



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
21.06.2006 Bulletin 2006/25

(51) Int Cl.:
B65D 47/20 (2006.01)

(21) Application number: **04029688.1**

(22) Date of filing: **15.12.2004**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IS IT LI LT LU MC NL PL PT RO SE SI SK TR**
Designated Extension States:
AL BA HR LV MK YU

• **Eichler, Tobias**
3672 Oberdiessbach (CH)

(71) Applicant: **NESTEC S.A.**
1800 Vevey (CH)

(74) Representative: **Ravenel, Thierry Gérard Louis et
al**
I C B
Ingénieurs Conseils en Brevets SA
Rue des Sors 7
2074 Marin (CH)

(72) Inventors:
• **Manser, Daniel**
3700 Spiez (CH)

(54) **Closure for container**

(57) The invention concerns a closure device for a squeezable container, said device having a cap body (11) adapted to be secured to the neck of the container and a valve portion formed of a membrane (12) having at least two juxtaposed flexible flaps (23) facing the dis-

charge orifice of the container. The closure device of the invention is characterised in that the cap body (11) and the valve portion (12) are made in a single piece out of at least one material capable of being injection moulded, said material having a modulus of elasticity higher than 100 N/mm²

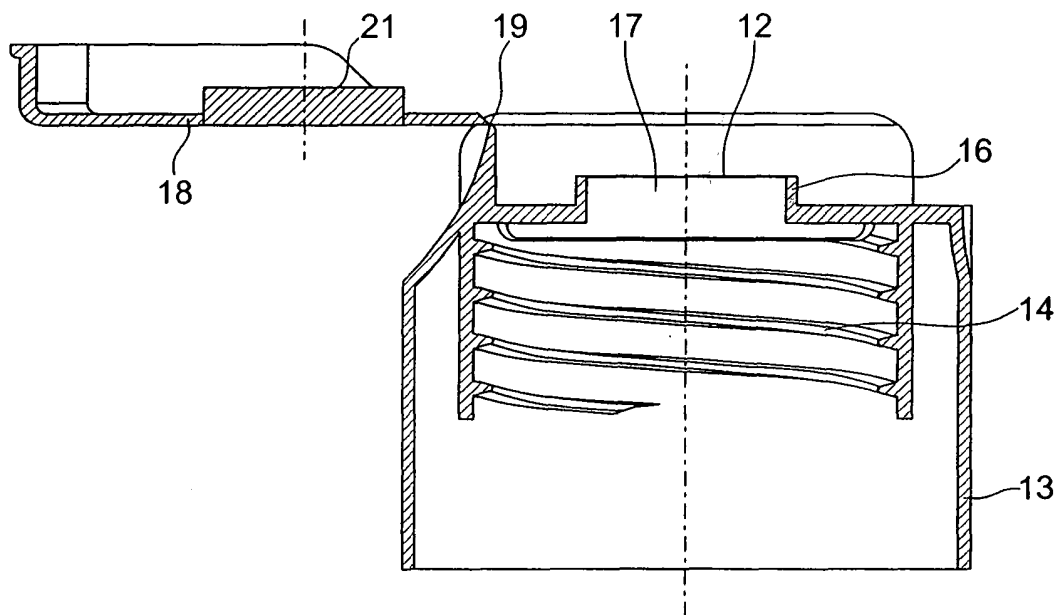


Fig. 2

Description

FIELD OF THE INVENTION

[0001] This invention relates to a closure device suitable for use with a squeeze type container for fluid products. The closure device incorporates a cap body and a self closing valve portion through which a fluid product can be discharged when the container is squeezed. More particularly the invention concerns a bi-material closure device wherein the cap body is made of a first material and the valve portion of a second material.

