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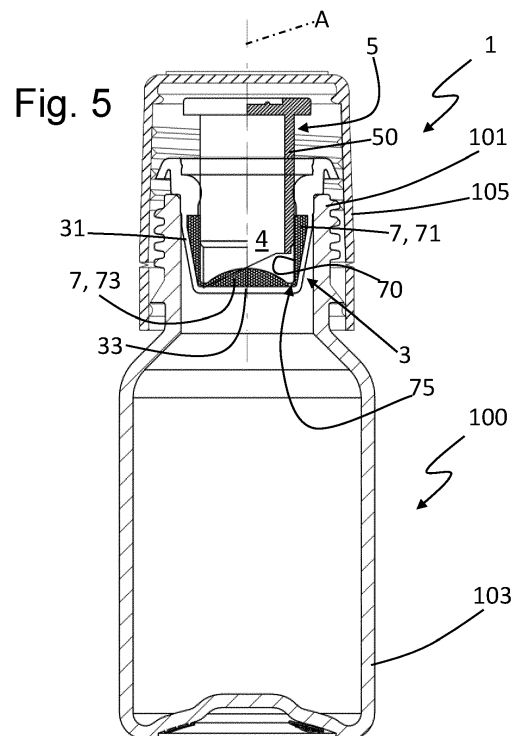
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(54) **CONTAINER CAP, PARTICULARLY FOR VIALS FOR PRODUCTS TO BE MIXED AT THE TIME OF USE**

(57) The present invention relates to a container cap (1), particularly for vials for products to be mixed at the time of use, suitable for closing an opening (101) of a container (103) of a vial (100) intended to contain a first product, said container cap (1) comprising a reservoir (3) defined by at least one lateral wall (31) and a breakable bottom (33), and a cutter (5) comprising a tubular body (50) comprising a first sharp axial end (52), said reservoir (3) and said cutter (5) defining, in combination, a chamber (4) intended to contain a second product, said cutter (5) being axially movable inside said reservoir (3) so as to press, with said first sharp end (52), said breakable bottom (33) of said reservoir (3) to break said breakable bottom (33) and open said chamber (4) towards said container (103) of said vial (100).

According to the invention, at least a portion of an inner face of said at least one lateral wall (31) and/or of said breakable bottom (33) of said reservoir (3) comprises adsorbent and/or hygroscopic material (7).



## Description

**[0001]** The present invention relates to a container cap, particularly for vials for products to be mixed at the time of use, as well as to a vial for products to be mixed at the time of use comprising such a container cap.

**[0002]** Vials for products to be mixed at the time of use comprising a container cap, i.e., a cap comprising a reservoir that contains a solid, powdered product, are currently known. This container cap closes the opening of a container containing a liquid product intended to be mixed with the solid powdered product.

**[0003]** The container cap comprises a cutter configured to break a breakable bottom with which the reservoir containing the solid product to be mixed with the liquid product is provided. Such a cutter is generally defined by a tubular body which is axially movable inside the reservoir itself, and has a sharp end.

**[0004]** The container cap further comprises a plug associated with the opening of the vial container. This plug may be internally threaded, so as to be associated with a corresponding thread present on the opening of the container, or unthreaded. In the latter case, the plug is fixed to the opening of the container by means of an undercut which engages under a band mouth to hold the plug thereon. This plug is removable at the time of use by acting on appropriate tabs and pre-breakage areas.

**[0005]** In the case of a container cap with threaded plug, the cutter is in turn associated with this plug, so that the screwing of this plug onto the opening of the vial container causes an axial advancement of the cutter inside the reservoir and the breaking of the breakable bottom of the reservoir itself.

**[0006]** In the case of a container cap with non-threaded plug, after removal of the plug the cutter can be manually pushed downwards, inside the reservoir, to break the breakable bottom of the reservoir.

**[0007]** In this way, in both solutions, the solid product contained inside the reservoir can fall by gravity into the container to be mixed with the liquid product.

**[0008]** In the case of threaded plug, the subsequent unscrewing of the plug allows the container cap to be removed as a whole (plug, reservoir and cutter) to access the mixture of the two products thus obtained.

**[0009]** In the case of non-threaded plug, after removal of the plug and the breaking of the breakable bottom of the reservoir, the reservoir and the cutter are removed manually by the user to access the mixture of the two products.

**[0010]** A drawback of the solid, powdered products, stored inside the reservoir of the container caps of the known type described above is linked to the fact that these solid products are particularly sensitive to humidity, and to any additional gases that are released by the liquid product present in the vial.

**[0011]** The presence of humidity inside the reservoir of the solid, powdered product causes two different types of problems.

**[0012]** A first problem concerns the deterioration of the chemical and/or physical properties of the solid, powdered product due to the presence of humidity.

**[0013]** A second problem concerns the risk that the solid, powdered product will agglomerate and adhere to the walls of the reservoir and/or of the cutter, making the emptying of the reservoir into the container of the vial difficult and partial.

