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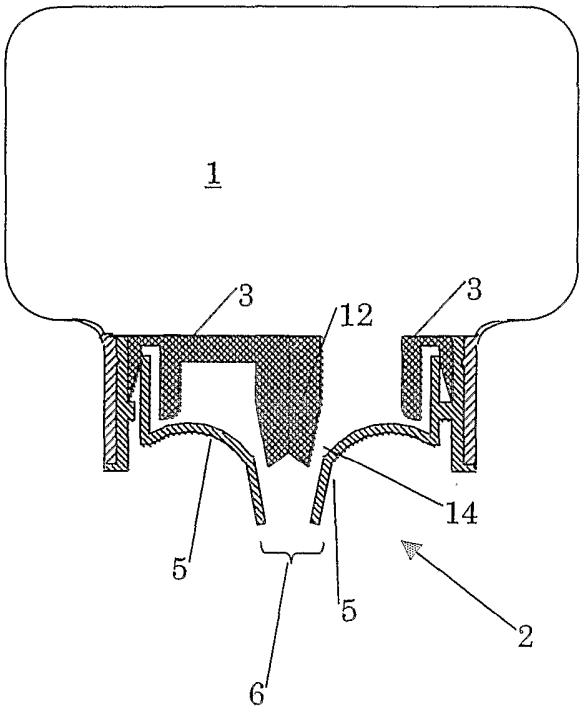
(54) Title: CLOSURE DEVICE



(57) Abstract: A fluid container (1) comprising a closure device (2) for closing the fluid container. The closure device (2) comprises a movable closure cap (5) provided with at least one outflow opening (6) and a stud (12) provided therein, wherein the closure cap (5) can move between a closing position and an outflow position, in which closing position the stud (12) closes the outflow opening (6) and in which outflow position the closure cap is moved away from the stud. The closure cap is designed to undergo a relatively sudden deformation and move to the outflow position under the influence of a relatively high first overpressure and to be a maintained in the outflow position under the influence of a relatively low second overpressure.

WO 2004/076308 A1

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Title: Closure device

The invention relates to a fluid container comprising a closure device for closing the fluid container, which closure device comprises a movable closure cap provided with at least one outflow opening, which closure device comprises a stud corresponding with the outflow opening, the closure cap being able to move, under the influence of overpressure in the fluid container, in axial direction of the stud between a closing position and an outflow position, in which outflow position the outflow opening is free with respect to the stud. Such a container is known from European patent publication EP700353 and serves to store and use fluids including viscous substances such as soaps and shampoos and the like.

The known closure cap is made of elastic material and contains a number of concentric folds intended to make the closure cap carry out a better axial movement along the stud. In this manner, the closure is improved and the closure cap can move back and forth like an accordion. However, a drawback of the known closure cap is that the dose rate strongly depends on the type of fluid enclosed in the container. As a result, with a relatively less viscous fluid, an undesirably large amount of fluid may flow out of the container, and with a relatively more viscous fluid, less fluid, or a considerably higher pressure may be needed to be able to dose the required amount of fluid. It is the object of the invention to avoid this drawback and to provide a fluid container which is less expensive to manufacture, contains fewer constituent components and offers a very reliable closure, the closure being virtually independent of the type of fluid present in the container or the pressure provided in the container.

This object is achieved by a fluid container of the above type, whose closure cap comprises a snap zone in order to undergo a relatively sudden

deformation and move to the outflow position under the influence of a relatively high first overpressure, and to be maintained in the outflow position under the influence of a relatively low second overpressure.

Such a "frog leg" effect is known per se and generates a rather abrupt deformation by using specific materials and forms, while the closure cap can assume two relatively stable, mutually different forms. This behavior can be compared to snap in straight, cylindrically thin-walled objects which are pressure-loaded and suddenly collapse when the collapsing load is exceeded without preceding visible deformation. In the closing condition, the closure cap is pressed against the stud under a slight prestress. The advantage of such a closure is that a relatively large force is needed for opening the container, so that a slight increase in pressure does not directly result in a leakage of the container. However, if the bottle is opened, by using this design technique, a lower force, which is more comfortable for the user, can be applied to keep the opening opened and to more easily dose the fluid. Further, such a snap effect offers the advantage that the closure device snaps to, as it were, and is thus closed relatively quickly, so that bothersome dripping or string formation occurs hardly, if at all, because the fluid jet is cut off, as it were.

It is noted that the closure cap in patent publication EP700353 has no snap zone because this closure cap does not move between an unsnapped and a snapped condition but has a number of permanent folds.

In a preferred embodiment, the snap zone comprises an annular middle part, which comprises a curve in which, during the provision of overpressure in the container, a pressure build-up may be created. The snap zone may comprise a weakening. Such a weakening offers the opportunity to achieve a more reliable and reproducible snap, which always occurs under roughly the same conditions at virtually always the same location.

Analysis shows that a concentration of pressure forces occurs therein, so that the closure cap can spontaneously deform due to increasing pressure,

virtually without a gradual change preceding this. Preferably, the snap zone has a smaller thickness than a part of the closure cap located closer to the rims. The closure cap preferably has an inward conical form in the closing position and an outward conical shape in the outflow position. By such an inward conical shape, upon axial movement, the closure cap will be slightly compressed, so that the pressure build-up can be increased.

