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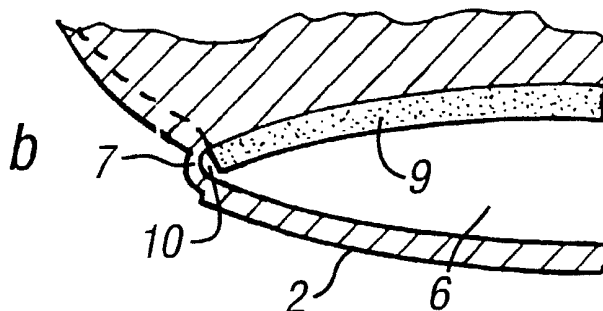
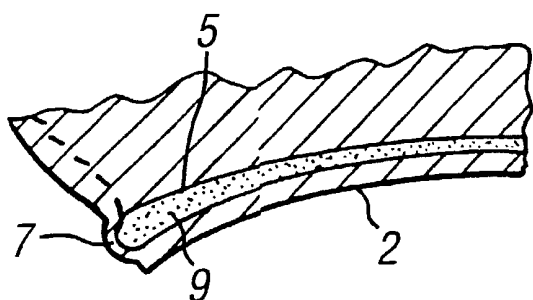
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(54) Title: SNAP-ACTION CLOSURE WITH AN ELASTIC SEAL



(57) Abstract: The present invention relates to improvements to snap-action closures. The problem of leakage in the conventional snap-action closures is overcome by providing a resilient seal comprising an elastic gel composition between the opening and the flexible panel (2) which deforms when the flexible panel (2) is closed to create a liquid-tight seal. In particular, the gap in the region of the closure hinge (7) is closed by the elastic flow of sealant material (9) where very little, if any, closing force is otherwise exerted.

SNAP-ACTION CLOSURE WITH AN ELASTIC SEAL

Field of the Invention

This invention relates to improvements to snap action closures.

5

Background to the Invention

Snap-action closures are used extensively on containers for liquids and creams, such as cosmetics and household cleaning products. While not necessarily more effective than other closures, such as screw closures for example, they are well liked by consumers and consequently have had considerable commercial success.

10

Figures 1a-1c show an example of a snap-action closure which is described in more detail in UK patent application GB 2 269 811. Part of the wall at the dispensing end of the container is flexible and is defined by a thin section which acts as a hinge. The hinge also defines an aperture through which a flexible panel must pass. The area of the aperture is slightly smaller than the area of the flexible panel. The flexible panel can either be in a convex, open position (not shown) or a concave, closed position (shown). By pressing on the flexible panel when it is in the convex and open position, it is deformed to pass through the smaller aperture, so as to reverse its curvature and snap into a concave opening in the container thus closing it.

15

20

In practice, however, snap closures of this type usually fail to seal solely by the action described above. A flexible panel made from plastics may fail to seal at the corners of the

aperture (see Figures 1a and 1b), since the force distribution over the flexible panel is not normal to the closure surfaces except at the centre of the panel. Furthermore, although the aperture should be moulded to conform to the natural shape of the flexible panel, the seal will not be consistent due to the variations in the material properties of the closure, such as stiffness at different temperatures, or hysteresis and creep in the materials used in its construction.

Thus, insufficient force is provided by the flexible panel in the closed position to maintain a seal. Whilst this may be adequate for powdered or granulated products, this is not true of liquids. In particular, when such containers are subjected to increased internal pressure, through a temperature rise for example, leaks may occur. Clearly, a closure which does not seal properly in these circumstances is of limited use particularly when it is required for longer term storage.

Summary of the Invention

According to a first aspect of the present invention, a resealable closure comprises a curved flexible panel forming part of the wall of a container or cap therefore, the area of the curved flexible panel being greater than the area of the wall of the container or cap defined by a hinge line of action, so that the curved flexible panel may be forced to pass from a convex form to a concave form and *vice versa* with an over centre snap action as the curved flexible panel is caused to pass through area of the wall of the container or cap defined by the hinge, and the curved flexible panel being inwardly concave to at least partially close an opening in the container or cap when in a first position, and being

outwardly convex to form a dispensing opening in the second position, wherein the container or cap has a seal comprising an elastic seal attached thereto which seals the opening when the curved flexible panel is in the first position.

- 5 In the present invention, the problem of leakage in the conventional snap-action closures described above is overcome by providing a resilient seal between the opening and the flexible panel which deforms when the flexible panel is closed to create a liquid-tight seal. In particular, the gap in the region of the closure hinge is closed by the elastic flow of sealant material where very little, if any, closing force is otherwise exerted.

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The seal may be co-injection moulded onto a portion of the perimeter of the opening or instead, or in addition, onto a perimeter portion of the flexible panel. Alternatively, the seal may be an initially separate component which is then assembled to the closure during manufacturing.

15

Preferably, the material of the elastic seal has an elongation of at least 100%, preferably at least 200%, most preferably at least 1000%, a compression set at 70°C of less than 30%, preferably less than 20%, most preferably less than 10%, a cone penetration (ASTM D217 for greases) of from 10 to 40 mm, an initial softening point of greater than

- 20 100°C and a stress relaxation of greater than 500 seconds.

Whilst the elastic seal can be a closed cell foam, silicone or polyurethane rubber, preferably it is an elastic gel composition.

It is advantageous if the elastic gel composition exhibits a low compression set since this enables the seal to return rapidly to essentially the same form when the compressive force of the flexible panel is removed. It is desirable that the elastic gel composition is tacky, so that it conforms and lightly adheres to the mating surface. This enables the closure to survive transient pressure increases. Preferably, the seal is capable of adhesive release from the mating surface without rupture, and further should be sufficiently soft to accommodate some foreign material contaminating the seal surface without loss of sealing.

10

One particularly suitable material for use as a sealant is a liquid-extended polymer composition. Preferably, the polymer of the liquid-extended polymer composition is a block co-polymer. More preferably, the polymer of the liquid-extended polymer composition is a block copolymer having hard blocks and soft blocks. More preferably, the polymer of the liquid-extended polymer composition is a styrene-diene block copolymer. Most preferably, the polymer of the liquid-extended polymer composition is a poly(styrene-butadiene-styrene) block copolymer (SBS), a poly(styrene-isoprene-styrene) block copolymer (SIS), a poly(styrene-ethylene-butylene-styrene) block copolymer (SEBS), a poly(styrene-ethylene-propylene-styrene) block copolymer (SEPS) or a poly(styrene-ethylene-propylene) block copolymer (SEP).

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Other suitable elastic gels include bio-gels, ie gels derived from plants and animals. Examples of these include polysaccharides, for example hydroxypropyl cellulose, derived from cellulose; or protein gels such as gelatin, derived from collagen; and, latex rubber.

- 5 According to a second aspect of the present invention, there is provided the combination of a container and a resealable closure according to the first aspect of the present invention.

A package comprising the combination of the container and a resealable closure
10 according to the present invention is capable of containing a liquid under pressure, and in particular a liquid which contains a dissolved gas. Accordingly, the invention may be used to store and dispense carbonated beverages.

In one preferred example, the container comprises a flexible tube which may contain a
15 paste or cream.

In another example, the container has a tab fitted to or integral with the flexible panel, to assist operation of the resealable closure.

20 **Brief Description of the Drawings**

Examples of the present invention will now be described in detail with reference to the accompanying drawings, in which:

Figure 1a shows an example of a known snap-action in the closed position and Figures 1b and 1c are scrap cross-sections through that closure and its film hinge showing the poor seal resulting from a gap in the corners;

Figure 2a shows the same closure as in Figures 1a-1c having a seal according to the present invention and Figure 2b shows the same closure in the open position;

Figures 3 and 4 show the flexible panel closure as an integral part of a container, each in the closed and open positions;

Figure 5 shows an alternative integral design based on a flexible tube type of container;

Figures 6a, 6b and 7 show examples of tamper-evident closures;

Figures 8a-8f show a flexible panel-type closure in which the flexible panel section is an initially separate part;

Figures 9a-9d show a closure with integral seal for sealing between a container and the closure body;

Figures 10a and 10b show a cap attached to a container by a co-operating snap fit;

Figure 11 shows a flexible panel closure welded to a container; and,

Figures 12a-15c show a tab attached to the flexible panel to assist operation of the resealable closure.

Detailed Description

Figure 1a is a cylindrical closure for attachment to a container, comprising a body 1, with a flexible panel 2 attached to the cylindrical wall, and an end wall 4 against which the flexible panel 2 closes – that is, the curved flexible panel 2 co-operates with a substantially matching cut-out 5 in the end wall 4. One or more ribs 3 attached to or

integral with flexible panel 2 stiffens the flexible panel 2 in the longitudinal direction, whilst maintaining flexibility in the radial plane; this results in a crisp and repeatable action of the closure.

