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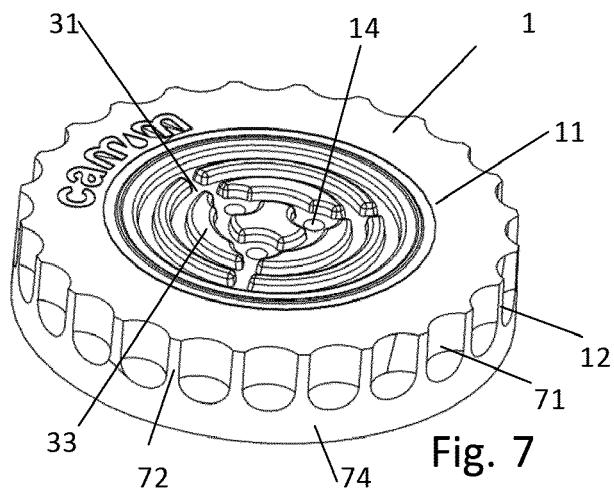
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### (54) VALVE, AND PACKAGE

(57) According to an aspect of the present invention, a pressure-relief valve is provided, the valve comprising a cup shaped main body (1) with a bottom (11) and a circumferential wall (12) to be fastened to a flexible package material. The bottom has at least one through hole (14) forming a passage through the main body. A valve

membrane lies against the main body on a package side in a region around the through hole(s) (14), with a sealing liquid between the main body and the valve membrane. The valve membrane thereby covers the at least one through hole (14). The circumferential wall (12) has, on its outside, a plurality of indentations (71).



## Description

**[0001]** The present invention is in the field of pressure relief valves for food packages.

**[0002]** Certain food products, for example fresh roasted coffee beans or coffee powder, have a tendency of degassing for some time. Therefore, according food packages, for example coffee bags (coffee pouches) have a pressure relief valve. Pressure relief valves allow the gases - for example carbon dioxide - generated in the interior of the package to evade while preventing the surrounding air to enter into the package so that no oxygen will get into the package and freshness is preserved.

**[0003]** Pressure relief valves usually have a cup-shaped main body, wherein of edge the circumferential wall of the main body is welded or glued to an inside of the package material. Both, the bottom of the main body and the package each have an opening. On the bottom of the main body lies a disc as valve membrane, with an oil, for example a silicone oil, serving as sealing liquid between the bottom and the disk. If there is an overpressure within the package, the gas communicating through the opening of the bottom lifts the disc, so that the gas can evade into the interior of the main body and from there through the package opening out of the package. When there is no overpressure within the package, the disc lying against the bottom of the main body ensures a leak-tight sealing.

**[0004]** Pressure relief valves of this kind are beneficial in that they make possible that fresh food is directly packaged to be delivered to the end customer, without any intermediate re-packaging being necessary. This, in addition to ensuring freshness for the customer, has also advantages in terms of ecology. However, the pressure relief valves add to the environmental footprint of the package.

**[0005]** It is therefore an object of the present invention to overcome disadvantages of prior art pressure relief valves. It is especially an object of the present invention to provide a pressure relief valve having a shape designed or optimum efficiency and minimum environmental footprint.

**[0006]** The present invention concerns a pressure-relief valve, the valve comprising a cup shaped main body with a bottom and a circumferential wall that is fastened to a flexible package material. The bottom has at least one through hole forming a passage through the main body. A valve membrane lies against the main body on a package side (in the cup constituted by the main body) in a region around the through hole(s), with a sealing liquid between the main body and the valve membrane. According to an aspect of the present invention, the circumferential wall has, on its outside, a plurality of indentations.

**[0007]** The side of the bottom opposite to the package side is called "product side" in this text.

**[0008]** It has been found that the relatively easy-to-implement measure of indentations on the outside is suit-

able to reduce the amount of material required for the pressure relief valve without making any compromise in function or mechanical stability

**[0009]** The indentations may especially have the form of axially extending grooves, with ribs between the grooves. The grooves may be regularly arranged around the periphery of the main body.