**[0014]** Currently, in an attempt to protect the solid product contained inside the reservoir from humidity, solutions have been developed which provide for coating with a layer of adsorbent and/or hygroscopic material the inner surface of the cutter, i.e. the surface thereof that faces onto the inner chamber of the reservoir, where the solid product is contained, or solutions that involve making the cutter itself, in whole or in part, with adsorbent and/or hygroscopic material, or solutions that envisage for providing the cutter with elements made with adsorbent and/or hygroscopic material, protruding inside the internal chamber of the reservoir itself.

**[0015]** However, these known types of solutions are not free from drawbacks, including the fact that they do not guarantee optimal absorption of the humidity, and in particular of the humidity coming from the liquid product present in the vial itself.

**[0016]** Another drawback of these known solutions consists in the fact that the application of a sufficient quantity of adsorbent or hygroscopic material to the cutter involves a reduction of the inner volumetric capacity of the reservoir, since this material occupies part of the space inside the reservoir chamber.

**[0017]** The main task of the present invention consists in realising a container cap, particularly for vials for products to be mixed at the time of use, which avoids the drawbacks of the prior art and enables to ensure an optimal absorption of humidity that might deteriorate the solid, powdered product contained in the container cap itself.

**[0018]** Within the scope of this task, an object of the invention consists in realising a container cap which is capable of giving the greatest guarantees of reliability and safety in use.

**[0019]** Another object of the invention consists in realising a container cap which is easy to realise and economically competitive when compared to the prior art.

**[0020]** The above-mentioned task, as well as the purposes mentioned and others which will better appear later, are achieved by a container cap, particularly for vials for products to be mixed at the time of use, as recited in claim 1.

**[0021]** Other features are comprised in the dependent claims.

**[0022]** Further features and advantages will become clearer from the description of three preferred, but not exclusive, embodiments of a container cap, particularly for vials for products to be mixed at the time of use, illustrated by way of non-limiting indication with the aid of the accompanying drawings in which:

Figures 1 and 2 are views in axial section of a first embodiment of a container cap, according to the invention, associated with a relative vial, and illustrated respectively in closed and open configuration;  
 Figures 3 and 4 are views in axial section of a second embodiment of a container cap, according to the invention, associated with a relative vial, and illustrated respectively in closed and open configuration;  
 Figures 5 and 6 are views in axial section of a third embodiment of a container cap, according to the invention, associated with a relative vial, and illustrated respectively in closed and open configuration;  
 Figure 7 is a view in axial section of the reservoir of the container cap of Figures 5 and 6, according to the invention;  
 Figure 8 is a sectional view of the reservoir represented in Figure 7 taken along the axis VIII-VIII, including an enlarged representation of a detail thereof.

**[0023]** With reference to the above figures, the container cap, particularly for vials for products to be mixed at the time of use, is globally indicated with the reference number 1. Such a cap is adapted to close an opening 101 of a container 103 of a vial 100, wherein said container 103 is intended to contain a first product, preferably in liquid form.

**[0024]** The container cap 1 comprises a reservoir 3, defined by at least one lateral wall 31 and a breakable bottom 33, and a cutter 5 comprising a tubular body 50 comprising in turn a first sharp axial end 52.

**[0025]** The reservoir 3 and the cutter 5 define, in combination, a chamber 4 intended to contain a second product, preferably in solid form, and even more preferably in powder.

**[0026]** The cutter 5 is axially movable inside the reservoir 3, for example along the central axis A of the container cap 1 and of the bottle 100, so as to press, with its sharp end 52, the breakable bottom 33 of the reservoir 3, to break said breakable bottom 33 and open the chamber 4 towards the container 103 of the vial 100.

**[0027]** In this way, the second product, in solid form, present, in use, in the reservoir 3, falls by gravity into the container 103 reaching the first product, in liquid form, and mixing with it.

**[0028]** According to the invention, at least a portion of the breakable bottom 33 of the reservoir 3 and/or at least a portion, bordering said breakable bottom 33, of an inner face of said at least one lateral wall 31 of the reservoir 3 comprises adsorbent and/or hygroscopic material 7, i.e., dehydrating material.

**[0029]** Such an adsorbent and/or hygroscopic material 7 is adapted to absorb gases and/or humidity from the surrounding environment.

**[0030]** It should be noted that in the case of reservoir 3 with circular cross-section, there is a single cylindrical lateral wall 31, whereas in the case of reservoir 3 with a polygonal cross-section, the lateral walls defining the res-

ervoir 3 are equal in number to the sides of the polygon of the section. For simplicity's sake, in the following description reference will be made to the embodiment of the cylindrical reservoir 3, i.e., with single cylindrical lateral wall 31.

**[0031]** Advantageously, therefore, the reservoir 3 has adsorbent and/or hygroscopic material 7:

- (i) on a portion, bordering the breakable bottom 33, of the inner face of the lateral wall 31, like in the case of the first embodiment of the container cap 1 illustrated in Figures 1 and 2, or
- (ii) on a portion of the inner face of the breakable bottom 33, like in the case of the second embodiment of the container cap 1 illustrated in Figures 3 and 4, or, preferably
- (iii) both on a portion of the inner face of the lateral wall 31 and on a portion of the inner face of the breakable bottom 33, like in the case of the third embodiment of the container cap 1 illustrated in Figures 5 and 6.