- 5 Figure 1b is a scrap cross-section through the end wall 4 of closure shown in Figure 1a, showing how the flexible panel 2 closes against the cut-out 5 in the end wall 4.

Unfortunately, in some circumstances the closure does not offer an adequate seal, particularly at the corners.

10

The reason that this simple closure does not always provide a good seal may be seen from Figure 1c. When the flexible panel 2 is closed, as shown in Figure 1c, the film hinge 7 is too stiff to permit a complete matching of the flexible panel 2 and cut-out 5, with the result that an aperture 8 remains. Another cause of this problem is that all of the force on the flexible panel 2 in the area of the film hinge 7 will be in the direction of arrow F, and the maximum closing force will be at the centre of the flexible panel 2 in the direction of arrow G. Thus there is almost no force available to close the aperture 8 against the resistance of the film hinge 7.

- 20 An example of the present invention is shown in Figures 2a and 2b. In the present invention, the aperture 8 is sealed by the application of a seal 9 to the cut-out 5. It may not be desirable or possible for the seal 9 to join with the film hinge 7, particularly if the seal 9 is to be co-injection moulded onto the cut-out 5, where for certain sealant

materials, the moulding temperature would melt the film hinge 7. In this case, a small gap 10 may remain between the seal 9 and film hinge 7; this is not detrimental because the sealant material will flow to seal the small gap 10. If the application so requires the sealant material may be moulded onto the flexible panel 2.

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When the flexible panel 2 is closed against the cut-out 5, as shown in Figure 2a, the seal 9 is sufficiently soft to elastically flow into the apertures 8 and 10, thus to form a seal between the adjacent surfaces of the cut-out 5, flexible panel 2, and film hinge 7. Even though the closing force of the flexible panel 2 is virtually zero at the film hinge 7 area, 10 the sealant material elastically flows into the apertures 8 and 10, and will in fact exert a small pressure against the adjacent surfaces, and compensate for the lack of closing force in this area.

The applicant has found that a sealant material comprising a liquid-extended polymer 15 composition is particularly effective in this application as it acts almost as a hydraulic fluid, so that the pressure exerted in the centre of the flexible panel 2 is transmitted laterally until the pressure throughout the seal 9 is nearly uniform.

Figures 3 and 4 show containers having a flexible panel closure, in the closed and open 20 positions. In Figure 3, the flexible panel 2 is attached to the top wall 11 with a film hinge 7 and closes against the cut-out 5 in the side wall 12. This arrangement is preferred for pourable liquids such as fruit juice or milk, because the air can enter the container via the open part marked Z, whilst the liquid pours from the lower part K, and this prevents

“glugging” caused by air passing through the liquid and into the container. A lip 13 extending from cut-out 5 helps the liquid to pour in a controlled fashion, and may also serve to provide a convenient opening from which to drink. Furthermore, the lip may be the remainder of the tamper-evident device after removing the tear-off strips described below with reference to Figures 6a and 6b. In Figure 4 the flexible panel 2 is attached to the side wall 12 of a container by film hinge 7, and closes against a cut-out 5 in the end wall 4 of the container. This arrangement is suitable for more viscous liquids, powders and granules.

Figure 5 shows a flexible tube type of container frequently used for creams and pastes. Flexible tube 14 has a flexible panel closure 2 attached to end wall 4 with a film hinge 7, and which closes against the cut-out 15 in side wall 16. A seal 9 as previously described is attached to the flexible panel 2 or the cut-out 15. Preferably, the side wall 16, cut-out 15, film hinge 7 and flexible panel 2 are moulded integrally with the flexible tube 14. The flexible panel 2 may be thermo-sealed or otherwise bonded to the cut-out 15 to provide tamper evidence, as described below. The advantage of this design is that the flexible tube type of container may be filled from the open end, and heat sealed, crimped, or otherwise sealed to retain the contents, to provide a cost-effective pack. Another advantage of this embodiment is that the tube may be safely stood upright on the closure end without the contents leaking.

A common requirement for closures is that they should be tamper-evident – i.e., there should be unambiguous evidence that the closure has been opened. Figures 6a and 6b are

a scrap cross-section on the longitudinal axis through a flexible panel type of closure, and illustrate a principle applicable to all of the examples described herein. Body 1 has an end wall 4, and flexible panel 2, shown in the open position. During manufacture, the seal 9 is moulded onto either the sealing face of cut-out 5, or preferably onto the flexible panel 2, when the flexible panel 2 is in the open position. The flexible panel 2 has a strip 17 attached by a thin web 18, and the cut-out 5 has a flange 19, also with a rib 17 attached by a thin web 18. The flexible panel 2 is then closed as shown in Figure 6b, and the strips 17 are heat sealed together or otherwise sealingly bonded. The thin webs should be adjacent to one another. Seal 9 is compressed to seal the aperture, and a further seal is provided by the bonded strips 17. When it is required to open the closure for the first time, the bonded strips 17 are torn off along the line of the thin web, which permits the flexible panel 2 to be opened. The seal 9 then performs as previously described.

Figure 7 shows an enhancement which may be adapted to all of the foregoing flexible panel types of closure. Cap 20 has a flexible panel 2, and attached to it by frangible means at approximately right angles is a tear-off strip 21, having a finger grip 22. This construction prevents the flexible panel 2 from flexing until the tear-off strip 21 is removed.

An alternative method of making a flexible panel closure is shown in Figures 8a-8f, where the flexible panel is an initially separate component. Referring to Figure 8a, body 1 has an end wall 4, and a panel 22 between the end wall 4 and body 1. The panel 22 is perforated by an aperture 23, and the wall 24 of the body 1 is cut away to form a groove

25 around the panel 22. The groove 25 extends to form a pocket 26 between the wall 24 and panel 12. A hole 27 is formed through the wall 24 into the pocket 26. Flexible panel 2 has a retaining clip 28 having a hole 29 through, and is attached to the flexible panel 2 by at least one frangible connection 30. The hole 29 is of a size to engage with the
5 frangible undercut projection 31 on the top surface of the end wall 4. A detent 32 is sized to fit into the hole 27 in wall 24 of the body 1. A seal 9 is attached to the perimeter of the flexible panel 2. A view of the other side of the flexible panel 2 shows the seal 9. To build the closure, the flexible panel 2 is inserted into the groove 25 until the detent 32 engages in the hole 27. The undercut on detent 32 ensures that the panel 2 cannot be
10 removed once assembled. The hole 29 is then pushed over the frangible projection 31, and again, the undercut on the frangible projection prevents removal without breaking the projection.

Figures 8b and 8c are cross-sections to show the flexible panel in the open and closed
15 positions, respectively, and how the seal 9 seals against the panel 22. Figure 8d shows a rear view of the flexible panel 2.

Figure 8e shows the assembled closure, and Figure 8f shows the appearance after removing the retaining clip 28 from the flexible panel 2. This breaks the frangible
20 projection to leave a small pip 31a, thus providing evidence that the closure has been opened. The shape of the seal 9 should follow the shape of the aperture 13, so that product does not accumulate in the pocket 26. Again, it is quite possible to mould or otherwise attach the seal 9 to the face of panel 12, surrounding the aperture 13.

Figures 9a-9d and Figures 10a and 10b show a closure of the flexible panel type, where the sealing element for the moveable panel is continuous with a seal for sealing between the closure body and its associated container.

5

Figure 9a shows a cap 20 comprising a side wall 1 and end wall 4, and the flexible panel 2 attached by the film hinge 7 to the end wall 4. The flexible panel 2 is shown in the open position for clarity. Figure 9b is a view of the inside of the cap 20. A seal 9 is moulded into or otherwise attached into a groove 33 on the inside face of the end wall 4, and
10 continues over the inside face of the flexible panel 2. Thus, the seal 9 may be likened to an 'O' ring (or similar section seal), fixed to the end wall 4 of the cap 20, and free to move with the flexible panel 2. There is a cut-out 34 in the side wall 1, which is clear of the flexible panel 2 and seal 9 when the panel 2 is closed. Referring to Figure 9c, 35 is a container or the body of a cap (for example a screw cap) having a rim 36 and cut-out 37,
15 the shape of which conforms to seal against the seal 9 attached to the flexible panel 2 when in the closed position. When the cap 20 is assembled to the container 35, as shown in Figure 9d, the panel 2 presses the seal 9 into the cut-out 37 in container 35.