**[0010]** Circularly cylindrical parts with a ribbed structure on the outside are known in the art, for example as caps for beverage bottles or other rotatable parts, in that a ribbed structure enhances the grip, so that it is easier to manually turn the respective part. The main bodies of pressure relief valves, however, are designed to be secured to a package, and not to be rotated. Nevertheless, it is an insight of the present invention that a structure with grooves and ribs or with other indentations on the outside of the circumferential wall of the main body is advantageous in that it serves to improve the mechanical stability given a certain material volume - or, viewed from a different perspective, to reduce the material volume necessary to achieve a certain mechanical stability.

**[0011]** Especially, it has been found that a structure of indentations, especially having the shape of axially running grooves, act to stiffen the main body.

**[0012]** The overall shape of the main body may be such that the outer surface corresponds to the surface of an essentially disc-shaped body, namely cylindrical or slightly conical with a relatively small axial extension, with the indentations on the outer surface and possibly an outwardly protruding flange. Thereby, machines developed for handling prior art pressure relief valves without the indentations may be used for processing the pressure relief valve, especially for attaching it to an interior of a package. Thus, the approach of the present invention does not require any extra investment in machinery.

**[0013]** The indentations may be arranged equally distributed - with equal spacings between neighboring indentations - around the periphery of the main body.

**[0014]** The number of indentations may for example be between 10 and 40, especially between 15 and 30.

**[0015]** If the indentations are axially running grooves, their shape in horizontal section (section through a plane perpendicular to the axis) may be continuously curved concave. Especially, the indentations may be shallow in that a central angle of the curved section is smaller than 180°, especially smaller than 120° or smaller than 90°.

**[0016]** In a group of embodiments, the circumferential wall of the main body has a package-side section that is an outwardly protruding flange, in addition to a structured section that has the indentations. The structured section may extend to the product-side end of the main body.

**[0017]** In a group of embodiments, a package-side section is a portion with an outer surface that is smooth in that it does not have any grooves or ribs. Also in this group, the structured section may optionally extend to the product-side end of the main body

**[0018]** Alternatively to the structured section extending to the product-side end of the main body, the outer sur-

face of the circumferential wall of the main body may have an even further, third section that is on the product-side of the structured section and that is again smooth, whereby the indentations in this alternative are confined to a central (with respect to axial directions) part of the outer surface of the circumferential wall.

**[0019]** The bottom of the main body is unaffected by the indentations in the circumferential wall. On the product-side, the bottom of the main body may comprise at least one grease groove for accommodating a reservoir of the sealing liquid.

**[0020]** In a group of embodiments, especially if the valve has a permeable membrane, the bottom of the main body has at least one indentation on the product-side, thus forming an indented portion. The at least one through hole - or at least one of the through holes - has its product-side mouth in the indented portion. Thereby, the mouth of the through hole(s) on the product side is offset with respect to a product-side outermost plane. This means that if a permeable membrane is present, the mouth of the through hole(s) is offset with respect to a plane of the permeable membrane. The indented portion can effectively constitute a system of ventilation grooves, with spacers between them.

**[0021]** In embodiments, the spacers have rounded edges. Therefore, there is less risk of damaging the permeable membrane when the package is subject to mechanical stress.

**[0022]** In embodiments, if the package is to contain a finely grained product such as coffee powder (ground coffee), the valve further comprises a permeable membrane, which is attached to the product side of the bottom covering the at least one through hole so as to prevent the product from clogging the through opening while being permeable for gases. The permeable membrane may be a fabric membrane. In this text, "fabric" is used to cover all kinds of flexible materials from fibers or yarns or threads that are interlocked, including nonwovens, woven or knitted textiles or other textile structures.

