



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
05.04.2023 Bulletin 2023/14

(51) International Patent Classification (IPC):
A62B 18/10 (2006.01)

(21) Application number: **21200216.6**

(52) Cooperative Patent Classification (CPC):
A62B 18/10

(22) Date of filing: **30.09.2021**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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(54) **VALVE DEVICE FOR A RESPIRATORY MASK, RESPIRATORY MASK**

(57) The present invention relates to a valve device (3) for a respiratory mask (1), comprising a support body (9) which is designed to be attached on a front side of a filtering mask body (2) of the respiratory mask (1) at a mask body opening (8) and which provides a support body opening (14), whereby the support body (9) features a valve seat (18) that surrounds the support body opening (14) in a circular manner with a continuous sealing surface (19), further comprising an elastic valve element (11) with a circular disc shape that is attached to the support body (9) such that it rests on the sealing surface (19) with its outer edge in its unactuated state and such that its outer edge is at least partially moved away from the sealing surface (19) in its actuated state, and further comprising a cover (10) that is attached to the support body

(9) and that at least essentially covers the valve element (11), whereby the support body (9) comprises a support body main section (12) that is designed to rest on the front side (13) of the mask body (2) and at least one support body fastening latch (35) that protrudes in axial direction from the support body main section (12) in a direction away from the cover (10) to at least partially extend through the opening (8) of the mask body (2), whereby the fastening latch (35) is designed to accommodate a first fastening element (38) to fasten the valve device (3) to the mask body (2). It is provided that the cover (10) comprises a recess (23) that corresponds to a section of the fastening element (38) that faces away from the support body (9).

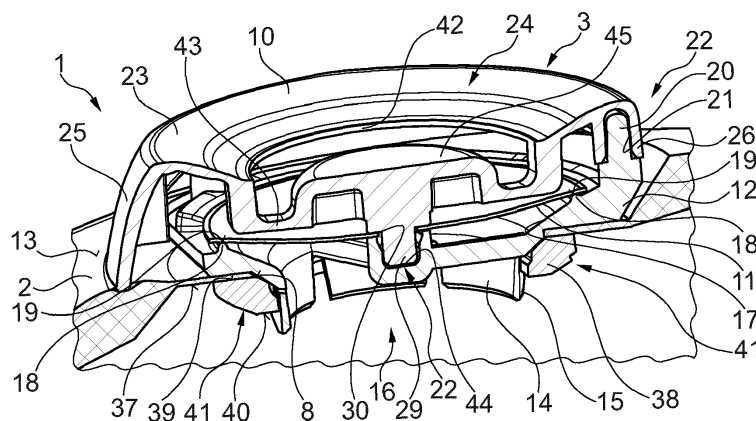


Fig. 3

Description

[0001] The present invention concerns a valve device for respiratory mask, comprising a support body which is designed to be attached on a front side of a filtering mask body of the respiratory mask at a mask body opening and which provides an valve opening, whereby the support body features a valve seat that surrounds the valve opening in a circular manner with a continuous sealing surface, further comprising an elastic valve element with a circular disc shape that is attached to the support body such that it rests on the sealing surface with its outer edge in its unactuated state and that its outer edge is at least partially moved away from the sealing surface in its actuated state, and further comprising a cover that is attached to the support body and that at least essentially covers the valve element, whereby the support body comprises a support body main section that is designed to rest on the front side of the mask body and at least one support body fastening latch that protrudes in axial direction from the support body main section in a direction away from the cover to at least partially extend through the opening of the mask body, whereby the fastening latch is designed to accommodate a first fastening element to fasten the valve device to the mask body.

[0002] The present invention further concerns a respiratory mask comprising a mask body that is designed to cover the mouth and nose of a user and that comprises a mask body opening, and that further comprises a valve device as described above that is arranged at the mask body opening.

[0003] Valve devices and respiratory masks, as described above, are known from the prior art. The not yet disclosed patent application EP 20 199 306 describes a valve device according to the preamble of claim 1. A support body of the valve device is attached to a mask body such that it reaches through a mask body hole with a couple of fastening latches. The support body covers the mask body opening and provides a support body opening that communicates with the mask body opening to allow air to be led through the mask body and the support body. A disc-shaped valve element is arranged at the support body opening such that it lies with its outer edge on a circular sealing surface that surrounds the support body opening. In its unactuated state the valve element sealingly closes the support body opening such that air may not flow through the mask body opening. To that regard, the valve element acts as non-return valve: If an airstream hits the valve element with a sufficient force through the support body opening, the valve element may be moved away from the sealing surface on its edge thereby allowing the airstream to pass through the valve device. In the absence of airflow the elasticity of the valve element acts as pre-tension that moves the valve element at its outer edge against the sealing surface and closes the passage. The valve device therefore allows a user who wears a respiratory mask that comprises the valve device to easily exhale through the valve device.

When inhaling the valve element closes the support body opening and air may only flow through the mask body itself, such that the wearer only receives air that is filtered by the mask body of the respiratory mask.

[0004] In order to safely attached the valve device to the mask body, the at least one fastening latch is pushed through the mask body opening and a first fastening element is arranged between a back grip of the fastening latch and the backside of the mask body to secure the support body element on the mask body. Here, the fastening latch is of circular shape and the fastening element is a fastening ring that is pushed over the back grip of the circular fastening latch under elastic deformation securing itself on the fastening latch and at the same time fastening the support body element on the mask body. A cover secures the valve element such that it can freely move while it is guarded from outside manipulation and secured from harm.

[0005] It is an object of the present invention to provide a better valve device, in particular with respect to packaging and transport.

[0006] The inventive valve device with the features of claim 1 is characterized in that the cover comprises a recess that corresponds to a section of the fastening element that faces away from the support body. Therefore, the low side of the fastening element and the upside of the cover corresponds to one another such that the fastening element could be arranged at least partially within the recess of the cover. The fastening elements may, for example, be an elastic fastening ring that is designed such that when pushed onto the fastening latch it stretches under elastic deformation so that a pretension of the fastening ring acts on the fastening latch in radial direction so that the fastening ring is retained on the fastening latch by frictional force. In the mounting process the fastening element or in this example the fastening ring is pushed onto the fastening latch after the fastening that has been pushed through the mask body opening so that the mask body close to the mask body opening is axially held between the support body that rests on the front side of the mask body and the fastening ring or element that is arranged on the backside of the mask body, thereby retaining the support body or the valve device safely on the mask body. However, when multiple valve devices that is designed according to the present invention are stacked on one another, the fastening element of one valve device may at least partially be accommodated within the recess of the cover of another valve device. Due to the corresponding shape of the recess and the fastening element the stacking of the valve devices or of respiratory masks that comprises these valve devices requires less space than before because the valve devices are partially staked within one another. The recess is the last designed to at least partially accommodate a second fastening element that corresponds to the first fastening element. With two valve devices that are both designed according to the present invention, one valve device on top of the other valve device can be partially

pushed with its fastening element into the cover of the other valve device below, thereby creating a very densely packed stack of valve devices or respiratory masks. that corresponds to the first fastening element. The recess and the first fastening element therefore correspond to one another with respect to their shape and/or dimensions, at least with respect to the section of the fastening element that faces away from the support body.