**[0032]** The inner face is the face of the lateral wall 31 and/or of the breakable bottom 33 turned towards the inner chamber 4 of the reservoir 3.

**[0033]** In general, the fact of providing adsorbent and/or hygroscopic material 7 directly on the walls 31 or on the bottom 33 of the reservoir 3 allows to effectively intercept gases or humidity that may penetrate from outside, in the contact area between the lateral wall 31 of the reservoir 3 and the wall of the cutter 5, as this is a very critical area for the penetration of gases and humidity from the outside, as well as gases and humidity generated by the presence of the first product, in liquid form inside the container 103, which tends to penetrate through the walls 31 or the bottom 33 of the reservoir 3 itself, in any case before gases and humidity reach the second product, in solid form, present in the reservoir 3.

**[0034]** Advantageously, the portion of the inner face of the lateral wall 31 comprising the adsorbent and/or hygroscopic material 7 is located in proximity to the breakable bottom 33, i.e., so as to border it, and/or in correspondence with the breakable bottom 33, i.e., on the breakable bottom 33 itself.

**[0035]** In other words, in the embodiments which provide for the presence of adsorbent and/or hygroscopic material 7 on at least one inner face of the lateral wall 31 (such as the first and third embodiments of the container cap 10 illustrated in Figures 1, 2, 5 and 6), this adsorbent and/or hygroscopic material 7 is located right in proximity to the breakable bottom 33.

**[0036]** In the embodiments which provide for the presence of adsorbent and/or hygroscopic material 7 on the inner face of the breakable bottom 33 (such as the second and third embodiments of the container cap 10 illustrated in Figures 3, 4, 5 and 6), this adsorbent and/or hygroscopic material 7 is located exactly in correspondence with the breakable bottom 33.

**[0037]** Therefore, the adsorbent and/or hygroscopic material 7 is preferably located in the lower part of the reservoir 3, where the second product, of solid form, tends to accumulate by gravity.

**[0038]** Furthermore, since gases and humidity tend to rise upwards from the first product, of liquid form, the placement of the adsorbent and/or hygroscopic material 7 in correspondence with the breakable bottom 33, like in the case of the second and third embodiment of the container cap 1 illustrated in Figures 3 to 6, or in any case in proximity to, or in a bordering manner to, the breakable bottom 33, like in the case of the first embodiment of the container cap 1 illustrated in Figures 1 and 2, allows the adsorbent and/or hygroscopic material 7 to even more effectively intercept the humidity that is generated by the liquid product present in the container 103.

**[0039]** Advantageously, the adsorbent and/or hygroscopic material 7 comprises a layer of adsorbent and/or hygroscopic material 7 applied to the inner face of the lateral wall 31 and/or of the breakable bottom 33 of the reservoir 3.

**[0040]** Advantageously, the adsorbent and/or hygroscopic material 7 can be made as one piece, for example by means of injection moulding techniques of polymeric materials additivated with substances capable of absorbing gases and/or humidity, and assembled in a manual or automated manner inside the reservoir 3 itself.

**[0041]** Alternatively, the portion of the inner face of the lateral wall 31 and/or of the breakable bottom 33 is made directly in adsorbent and/or hygroscopic material 7, for example by means of co-injection moulding techniques of polymeric materials additivated with substances capable of absorbing humidity, with other polymeric materials.

**[0042]** Advantageously, therefore, the adsorbent and/or hygroscopic material 7 may be an adsorbent and/or hygroscopic polymer.

**[0043]** Advantageously, at least a portion 70, 72, 73 of the adsorbent and/or hygroscopic material 7 present on the lateral wall 31 and/or on the breakable bottom 33 is adapted to come into direct contact with the second product, in solid form, intended to be contained inside the chamber 4.

**[0044]** In particular, in the case of the second and third embodiment of the container cap 10, illustrated in Figures 3 to 6, in use, the portion 72, 73 of adsorbent and/or hygroscopic material 7 present on the breakable bottom 33 is in direct contact with the second material present in the reservoir 3.

**[0045]** As illustrated in the accompanying figures, the sharp end 52 of the cutter 5 is defined by a portion of the tubular body 50 thereof cut along an inclined plane.

**[0046]** In the case of the first embodiment of the container cap 10, illustrated in Figures 1 and 2, the sharp end 52 of the cutter 5 is configured so that a portion of the lateral wall 31 of the container 3 directly faces onto the chamber 4. Well, the presence of a portion 70 of adsorbent and/or hygroscopic material 7 right in corre-

spondence with the lateral wall 31 of the reservoir 3 not covered by the tubular body 50 of the cutter 5 allows the second product to come into direct contact with said portion 70 of adsorbent and/or hygroscopic material 7.

**[0047]** This also occurs in the case of the third embodiment of the container cap 10, illustrated in Figures 5 and 6, in which both the portion 70 and the portion 73 of adsorbent and/or hygroscopic material 7 in direct contact with the second material, of solid form, present in the reservoir 3, are provided.

**[0048]** Advantageously, the adsorbent and/or hygroscopic material 7 is distributed substantially over the entire surface of the inner face of the breakable bottom 33.