In Figure 10a, the cap 20 and container 35 have a co-operating snap fit 38. The cap 20 is
20 pushed on to the container 35 so that the rim 36 of container 35 presses sealingly into the seal 9 in the groove 33, and is maintained in that position by the snap fit 38. The seal 9, which continues over the flexible panel 2 thus co-operates with and seals against the cut-out 37 in the wall of the container 35 when the flexible panel 2 is in the closed position.

Figure 11 shows a similar type of closure, with the seal 9 attached to the container instead of the flexible panel 2. In this arrangement, the connection between the cap 20 and container 35 is effected by ultrasonic welding at 39, or by adhesive or sealant.

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Alternatively, a metal-loaded plastic sealing ring may be incorporated, which is melted by the application of radio frequency energy to join and seal the two parts.

For some applications, such as closures to be used for dispensing drinks, or those for
10 dispensing irritating or harmful chemicals, it is preferable that the user's hand does not come into contact with the product to be dispensed. Figures 12a, 12b and 12c show a closure having a tab 40 attached by the hinge 41 to the flexible panel 2. As shown in Figures 12a and 12b, when the panel 2 is in the closed position, tab 40 provides additional security to prevent inadvertent opening by co-operating with the lip 42 of the
15 closure body 1. With the tab 40 is unclipped from the lip 42, it serves as a grip which the user grasps to pull open the flexible panel 2, as shown in Figure 12c.

Figures 13a and 13b show a flexible panel 2 with a fixed tab 43 with which the user can push or pull the flexible panel to close or open it.

20

A simpler way of keeping the user's hand clear of the product being dispensed is to extend the front of the flexible panel 2 to form a tab 44 by which the panel may be operated, as shown in Figure 14.

Figures 15a, 15b and 15c show how the flexible panel may be operated more remotely by attaching a paddle 45 to a rib 46, which in turn is attached to the flexible panel 2. The paddle 45 operates a fulcrum 47, so that when the user presses on the paddle 45 in the direction of the arrow S, a force is exerted on the panel 2 in the opposite direction to the arrow S causing the panel to open. To close the panel 2, the user pushes on the rib 46.

In all of the embodiments shown in Figures 12-15, it is beneficial to have one or more ribs running longitudinally along the flexible panel to ensure sufficient stiffness to transmit the opening or closing force without buckling.

Claims

1. A resealable closure comprising a curved flexible panel forming part of the wall of a container or cap therefor, the area of the curved flexible panel being greater than the area of the wall of the container or cap defined by a hinge line of action, so that the curved flexible panel may be forced to pass from a convex form to a concave form and *vice versa* with an over centre snap action as the curved flexible panel is caused to pass through area of the wall of the container or cap defined by the hinge, and the curved flexible panel being inwardly concave to at least partially close an opening in the container or cap when in a first position, and being outwardly convex to form a dispensing opening in the second position, wherein the container or cap has a seal comprising an elastic gel composition attached thereto which seals the opening when the curved flexible panel is in the first position.
2. A resealable closure according to claim 1, wherein the elastic gel composition has an elongation of at least 100%, preferably at least 200%, most preferably at least 1000%, a compression set at 70°C of less than 30%, preferably less than 20%, most preferably less than 10%, a cone penetration (ASTM D217 for greases) of from 10 to 40 mm, an initial softening point of greater than 100°C and a stress relaxation of greater than 500 seconds.

3. A resealable closure according to claim 1 or 2, in which the gel composition comprises a block copolymer having hard blocks and relatively elastomeric blocks extended with an oil in a preferred ratio of 5 parts oil to 1 part copolymer.

5 4. A resealable closure according to any preceding claim, in which the gel composition is a liquid-extended polymer composition.

5. A resealable closure according to claim 4, wherein the polymer of the liquid-extended polymer composition is a block copolymer.

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6. A resealable closure according to claim 4 or 5, wherein the polymer of the liquid-extended polymer composition is a block copolymer having hard blocks and soft blocks.

7. A resealable closure according to any of claims 4 to 6, wherein the polymer of the
15 liquid-extended polymer composition is a styrene-diene block copolymer.

8. A resealable closure according to any of claims 4 to 7, wherein the polymer of the liquid-extended polymer composition is a poly(styrene-butadiene-styrene) block copolymer (SBS), a poly(styrene-isoprene-styrene) block copolymer (SIS), a
20 poly(styrene-ethylene-butylene-styrene) block copolymer (SEBS), a poly(styrene-ethylene-propylene-styrene) block copolymer (SEPS) or a poly(styrene-ethylene-propylene) block copolymer (SEP).

9. A resealable closure according to any of claims 4 to 8, wherein the extender liquid of the liquid-extended polymer composition is a paraffinic or naphthenic oil.

10. A resealable closure according to any of claims 4 to 9, wherein the liquid-extended polymer composition comprises between 80 and 90% extender liquid and between 10 and 20% polymer.

11. A resealable closure according to any preceding claim, which has a tab fitted to or integral with the flexible panel to assist operation of the resealable closure.

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12. A resealable closure according to claim 11, wherein the tab is attached to the flexible panel via a fulcrum.

13. A resealable closure according to any preceding claim, which further comprises a tamper-evident seal.

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14. A resealable closure according to claim 13, in which the tamper-evident seal comprises an extension portion formed in the flexible panel.

20 15. A resealable closure according to any preceding claim, which is manufactured as an integral part of the container.

16. A resealable closure according to any preceding claim, wherein the hinge is an integral part of the resealable closure.

17. A resealable closure according to any preceding claim, in which the flexible panel
5 is manufactured as an initially separate component securable to the container or cap.

18. A resealable closure comprising a curved flexible panel forming part of the wall
of a container or cap therefor, the area of the curved flexible panel being greater than the
area of the wall of the container or cap defined by a hinge line of action, so that the
10 curved flexible panel may be forced to pass from a convex form to a concave form and
vice versa with an over centre snap action as the curved flexible panel is caused to pass
through area of the wall of the container or cap defined by the hinge, and the curved
flexible panel being inwardly concave to at least partially close an opening in the
container or cap when in a first position, and being outwardly convex to form a
15 dispensing opening in the second position, wherein the container or cap has an elastic seal
attached thereto which deforms to create a liquid-tight seal when the curved flexible
panel is in the first position.

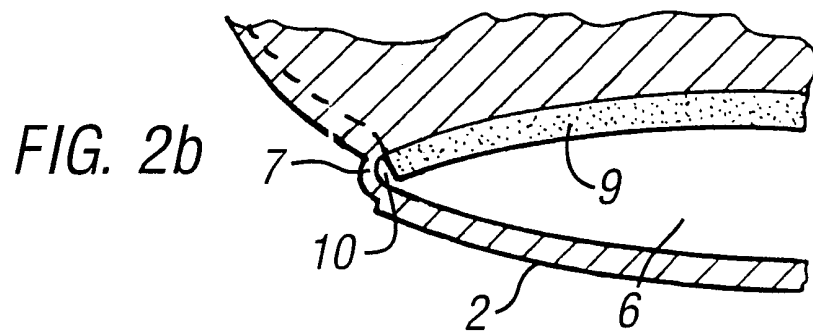
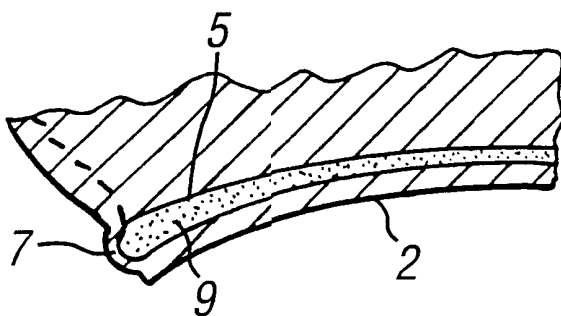
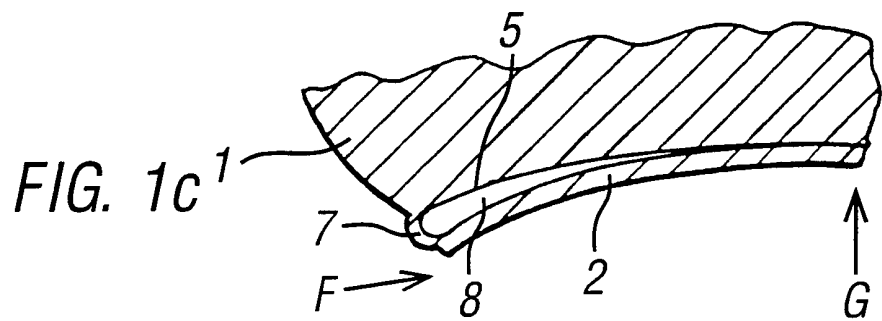
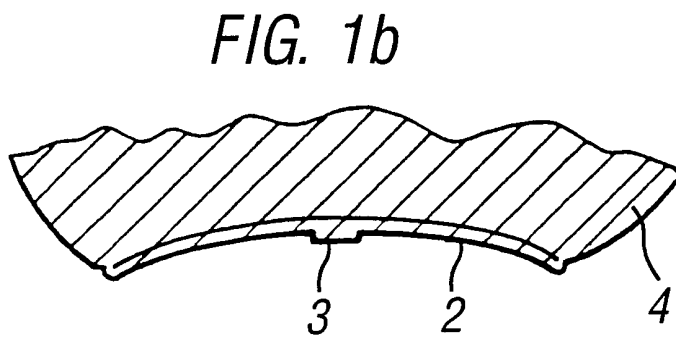
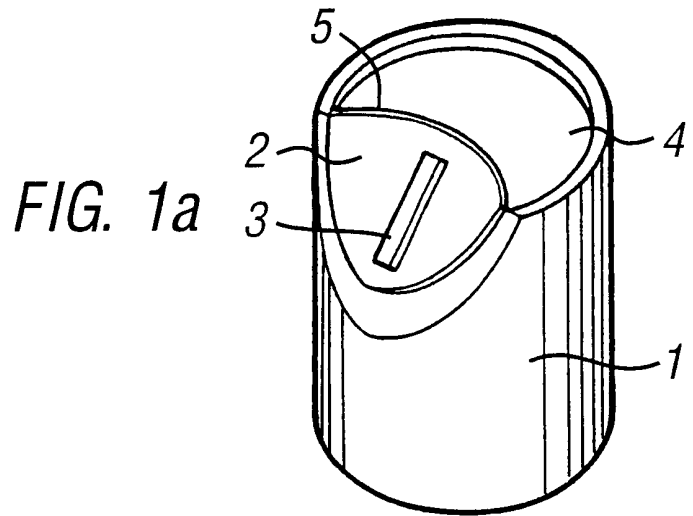
19. The combination of a container and a resealable closure according to any
20 preceding claim, wherein the seal for the flexible panel is continuous with a seal for
sealing between the closure body and a container.