[0007] According to a preferred embodiment of the present invention, the recess is funnel-shaped. This has the advantage that the recess of the cover acts as centering device for a further valve device which is to be stapled on the valve device in the above-described manner with its fastening element in the recess. The funnel-shaped recess is preferably arranged coaxially to the main or center axis of the support body opening that in particular defines the valve opening. Furthermore, the funnel-shaped recess has the advantage that the second fastening element or the fastening element of the second valve device, which is arranged within the funnel-shaped recess, may easily be taken out of the recess without harm. Therefore, the initially stapled valve devices or respiratory masks can easily be taken apart from the staple without harming the fastening element of one valve device or the cover of the other valve device. Preferably, the funnel-shaped recess is arranged coaxially to the valve element or the support body opening.

[0008] Preferably, the fastening latch comprises at least one back grip element that extends radially outward to accommodate the first fastening element axially between the back grip element and a backside of the mask body when the valve device is mounted to the mask body. In this case the fastening element, also if designed as fastening ring, is held on the at least one fastening latch not only via a frictional lock but also via a form-fit between the back grip element and the backside of the mask body or - if not yet mounted to the mask body - between the back grip element and the support body main section.

[0009] Furthermore, the recess or the cover preferably comprises at least one cover opening that allows air coming from the valve opening to pass the cover. While the cover essentially protects the valve element beneath, it also provides a pass way for the air exiting the respiratory mask, the exhalation air. The cover opening is preferably arranged in a side wall of the cover such that the exiting air does not directly pass the valve device but gets deflected by the cover to exit the valve device sideways or with regard to the main/center axis radially. It is particularly preferred that the cover comprises two cover openings that are arranged distanced from another to allow the airflow with only low resistance. According to a further embodiment, the at least one cover opening is arranged in the cover distanced to the funnel-shaped recess. Furthermore, the cover preferably comprises at least one central cover opening in the area of the recess. The central cover opening in the area of the recess is preferably designed to accommodate the at least one fastening latch of another valve device that is designed according

to the present invention when the valve devices are stapled or stacked on one another. Therefore, the contour of the central cover opening preferably corresponds at least essentially to the contour of the fastening latch. As such the central cover opening is preferably designed as ring shaped opening to accommodate at least one ring shaped fastening element of the support body.

[0010] According to a preferred embodiment of the present invention, the fastening latch at least partially forms the valve opening. The fastening latch is in particular a longitudinal or axial extension of the support body at the area of the support body opening, thus prolonging the opening of the support body defining an air channel that reaches through the support body and the mask body, respectively. The fastening latch is therefore not only designed to fasten the support body to the mask body but also to direct the air passing through the valve opening.

[0011] According to a preferred embodiment of the present invention, the first fastening element is arranged between the at least one fastening latch and the support body main section. As such, the valve device that includes the first fastening element can easily be handled prior to mounting to the mask body. If mounted to the mask body, the mask body partially lies between the fastening element and the support body main section.

[0012] Preferably, the support body comprises multiple fastening latches that are arranged in a circular manner in particular to form the valve opening. According to this embodiment, the multiple fastening latches extend into the same direction, in particular in axial direction from the support body main section so as to protrude through the mask body opening if mounted to the mask body. Due to their circular arrangement, the fastening latches themselves form a sleeve or tube that comprises the valve opening or more particular the air channel. Preferably, the fastening latch or latches are designed elastically deformable, in particular such that they may deflect radially inward with their free ends. It is in particular preferred that the back grip of each fastening latch is arranged on the respective free end of the fastening latch. According to an alternative embodiment of the present invention, the fastening latch is preferably designed as circular fastening latch ring having an inner diameter that defines the valve opening. Instead of multiple fastening latches that are arranged in a circular arrangement, the circular fastening latch ring precisely defines a tube for the air channel. The circular fastening latch ring may have one or more back grips on its outer circumference that protrude radially outward to accommodate at least one fastening element between the back grip and the support body main section or - if mounted - the mask body.

[0013] Preferably, the first fastening element is designed as at least essentially stiff fastening ring. The fastening ring may be made of plastic, in particular hard plastic. The fastening ring has the advantage that it holds itself on the circular arranged fastening latches or the circular fastening latch. In the mounted state, the fasten-

ing ring is axially retained between the back grips of the one or the multiple fastening latches and the backside of the mask body. The fastening ring is particularly preferred arranged coaxially to the valve opening and on the outer circumference of the multiple fastening latches or the circular fastening latch. Preferably, the inner diameter of the fastening ring is smaller than the outer diameter of the fastening latches that is defined by the back grips. During the assembly process the fastening ring is pushed over the back grips by elastically deflecting the fastening latches radially inward. The fastening ring is therefore stiff in comparison to the fastening latches in order to deflect the fastening latches during the assembly process. The fastening ring is therefore easily mountable and securely fixed onto the support body and the mask body. The described design has the advantage that, although the mounting process is easy, the fastening ring is safely secured to the mask and cannot be lost due to the form-locking arrangement axially between the back grips on one side and the mask body on the other side.

[0014] Preferably, an inner diameter of the first fastening ring is greater than an outer diameter of the circularly arranged fastening latches or the one circular fastening latch, in particular axially distanced to the back grips, so that the fastening ring is arranged on the support body or the fastening latches with radial play. This allows an easy mounting process without the need for high forces and the fastening ring is safely secured between the back grips and the mask body

[0015] According to an alternative embodiment of the present invention the first fastening ring is elastically deformable. Therefore, the fastening ring preferably provides a pretension when mounted on the mask body such that the support body is safely held on the mask body, and particularly loose-prove. The elasticity of the fastening ring furthermore facilitates the mounting of the fastening ring to the circular fastening latch or latches by widening the inner diameter of the fastening ring when overpassing the respective back grip. The attachment of the main body to the mask body is therefore facilitated by the use of the elastic deformable fastening ring without the need for other attachment means such as glue, a weld joint, stitching or the like. The usage of the elastic deformable fastening ring has the further advantage that the respiratory mask that comprises the inventive valve device is easily dismountable without the need to destroy any connection.

[0016] Furthermore, the inner diameter of the first fastening ring in its relaxed state is smaller than the outer diameter of the outer circumference of the multiple fastening latches or the circular fastening latch. Thereby, the fastening ring is also held radially fixed to the support body of the valve device.