BACKGROUND TO THE INVENTION

[0002] US 6,230,940 describes a dispensing system comprising an annular mounting flange extending inwardly adjacent the discharge opening of a container and a dispensing valve moulded to define a flexible resilient structure arranged within the flange. The dispensing valve has a flexible central head portion having intersecting slits, a sleeve extending outwardly from the central head portion and a marginal portion whose wall defines an annular groove for receiving the mounting flange. When the container is squeezed, the valve slits open and the fluid contents of the container are discharged. The valve automatically closes to shut off fluid flow upon removal of the increased pressure.

[0003] WO 03/002417 describes a closure comprising a valve made from silicone or rubber whose central part is cut by intersecting slits in the form of a cross. The valve portion has an edge which fits with a corresponding groove in the main body of the closure

[0004] The valve formed by the intersecting slits operates effectively as a self-closing valve, but is expensive to manufacture because the separate parts, particularly the valve on the one hand and the flange or main body on the other hand, need to be separately made from different materials and then assembled.

[0005] It is one of the main objects of the invention to overcome the aforementioned drawbacks by providing a low cost closure device structure for use in a squeeze type container

SUMMARY OF THE INVENTION

[0006] A closure device for a squeezable container according to the invention has a cap body adapted to be secured to the neck of the container and a valve portion formed of a membrane facing the discharge orifice of the container, and is characterised in that the cap body and the valve portion are made in a single piece out of at least one material capable of being injection moulded, said at least one material having a modulus of elasticity higher than 100 N/mm².

[0007] The membrane usually has at least two juxtaposed flexible flaps. The flexible flaps can be formed by intersecting slits in the membrane. According to another

aspect there are at least two slits in the membrane meeting to define at least one flexible flap between them.

[0008] Owing to these characteristics, the closure device can be manufactured in a single piece by a single injection moulding operation. One can use a single material thereby achieving a cheaper closure device than those from the prior art while having similar operational properties. In particular the applicant has found out that the valve of the closure device of the invention has product cut-off properties when one stops squeezing the container, which are similar to those of elastomeric valve of the prior art.

[0009] Alternatively, in a preferred embodiment of the invention one may use two different materials for manufacturing the closure device, i.e. a first material for said cap body and a second material for said valve portion. Advantageously, said first material has a modulus of elasticity in the range 700 to 1500 N/mm² and said second material has a modulus of elasticity in the range 200 to 500 N/mm². Although this embodiment may be more expensive than that using a single material for both the cap body and the valve portion of the closure device, this embodiment offers a higher flexibility as to the choice of materials for the cap body and the valve portion, thereby allowing a choice of material specifically adapted to the respective functions of the cap body and the valve portion.

[0010] The method according to the invention, for the manufacturing of a closure device comprising a cap body adapted to be secured to the neck of a container and a valve portion formed of a membrane having at least two juxtaposed flexible flaps, is characterised by injection moulding the cap body and the valve portion in a single piece from at least one thermoplastic material having a modulus of elasticity higher than 100 N/mm²

[0011] Other features and advantages of the present invention will appear hereinafter in the detailed description of two embodiments, given by way of non-limiting examples with reference to the annexed drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

- Figure 1 is a perspective view of a preferred closure device of the invention;
- Figure 2 is a cross-section along the line II-II of Figure 1;
- Figures 3a to 3e are cross-sections of alternative valve structures for use in the closure device of the invention; and
- Figure 4a is a cross-section of an alternative valve structure for use in the closure device of the invention with Figure 4b showing the detail at point A in enlargement.

DETAILED DESCRIPTION OF THE INVENTION

[0013] The closure device of Figures 1 and 2 comprises a cap body 11 and a valve portion comprising a membrane 12. The cap body 11 comprises a skirt 13, a screw thread 14, adapted to be secured to a corresponding screw thread at the neck of a container, a recess 15 and a spout 16 surrounding a central aperture 17. The membrane 12 extends across the spout 16 to close the central aperture 17, which is aligned with the discharge orifice of the container. The cap body further comprises a snap lid 18 attached to the body 11 by a hinge 19. Such a snap lid is not essential to cover the self-closing valve 12, but is generally used to prevent inadvertent discharge by squeezing during transit. The snap lid 18 shown has a protrusion 21 which abuts against the valve 12 when the snap lid is closed. The closure device of Figures 1 and 2 can for example be used to close a container of the type shown in Figure 1 of WO 03/002417. The container can be a squeezable container or other.