**[0023]** In embodiments, the valve further comprises a fixing part. The fixing part is shaped to be placed on the package side of the valve membrane. It prevents the valve membrane from falling out of the main body even in situations in which the valve is subject to substantial mechanical shock. The valve may especially be subject to such shock, during transportation and assembly processes, if it is provided as a bulk material. In a situation of mechanical shock, the fixing part keeps the valve membrane in place even if adhesion by the sealing liquid might not be sufficient to do so. The fixing part may be held relative to the main body by the circumferential wall of the main body forming an undercut, so that the fixing part is clickable into the main body.

**[0024]** In embodiments, the valve may be bio-degradable, i.e., all components may be made of bio-degradable material.

**[0025]** In the present text, "bio-degradable" may mean biologically degradable according to the European stand-

ard EN 13432 (as of the end of 2021). In addition or as an alternative, it may mean biologically degradable according to the European standard EN 14995 (as of the end of 2021). Thus "bio-degradable" especially refers to "biologically degradable according to EN 13432 and/or according to EN 14995.

**[0026]** As far as in the present text water-soluble polymers are mentioned, such water soluble polymer may optionally be degradable in sewage treatment plants (aerobic biodegradability) in accordance with DIN EN ISO 9888 (as of the end of 2021); determined in accordance with the so-called Zahn-Wellens test.

**[0027]** Especially, at least one component, for example the main body, of the valve may be made of a polymer composition comprising a water-soluble polymer. In embodiments, the polymer composition further comprises a salt, especially a hygroscopic salt.

**[0028]** In addition to comprising a water-soluble polymer and a salt, the composition may comprise a plasticizer. The plasticizer may be selected from the group consisting of polyols (oligo- and polyhydroxy compounds) and low molecular weight amides

**[0029]** In embodiments, the main body and, if present the permeable membrane and the fixing part each are of a polymer composition that comprises a polyvinyl alcohol (PVOH) as a water-soluble polymer, a salt, and glycerin as a plasticizer.

**[0030]** In embodiments, the valve membrane is of a polymer composition that is not water-soluble but biodegradable, for example of Polyhydroxybutyrate (PHB).

**[0031]** In addition to concerning a pressure relief valve, the invention also concerns a package, especially a coffee pouch for coffee beans or ground coffee. The package comprises flexible, pliant packaging material as well as a pressure relief valve as described in the present text. The main body of the pressure relief valve is attached to the packaging material. Especially, the annular end face of the pressure relief valve may be attached to the packaging material, with the valve membrane (and if present the fixing part) being arranged in the hollow space between the bottom of the main body and the packaging material. The packaging material is generally gas-tight but has an opening or other permeable structure at a position encompassed by the circumferential wall of the main body.

**[0032]** Hereinafter, embodiments of the present invention are described with reference to drawings. In the drawings, same number designate same or corresponding elements. The drawings show:

50 Fig. 1 An exploded view of the components of a pressure relief valve;

55 Fig. 2 a main body in a view;

Fig. 3 a view of the cut assembled valve;

Fig. 4 the main body in a different view;

Fig. 5 yet a further view of the main body;

Fig. 6 a further view of the cut assembled valve;

Fig. 7 an alternative embodiment of a main body;

Fig. 8 an even further alternative embodiment of a main body;

Fig. 9 schematically, a side view of yet another embodiment of a main body; and

Fig. 10 schematically, the valve in a package.

**[0033]** The pressure relief valve shown in **Figures 1, 3 and 6** comprises a main body 1 that is also shown in **Figures 2, 4 and 5**. The main body 1 has an overall shape of a flat cup, with a bottom 11 and a circumferential wall 12. The bottom 11 has a sealing surface and, opposite the sealing surface, a product-side surface.

**[0034]** The circumferential wall 12 surrounds the sealing surface of the bottom 11. It has an essentially circularly cylindrical or slightly conical outer surface, with axially running grooves 71 arranged at regular distances, and with ribs 72 between the grooves. The axially running ribs 72 enhance the mechanical stability even if the circumferential wall 12 is relatively thin, i.e., is made using a minimum of plastic material.