[0017] According to a further embodiment of the present invention, the first fastening ring comprises a first surface that is oriented towards the support body main section - or in the mounted state towards the mask body - and a second surface that is oriented away from the

support body main section, whereby the second surface is funnel-shaped, in particular corresponding to the funnel-shaped recess of the cover. The ring in its sectional view deviates from a circular design. In particular, the fastening ring in its cross section has a trapezoidal design, whereby in particular the second surface or lower surface is designed to provide the funnel shape on the lower end. Thus, the fastening element is funnel-shaped on its free surface (the surface facing away from the mask body) which may be arranged on or more precise at least partially in the recess of a cover of another valve device that is designed according to the present invention.

[0018] Preferably, the funnel-shaped recess is constituted by a cover ring section, whereby an outer edge of the cover ring section is fastened to the support body. It is particularly preferred that the cover ring section is deformed to provide the funnel-shape of the recess. This means, that the thickness of the cover in the area of the recess is essentially the same such that the cover in the area of the recess protrudes towards the valve element beneath due to the funnel-shape. Distanced to the funnel-shaped recess, the cover is fastened to the support body so that the funnel-shaped recess is arranged distanced to the main body as well as the valve element allowing the valve element to be deformed during an exhaling process.

[0019] The support body and the cover preferably form at least one plug-in connection radially distanced to the valve opening. The plug-in connection allows for an easy attachment of the cover to the main body and therefore for an easy and cost-efficient mounting process of the valve device.

[0020] According to a preferred embodiment of the present invention, the plug-in connection comprises a pin that protrudes from the support body or the cover and a receptacle in the cover or the support body, whereby the pin is plugged into the receptacle in a form- and in particular force-fitting manner. By providing a force-fit between the pin and the receptacle, the cover is safely held on the support body. It is particularly preferred that only one, only two, only three or more than three plug-in connections are arranged between the cover and the support body as described above, and that the plug-in connections are preferably evenly distributed around the circumference of the valve opening and radially distanced thereto. By providing at least three plug-in connections a safe and robust connection of the cover to the support body is guaranteed for a long time of usage.

[0021] According to a further embodiment of the present invention, the cover preferably comprises a fastening protrusion that centrally presses the valve element against the above-described valve seat. The pretension of the valve element that guarantees the sealing contact of the valve element on the sealing surface of the valve seat is hereby provided by the fastening protrusion. The fastening protrusion extends axially so far that it reaches in axial direction up to the valve seat and in particular beyond the valve seat to pre-tense and pre-form the valve

element in its unactuated state.

[0022] The valve seat preferably comprises an annular sealing surface that is preferably arranged in a straight plane, in particular perpendicular to the axial extension of the support body ring section. Therefore, the sealing surface is easily realized during manufacturing and the overall geometry of the valve element and the sealing surface allows a safe and tight sealing contact along the whole circumference of the valve element at its outer edge.

[0023] The support body preferably comprises a support seat adjacent to the fastening protrusion such that the valve element is clamped between the fastening protrusion and the support seat axially distanced to the valve seat. The support seat opposite to the fastening protrusion limits the maximum deformation of the valve element when the cover is mounted on the main body. The support seat hinders the protrusion to protrude axially so far that that it deforms the valve element in particular such that it partially opens.

[0024] By clamping the valve element between the fastening protrusion and the support seat, the valve element is safely fixed to the valve device. It is particularly preferred that the valve element has a central through hole through which an end portion of the fastening protrusion extends in particular such that it is plugged into a receptacle of the support seat in a form and force fitting manner. Hereby, a further plug-in connection is provided that is centrally arranged.

[0025] Preferably, the support seat is held in the valve opening by at least one support beam that extends from the support body, in particular radially into the valve opening. It is particularly preferred that the valve seat is held by at least two, preferably at least three support beams that extend radially into the valve opening and which are evenly distributed around the circumference of the valve opening. The main cross-section of the valve opening is not impaired by two or three support beams and thus the beams do not provide a further or noticeable airstream resistance.

[0026] The cover preferably comprises a support beam that extends from the fastening protrusion diagonally across the valve element, and particularly lying on the valve element. Thereby, the valve element may be moved away from the valve seat or the sealing surface preferably only in an area far away from the support beam, in particular on both sides of the support beam. In the longitudinal extension of the support beam, the valve is safely secured to the valve seat by the support beam. Due to this design, the airflow is directed to the left and to the right of the support beam and the valve element always opens in a same area of the valve element. The support beam is particularly arranged such that in the mounted state on the mask body it lies within the extension of a nose line of a user such that acceleration air will be passed to the left and to the right of the user instead of top and to the bottom. This has the advantage that condensation that might occur during the

usage of the respiratory mask will not flow into the mask in the moment the valve element is in its actuated state.

[0027] The inventive respiratory mask is characterized by the inventive valve device, thereby obtaining the advantages described above.

[0028] Further advantages and preferred embodiments and combinations thereof result from the further description and the claims. The invention shall be described in more detail with reference to the figures below. It is shown in

Figure 1 a respiratory mask with a valve device in a top view,

Figure 2 the respiratory mask in an enlarged side view,

Figure 3 a cross-sectional view of the respiratory mask,

Figure 4 a perspective view of a support body of the valve device,

Figure 5 a perspective view of a cover of the valve device,

Figure 6 a side view of the support body and

Figure 7 a cross-sectional view of multiple respiratory masks that are stapled on one another.

[0029] Figure 1 shows in a top view an advantageous respiratory mask 1 that comprises a mask body 2 and a valve device 3. The mask body 2 is a filtering mask body that allows air to flow through the material of the mask body 2 and it is designed to cover the mouth and nose of a user's face. The mask body 2 is therefore essentially cup-shaped with a sealing surface face 4 on its outer edge 5 which is to lie on the user's face during use so that an airflow between the mask body 2 and the wearer's face is prohibited. The mask body 2 comprises a nose portion 6 that is designed to accommodate at least partially a nose of the wearer and a main portion 7, from which the nose portion 6 essentially radially extends. The main portion 7 and the nose portion 6 are essentially of a concave shape. The valve device 3 is arranged in the bottom part of the main portion 7 distant to the edge 5 of the mask body 2 so that the valve device 3 is distant to the nose and mouth of the wearer during use.

[0030] Figure 2 shows the respiratory mask 1 in an enlarged side view of the valve device 3. The valve device 3 is arranged at a mask body opening 8 that extends through the mask body 2 at the bottom section of the cup-shape at the main portion 7. The valve device 3 covers the mask body opening. The valve device 3 comprises a support body 9 that is fixed to the mask body 2 and a cover 10 that is attached to the support body 9. Furthermore, the valve device 3 comprises a valve element

11 that is elastically deformable and which acts as one way valve as will be explained in more detail below. The cover 10 protrudes from the mask body 2 in the mounted state of the valve device 3 so as to secure and protect the valve element 11.