[0014] The membrane 12 shown in Figure 1 has two intersecting slits 22 defining four flexible flaps 23 between them. Whilst the membrane can have only two slits meeting at an angle of 30 to 150°, preferably 60 to 120°, to define a single flap between them, the membrane preferably has at least two flaps. The membrane can for example have three or five slits meeting centrally to define three or five flaps. More preferably, the membrane has two, three or four intersecting slits defining four, six or eight flexible flaps between them. When the container is squeezed, the pressure of the fluid product against the membrane 12 opens the flaps 23 between the slits 22 so that they are bent away from the container. When the squeezing pressure is stopped, the flaps 23 revert to their starting position as closed slits and interrupt the product flow. The fluid product does not drip out of the container even if the container is left with the cap 11 downwards.

[0015] In an alternative embodiment, membrane 12 may only have one slit defining two flaps able to elastically deform and move away from each other to let the product flow. The two flaps revert to closed slits when the squeezing pressure is stopped.

[0016] The thickness of the membrane 12 is generally in the range 0.1 to 0.5 mm., preferably 0.15 to 0.25 mm. Membranes of this thickness are sufficiently flexible that the flaps 23 open under squeezing pressure but have sufficient resilience and rigidity that the flaps revert to closed slits when the squeezing pressure is stopped. The membrane is thinner than the cap body 11, which is usually about 1 mm thick or more.

[0017] The closure device is made from at least one thermoplastic material having a modulus of elasticity higher than 100 N/mm² up to about 4000 N/mm² and preferably a modulus of elasticity in the range 500 to 2000 N/mm². Preferred materials include polypropylene, which generally has a modulus of elasticity in the range 700 to 1500 N/mm², and high density polyethylene, which generally has a modulus of elasticity in the range

900 to 1500 N/mm². Blends of compatible materials can be used if the blend has the required modulus. The applicant has found that a membrane 12 formed from these materials with two intersecting slits 22 has enough flexibility to discharge fluid product when squeezed but still has sufficient 'springback' (resilience and stiffness) to return to its closed position after several product discharges. The membrane 12 can alternatively be formed from low density polyethylene, which generally has a modulus of elasticity in the range 200 to 500 N/mm², although this does not interrupt the product flow so cleanly, or from a thermoplastic polyester such as polyethylene terephthalate (PET), which generally has a modulus of elasticity in the range 2000 to 3100 N/mm², although this may require excessive squeezing pressure to discharge product.

[0018] Previously known self-closing valves of the intersecting slit type, for example those described in US 6,230,940 and WO 03/002417, have been made of silicone rubber, which has a modulus of elasticity of the order of 1 or 2 N/mm². The silicone rubber is resilient and flexible and forms an effective valve, but is far too soft and flexible to be used for cap body 11. The applicant has found that if the valve is formed by slits 22 in a membrane 12 which is much thinner than the main cap body 11, the whole closure device can be made of at least one material and can consequently be formed if desired in a single injection moulding operation. The slits 22 can be formed by narrow ribs less than 0.2 mm thick, for example a cross-shaped insert having ribs 0.1 mm. thick. Alternatively the slits 22 can be formed by a cutting device operating at the end of each injection moulding cycle.

[0019] In a preferred embodiment the closure device is made of two materials, i.e. a first material for the cap body 11 and a second material for the valve portion 12, so that the material of each of these two elements is specifically adapted to their respective functional requirements, typically the rigidity for the cap body 11 and the ability of being injected moulded to make parts having particularly thin portions (typically in the range 0.1 to 0.5 mm thick) as well as the resilience for the valve portion 12.