20. The combination of a flexible tube container having a resealable closure according to any preceding claim.

21. The combination of a container and a resealable closure according to any
5 preceding claim, which contains a liquid under pressure.

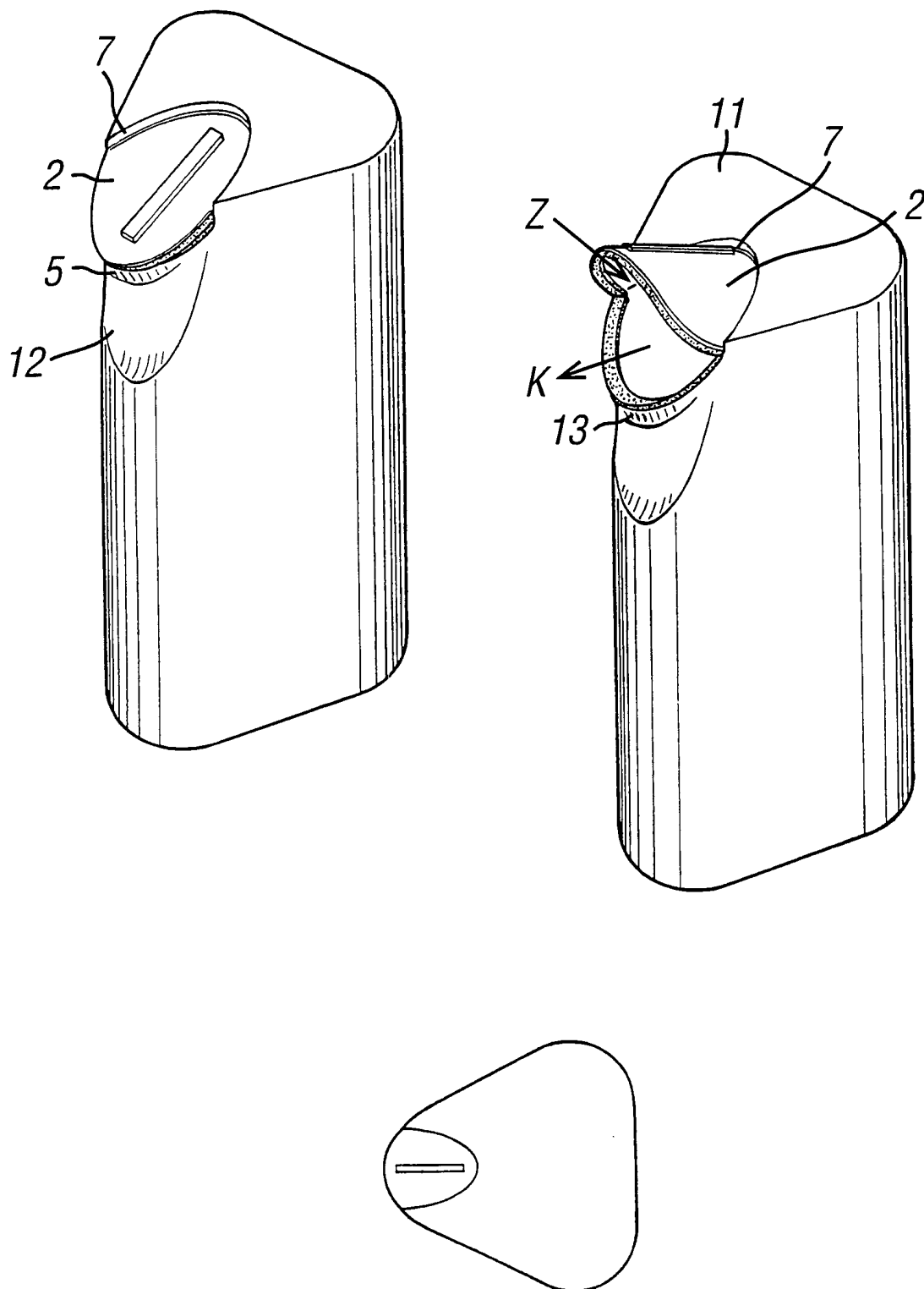
22. A container according to claim 21, in which the liquid contains a dissolved gas.