[0031] Figure 3 shows a cross-sectional view of the respiratory mask 1 along the line A-A as shown in figure 1. The support body 9 comprises an essentially circular support body main section 12 that rests on a front surface face 13 of the mask body 2 at the mask body opening 8 such that the support body main section 12 lies on the surrounding edge of the mask body 2 that surrounds the mask body opening 8. The support body main section 12 comprises a support body opening 14 having an inner diameter that is smaller than the inner diameter of the mask body opening 8. The support body opening 14 is constituted by a tube element 15 that extends essentially perpendicular to the support body main section 12 such that it reaches through the mask body opening 8. The tube element 15 thereby constitutes an air channel 16 that reaches through the mask body opening 8 and extends in axial direction of the tube element 15.

[0032] The support body main section 12 furthermore comprises a support body recess 17 on its upper side opposite to the tube element 15. The recess 17 is funnel-shaped and coaxially aligned to the tube element 15. The recess 17 ends at the inner diameter of the support body opening 14 and is limited on its outer circumference by a protruding circular or annular valve seat 18 which provides a continuous circular sealing surface 19 for the valve element 11. The sealing surface 19 extends in a straight plane that is oriented at least essentially perpendicular to the axial extension of the valve opening 14 or the air channel. The valve element 11 is of a circular disc shape and arranged coaxially to the valve opening 14 and the sealing protrusion 18, respectively. In its unactuated state, the valve element 11 rests with its outer edge on the sealing surface 19 to safely close the valve opening 14 and thus to prohibit air to stream through the valve device 3. The outer edge is to be understood as the outer rim area, that extends along the whole circumference of the valve element 11, facing the sealing protrusion 18 or sealing surface 19, and that reaches from the outer border that extends along the outer diameter of the valve element 11 radially inward so that the outer edge is understood as the outermost ring segment of the valve element 11 in particular with a radial width of 0,5 mm to 4 mm, in particular 1 mm to 2 mm. To ensure that the valve element 11 sealingly rests on the sealing surface 19 along its whole circumference, the valve element 11 is slightly pressed into the support body recess 17 by the cover 10, whereby the pressing force acts on the center or the middle of the valve element 11 such that it is evenly elastically deformed to obtain a concave shape. In its relaxed state, the valve element 11 extends in a straight plane so that when the valve element 11 is slightly pressed into the recess 17, the inherent elasticity produces a preload or pretension that acts on the sealing

surface 19 so that the sealing arrangement of the valve element 11 on the sealing surface 19 along its outer circumference or edge is secure.

[0033] The support body 9 is shown in a perspective view in figure 4. The support body 9 comprises on its outer edge three axially protruding pins 20 that are equally distributed along a circumference of the support body 9. The pins 20 are arranged parallel to one another and protrude away from the tube element 15 in the direction of the cover 10.

[0034] The cover 10 comprises for each of the pins 20 a receptacle 21. Each receptacle 21 has an inner diameter that is preferably at least partially smaller than the outer diameter of the pin 20 so that when a pin 20 is pushed into a receptacle 21, a form- and force fit between the cover 10 and the support body 9 is produced. The form- and force fit secures the cover 10 on the support body 9 safely. Alternatively or additionally, the cover 10 may be attached to the support body 9 via a material bond that is, for example, facilitated by welding or with an adhesive. The receptacles 21 are distributed along the outer circumference of the cover 10 corresponding to the distribution of the pins 20 so that for each pin 20 a receptacle 21 is available. Each pin 20 and receptacle 21 constitute a plug-in connection 22 that holds the cover 10 on the support body 9.

[0035] The cover 10 is shown in a perspective view in figure 5. Corresponding to the number of pins 20, the cover 10 comprises three receptacles 21 which are designed as recesses in the cover 10. The pins 20 and the receptacles 21 preferably comprise an at least partially conical shape to facilitate the respective plug-in connection 22. The conical shape provides a self-centering function for the cover when mounted on the support body 9.

[0036] The cover 10 furthermore comprises a funnel-shaped recess 23 as shown in figure 3. The funnel-shaped recess 23 is provided by a circular ring section 24 of the cover 10. An inner diameter of the ring section 24 is smaller than the outer diameter of the valve element 11, such that in the mounted state, when the ring section 24 is arranged coaxially to the valve element 11, the ring section 24 partially covers the valve element 11, in particular the ring section 24 safely covers the outer edge of the valve element 11. The thickness of the ring section 24 is essentially constant so that the funnel-shaped recess 23 on the top side of the cover 10 is also visible on the downside of the cover 10 which faces the valve element 11.

[0037] On its outer circumference, the ring section 24 merges into an upper side wall 25 and in a lower side wall 26 which are arranged diametrically opposed on the cover 10 and which extend sideways from the cover 10 in the direction of the support body 9, as also shown in figure 5. The upper side wall 25 is preferably designed to rest on the front surface 13 of the mask body 2 facing the nose portion 6 so that the side wall 25 prohibits exhaled air to flow directly into the direction of the eyes of the wearer. The lower side wall 26 comprises one of the

receptacles 21. Between the side walls 25 and 26, the cover 10 is distant to the mask body 2 in the mounted state, in particular as shown in **figure 2**, so that the cover 10 and the mask body 2 provide two side openings 27, through which air that passes through the valve opening 14 may pass through as well. The side openings 27 are therefore arranged on the left and the right side of the valve device 3 during use, such that exhaled air exits the valve device 3 sideways, as indicated with arrows in **figure 1**.

[0038] The cover 10 furthermore comprises a fastening protrusion 28 that is arranged centrally in the cover 10 and which protrudes axially into the direction of the valve opening 14 and the valve element 11. The fastening protrusion 28 is designed as fastening pin that preferably comprises a tip 29 with a conical shape to provide a self-centering function. The tip 29 has an outer diameter that is smaller than an inner diameter of a central valve element opening 30, so that the pin 29 may be pushed through the valve element 11. The protrusion 28 furthermore comprises a shoulder 31 with an outer diameter that is greater than outer diameter of the pin 29. The outer diameter of the shoulder 31 is such that it is greater than the inner diameter of the valve element opening 13 so that, when the pin 29 is pushed through the valve element opening 30, the shoulder 31 may rest on the valve element 11 as shown in **figure 3**, for example. However, the pin 29 is preferably designed such that the shoulder 31 is distanced to the valve element 13 so that the shoulder does not exercise a force onto the valve element 13. The shoulder 31 is designed such that when the cover 10 is mounted on the support body 9, the shoulder 31 lies axially distanced to the sealing surface 19 within the support body recess 17, whereby this distance preferably corresponds to the thickness of the valve element 13. Hence, the valve element 11 is pushed by the shoulder 31 into the recess 17 thereby providing the above-described pretension on the sealing surface 19.