**[0035]** The circumferential wall 12 in this embodiment further has, at its end opposite the bottom 11, a flange 13, i.e., an outwardly protruding collar, so that the annular end face 16 that carries a package-side energy directing rib 18 is broader. The bottom as at least one through hole 14 - in the depicted embodiment there are three through holes 14 - that is covered by the valve membrane 2 lying against the bottom 11 on the sealing surface thereof. Between the bottom 11 and the valve membrane 2 there is a thin layer of a sealing liquid, especially an oil, for example a silicone oil.

**[0036]** In the present text, "circumferential" as well as "radial" or "outward" or "inward" are meant to refer to an axis 10 of the main body.

**[0037]** The main body 1 on the inside of the circumferential wall 12 and in the plane defined by the valve membrane 2 comprises an extension accommodating groove 41 that may accommodate any extension of the valve membrane so that the valve membrane does not bulge upon an expansion, for example if it absorbs some moisture.

**[0038]** In embodiments, the pressure relief valve has a permeable membrane 3 in addition to the main body 1 and the valve membrane 2. The permeable membrane 3 may for example be a fabric, such as a nonwoven fabric. The permeable membrane is attached to the product-side surface of the bottom and covers at least the through opening(s) 14.

**[0039]** In the side of the sealing surface, the main body has a plurality of grease grooves. More in concrete the

main body has an inner grease groove 21 surrounding the opening and moreover has a ring of three first outer grease grooves 22 and a ring of three second outer grease grooves 23, the first outer grease grooves 23 being arranged around the second outer grease grooves 22.

**[0040]** The outer grease grooves have the function of serving as a reservoir for the sealing liquid. To this end, they are located at a radial position so as to be covered by the valve membrane (see for example Fig. 3 or Fig. 6).

**[0041]** In embodiments, the pressure relief valve in addition to the main body 1 and the valve membrane 2, and, as the case may be, to the permeable membrane 2 has a fixing part 4. The fixing part 4 is optional and may serve as a spacer between the flexible package material and the valve membrane 2, making sure that the valve membrane 2 cannot be displaced even in events of severe mechanic concussion. In the depicted embodiment, the fixing part 4 is star shaped with three rays.

**[0042]** On the product side, the main body 1 is structured to comprise a system of ventilation grooves 31 and spacers 33. The system is such that the through holes 14 are on a bottom of a ventilation groove, i.e., at a position where the product-side surface is indented.

**[0043]** In the embodiment of Figures 1-6, the overall shape of the main body with the flange 13 and the broadened end face 16 (that is bonded to the package material) may be beneficial for a process of bonding the valve to the package material and for the stability of the bond.

Namely, the shoulder that is defined by the flange being an outwardly protruding collar yields a coupling face 17 on which a tool for bonding the valve to the package material can directly act. Thereby, the energy - usually ultrasonic energy - coupled by the tool into the main body 1 for the bonding process does not need to be coupled through the entire height (axial extension) of the main body but only across the thickness of the flange 13. This makes the bonding process more efficient compared to a situation in which the tool would press against the product-side end face of the main body.

**[0044]** The tool may for example be a tube shaped sonotrode, with a tube diameter approximately corresponding to the diameter of the flange 13.

**[0045]** However, the flange 13 and the broadened end face 16, are just optional. In alternative embodiments, the main body 1 does not have this structure. The main body 1 also in these alternative embodiments may be weldable to the package material in that a sonotrode impinges on the product-side end face of the main body. Also in these embodiments, the used sonotrode may optionally be tube shaped, with a tube diameter being greater than an outer diameter of the region that has the system of ventilation grooves and spacers. However, alternatively, the sonotrode then may have a flat outcoupling face.

**[0046]** **Figure 7** shows an according embodiment without the flange. As in the embodiment of Figs. 1-6, the axially running grooves run from a product-side end of

the main body. On the package-side, the outer surface of the circumferential wall in addition to the section with the axially running grooves has a second, smooth section 74 but no flange as in the previous embodiment. An energy directing rib (not visible in Fig. 7) may be arranged on the package-side end face formed by the circumferential wall.