[0020] Advantageously, said first material has a modulus of elasticity in the range 700 to 1500 N/mm² and said second material has a modulus of elasticity in the range 200 to 500 N/mm². Preferred materials for the cap body are selected from polypropylene and high density polyethylene and preferred materials for the valve portion 12 are selected from low density polyethylene, linear low density polyethylene, a mixture of polypropylene and polyethylene, a mixture of polyimide and polyethylene or a mixture thereof.

[0021] In this case one uses a multi material injection moulding technique allowing the injection of a first material for the cap body and a second material for the valve portion in a same mould, the injection of the first and second material being made typically in a sequential manner.

[0022] The diameter and the shape of the membrane

12 can vary according to the diameter and the shape of the discharge orifice of the container, but the diameter is usually in the range 5 to 20 mm. The slits 22 can extend substantially all the way across the membrane 12, as shown in Figure 1, or only partly across the membrane as shown in Figure 3 of WO 03/002417. The length of the slits 22 can be selected according to the fluid material to be discharged from the container. In general, relatively long slits 22 are preferred for a more viscous material and relatively short slits for a less viscous material.

[0023] Although the membrane 12 can extend across a simple aperture 17 in the cap body 11, the aperture 17 is preferably surrounded by a spout 16 which can be a circular collar extending upwardly from the cap body 11 as shown in Figure 2, and/or downwardly from the cap body. The height of the spout 16 in a direction perpendicular to the membrane 12 is preferably at least 1 mm. and can for example be up to 10 mm. or even more, although 1 to 5 mm is preferred.

[0024] The membrane 12 preferably extends across the top of the spout 16 as shown in Figure 2, i.e. the portion of the spout adapted to be furthest from the container when the cap is secured to the container. The membrane 12 can alternatively extend across the middle or bottom of the spout 16, but cleaning of the membrane in case of product residues is then more difficult. The applicant has found that flow of fluid product is interrupted more cleanly when the membrane 12 extends across the top of the spout 16, and particularly when the membrane extends across the top of a spout 16 which extends upwardly from the cap body 11. The applicant believes that suck back of the fluid product on release of squeezing pressure is aided by the capillary effect of the tubular inside surface of spout 16.

[0025] The membrane 12 can be of uniform or varying thickness, and can extend in a plane across the aperture 17 or can be shaped in three dimensions. The membrane shown in Figure 2 is planar and has substantially uniform thickness. The membrane can alternatively be shaped so that the membrane is further from the container in the central portion of the membrane than in a peripheral portion adjacent the spout. Membranes 12a, 12b and 12c shown in Figures 3a to 3c are of this type.

[0026] Membrane 12d shown in Figure 3d has decreasing thickness towards the centre of the membrane.

[0027] Membrane 12e shown in Figure 3e is shaped so that the membrane is further from the container in the central portion of the membrane than in a peripheral portion adjacent the spout 16e, and has a more pronounced deviation from a planar shape than the membranes of Figures 3a to 3c. The spout 16e extends further upwards from the cap body 11 to accommodate the raised central portion 24 of the membrane 12e. The slits in this membrane are in the raised central portion 24.

[0028] Opening and re-closing of the flaps 23 of the membrane 12 may be facilitated if the membrane is thinner in a peripheral portion adjacent the spout 16 than in the central portion of the membrane so that the mem-

brane bends more easily in this peripheral portion. One example of this is shown in Figures 4a and 4b. In the peripheral portion 25 of the membrane 12, the top surface 26 of the membrane further from the container is depressed adjacent the spout 16 so that the peripheral portion 25 of the membrane is thinner than the central portion.

[0029] The closure device of the invention acts as an effective self-closing valve for a wide variety of fluid materials of suitable viscosity (generally substantially higher viscosity than water) which are packaged in flexible containers. Such fluid materials can for example be cleaning products or foodstuffs. Examples of foodstuffs include sweetened condensed milk (for example the container can be of the type described in WO 03/002417), sauces, ketchup or mayonnaise. Examples of cleaning products include personal care products such as shampoo, shower gel or hand or skin lotion, and household cleaning products such as detergent, for example for dishwashing.