[0039] The support body 9 preferably comprises a support seat 32 that is arranged centrally in the valve opening 14. The support body 9 comprises at least one, in the present example three, evenly distributed support beams 33 that extend radially from the support body main section 12 into the valve opening 14 and which are connected with the valve seat 32. In particular, the support body 9, the support beams 33 and the valve seat 18 are designed in one piece. The support beams 33 therefore carry or support the support seat 32. The support seat 32 comprises a receptacle 44 that is designed to accommodate at least partially the pin 29 of the cover 10 as shown in **figure 3**. The receptacle 33 preferably also comprises a conical shape, at least in its entrance region, so that the pin 29 is easily self-centered in the receptacle 44. The cover 10 is thereby additionally supported by the central fourth plug-in in connection 22 that is constituted by the pin 29 and the support seat 32.

[0040] The support seat 32 is preferably designed such that its outer diameter is larger than the inner diameter

of the valve element opening 30 so that the valve element 11 is axially held between the shoulder 31 and the support seat 32. It is particularly preferred that the valve element 11 is held between the shoulder 31 and the support seat 32 in a form-fitting manner in particular with no or only minimal axial play so that the valve element is not axially pressed between the shoulder 31 and the support seat 32. For this the axial extension of the pin 29 is such that if the pin rests on the bottom of the receptacle 44 the distance between the shoulder 31 and the support seat 32 is equal or just a little bit greater than the thickness of the valve element 13.

[0041] **Figure 6** shows a side view of the support body 9. In this view, the structure of the tube element 15 is visible. The tube element 15 is designed with axial slits or axial extending recesses 34 which are evenly distributed over the circumference of the tube element 15. Between two neighbouring recesses 34, the remaining part of the tube element 15 provides a fastening latch 35 which is elastically deformable such that it may be moved or deflected radially inward at its free end under elastic deformation. Preferably, each fastening latch 35 comprises at its free end a back grip element 36 that protrudes radially outward from the respective fastening latch 35. Due to the tube-design, the fastening latches 35 are arranged in a circular manner. According to an alternative embodiment, instead of having multiple fastening latches 35, the tube element 15 is designed as one circular fastening latch that comprises a continuous mantel wall that comprises either one back grip element 36 that extends over the whole outer circumference of the tube element 15 or multiple back grip elements 36 that are arranged evenly distributed over the outer circumference of the tube element 15. In that case, the fastening element 38 itself is preferably elastically deformable.

[0042] The support body 9 is designed such that the back grip elements 36 are arranged distanced from a backside 37 of the mask body 2 in the mounted state of the valve device 3, so that a cavity is provided between the back grip elements 36 and the mask body 2.

[0043] The valve device 3 furthermore comprises a fastening element 38 that is preferably designed as fastening ring. The fastening ring is preferably rather stiff, at least stiffer than the fastening latches 35, so that the fastening latches 35 are deflected radially inward when the fastening ring is pushed onto the tube element 15, and has an inner diameter which is somewhat greater than the outer diameter of the tube element 15 next to the back grips 38 and smaller than the outer diameter of the tube element 15 at the back grips 38.

[0044] In order to mount the valve device 3 to the mask body 2, the valve device 3 is firstly pushed through the mask body opening 8 with the tube element 15 such that the back grip elements 36 are arranged axially distanced to the mask body 2. Secondly, the fastening ring or fastening element 38 is pushed onto the tube element 15 or the fastening latches 35. In order to overcome the back grip elements 36, the fastening latches 35 are elastically

deformed and deflected radially inward. The axial height of the fastening ring is designed such that the fastening ring 17 can be accommodated between the back grip elements 36 and the backside of the mask body 2. Therefore, once the fastening ring has passed the back grip elements 36, the fastening latches 35 snap back into their original position such that the fastening ring is captured between the back grips 36 and the backside 37 of the mask body 2.

[0045] Optionally, in case the fastening ring itself is elastically deformable, the height of the fastening ring is designed such that it is somewhat larger than the axial distance between the back grip elements 36 and a backside 37 of the mask body 2 so that the fastening ring 17 produces a pretension in axial direction between the back grip elements 36 and the mask body 2, thereby pulling the support body main section 12 onto the front surface 13 of the mask body 2 and safely retaining the valve device 3 on the mask body 2. In case the latches 35 are designed without back grip element 36, as shown in the example of **figure 3**, the radial pre-tension of the fastening element 38 retains the fastening ring on the fastening latches 35 and thereby the valve device 3 on the mask body 2 by frictional-locking on the outer circumference of the fastening latches 35.

[0046] The fastening ring comprises a first surface 39 that, in the mounted state, is pressed against the backside 37 of the mask body 2, and a second surface 40 that is oriented away from the mask body 2. The distance between the first surface 39 and the second surface 40 in axial direction defines the height of the fastening ring as described above. The lower or second surface 40, as shown in **figure 3**, comprises a funnel-shaped protrusion 41. The funnel-shaped of the protrusion 41 corresponds to the funnel-shaped of the recess 23 of the cover 10 with regard to its inner and outer diameter and its inclination.

[0047] Furthermore, the outer diameter of the tube element 15 including the back grip elements 36 is preferably smaller than the inner diameter of the ring section 24 of the cover 10, the inner diameter defining a center cover opening 42. Thus, the ring section 24 ends at the central cover opening 42 that is arranged coaxially to the valve element 11.

[0048] The cover 10 furthermore comprises a support beam 43 which is axially distanced to the ring section 24 and which carries the fastening protrusion 28. In particular, at least the fastening protrusion 28, the valve support beam 43 and the ring section 24 are made in one piece. The support beam 43 extends diagonally across the cover 10 and the valve element 11 in a direction from the side wall 26 to the side wall 25 and - if mounted on the mask body 2 - along the vertical line A-A that runs from the nose section 6 through the central axis of the valve device 3, in particular the valve element 11. The support beam 43 is axially distanced to the ring section 24 of the cover such that it lies on the valve element or is arranged close to it so that it guarantees that the valve element 11 can preferably only be lifted on its edge from

the sealing surface 19 in the vicinity of the side openings 27 between cover 10 and mask body 2. The valve element support beam 43 preferably hinders the valve element 11 on its upper and lower edge to be lifted from the sealing surface 19. The valve element 11 can therefore only be deformed into a v-like shape by lifting its edge from the sealing surface 19 on diagonally opposing sides.

[0049] The fastening protrusion 29 is preferably arranged on a central disc section 45, the outer diameter of which is smaller than the inner diameter of the central cover opening 42. Thereby, the remaining central opening 42 obtains a ring-form.

[0050] During use, when inhaling, a user can draw fresh air only through the filtering material of the mask body 2 due to the one-way valve function of the valve device 3. When exhaling, the air pressure acts against the valve element, as shown with arrows in **figure 3**, such that it may be lifted on its edge from the sealing surface 19 close to the side openings 27. Exhaled air may pass through the valve device 3 and exit the valve device 3 sideways, as shown in **figure 1**. The exhalation process is easy and comfortable due to the low-pressure resistance of the valve device 3. The described design of the valve device 3 and the respiratory mask 1 has the advantage that a number of valve devices 3 or respiratory masks 1 can be stapled on one another to form a stack for a transport that is very tight compared to known solutions, as shown in **figure 7**.