**[0049]** Advantageously, the adsorbent and/or hygroscopic material 7 is distributed on the surface of the inner face of the at least one lateral wall 31 around an angle of 360°, i.e., so as to define a 360° closed band of adsorbent and/or hygroscopic material 7 on the inner face of the reservoir 3.

**[0050]** Advantageously, between the breakable bottom 33 and the lateral wall 31, there is provided a weakening line 35, illustrated in particular in Figures 1 and 2, which is adapted to facilitate breaking of the breakable bottom 33 by the action of the cutter 5. The lateral wall 31 comprises a first portion 71 of adsorbent and/or hygroscopic material 7 and the breakable bottom 33 comprises a second portion 73 of adsorbent and/or hygroscopic material 7.

**[0051]** As illustrated in Figures 5 to 8, this first portion 71 and this second portion 73 of adsorbent and/or hygroscopic material 7 are mutually connected, in correspondence with the aforesaid weakening line 35, by means of a thinned portion 75 of adsorbent and/or hygroscopic material 7, i.e., a reduced volume portion.

**[0052]** This thinned portion 75 of adsorbent and/or hygroscopic material 7 may be defined by a thin wall, or, as illustrated in particular in Figures 7 and 8, by a plurality of connecting bridges 76 between the two portions 71 and 73 of adsorbent and/or hygroscopic material 7.

**[0053]** In this way, in the third embodiment of the container cap 10, illustrated in Figures 5 and 6, the adsorbent and/or hygroscopic material 7 forms a kind of glass which internally covers the lateral wall 31 and the breakable bottom 33 of the reservoir 3, and which contains, in its inside, the second product, in solid form, of which the chemical and physical properties are to be preserved from humidity.

**[0054]** Advantageously, the aforesaid thinned portion 75 comprises a number of connecting bridges 76 that is greater than or equal to two, distributed substantially uniformly along the weakening line 35, i.e., along the perimeter circumference of the breakable bottom 33.

**[0055]** As shown in the example in Figure 8, there are eight connecting bridges 76.

**[0056]** Advantageously, the connecting bridges 76 have, in plan, a transverse width approximately comprised between 3% to 15% of the length of the diameter of the breakable bottom 33.

[0057] In this way, the connecting bridges 76 allow on the one hand to ensure the presence of a continuity of adsorbent and/or hygroscopic material 7 between the portions 71 and 73 respectively placed on the lateral wall 31 and on the breakable bottom 33 of the reservoir 3, and on the other hand not to constitute reinforcing structures of the connection of the breakable bottom 33 to the lateral wall 31 of the reservoir 3, which might preclude or in any case make it difficult to break the breakable bottom 33 along the weakening line 35.

[0058] The present invention also concerns a vial 100 for products to be mixed at the time of use.

[0059] According to the invention, this vial 100 comprises a container 103 intended to contain a first product, in liquid form, and a container cap 1, as described above, adapted to close an opening 101 of this container 103.

[0060] The container cap 1 further comprises a plug 105 associated with the opening 101 of the container 103 of the vial 100 by means of a thread, or by means of a band.

[0061] In the case of threaded plug 105, this plug 105 is associated with the cutter 5 in such a way that screwing the plug 105 onto the opening 101 causes the axial displacement of the cutter 5 in order to break the breakable bottom 33 of the reservoir 3.

[0062] The operation of the container cap 1 is clear and evident from what has been described.

[0063] In particular, the presence of adsorbent and/or hygroscopic material 7 in the reservoir 3, right in the lower portion of the same, (i) where the product in solid form, for example in powder, to be protected from humidity, tends to accumulate, (ii) where the effect of generation of gases and humidity by the product in liquid form present in the container 103 is more evident, and (iii) where the passage of humidity from the outside is more marked, in the contact area between the lateral walls of the reservoir 3 and the cutter 5, allows to prevent the presence of gases and humidity inside the reservoir 3 and therefore, on the one hand, to protect its contents and on the other hand to guarantee the correct operation of the container cap 10. In fact, the protection of the solid product from humidity ensures that, as soon as the cutter 5 breaks and opens the breakable bottom 33 of the reservoir 3, all the content of the reservoir 3 fall by gravity into the container 103, without packing and sticking to the walls of the reservoir 3 and/or the cutter 5.

[0064] In practice, it has been found that the container cap, particularly for vials for products to be mixed at the time of use, according to the present invention, fulfils the task as well as the intended purpose as it prevents the formation of humidity inside the container containing the product in solid form, in powder, to be mixed with the product in liquid form in the vial.

[0065] Another advantage of the container cap, according to the invention, consists in preventing the deterioration due to the humidity of the product in solid form.

[0066] A further advantage of the container cap, according to the invention, consists in always guaranteeing

the correct and complete emptying of the reservoir containing the product in solid form.

[0067] Yet another advantage of the invention consists in the fact that the application of adsorbent and/or hygroscopic material to the walls and/or to the bottom of the reservoir does not necessarily involve a reduction of the internal volumetric capacity of the reservoir itself, as instead occurs in the case in which such material is applied to the cutter. In fact, as can be appreciated from the accompanying figures, the inner containment chamber of the second product is defined by the space comprised inside the cutter which space, according to the invention, does not undergo volume reductions due to the presence of the aforesaid adsorbent and/or hygroscopic material.