This makes it possible that the closure device comprises a return valve so that air can be sucked into the fluid container to compensate for the fluid flown out. In the conventional closures, is was usually necessary to use relatively rigid container walls to promote this return flow. By use of the return valve as mentioned above, the container can have a thinner and therefore less expensive design because the return flow is more easily effected, without there being a risk of leaking. In this context, the return valve serves as a so-called "double ventilation", with air flowing in via the outflow opening, when the overpressure in the bottle falls out because the user stops squeezing it. Because of the semi-stable opening position of the closure cap, the air can initially flow back via the outflow opening, so that the fluid jet is interrupted. The ventilation is then taken over by opening the return valve, so that the pressure is normalized. This allows the air to flow into the container and the fluid jet is interrupted in an abrupt movement, without bothersome dripping or the formation of fluid strings occurring. It is noted that this double ventilation can be used independently.

The return valve may be designed with a slot provided in a rim piece which connects to the rim of the closure cap, which slot can be closed by a strip connected to the flexible closure cap.

In a further embodiment, the stud comprises means for carrying out a slight axial movement. Such means may comprise a flexible transverse part on which the stud is provided. Such a stud with a flexible design may function as a return valve in that, when the air flows back and due to underpressure in the container, the stud carries out a slight inward

movement. Further, such a flexible stud can prevent that, with too large pressure increases or accelerations, the closing device could be opened undesirably so that fluid could flow away in too large a dose. By suing the flexible suspension, in such a case, the stud initially moves along with the closure cap and a delay or slowing down of such phenomena is effected, so that the closure device has a slight lagging effect on the forces applied on it. This promotes the ease of use and prevents the container from being emptied undesirably.

For improvement of the closure and dosing possibilities, the stud may have a conical design. Here, the outflow opening of the closure cap may comprise an upstanding rim which, in closing position, fittingly closes over a length around the stud. Preferably, the upstanding rim is shortened in order to cut the fluid jet during the closing movement and thus create a clean closure without dripping or drawing fluid strings.

The invention will now be elucidated with reference to the drawing, in which:

Fig. 1 diagrammatically shows, in side elevational view, the fluid container according to the invention;

Fig. 2 diagrammatically shows, in side elevational view, the fluid container according to the invention, with the closure cap in closing position;

Fig. 3 diagrammatically shows, in side elevational view, the fluid container according to the invention, with the closure cap in outflow position;

Fig. 4 diagrammatically shows, in side elevational view, the fluid container according to the invention, with air being sucked in via the outflow position;

Fig. 5 diagrammatically shows, in side elevational view, the fluid container according to the invention, with air being sucked in via a return valve;

Fig. 6 diagrammatically shows an alternative embodiment of the fluid container according to the invention;

Fig. 7 diagrammatically shows, in side elevational view, the fluid container according to Fig. 6;

Fig. 8 shows, in cross section, a closure cap according to the preferred embodiment;

Fig. 9a diagrammatically shows the snapping behavior of the closure cap of Fig. 8;

Fig. 9b is a force-distance diagram which shows the snapping behavior at a position A-A in Fig. 9a.

In the Figures, the same or similar parts are designated by the same reference numerals.

With reference to Figs. 1 and 2, a (part of a) fluid container 1 is diagrammatically shown. In Fig. 1, the closure device 2 is shown in perspective view; Fig. 2 shows a cross-sectional view. The fluid container 1 is preferably manufactured from an inexpensive plastic, for instance LEP or LLDPE, and may further comprise numerous types of fluids (not shown), while the material of the lining can be adjusted to the type of fluid enclosed. In the following, fluid will also be understood to comprise various viscous substances and semi-fluids such as soaps, shampoos and the like. The container 1 is locked by a closure device 2. For reasons of clarity, the container and closure device are shown disproportionally. The closure device 2 comprises a rim piece 3 of a relatively rigid material. The rim piece is coupled along a perimeter 4 with a flexible closure cap 5 comprising a central outflow opening 6. In Fig. 2, the wall 7 is shown to form a part of the fluid container 1. This wall 7 is usually somewhat reinforced or at least manufactured from rigid material, and, according to the exemplary embodiment of Fig. 2, it forms a cylindrical cavity in which the rim piece 3 and the closure cap 5 can be clamped, with the closure cap being held

between the rim piece 3 and the wall 7. Although, in the side elevational view of Fig. 2, the rim piece 3 and closure cap 5 appear to consist of separate components, these components are connected to one another outside the plane of the drawing and both parts are preferably formed in one whole. Through combinations of a relatively rigid rim piece and a relatively more flexible material of the closure cap 5, by means of the construction shown, a good closure can be obtained near the perimeter 4. In the preferred embodiment, the closure cap further comprises a lip 8 which, together with a slot 9 in the rim piece 3, forms a return valve 10, whose function will be further elucidated with reference to Fig. 5.

In the rim piece 3, an opening 11 is formed, that is to say, fluid can flow through an opening 11 in the rim piece, and the perimeter of the rim piece is at least substantially contiguous to the wall 7 of the fluid container 1. In addition to a flow passage 11 for the fluid, the rim piece 3 further comprises a stud 12 which connected through at least one transverse part 13 to the perimeter of the rim piece 3 in order to position the stud 12. According to the example, the stud is positioned centrally in the opening 11 and fluid can flow all round through a star-shaped configuration of transverse part 13 contacting the stud 12. Needless to say, other configurations are also possible, for instance a configuration in which the stud 12 is positioned more near the perimeter of the rim and offers a passage only on one side for allowing fluid to flow through.