1/13

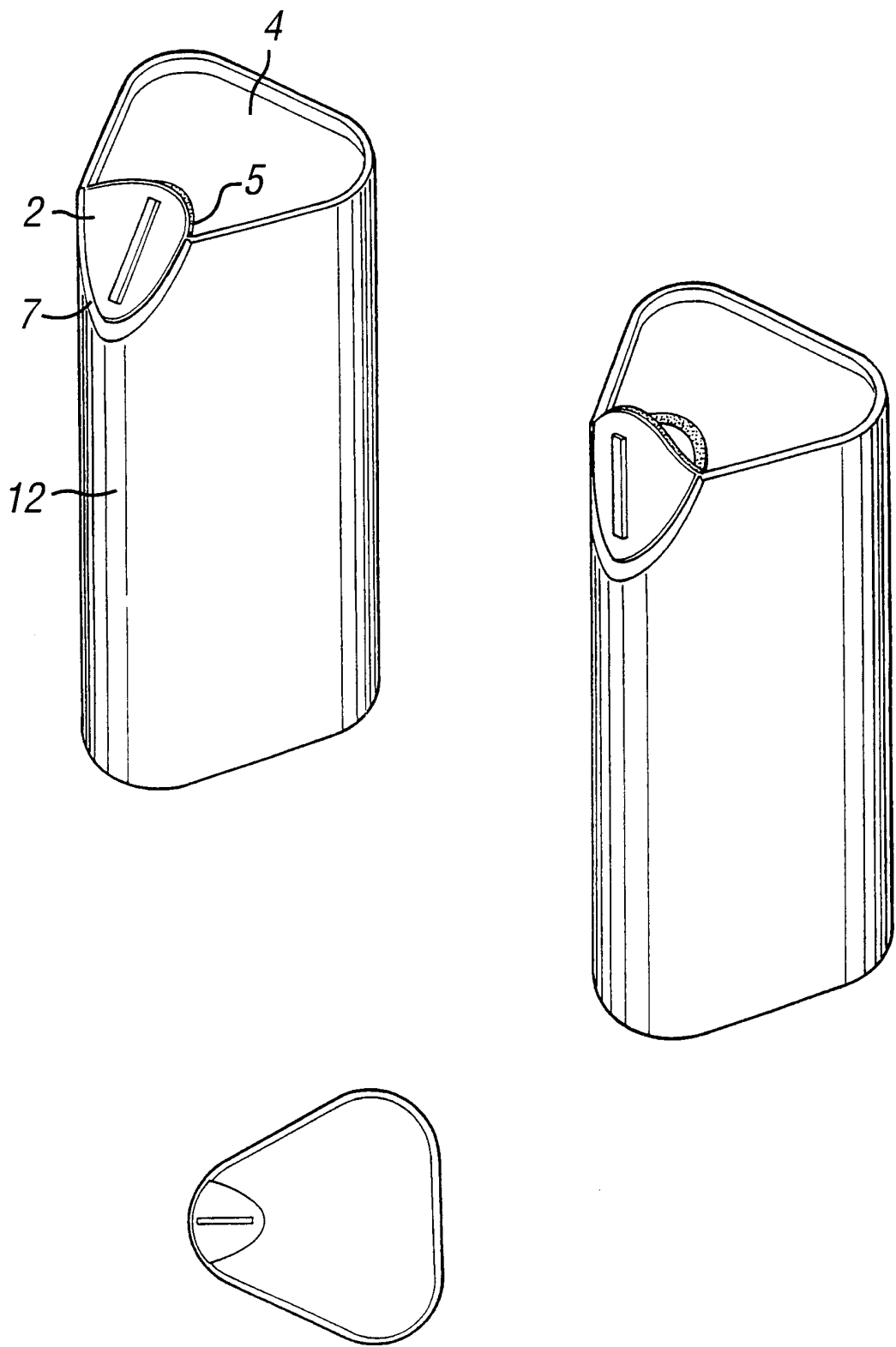


2/13

FIG. 3



3/13
FIG. 4



4/13

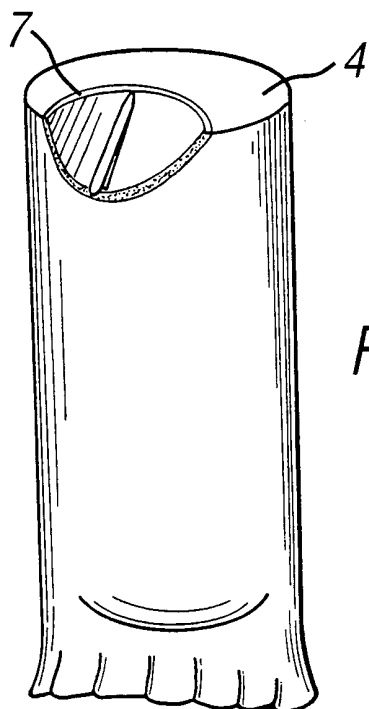


FIG. 5

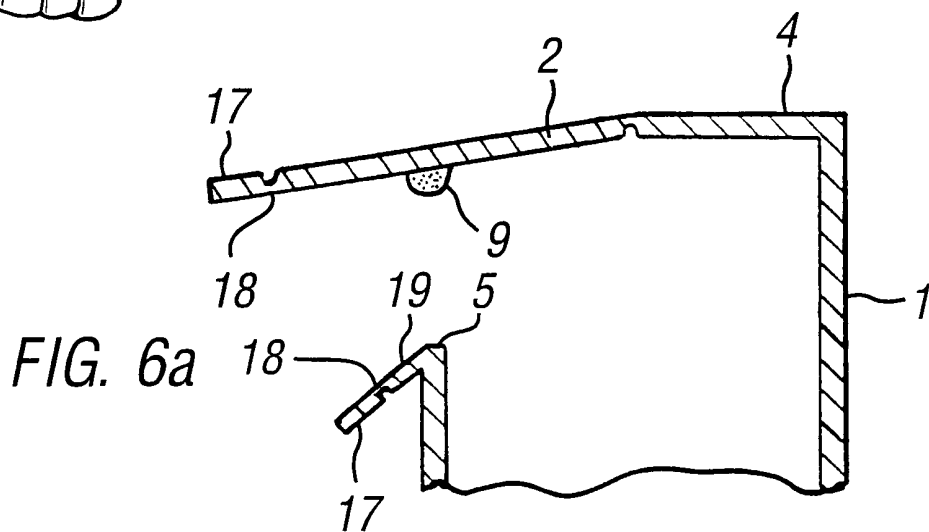


FIG. 6a

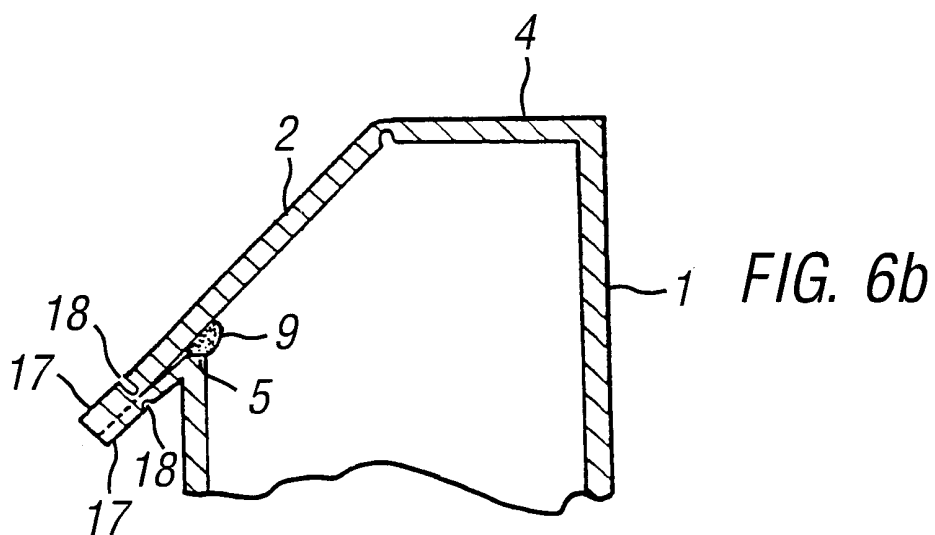
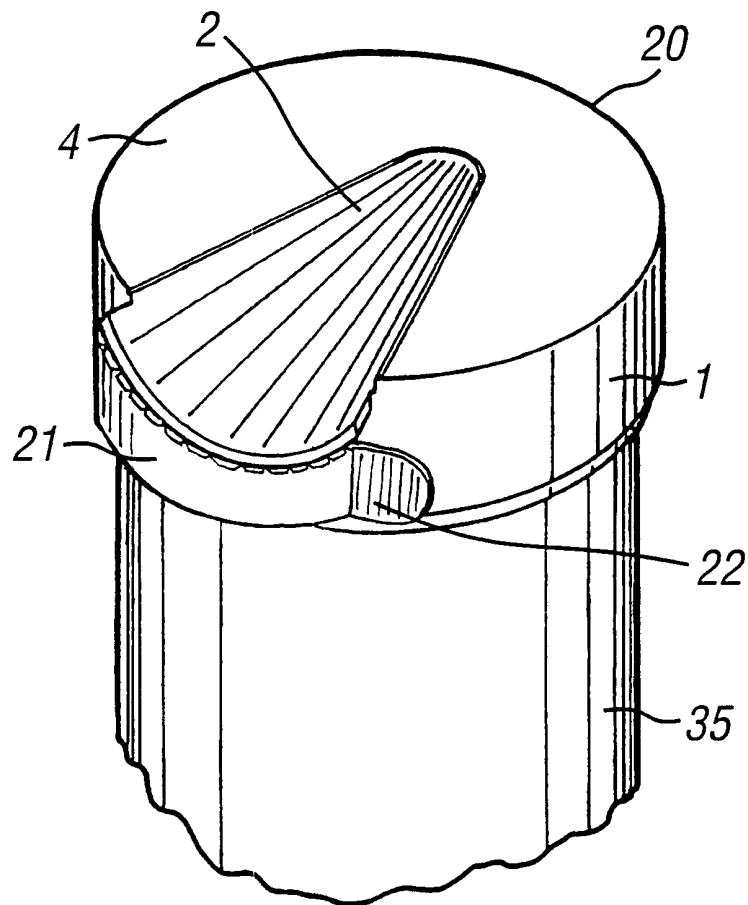