EXAMPLE

[0030] A closure device of the construction shown in Figures 1 and 2 and having a membrane 12 thickness' of 0.2 mm., membrane diameter 14 mm. and spout 16 thickness 1.5 mm was injection moulded from polypropylene of modulus of elasticity 1450 N/mm² sold under the Trade Mark 'ExxonMobil PP 1044L1 for the cap body and from low density polyethylene of modulus of elasticity 200 N/mm² sold under the Trade Mark 'ExxonMobil LDPE 653CE for the valve portion. The connection between the cap body and the membrane was made in the inside lateral wall region of spout. The slit membrane acted as an effective self-closing valve for a container of sweetened condensed milk.

[0031] The injection technique used is a co-injection technique and preferable, the cap body will be injected first followed by the injection of the membrane in a second

[0032] According to on co-injection technique using a rotating mould, the cap body is injected first, then the mould rotates and the injected cap body is repositioned into another part of the mould where the membrane made of the second material is injected. Another co-injection technique can also be used and which consists in enlarging the cavity, after the first component has frozen in the mould, the cavity is enlarged and the second component is injected by the second injection unit. The enlargement can be achieved either by the use of slides (core-back technique) or by changing the cavity with a revolving tool or a revolving stage.

[0033] The advantage of co-injection moulding is the possibility of connecting different materials in one part. It is possible to carry out hard soft connections and two-colour- combinations as well as the positive fitting of two non-adhesive materials. Hereby, the physical properties of materials can be combined in an optimal way.

[0034] While the invention has been described with reference to specific embodiments, it will be appreciated

that many modifications and/or improvements could be made by those skilled in the art without departing from the scope of the invention defined by the annexed claims. For instance, while two different materials are used for cap body 11, including the snap lid 18 and valve portion 11, one could in a variant use one or more additional materials for snap lid 18. Furthermore, in another variant one could use, for each of the functional part of the closure device, mixtures of materials to generate aesthetical effect such as coloring or patterning effect.

Claims

1. A closure device for a squeezable container, said device having a cap body (11) adapted to be secured to the neck of the container and a valve portion formed of a membrane (12) having at least two juxtaposed flexible flaps (23) facing the discharge orifice of the container, **characterised in that** the cap body (11) and the valve portion (12) are made in a single piece out of at least one material capable of being injection moulded, said at least one material having a modulus of elasticity higher than 100 N/mm²
2. A closure device according to claim 1, **characterised in that** the flexible flaps (23) are formed by intersecting slits (22) in the membrane (12).
3. A closure device for a squeezable container, said device having a cap body (11) adapted to be secured to the neck of the container and a valve portion comprising a membrane (12) covering the discharge orifice of the container, there being at least two slits (22) in the membrane meeting to define at least one flexible flap (23) between them, **characterised in that** the cap body (11) and the valve portion (12) are made in a single piece out of at least one material capable of being injection moulded, said at least one material having a modulus of elasticity higher than 100 N/mm²
4. A closure device according to any of claim 1 to 3, **characterized in that** said cap body is made of a first material and said valve portion in made of a second material.
5. A closure device according to any of the preceding claims, **characterised in that** the membrane has two intersecting slits (22) defining four flexible flaps (23) between them.
6. A closure device according to any of claims 1 to 5, **characterised in that** the average thickness of the membrane (12) is in the range 0.1 to 0.5 mm.
7. A closure device according to any of Claim 4, **char-**

acterised in that said first material has a modulus of elasticity in the range 700 to 1500 N/mm² and **in that** said second material has a modulus of elasticity in the range 200 to 500 N/mm²