[0068] The container cap, particularly for vials for products to be mixed at the time of use, as conceived herein is susceptible to numerous modifications and variations, all of which are part of the inventive concept.

[0069] Furthermore, all the details can be replaced by other technically equivalent elements.

[0070] In practice, any materials can be used according to requirements, as long as they are compatible with the specific use, the dimensions and the contingent shapes.

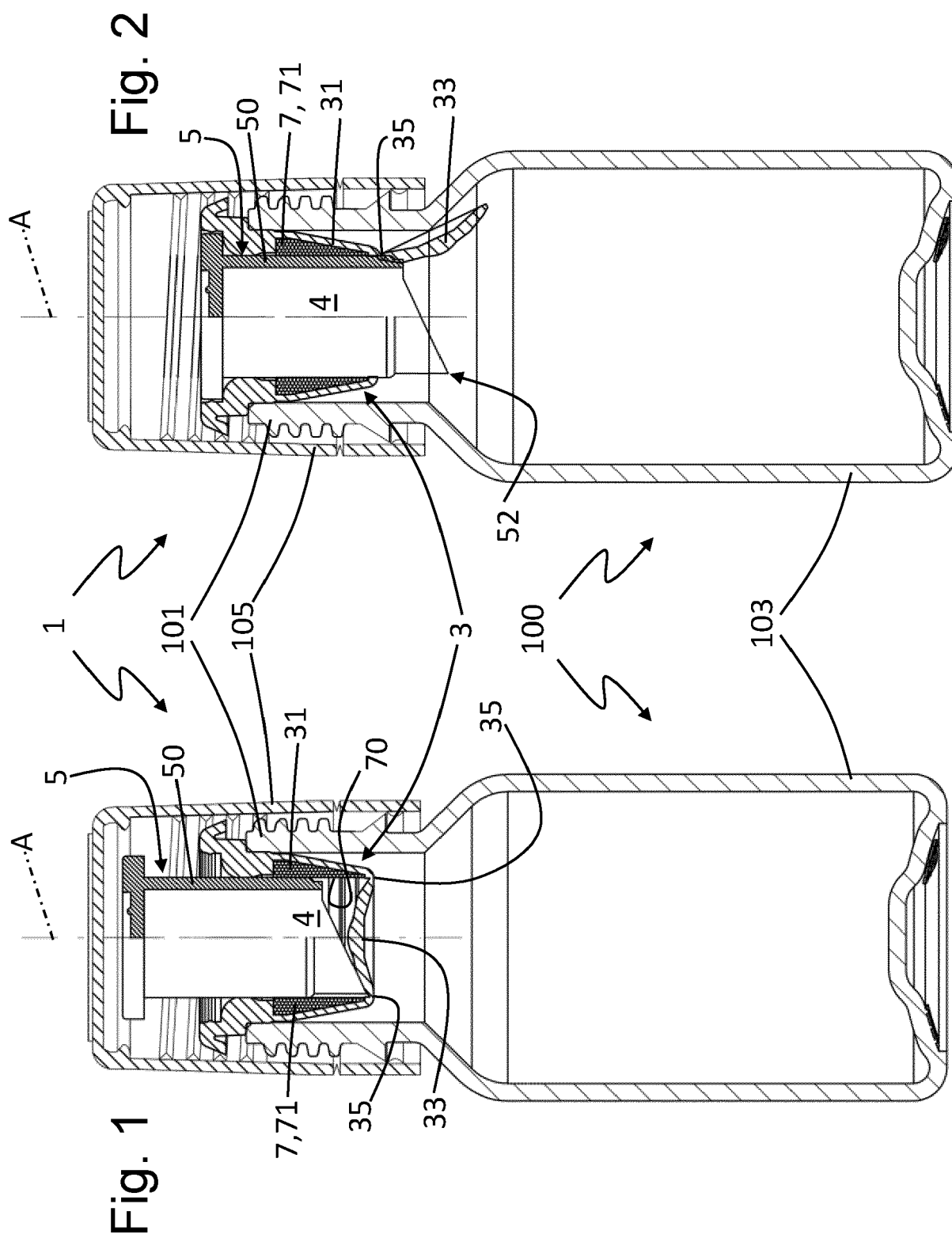
## Claims

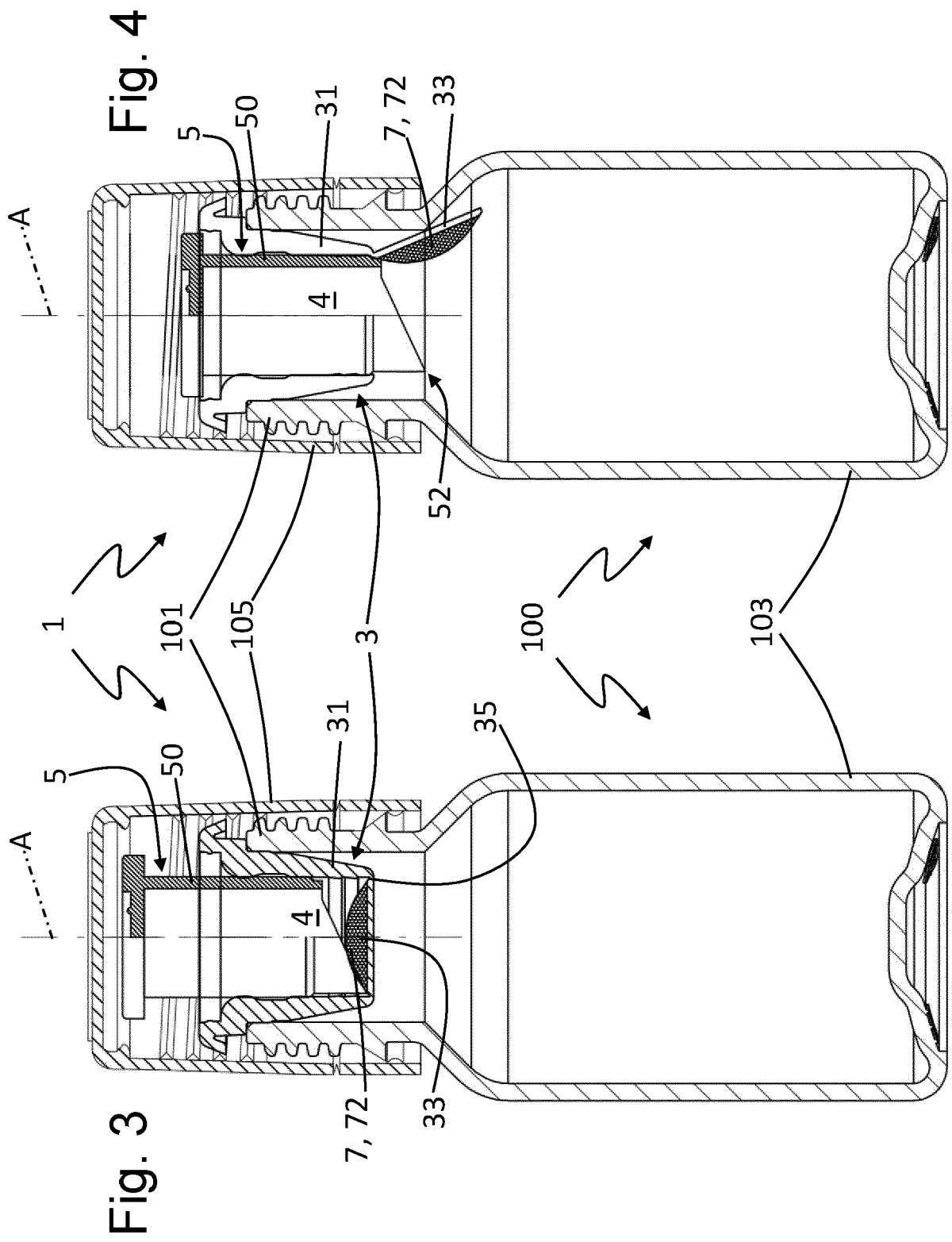
1. Container cap (1), particularly for vials for products to be mixed at the time of use, suitable for closing an opening (101) of a container (103) of a vial (100) intended to contain a first product, said container cap (1) comprising a reservoir (3) defined by at least one lateral wall (31) and a breakable bottom (33), and a cutter (5) comprising a tubular body (50) comprising a first sharp axial end (52), said reservoir (3) and said cutter (5) defining, in combination, a chamber (4) intended to contain a second product, said cutter (5) being axially movable inside said reservoir (3) so as to press, with said first sharp end (52), said breakable bottom (33) of said reservoir (3) to break said breakable bottom (33) and open said chamber (4) towards said container (103) of said vial (100), **characterized in that** at least a portion of said breakable bottom (33) of said reservoir (3) and/or at least a portion, bordering said breakable bottom (33), of an inner face of said at least one lateral wall (31) of said reservoir (3) comprises adsorbent and/or hygroscopic material (7).
2. Container cap (1), according to claim 1, **characterized in that** both said at least one portion of said inner face of said at least one lateral wall (31) and said at least one portion of said breakable bottom (33) comprise said adsorbent and/or hygroscopic material (7).
3. Container cap (1), according to claim 1 or 2, **char-**

**acterized in that** said adsorbent and/or hygroscopic material (7) consists of a layer of adsorbent and/or hygroscopic material (7) applied to said at least one portion of said inner face of said at least one lateral wall (31) and/or of said breakable bottom (33) of said reservoir (3). 5