**[0047]** **Figure 8** shows an even further variant in which the indentations are not axially running ribs but have an elliptical shape. Thereby, the outer surface of the circumferential wall does not only have a first section with the indentations and a second section 74 being a smooth section on the package side but also has a third, again smooth, section 75 on the product side.

**[0048]** Also other shapes of indentations are possible. **Figure 9** very schematically illustrates the possibility that the outer surface of the circumferential walls can have axially running grooves 71 that do not extend to the product-side surface.

**[0049]** The pressure relief valve for use is placed inside of a gastight flexible package in that the annular end face of the circumferential wall 11 is bonded to the package inner surface, for example by welding. **Figure 10** schematically shows a package with the valve. The main body 1 is welded to the packaging material 60. The package material has at least one gas passage (for example at least one through hole or a permeable section) at a place surrounded by the annular end face. If there is an overpressure inside the package, the gas will cause the valve membrane 2 to be lifted from the bottom 12, whereby a gas passage is created. Excess gas can then evade through the through hole(s) 14, between the valve membrane and the bottom and through the gas passage of the package. When there is no overpressure inside the package, the membrane closes the package by lying against the bottom, with the sealing liquid adhering to the bottom and the valve membrane by capillary forces forming a seal.

## Claims

1. Pressure-relief valve, the valve comprising a cup shaped main body (1), with a bottom (11) and a circumferential wall (12), equipped to be fastened to a flexible package material, the bottom (11) having at least one through hole (14) forming a passage through the main body, a valve membrane (2) lying against the main body on a package side in a region around the at least one through hole (14), and a sealing liquid between the main body (1) and the valve membrane (2), **characterized in that** the circumferential wall has, on its outer surface, a plurality of indentations (71, 81).
2. The valve according to claim 1, wherein the indentations (71, 81) are arranged equally distributed around the outside of the circumferential wall (12).

3. The valve according to claim 1 or 2, wherein the indentations are axially running grooves (71) extending from a product-side end of the main body, with ribs (72) between the grooves (71).
4. The valve according to any one of the previous claims, wherein the outer surface of the circumferential wall, with the exception of the indentations (71, 81), is cylindrical or slightly conical.
5. The valve according to any one of the previous claims, wherein the circumferential wall comprises, on a package-side end face, an energy directing circumferential rib (18).
10. The valve according to any one of the previous claims, wherein the circumferential wall comprises, on the package-side end, an outwardly protruding flange (13).
15. The valve according to any one of the previous claims, wherein the outer surface of the circumferential wall has a structured section with the indentations (71, 81) and further has a smooth section (74, 75) axially spaced from the structured section.
20. The valve according to any one of the previous claims, wherein at least one component of the valve is made of a polymer composition comprising a water-soluble polymer.
25. The valve according to any one of the previous claims, being bio-degradable.
30. The valve according to any one of the previous claims, further comprising a permeable membrane (3) being a fabric secured to the main body (1) to cover the at least one through hole (14) on a product side opposite the package side.
35. The valve according to any one of the previous claims, wherein the main body has a system of ventilation grooves, with spacers between them, the mouth of the through hole (14) or the at least one of the through holes (14) being in a ventilation groove.
40. The valve according to any one of the previous claims, further comprising a fixing part (4) fixed relative to the circumferential wall so that the valve membrane (2) is sandwiched between the bottom (11) and the fixing part (4).
45. A package for packaging food products, the package comprising a flexible, pliant packaging material (60) as well as a pressure relief valve according to any one of the previous claims, wherein the main body (1) is attached to the packaging material (60).
50. A package for packaging food products, the package comprising a flexible, pliant packaging material (60) as well as a pressure relief valve according to any one of the previous claims, wherein the main body (1) is attached to the packaging material (60).
55. A package for packaging food products, the package comprising a flexible, pliant packaging material (60) as well as a pressure relief valve according to any one of the previous claims, wherein the main body (1) is attached to the packaging material (60).