8. A closure device according to claim 7, **characterised in that** said first material is selected from polypropylene and high density polyethylene and **in that** said second material is selected from low density polyethylene, linear low density polyethylene, a mixture of polypropylene and polyethylene, a mixture of polyimide and polyethylene or a mixture thereof.
9. A closure device according to any of claims 1 to 8, **characterised in that** the membrane (12) extends across a spout (16) forming part of the cap body (11), the spout (16) having a thickness of at least 1 mm.
10. A closure device according to claim 9, **characterised in that** the membrane (12) extends across the portion of the spout (16) adapted to be furthest from the container when the cap is secured to the container.
11. A closure device according to any of claims 1 to 10, **characterised in that** the membrane (12) has substantially uniform thickness.
12. A closure device according to Claim 5 **characterised in that** the peripheral portion (25) of the membrane (12) is thinner than the central portion.
13. A process for the preparation of a closure device comprising a cap body (11) adapted to be secured to the neck of a container and a valve portion formed of a membrane (12) having at least two juxtaposed flexible flaps (23), **characterised by** injection moulding the cap body (11) and the valve portion (12) in a single piece from at least one thermoplastic material having a modulus of elasticity higher than 100 N/mm²
14. A process according to claim 13, **characterized by** injecting a first material for the said cap body and a second material for said valve portion in a same mould.
15. A process according to claim 14 **characterised in that** the injection of the first and second material is made sequentially.
16. A container comprising a closure according to any of claims 1 to 12.