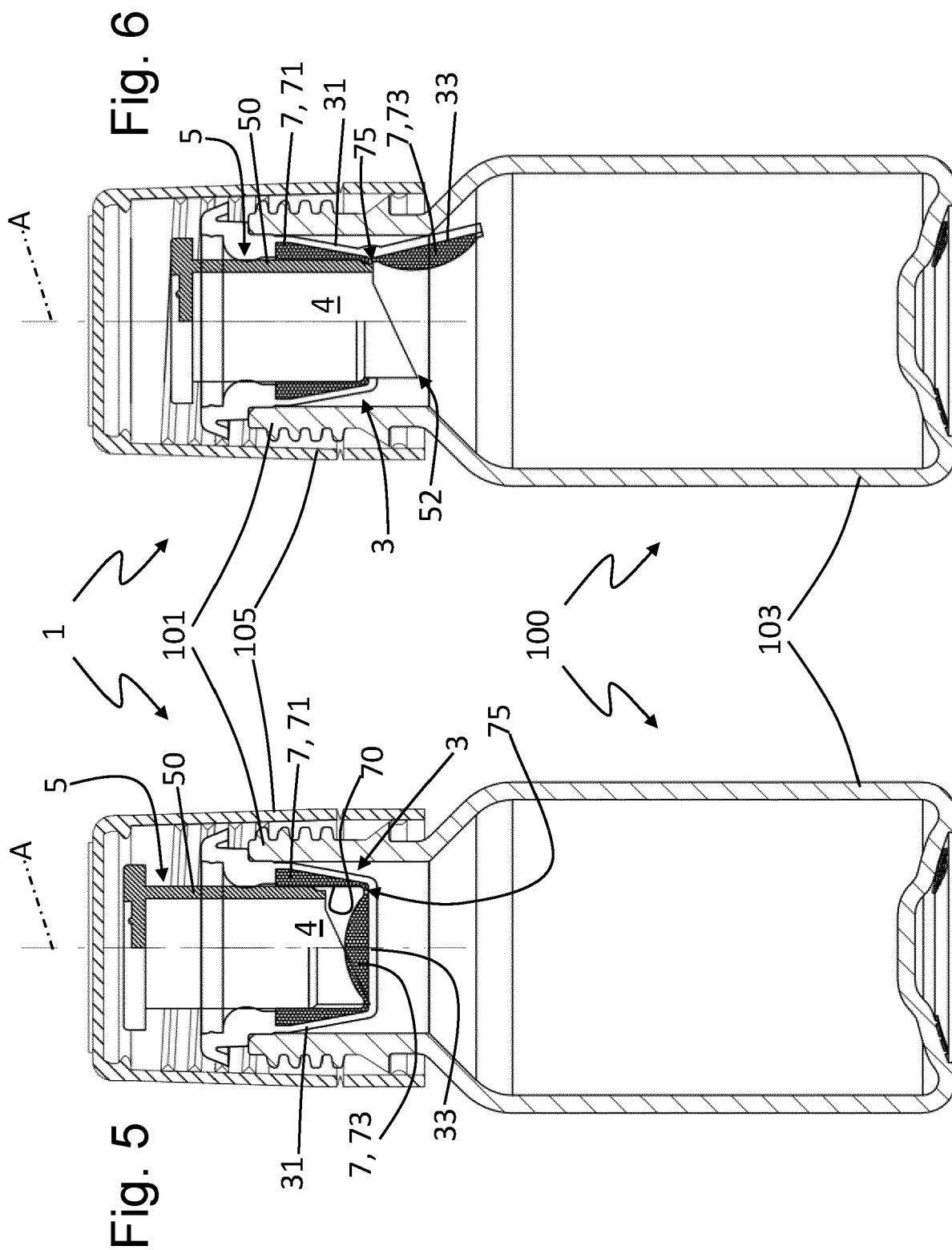
4. Container cap (1), according to claim 1 or 2, **characterized in that** said at least one portion of said inner face of said at least lateral wall (31) and/or of said breakable bottom (33) is made directly in said adsorbent and/or hygroscopic material (7). 10
5. Container cap (1), according to one or more of the preceding claims, **characterized in that** at least a portion (70, 72, 73) of said adsorbent and/or hygroscopic material (7) is adapted to come into direct contact with said second product intended to be contained in said chamber (4). 15  
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6. Container cap (1), according to one or more of the preceding claims, **characterized in that** between said breakable bottom (33) and said at least one lateral wall (31) there is provided a weakening line (35) adapted to facilitate breaking of said breakable bottom (33), said at least one lateral wall (31) comprising a first portion (71) of said adsorbent and/or hygroscopic material (7) and said breakable bottom (33) comprising a second portion (73) of said adsorbent and/or hygroscopic material (7), said first portion (71) of said adsorbent and/or hygroscopic material (7) and said second portion (73) of said adsorbent and/or hygroscopic material (7) being mutually connected in correspondence with said weakening line (35), by means of a thinned portion (75) of said adsorbent and/or hygroscopic material (7). 25  
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7. Container cap (1), according to claim 6, **characterized in that** said thinned portion (75) comprises a plurality of connecting bridges (76). 40
8. Container cap (1), according to one or more of the preceding claims, **characterized in that** said adsorbent and/or hygroscopic material (7) is distributed substantially over the entire surface of the inner face of said breakable bottom (33). 45
9. Container cap (1), according to one or more of the preceding claims, **characterized in that** said adsorbent and/or hygroscopic material (7) is distributed on the surface of the inner face of said at least one lateral wall (31) around an angle of 360°. 50
10. Vial (100) for products to be mixed at the time of use, **characterized in that** it comprises a container (103) intended to contain a first product, and a container cap (1) according to one or more of the preceding claims, adapted to close an opening (101) of said 55