As will be further elucidated with reference to Figs. 3-5, the closure cap 5 is axially movably provided over the stud 12. In Fig. 2, the closure cap is shown in a closing position. In this position, the closure cap 5 closes the fluid container 1 and the fluid cannot flow out of it because the closure cap 5 fittingly closes around the stud 12. This position is the position of rest; i.e. only by providing an overpressure in the container 1, for instance by squeezing it, the closure cap can be moved out of this position.

Fig. 3 shows how the closure cap 5 is brought into the outflow position. In this case, in the bottle, a relatively large overpressure is provided by squeezing it tightly for a moment. As a result, the closure cap 5 undergoes a deformation and moves from the closing position shown in Fig. 2 to the outflow position shown in Figure 3. The closure cap 5 has now moved in an axial direction along the stud 12 and thereby moves away from the stud 12. As a result, a space 14 is created around the stud so that fluid can flow out of the fluid container 1. The closure cap 5 is designed so that it undergoes a relatively sudden deformation by squeezing of the fluid container 1, and moves to the second outflow position shown. Once in this position, the closure cap 5 can be kept in the outflow position under the influence of a relatively low second overpressure. It is therefore not necessary for a consumer to keep squeezing the container tightly.

Figs. 4 and 5 further show the return movement of the closure cap, when, after squeezing the fluid out of the container, the pressure is reduced, so that the closure cap jumps back to the position of rest shown in Fig. 2 where the closure cap 5 is in the closing position. Before it is in this position, however, an amount of air can flow through the outflow opening 6 into the bottle as shown according to arrows P. In the preferred embodiment, as shown in Fig. 5, a return valve 10 has been provided in the rim piece, so that air can be sucked into the fluid container 1. Although other embodiments are possible, such a return valve 10 can be formed easily by a lip 8, which is part of the closure cap 5. The lip 8 is brought into a slot 9 and closes the container from the environmental air on one side 15. In the position of rest, or while applying a certain overpressure, or when the fluid presses against it, the lip is pushed against side 15, so that the lip closes the container. However, as is illustrated in Fig. 5, by the presence of an underpressure in the container, the lip 8 can move to the side 16 facing away from the side 15, so that the air flows into the container via slot 9 as shown by arrow Q. Because the air can be sucked into the container 1

already at a relatively small underpressure, the container can be manufactured from a less rigid material, which reduces production costs.

Figs. 6 and 7, finally, show a modification of the concept shown in Figs. 1-5 in which the stud 12 also can move flexibly because it is mounted on a flexible transverse part 17. The flexible transverse part 17 can comprise a slightly curved, for instance star-shaped suspension, so that the rigid middle stud 12 can carry out a slight axial movement under the influence of, for instance, a sudden acceleration, for instance by a shock caused by the bottle falling on the ground or by the bottle suddenly being squeezed. This embodiment initially prevents the outflow opening 6 from being opened because, in that case, the stud moves along with the closure cap 5 so that the outflow opening 6 remains closed. Only after the stud moves back, or if the closure cap moves further in axial direction than the stud 12 can move, a outflow opening 6 is formed.

Figs. 1-7 show the stud having a conical shape. The outflow opening of the closure cap can comprise a upstanding rim 18 which, in a closing position, fittingly closes over a length around the stud. On the stud, further, a concentric thickening (not shown) can be provided for obtaining a line closure.

Fig. 8 shows a further perspective view of a cross section of the closure cap 5 according to the invention. The closure cap 5 comprises a snap zone 19 in order to undergo a relatively sudden deformation and to move to a outflow position under the influence of a relatively high first overpressure, and to be maintained in the outflow position under the influence of a relatively low second underpressure. The snap zone 19 is shown in the Figure as an annular middle part which comprises a curve in which, during the application of an overpressure in the container, a pressure build-up may be created. Although the Figure shows a substantially uniform annular snap zone 19, other geometries like star-shaped zones or the like may achieve a similar effect. Analysis shows that *inter alia* the curve, the

thickness and the geometry of the snap zone 19 influence the snap effect in connection with the invention, so that the skilled person, in practice, *inter alia* by means of finite element analysis, is capable of adjusting the perimeters mentioned in order to control an optimal snap behavior of the closure cap 5. As can be seen from the Figure, the snap zone 19 is further provided with a relatively smaller thickness than the part 20 which is located closer to the perimeter of the closure cap 5. As a result, the pressure forces can be concentrated in the snap zone, what results in a controllable and reproducible snap effect.

Figs. 9a and 9b, finally, show a further preferred embodiment of the closure cap 5. The upstanding rim is shortened here. Through this shortening the fluid jet is better cut off during the closing movement so that dripping or the occurrence of fluid strings is prevented. The upstanding rim 18, in the position of rest, is substantially contiguous to the wall of the stud (not shown). The shortened part 21 comprises a top surface 22 oriented substantially transverse to the upstanding wall. Between the top surface 22 and the upstanding rim 18, a sharp transition 23 is present.

In the Figure, the closure cap 5 is illustrated in the position of rest 24 (closing position) wherein the closure cap comprises a concave conic form. In the same Figure, the outflow position 25 is illustrated. In this position a snap 26 has occurred, so that the closure cap can be kept in stable condition, by maintaining a relatively light overpressure in the container.