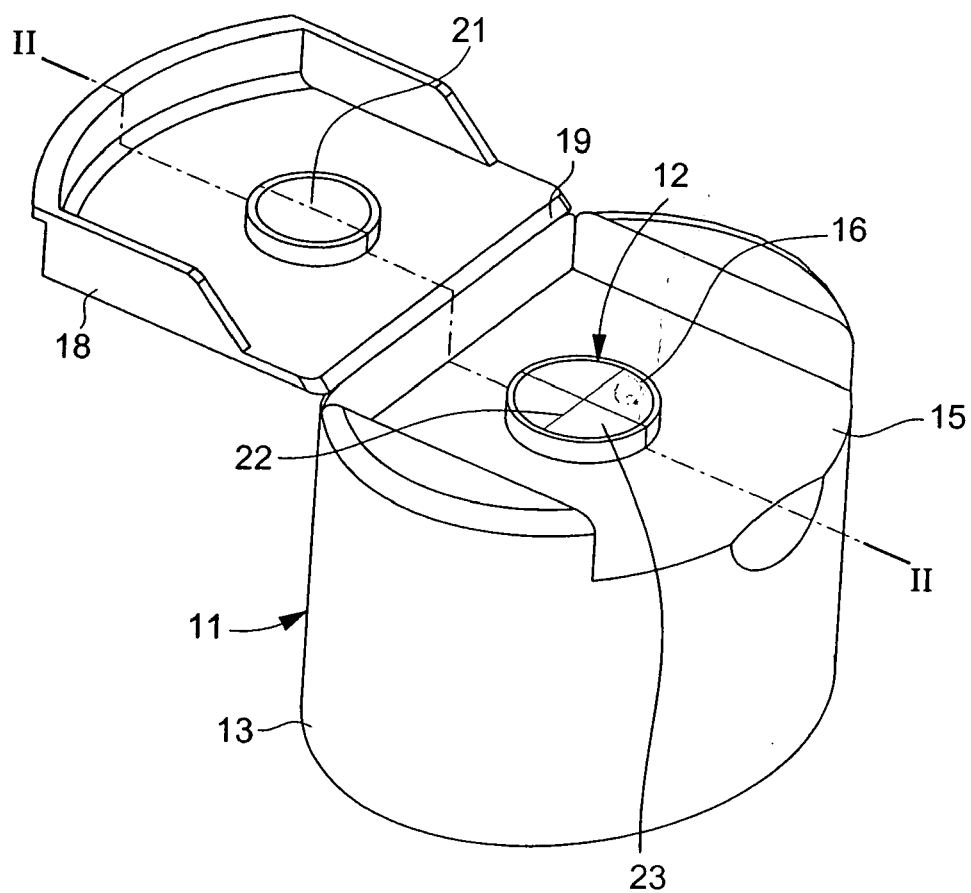


Fig. 1

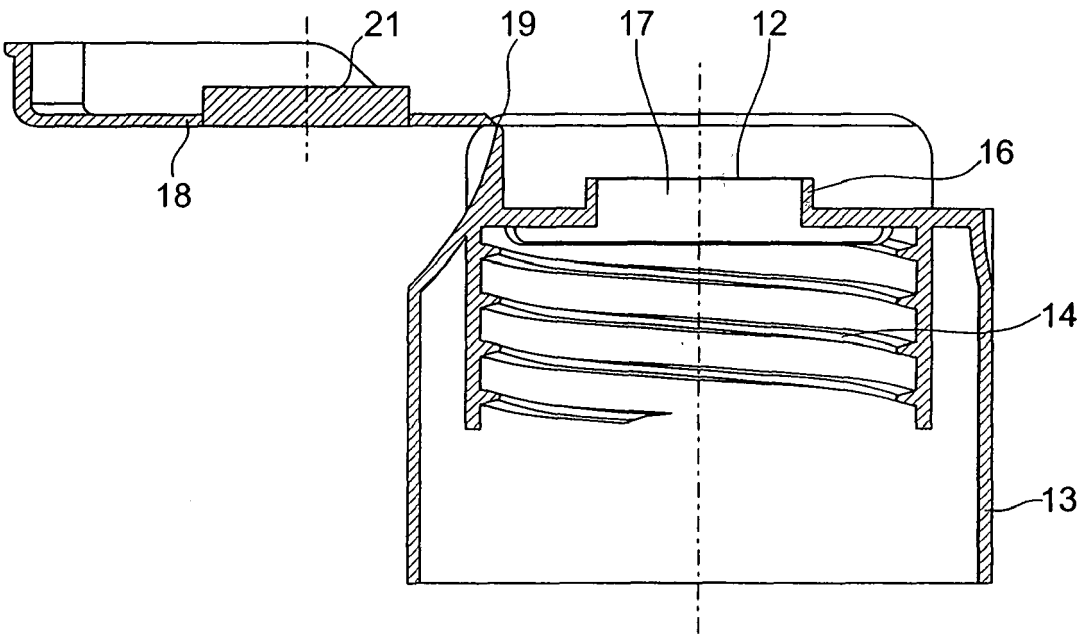


Fig. 2

Fig. 3a

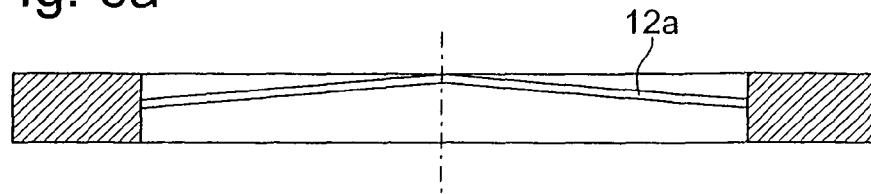


Fig. 3b

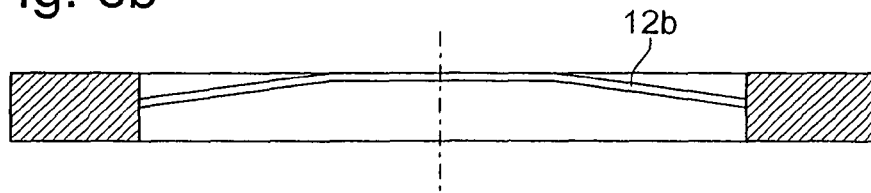


Fig. 3c

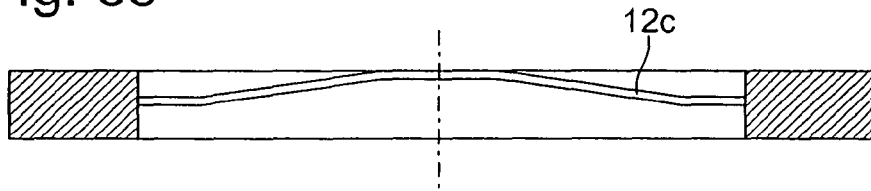


Fig. 3d

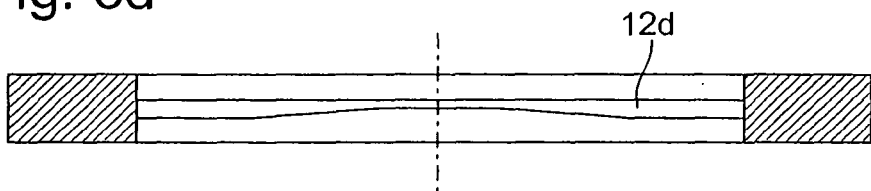
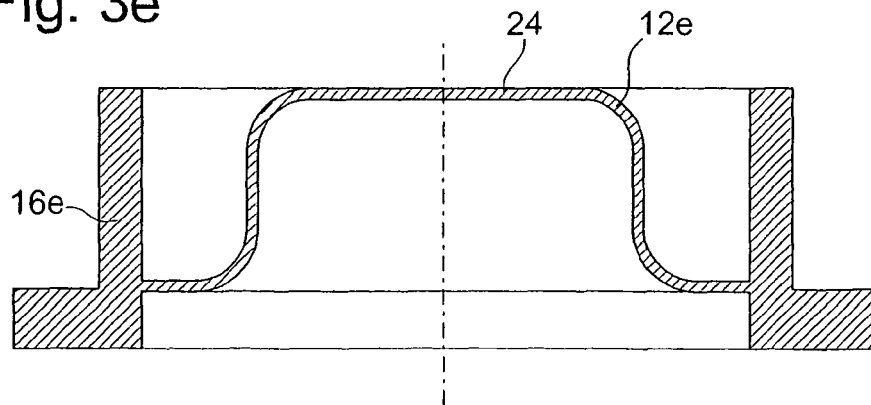


Fig. 3e