[0051] **Figure 7** shows four respiratory masks 1 that are each designed as the one described above and stapled on one another, such that the valve devices 3 are stacked into one another. The respiratory masks 1 are therefore aligned to one another with the valve devices 3 being axially stacked. Thereby, the tube element 13 of one respiratory mask or valve device 3 is pushed into the central cover opening 42 of the cover 10. Preferably, the inner diameter of the circle of the fastening latches 35 or the tube element 15 is larger than the outer diameter of the central disc 45 such that the fastening latches 35 may be pushed into the ring-shaped central opening 42 of the cover 10. The fastening ring or fastening element 38 is pushed into the funnel-shaped recess 32 of the cover 10 below. Thereby, the respiratory masks 1 or valve devices 3 are tightly stacked on one another.

Claims

1. Valve device (3) for a respiratory mask (1), comprising a support body (9) which is designed to be attached on a front side of a filtering mask body (2) of the respiratory mask (1) at a mask body opening (8) and which provides a support body opening (14), whereby the support body (9) features a valve seat (18) that surrounds the support body opening (14) in a circular manner with a continuous sealing surface (19), further comprising an elastic valve element (11) with a circular disc shape that is attached to the

- support body (9) such that it rests on the sealing surface (19) with its outer edge in its unactuated state and such that its outer edge is at least partially moved away from the sealing surface (19) in its actuated state, and further comprising a cover (10) that is attached to the support body (9) and that at least essentially covers the valve element (11), whereby the support body (9) comprises a support body main section (12) that is designed to rest on the front side (13) of the mask body (2) and at least one support body fastening latch (35) that protrudes in axial direction from the support body main section (12) in a direction away from the cover (10) to at least partially extend through the opening (8) of the mask body (2), whereby the fastening latch (35) is designed to accommodate a first fastening element (38) to fasten the valve device (3) to the mask body (2), **characterized in that** the cover (10) comprises a recess (23) that corresponds to a section of the fastening element (38) that faces away from the support body (9).
2. Valve device according to claim 1, **characterized in that** the recess (23) is funnel-shaped.
 3. Valve device according to one of the preceding claims, **characterized in that** the at least one fastening latch (35) comprises at least one back grip element (36) that extends radially outward to accommodate the first fastening element (38) axially between the back grip element (36) and a backside (37) of the mask body (2) when the valve device (3) is mounted to the mask body (2).
 4. Valve device according to one of the preceding claims, **characterized in that** the cover (10) comprises at least one opening (27) that allows air coming from the actuated valve element (11) to pass the cover.
 5. Valve device according to one of the preceding claims, **characterized in that** the at least one fastening latch (35) at least partially forms the support body opening (8).
 6. Valve device according to one of the preceding claims, **characterized in that** it comprises the first fastening element (38) arranged between the back grip element (36) and the support body main section (12).
 7. Valve device according to one of the preceding claims, **characterized in that** the support body (9) comprises multiple fastening latches (35) that are arranged in a circular manner in particular to form the support body opening (14).
 8. Valve device according to one of the preceding claims, **characterized in that** the fastening element (38) is an at least essentially stiff fastening ring and that the at least one fastening latch is at least partially elastically deformable.
 9. Valve device according to one of the preceding claims, **characterized in that** the inner diameter of the first fastening ring is larger than an outer diameter of the circle of multiple fastening latches (35) next to the back grips (36) and smaller than the outer diameter of the circle of multiple fastening latches (35) at the back grips (36).
 10. Valve device according to one of the preceding claims, **characterized in that** the first fastening element (38) comprises a first surface (40) that is oriented towards the support body main section (12) and a second surface (41) that is oriented away from the support body main section (12), whereby the second surface (41) is funnel-shaped, in particular corresponding to the funnel-shaped recess (23) of the cover.
 11. Valve device according to one of the preceding claims, **characterized in that** the funnel-shaped recess (23) is constituted by a deformed cover ring section (24), whereby an outer edge of the cover ring section is fastened to the support body.
 12. Valve device according to one of the preceding claims, **characterized in that** the support body (9) and the cover form (10) at least one plug-in connection (22) radially distanced to the support body opening (8).
 13. Valve device according to one of the preceding claims, **characterized in that** the respective plug-in connection (22) comprises a pin (20) that protrudes from the support body (9) or the cover (10) and a receptacle (21) in the cover (10) or the support body (9), and that the pin (20) is plugged into the receptacle (21) in a form- and force-fitting manner.
 14. Valve device according to one of the preceding claims, **characterized in that** the cover comprises a central fastening protrusion (28) that presses the valve element (11) against the sealing surface (19).
 15. Valve device according to one of the preceding claims, **characterized in that** the support body (9) comprises a support seat (32) adjacent to the fastening protrusion (28) and that the valve element (11) is held axially between the fastening protrusion (28) and the support seat (32) axially distanced to the valve seat.
 16. Valve device according to one of the preceding claims, **characterized in that** the support seat (32) is held within the support body opening (8) by at least

one support beam (33) that extends from the support body (9) in particular radially into the support body opening (8).

17. Valve device according to one of the preceding claims, **characterized in that** the valve seat (19) comprises an annular sealing surface (19) that is arranged in a straight plane, that is arranged perpendicular to the axial extension of the support body opening (8). 5 10
18. Valve device according to one of the preceding claims, **characterized in that** the cover comprises a support beam (43) that extends from the fastening protrusion (28) diagonally across the valve element (11). 15
19. Valve device according to one of the preceding claims, **characterized in that** the cover comprises a central opening (42) that is designed to accommodate the at least one fastening latch (35). 20
20. Respiratory mask (1), comprising a mask body (2) that is designed to cover the mouth and nose of a user and that comprises a mask body opening (8), 25 and that further comprises a valve device (3) that is arranged at the mask body opening (8), **characterized in that** the valve device (3) is designed according to one of claims 1 to 19. 30