FIG. 6b

5/13

FIG. 7



6/13

FIG. 8a

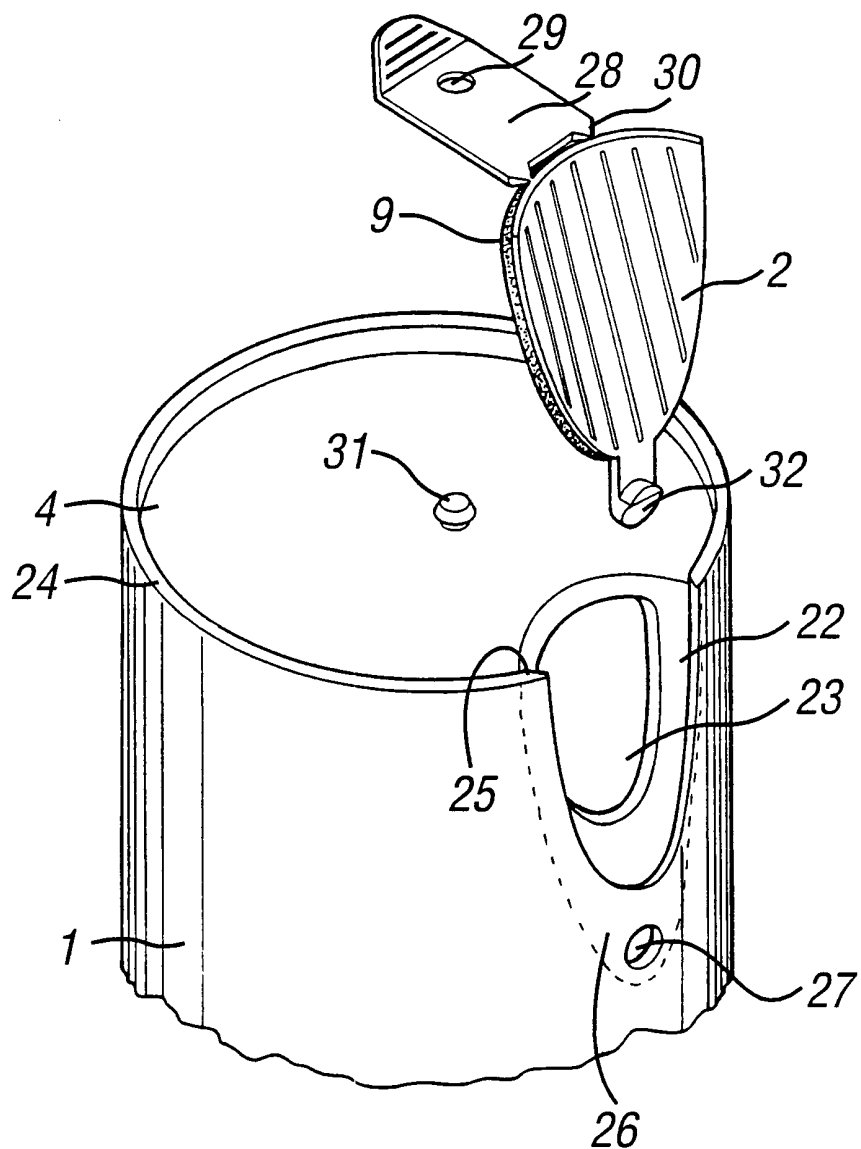


FIG. 8b

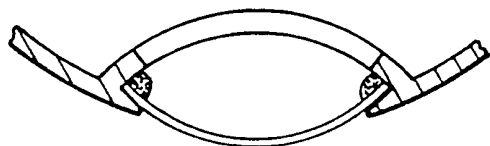
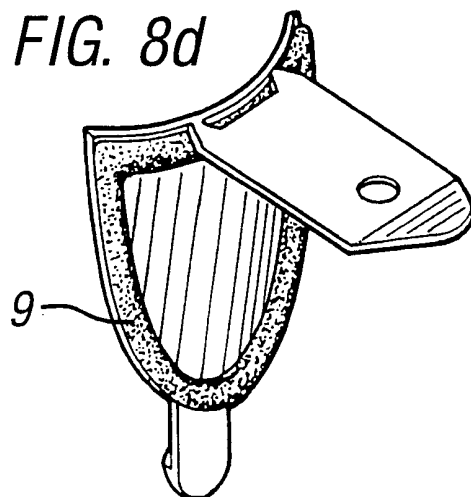