Fig. 9b shows the force-distance diagram obtained by finite element analysis in the configuration shown in Fig. 9a. Here, at the position of line A-A, a thickness variation was applied. Generally, it follows from Fig. 9b that a movement initially requires relatively much force (shown by the letter F), until a snap point is passed, where after the force applied relatively sudden becomes much less. By varying the thickness, the required maximum force can be adjusted, wherein the upper line 27 shows a force-distance curve with a relatively large thickness of the closure cap, and

the lower line 28 shows the force-distance curve with a relatively less large thickness of the closure cap at the location of the line A-A. In similar manner, a force-distance diagram can be influenced by applying a weakening 29 which can be arranged at a certain position along the line R in the snap zone. Varying of the thickness of the closure cap 5 at the location of rim parts B and C also appears to influence the snap behavior.

Although the invention has been disclosed with reference to the embodiments shown in the pictures, these may comprise modifications without diverting from the spirit and scope of the invention. It is possible that the rim piece 3 and the closure cap 5 are formed from one material through molding. Also it is possible that a plurality of studs are applied. These modifications are deemed to be within the scope of the invention as is claimed by the annexed claims.

Although the invention has been described with reference to the preferred embodiments shown in the drawing, it may contain modifications without departing from the spirit and scope of the invention. For instance, it is possible for rim piece 3 and closure cap 5 to be formed from one material by injection molding. Further, it is also possible that multiple studs are used. Such modifications are considered to be within the scope of the invention as defined in the following claims.

CLAIMS

1. A fluid container comprising a closure device for closing the fluid container, which closure device comprises a movable closure cap provided with at least one outflow opening, which closure device comprises a stud corresponding with the outflow opening, and wherein the closure cap can move, under the influence of overpressure in the fluid container, in axial direction of the stud between a closing position and an outflow position, in which closing position the stud closes the outflow opening and in which outflow position the outflow opening is free with respect to the stud, characterized in that the closure cap comprises a snap zone to undergo a relatively sudden deformation and move to the outflow position under the influence of a relatively high first overpressure and to be maintained in the outflow position under the influence of a relatively low second overpressure.

2. A fluid container according to claim 1, characterized in that the snap zone comprises an annular middle part comprising a curve in which, during the provision of overpressure in the container, a pressure build-up can occur.

3. A fluid container according to claim 1 or 2, characterized in that the snap zone comprises a weakening.

4. A fluid container according to claim 3, characterized in that the snap zone has a smaller thickness than a part of the closure cap which located closer to the rims.

5. A fluid container according to at least one of the preceding claims, characterized in that the closure cap has an inward conical shape in the closing position and that the closure cap has an outward conical shape in the outflow position.

6. A fluid container according to at least one of the preceding claims, characterized in that the closure device comprises a return valve so that air can be sucked into the fluid container.

7. A fluid container according to claim 6, characterized in that the return valve comprises a slot which has been provided in a rim piece which connects to the rim of the closure cap, which slot can be closed by a strip connected to the flexible closure cap.

8. A fluid container according to at least one of the preceding claims, characterized in that the stud comprises means for carrying out a slight axial movement.

9. A fluid container according to claim 8, wherein the means for carrying out an axial movement comprise a flexible transverse part on which a stud has been provided.

10. A fluid container according to at least one of the preceding claims, characterized in that the stud has a conical design.

11. A fluid container according to at least one of the preceding claims, characterized in that the outflow opening of the closure cap comprises an upstanding rim which, in closing position, fitting closes over an axial length around the stud.

12. A fluid container according to claim 11, characterized in that the upstanding rim is shortened.

13. A fluid container according to at least one of the preceding claims, characterized in that, on the stud, a concentric thickening has been provided for obtaining a line closure.

14. A fluid container according to at least one of the preceding claims, characterized in that the closure cap is an injection-molding product of a thermoplastic elastomer.

15. A fluid container according to at least one of the preceding claims, characterized in that the container is manufactured from a relatively thin flexible material.