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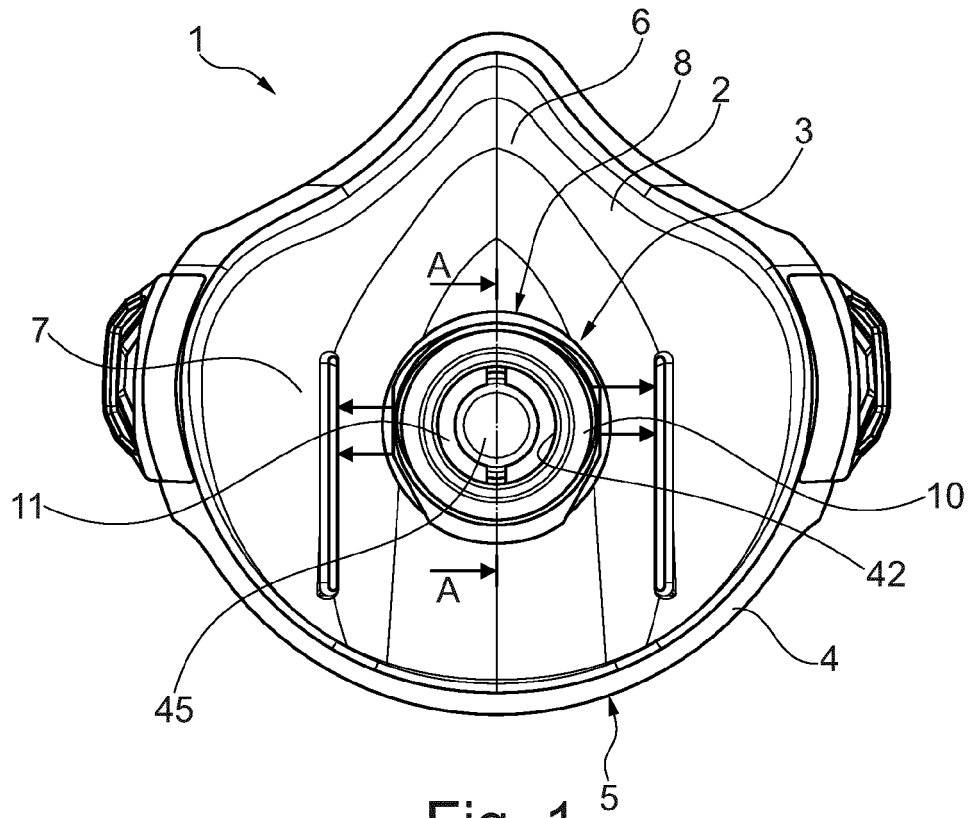