FIG. 8c



FIG. 8d



7/13

FIG. 8e

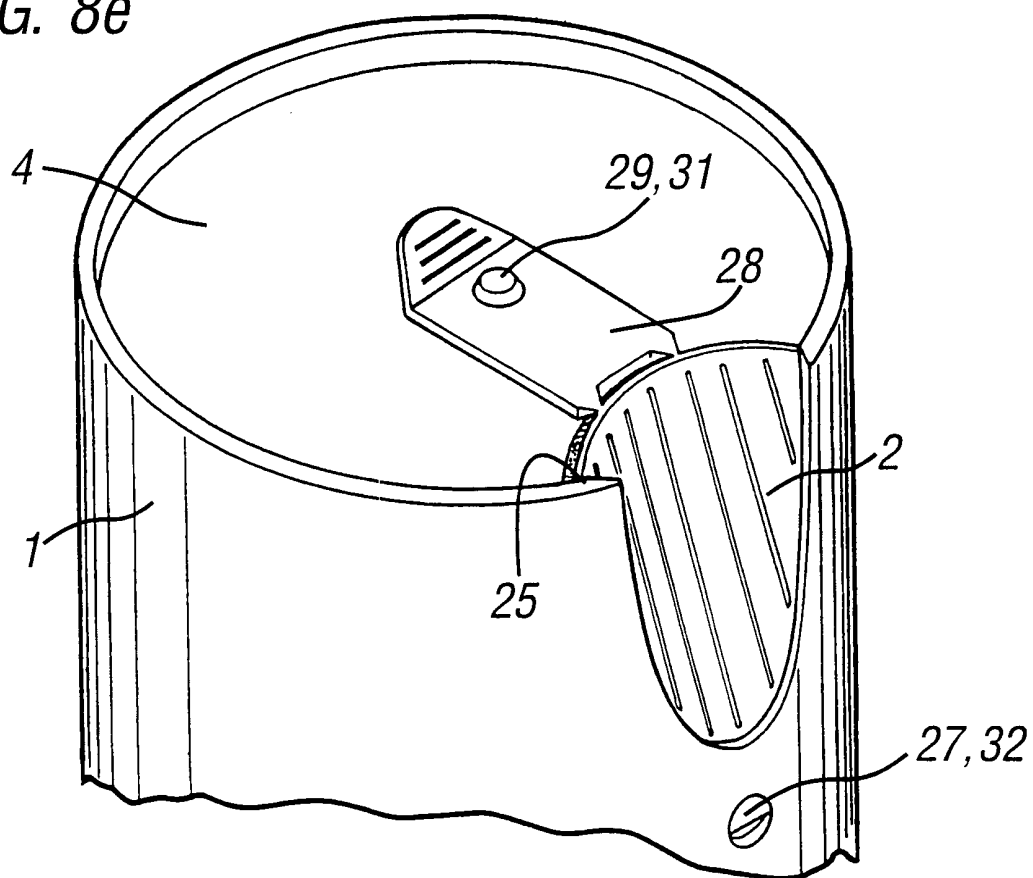
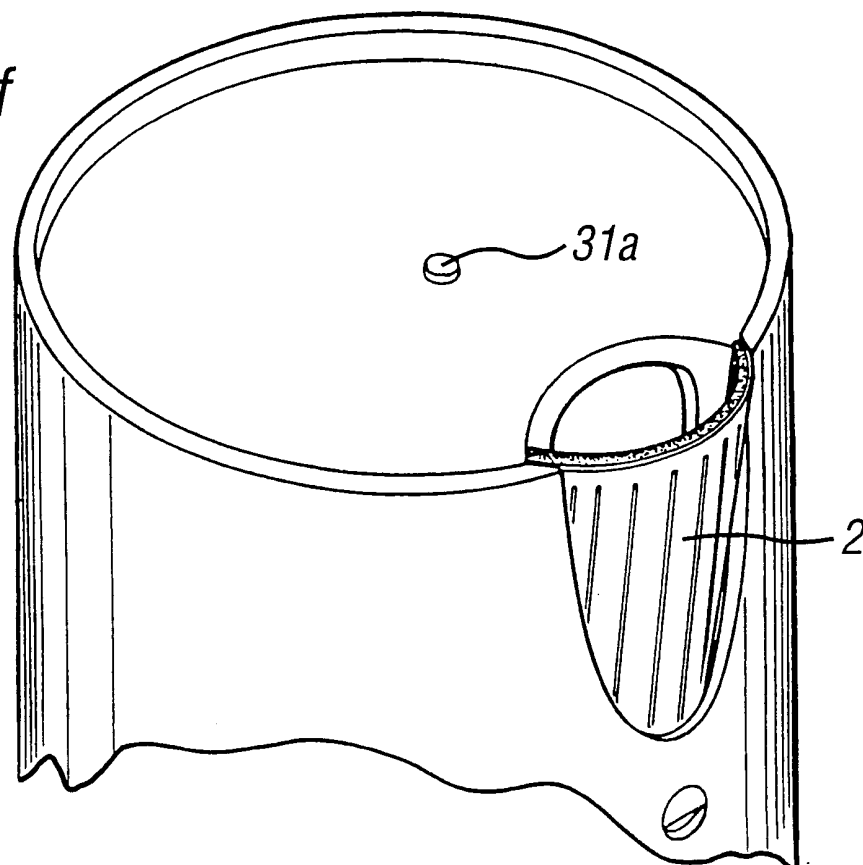
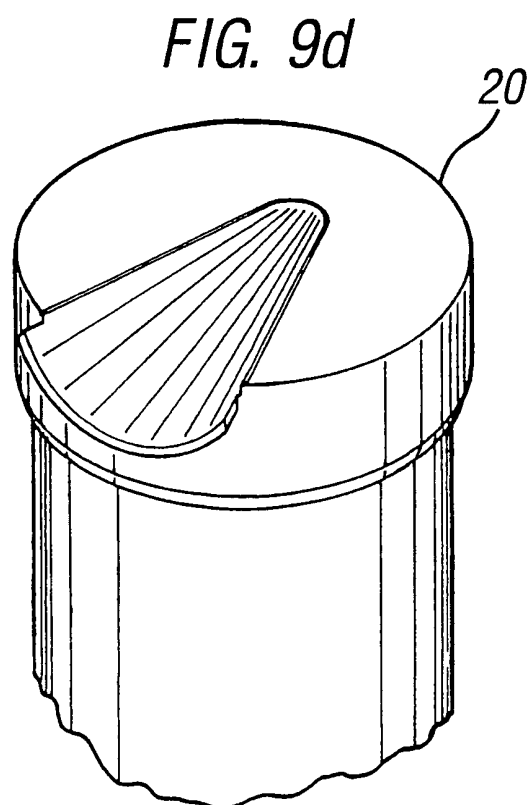
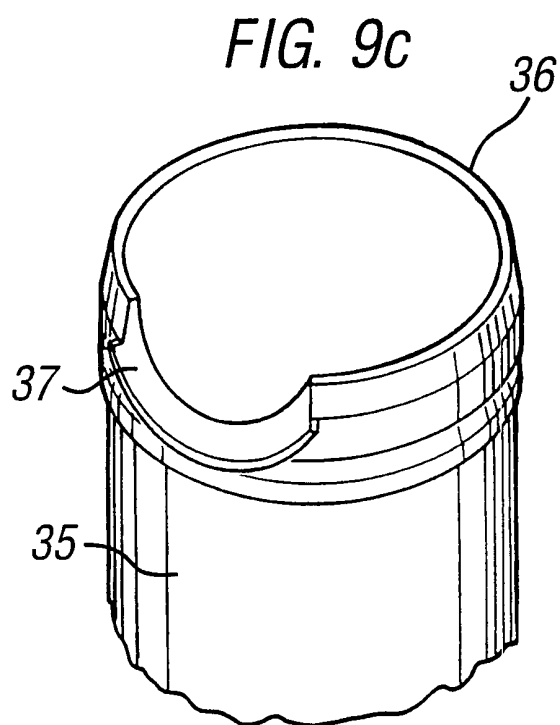
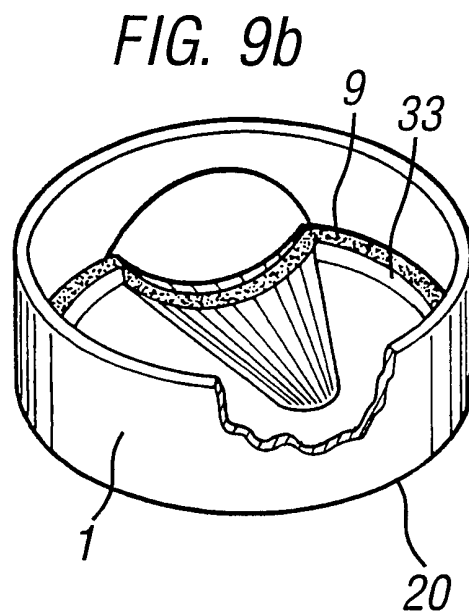
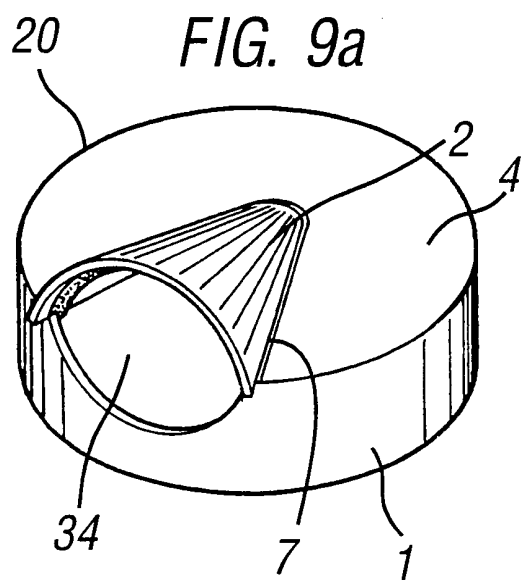