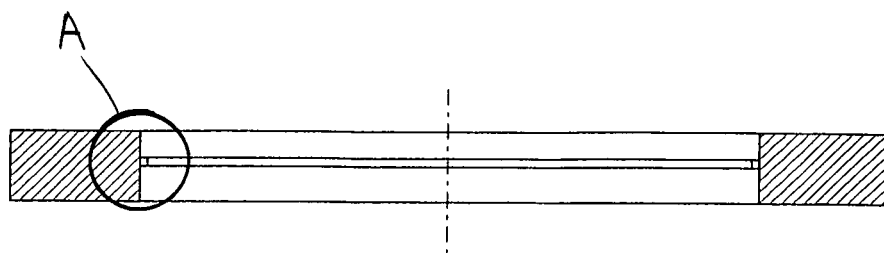


Fig. 4a

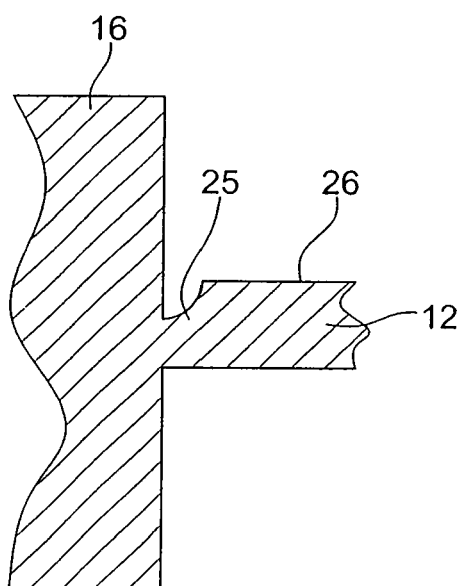


Fig. 4b



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 02 9688

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 1 June 2005	Examiner Mans-Kamerbeek, M
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 04 02 9688

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