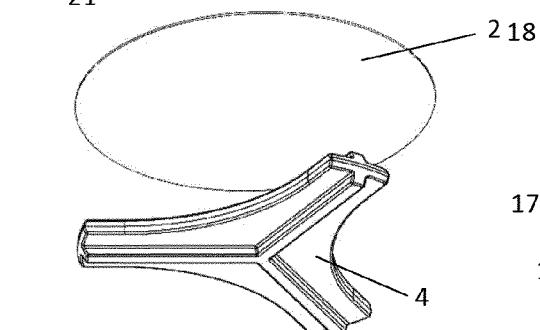
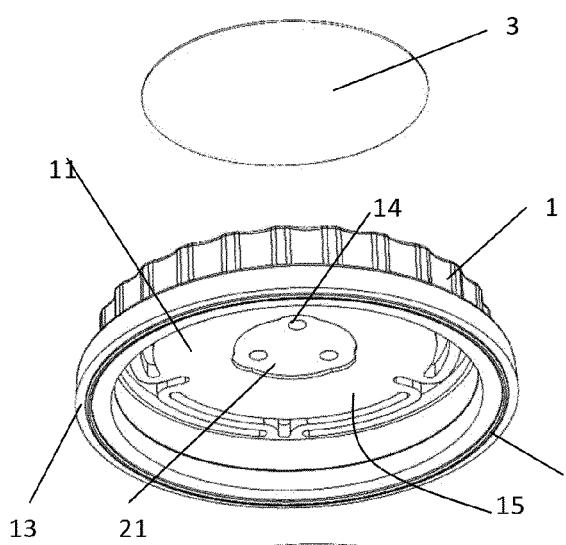