Fig. 1

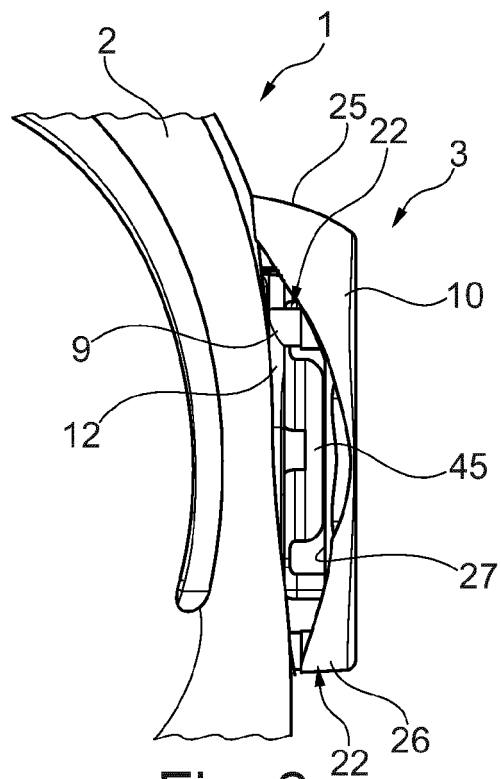


Fig. 2

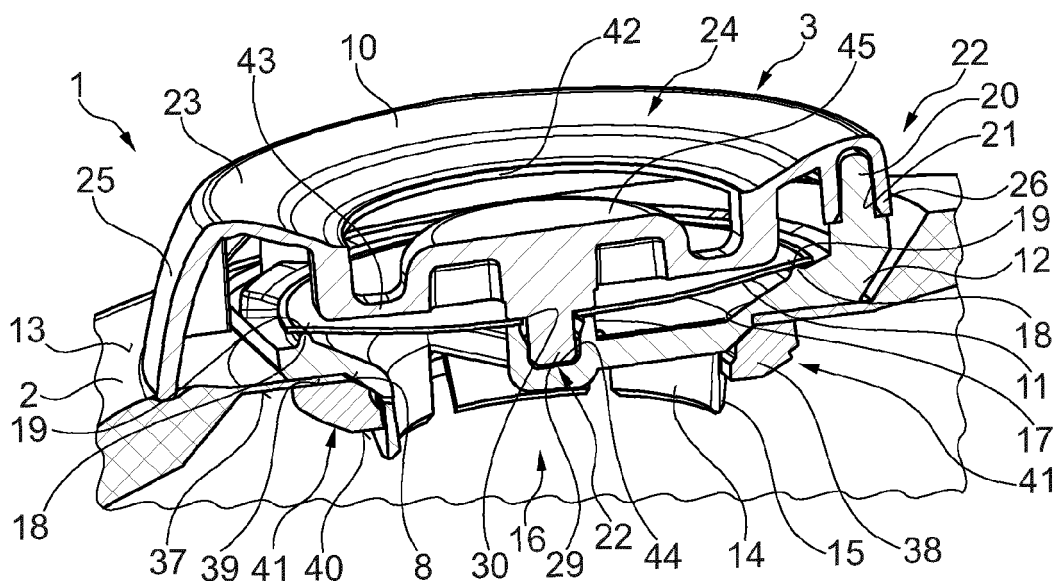


Fig. 3

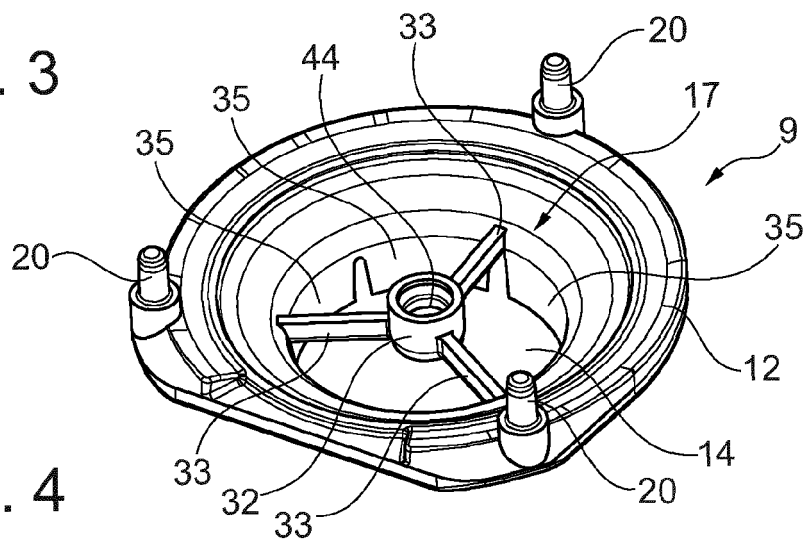


Fig. 4

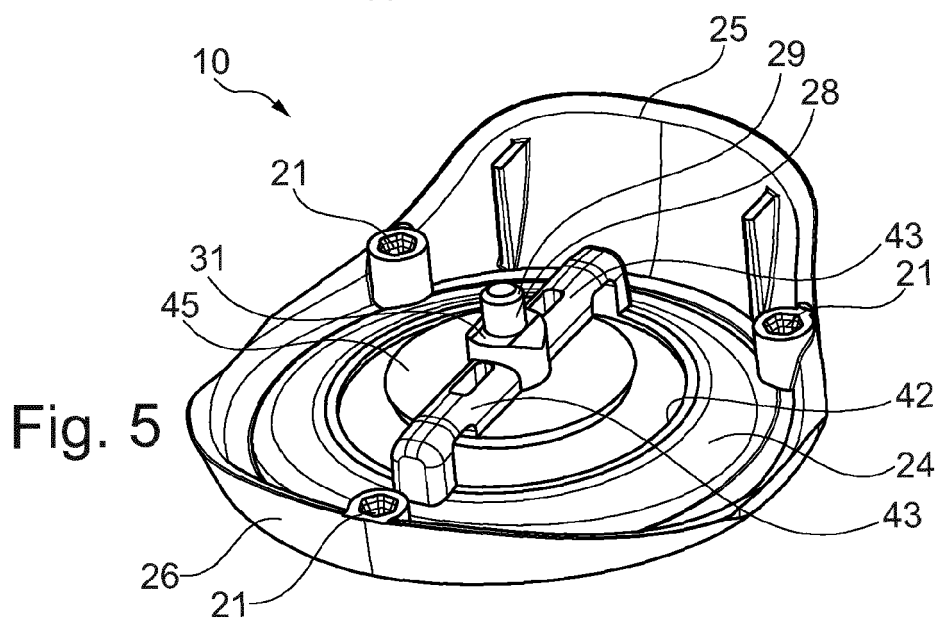


Fig. 5

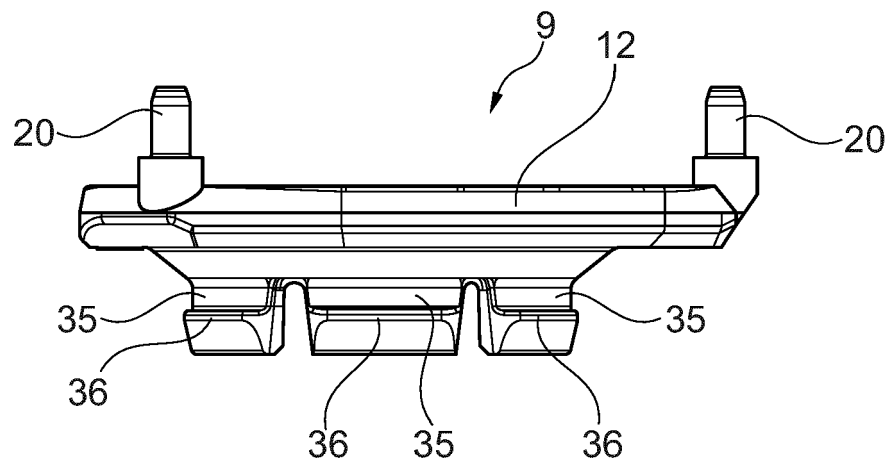


Fig. 6

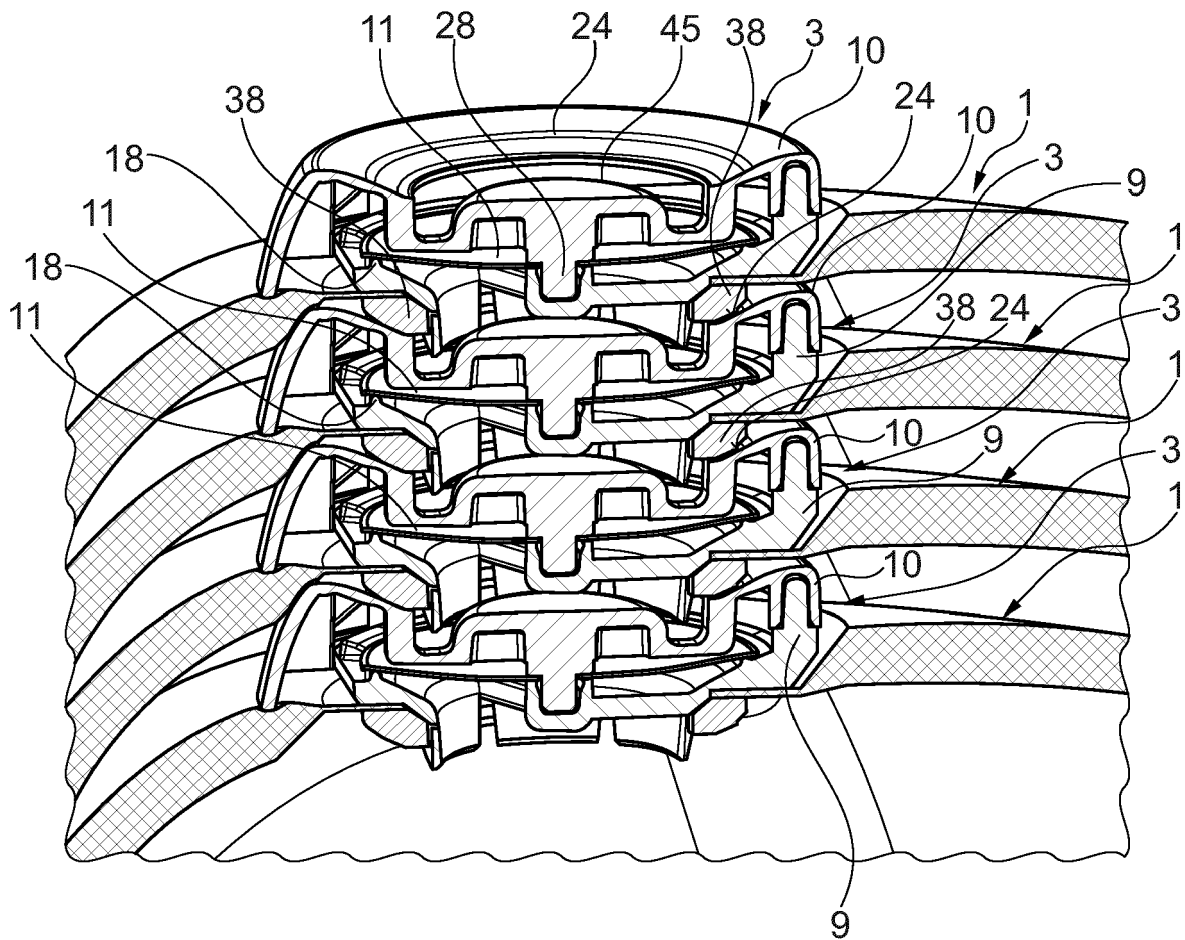


Fig. 7



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Place of search The Hague		Date of completion of the search 3 March 2022	Examiner Kroeders, Marleen
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