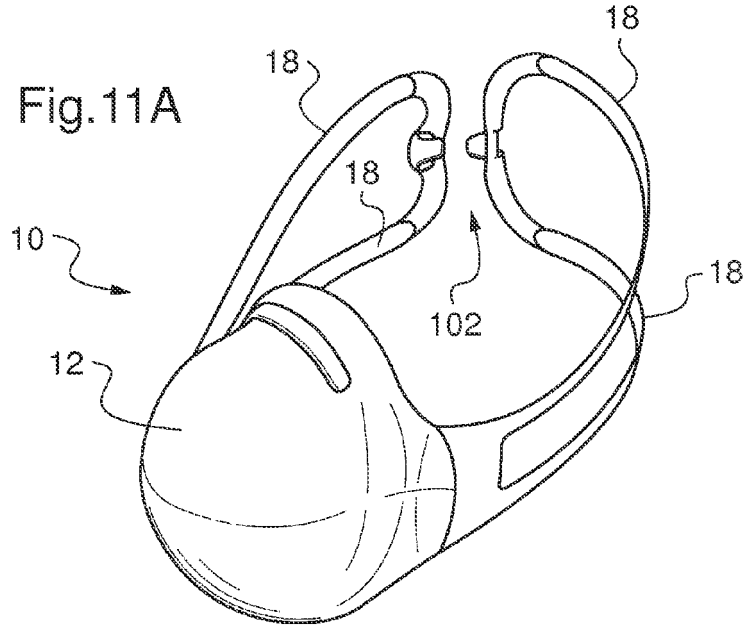


Fig.11B

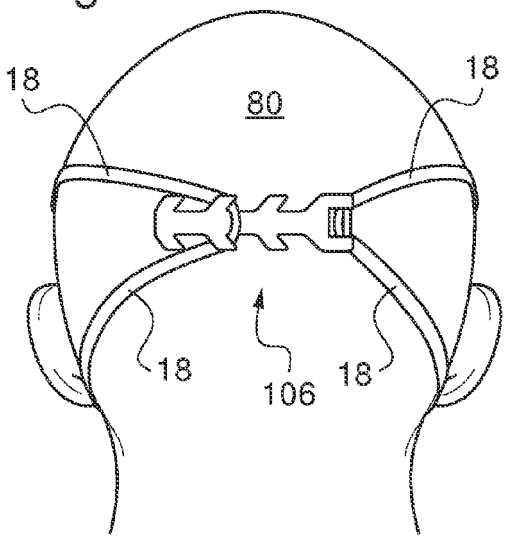
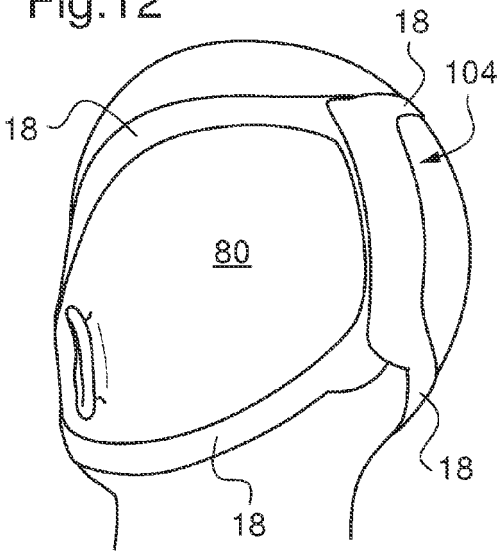