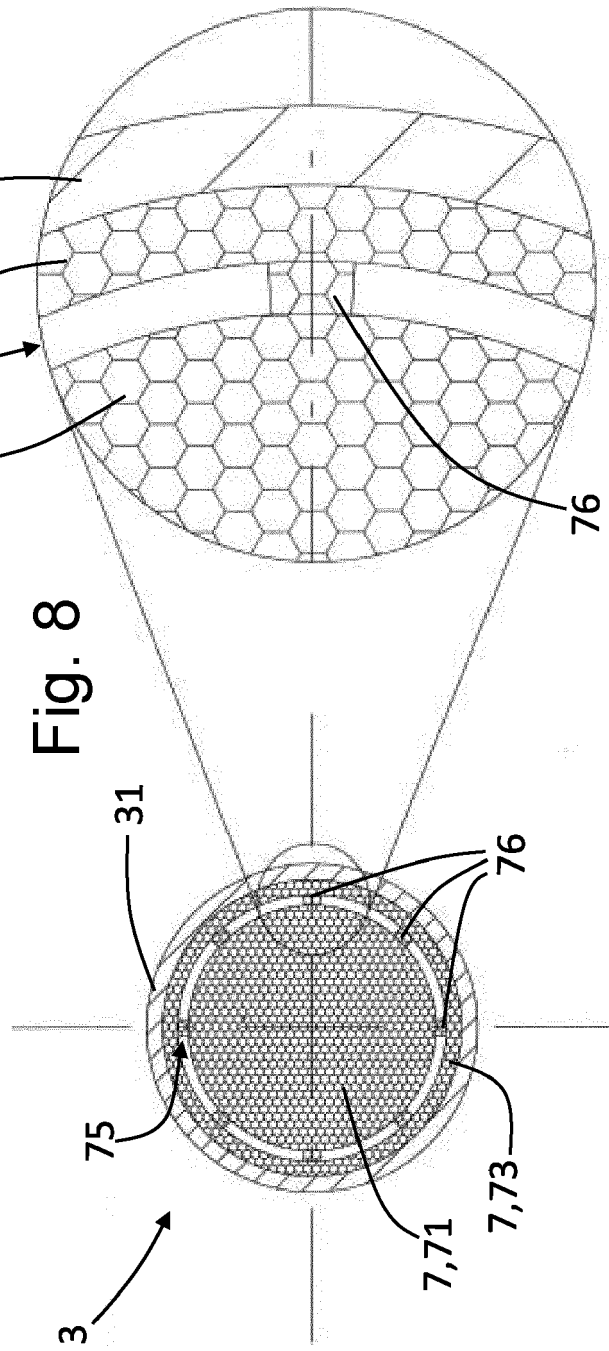
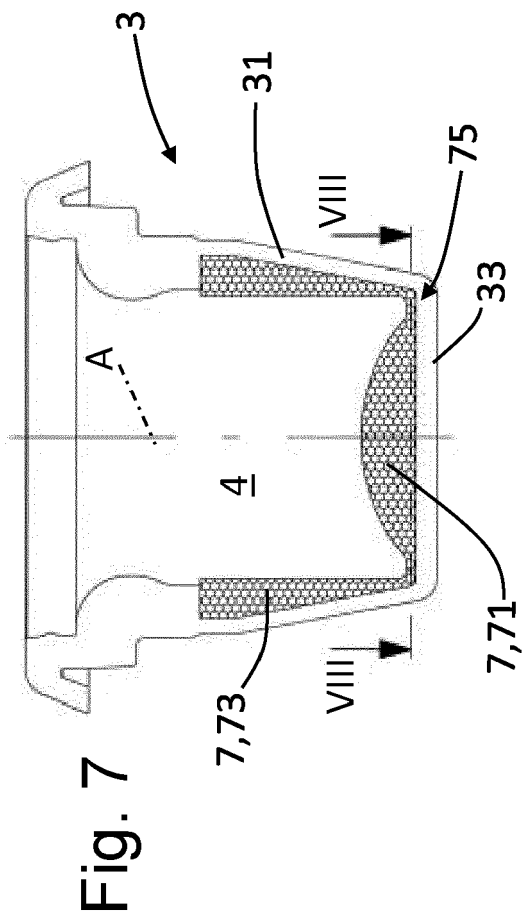
container (103).













## EUROPEAN SEARCH REPORT

Application Number

EP 21 19 5130

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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
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A	EP 2 704 962 A1 (BORMIOLI ROCCO SPA [IT]) 12 March 2014 (2014-03-12) * paragraphs [0016] - [0020]; figures * -----	1-10	
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			TECHNICAL FIELDS SEARCHED (IPC)
			B65D
1 The present search report has been drawn up for all claims			
Place of search <b>The Hague</b>		Date of completion of the search <b>21 January 2022</b>	Examiner <b>Serrano Galarraga, J</b>
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	

# **ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.**

EP 21 19 5130

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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  
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