Fig. 1

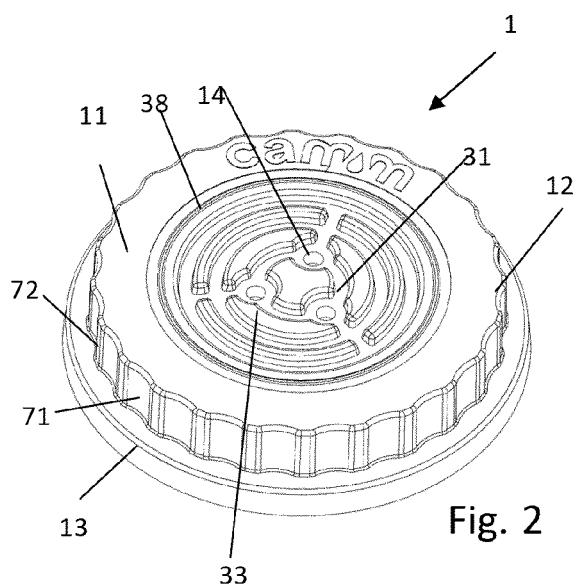


Fig. 2

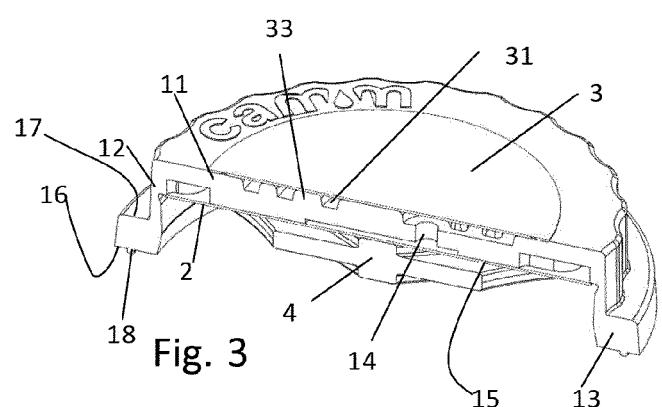


Fig. 3

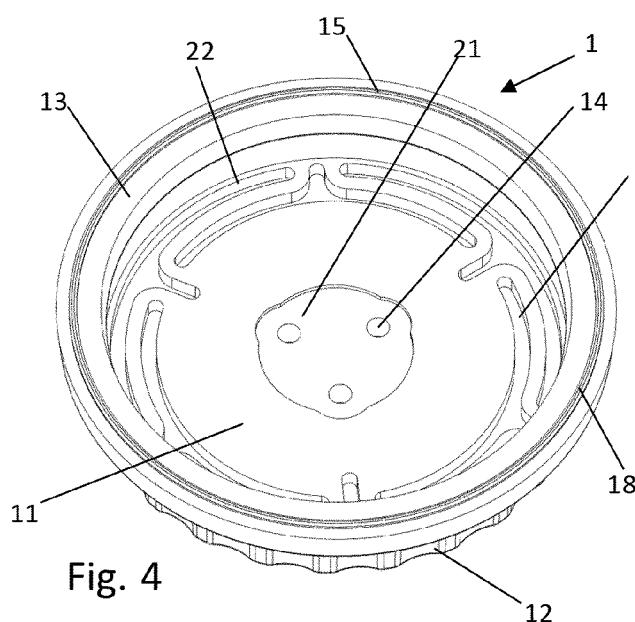


Fig. 4

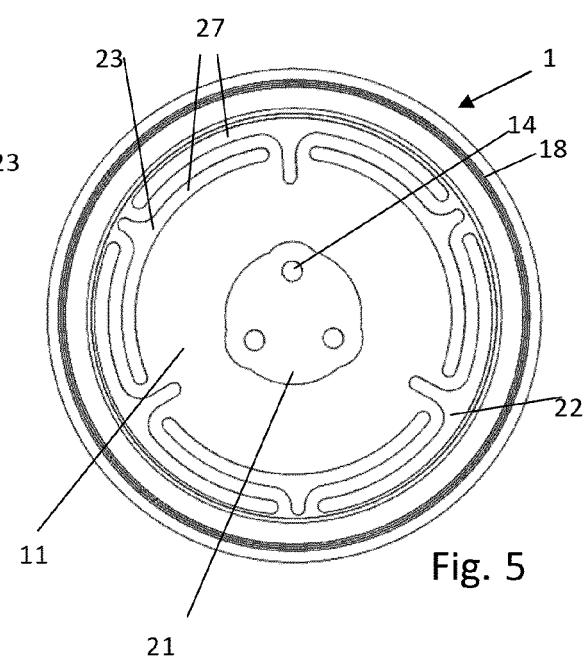
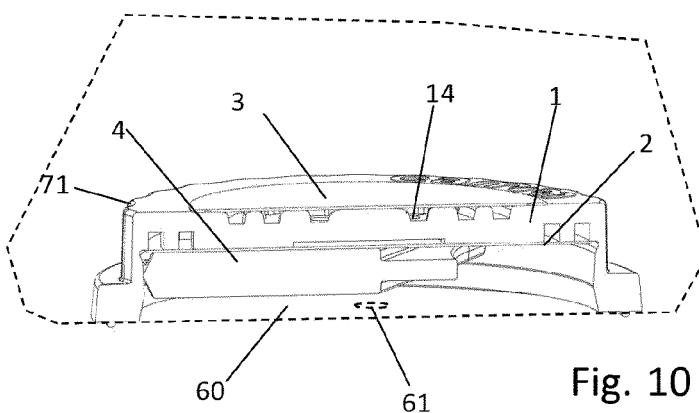
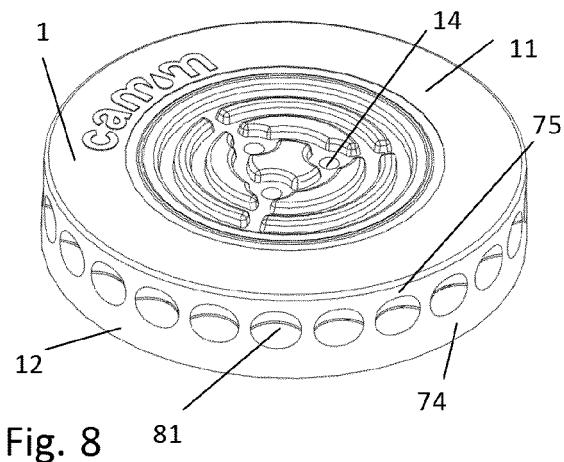
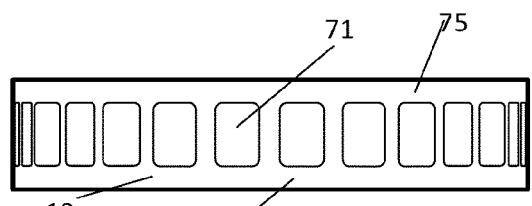
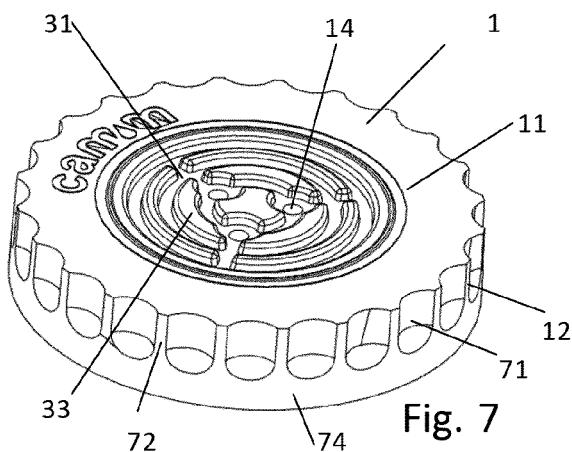
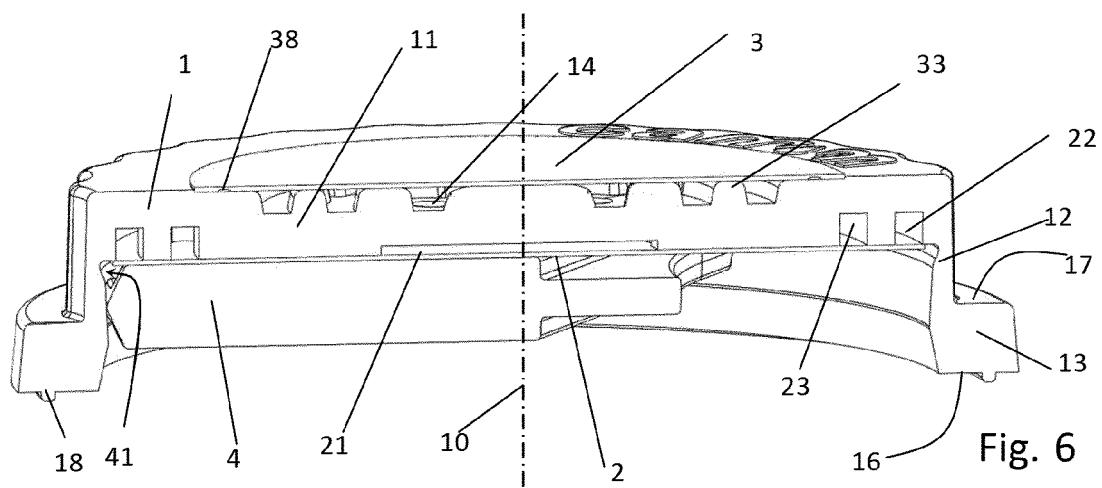


Fig. 5





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Application Number

EP 22 16 7474

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DOCUMENTS CONSIDERED TO BE RELEVANT			
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1 The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		14 September 2022	Derrien, Yannick
1.1 CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone			
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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