Fig.12



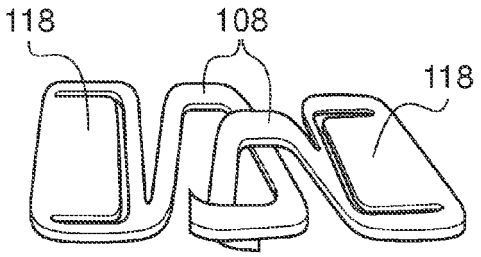


Fig.11C

Fig.13A

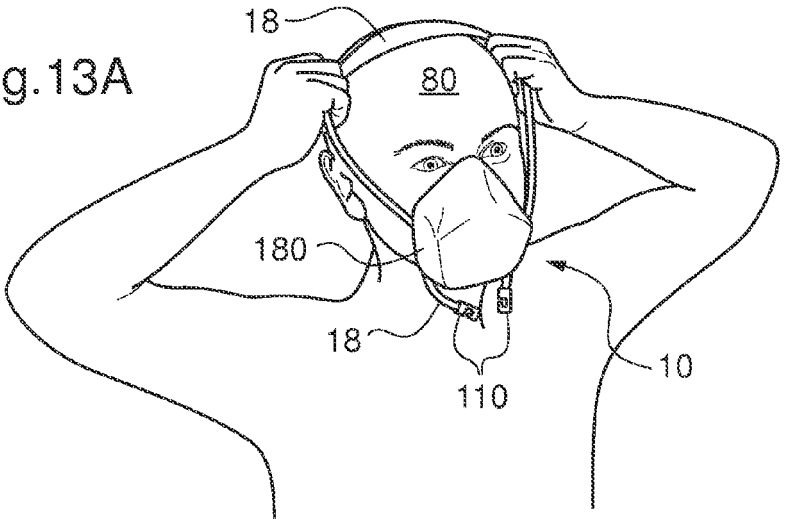


Fig.13B

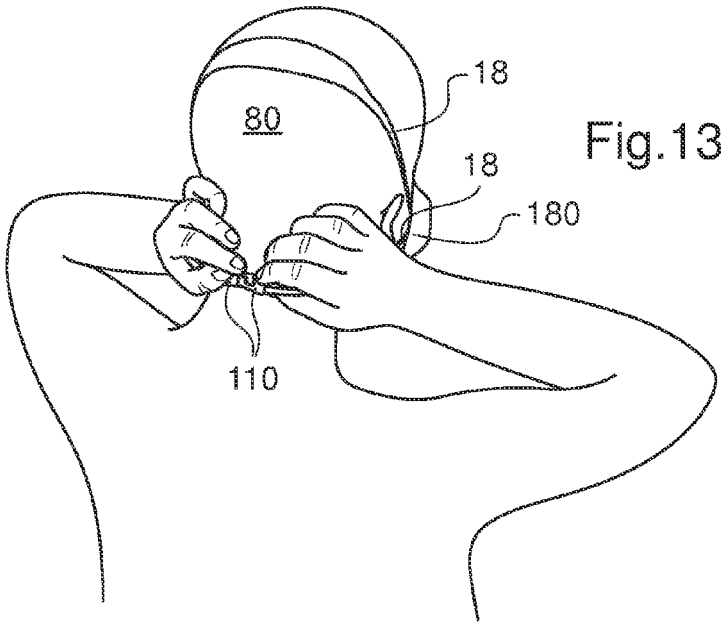
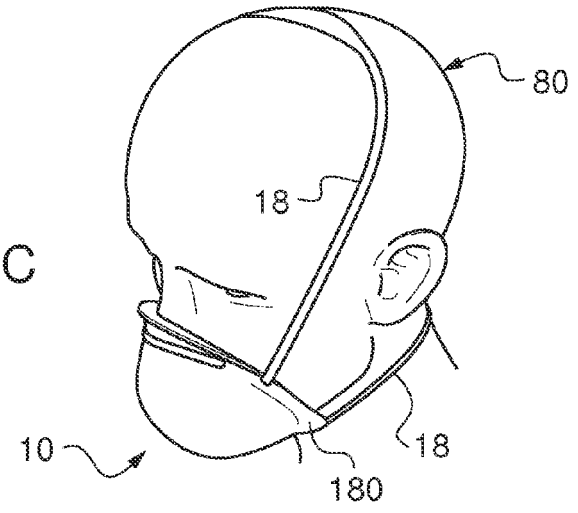


Fig.13C



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EUROPEAN SEARCH REPORT

Application Number
EP 11 30 5155

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 A	US 4 417 575 A (HILTON JOSEPH R [GB] ET AL) 29 November 1983 (1983-11-29) * claim 1; figures 3,14,15 *	1-9 14	INV. A41D13/11
X	JP 6 335535 A (K SEVEN KK) 6 December 1994 (1994-12-06) * abstract; figures 1,3,4 *	1-9	
X	JP 2006 218079 A (KURASHIKI SENI KAKO KK) 24 August 2006 (2006-08-24) * figures 1,3,5 *	1-9	
A	US 2004/255946 A1 (GERSON RONALD L [US] ET AL) 23 December 2004 (2004-12-23) * paragraphs [0034], [0035], [0038], [0045], [0054] - [0057]; claim 1; figures 1a,1b,7 *	1,14	
A	US 2003/226563 A1 (BRUNELL ROBERT A [US] ET AL) 11 December 2003 (2003-12-11) * claim 1.11; figures 1,3 *	1,14	TECHNICAL FIELDS SEARCHED (IPC)
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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	23 November 2011	D'Souza, Jennifer

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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EPO FORM 1503 03.82 (P04C01)

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Application Number
EP 11 30 5155

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

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☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

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LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 11 30 5155

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-13

A mask (10) having an opened state, capable of forming a cup-shaped air chamber over the nose and mouth of a wearer (80), and a store state in which the mask (10) is substantially flat-folded comprising a mask body (12) with:
- a central panel (20) flat in the store state, having at least two central angles (32, 52) opposite one another, each central angle (32 ; 52) being defined by an apex (30 ; 50) and first and second edges (24, 26),
- two first lateral panels (43, 45) flat in opened state for which first apex angles (34, 54) can be defined, being respectively linked to one first edge (24) of the two central angles (32 ; 52) through a fold-line, seam, weld or bond,
- two second lateral panels (63, 65) flat in opened state for which second apex angles (36, 56) can be defined, being respectively linked to one second edge (26) of the two central angles (32 ; 52) through a fold-line, seam, weld or bond,
wherein the first apex and second apex angles (34, 54 ; 36, 56) are arranged so that for each central angle (32 ; 52), the central panel (20), one first lateral panel (43 ; 45) and one second lateral panel (63 ; 65) form a trihedral (38, 58).

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2. claims: 14-17

A method for manufacturing a mask comprising:
- cutting a mask body in a bidimensional sheet being an assembly of different layers including at least one filtering layer,
- forming the mask by ultrasound welding layers of the mask body in three dimensions by using a holder with the desired form for the mask.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 11 30 5155

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