16. Closure device for a fluid container according to at least one of the preceding claims.

Fig 1

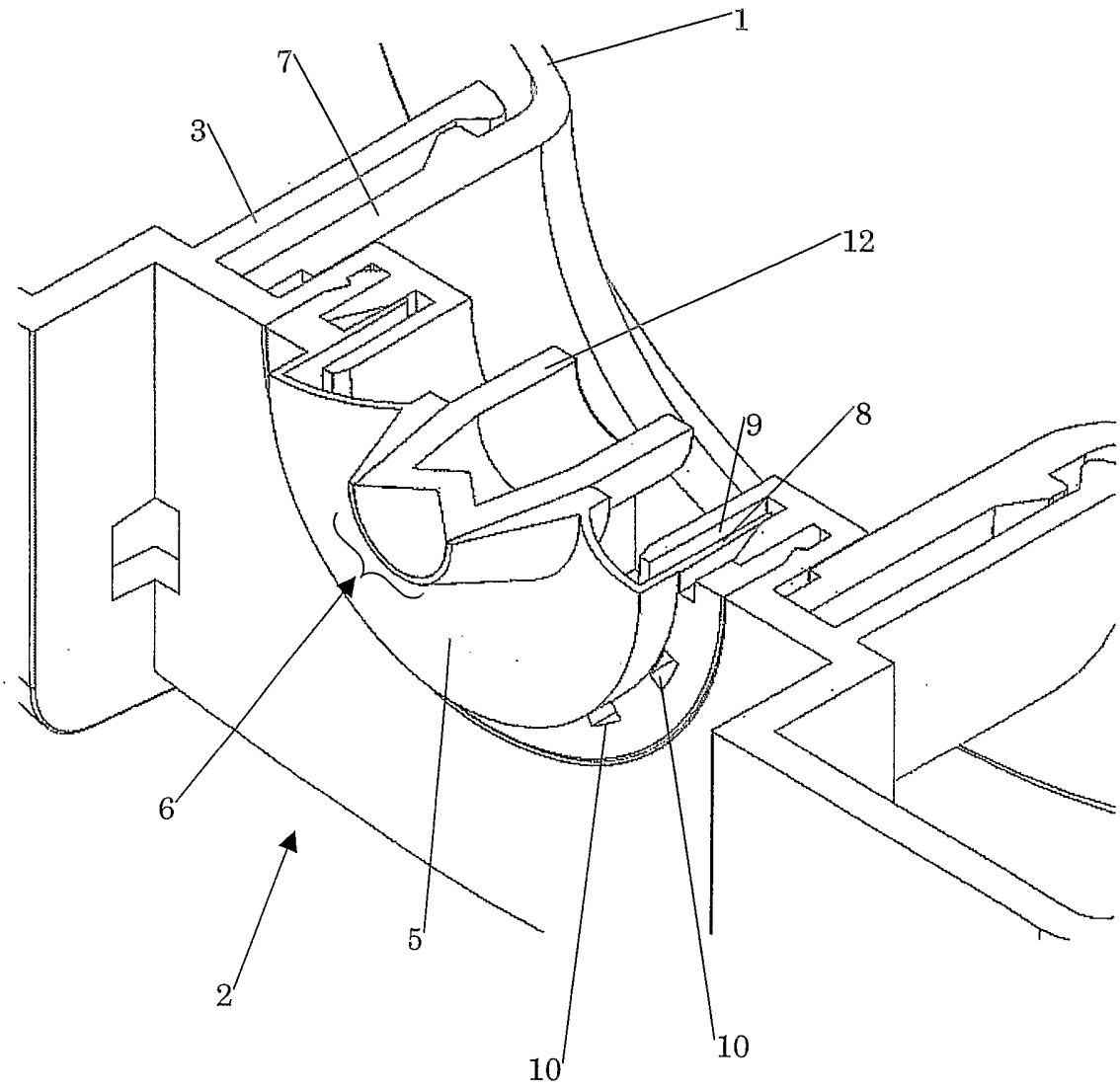


Fig 2

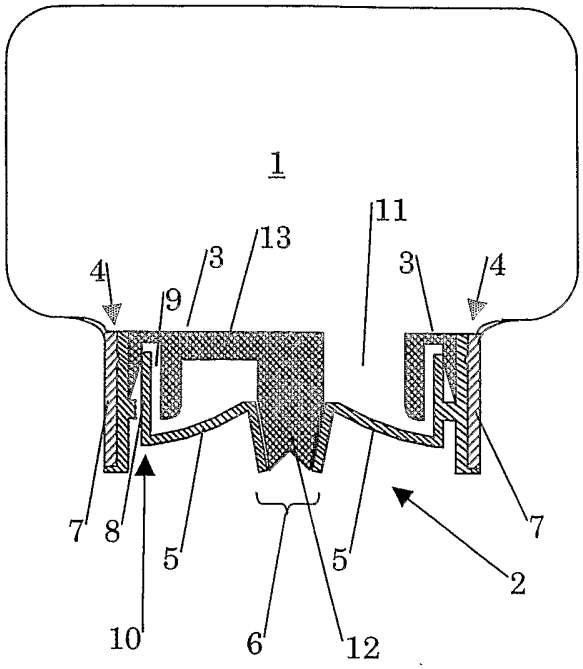


Fig 3

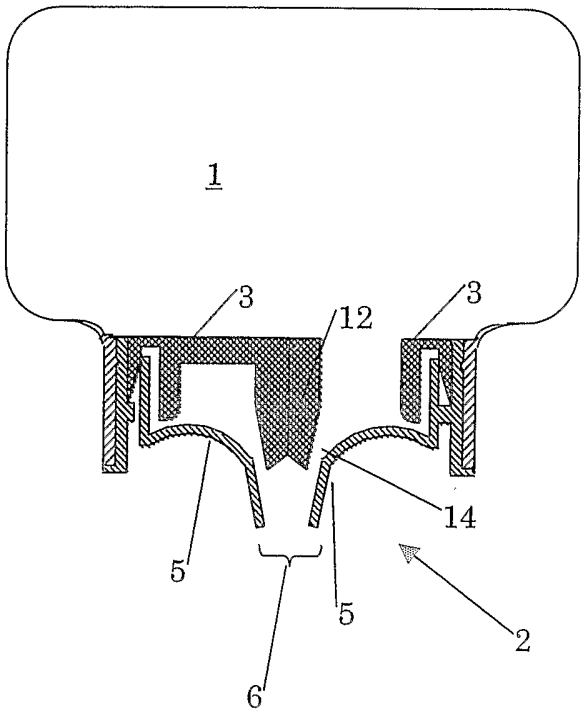


Fig 4

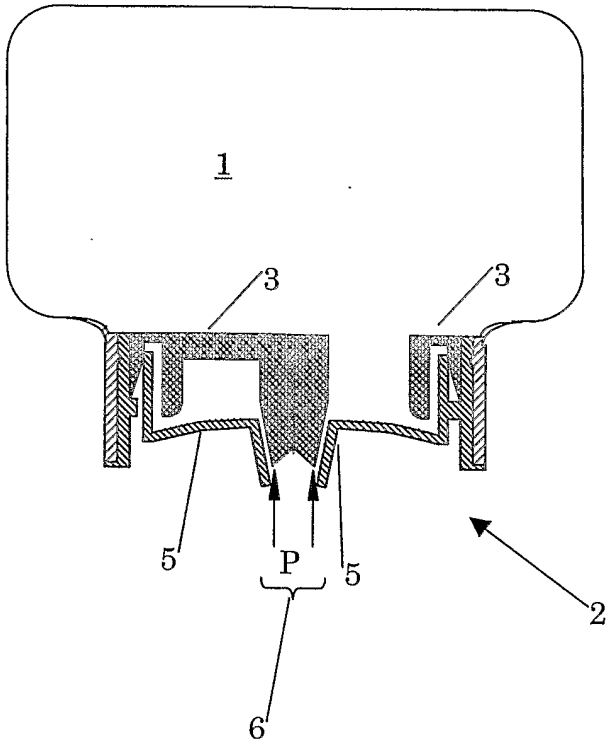


Fig 5

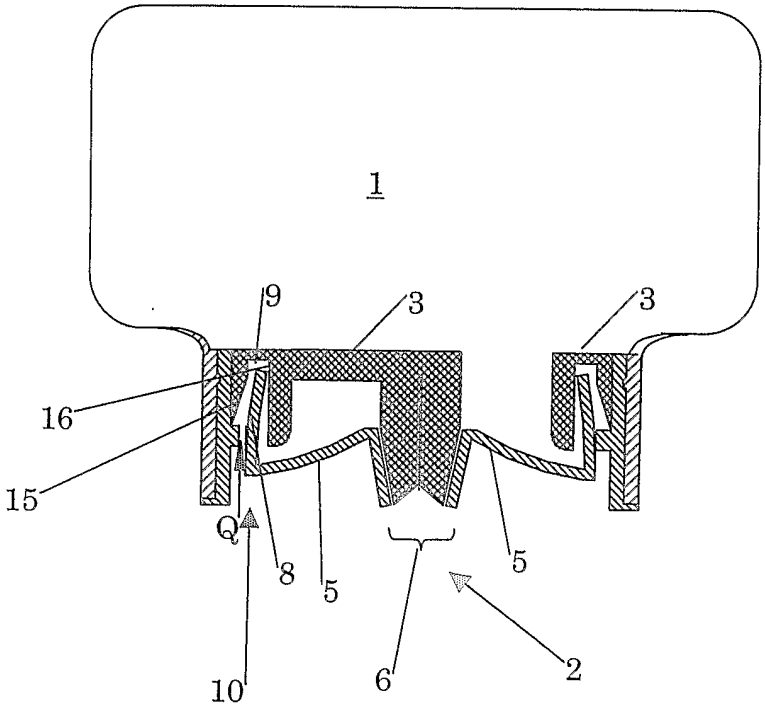


Fig 6

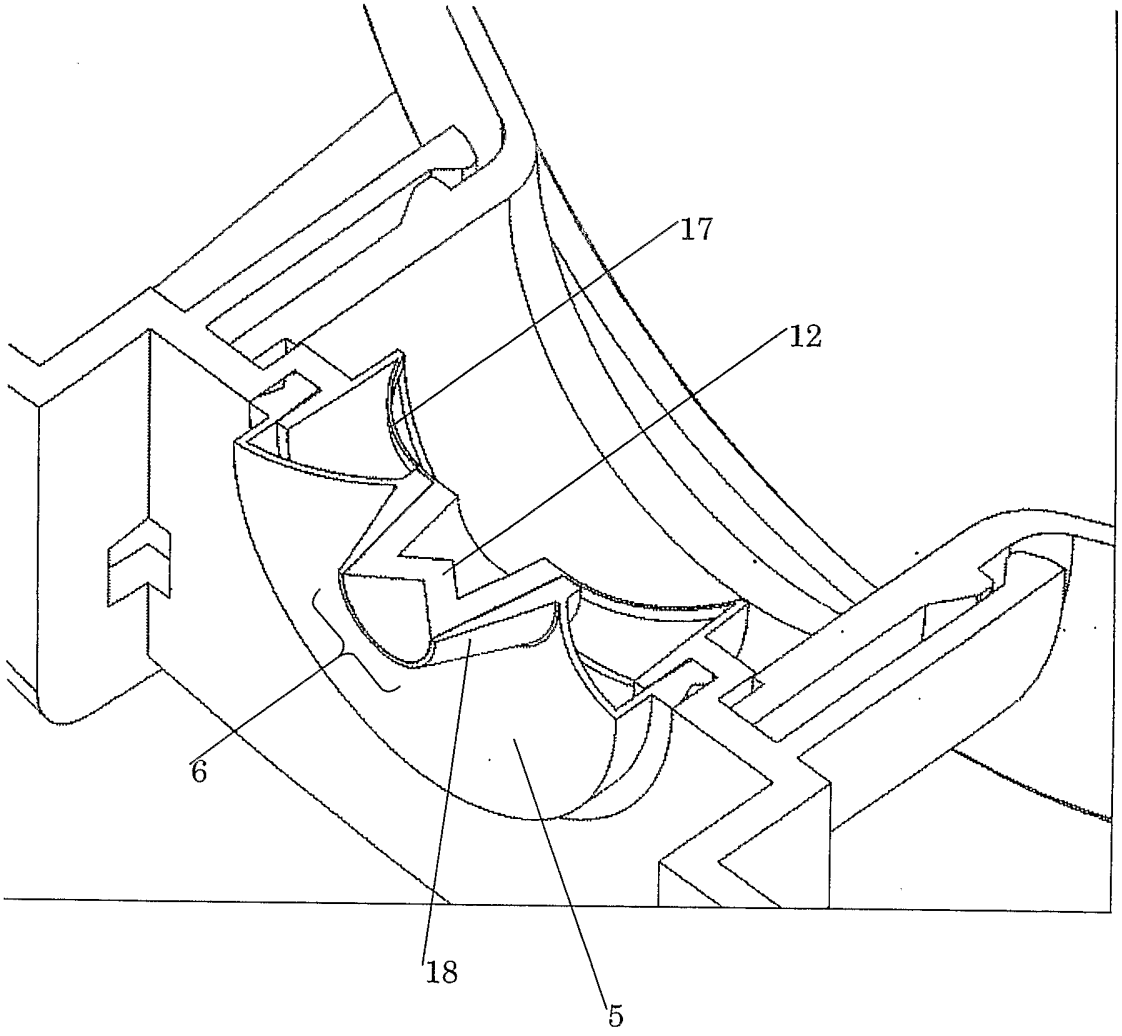


Fig 7

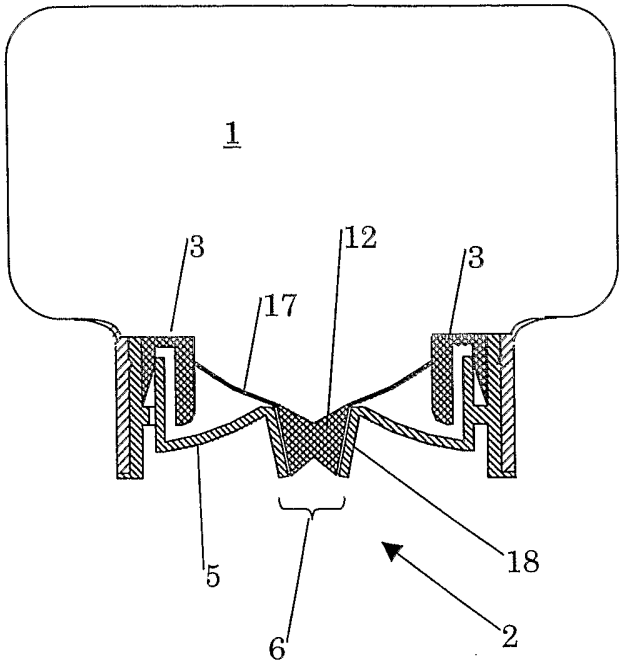


Fig 8

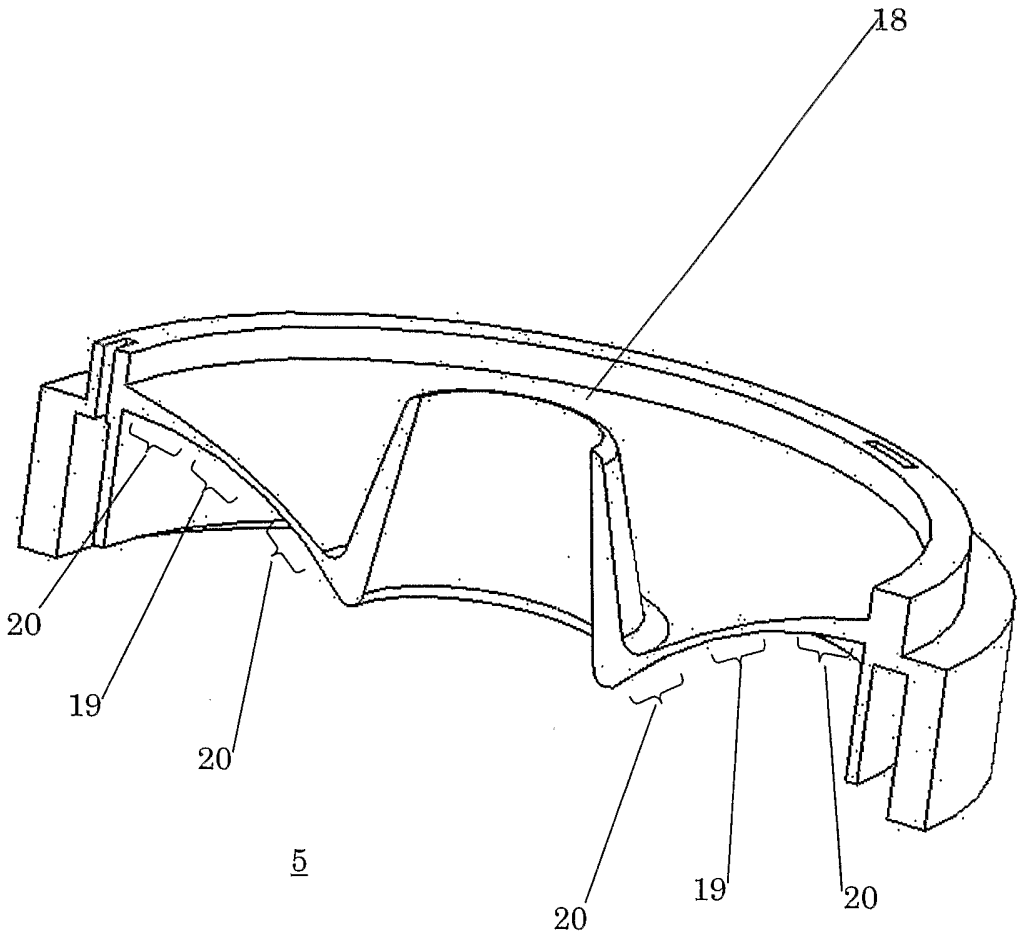


Fig 9a

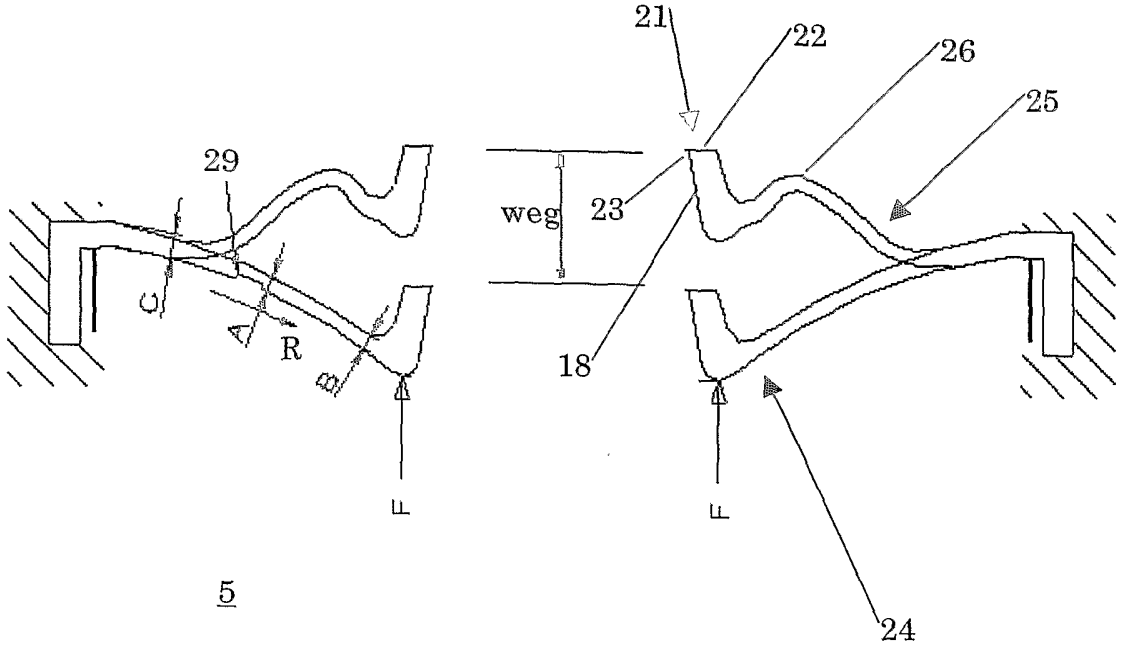
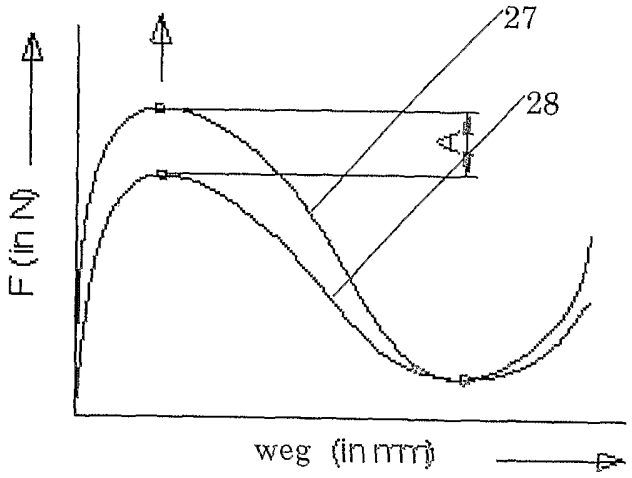


Fig 9b



INTERNATIONAL SEARCH REPORT

Application No
PCT/NL2004/000107

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B65D47/28 B65D47/32

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B65D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 1997, no. 06, 30 June 1997 (1997-06-30) -& JP 09 039990 A (TOYO SEIKAN KAISHA LTD), 10 February 1997 (1997-02-10) abstract	1-6,11, 14-16
A	US 5 857 595 A (NILSON BILLY) 12 January 1999 (1999-01-12) abstract; claims; figures	1
A	WO 00/21851 A (MENSHEN GEORG & CO KG ;HASE MICHAEL (DE)) 20 April 2000 (2000-04-20) abstract; figures	1
A	GB 2 198 418 A (HILCREST DESIGN LTD) 15 June 1988 (1988-06-15) abstract; claims; figures	1

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
27 May 2004	11/06/2004

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Fournier, J

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PCT/NL2004/000107

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 420 101 A (O'NEILL RICHARD K) 13 December 1983 (1983-12-13) abstract; figures 9-15	1

Form PCT/ISA/210 (continuation of second sheet) (January 2004)

INTERNATIONAL SEARCH REPORT

Application No
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