FIG. 8f



8/13



9/13

FIG. 10a

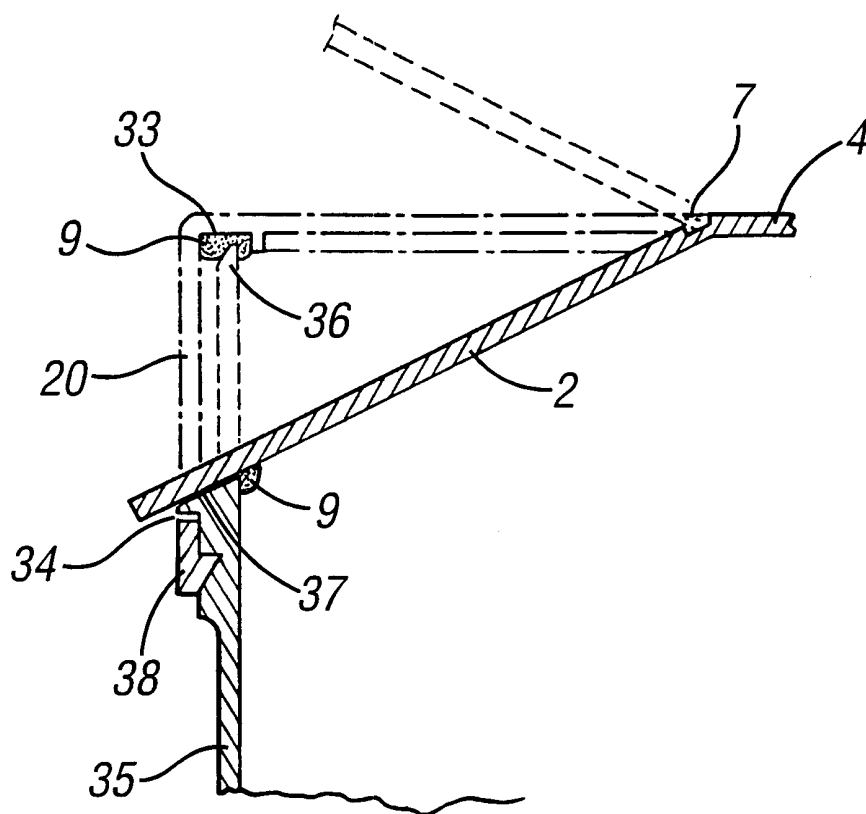
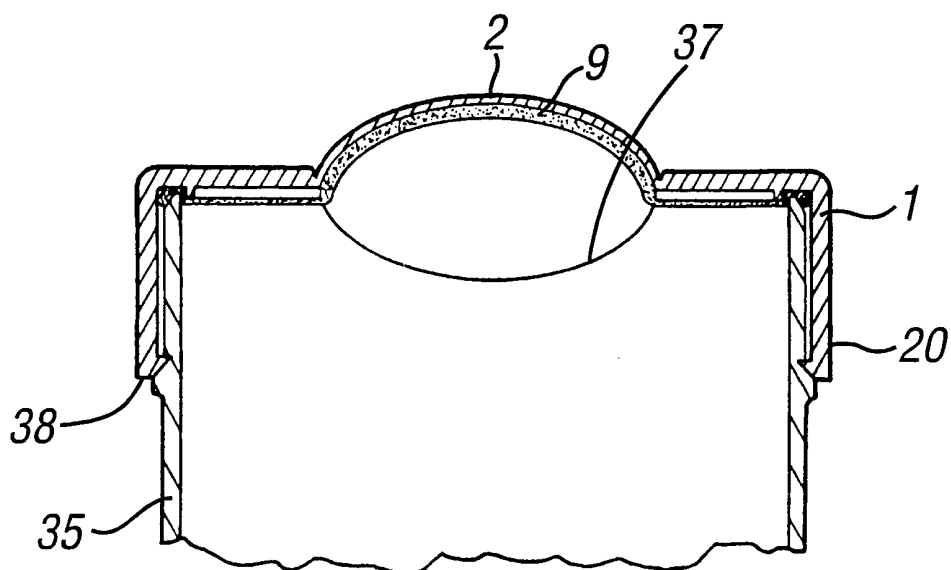
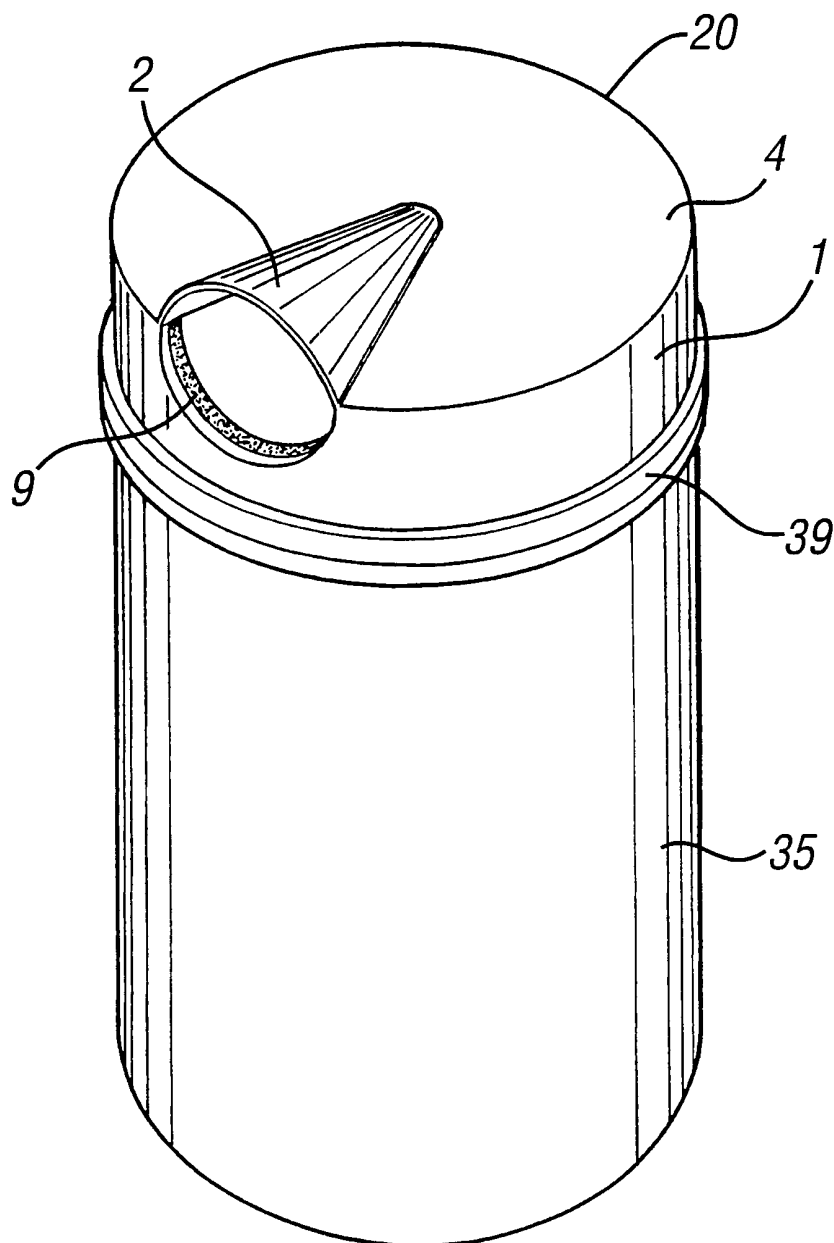


FIG. 10b



10/13

FIG. 11



11/13

FIG. 12a

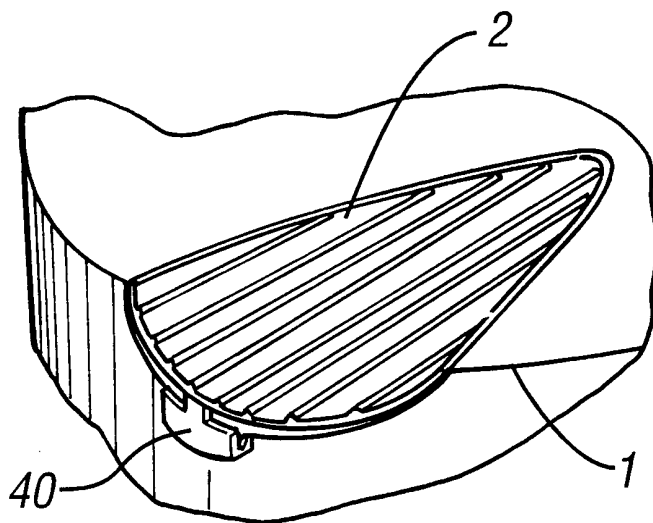


FIG. 12b

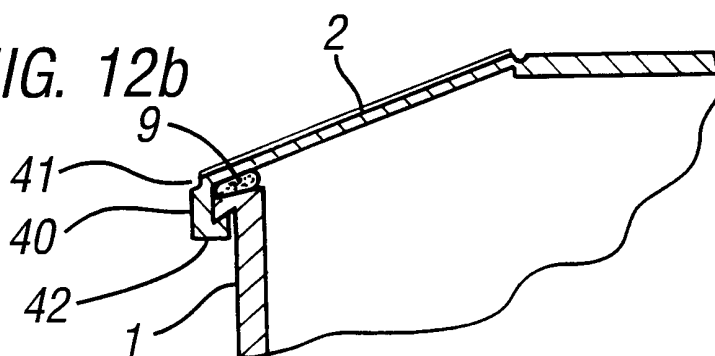
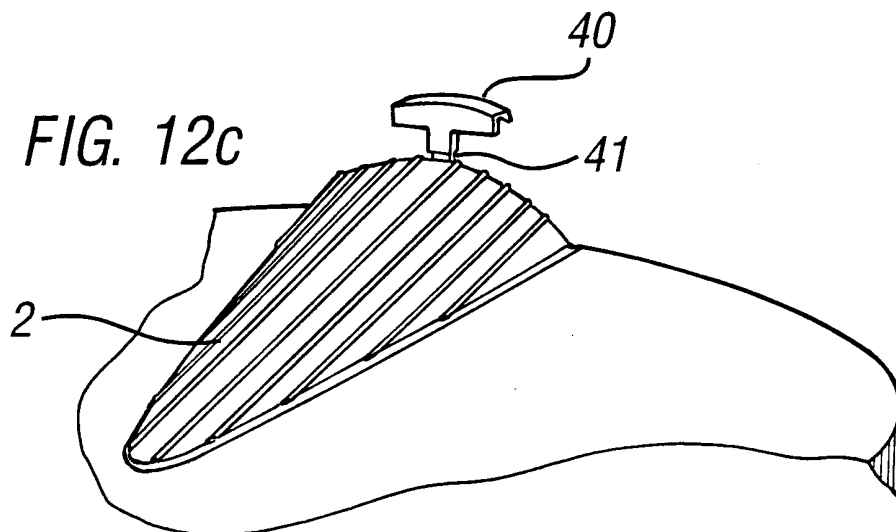


FIG. 12c



12/13

FIG. 13a

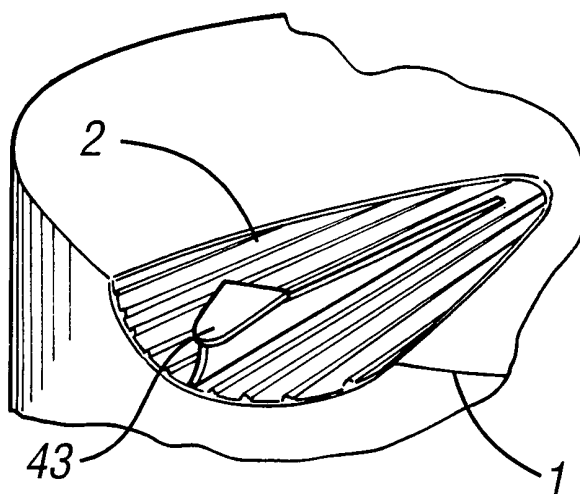


FIG. 13b

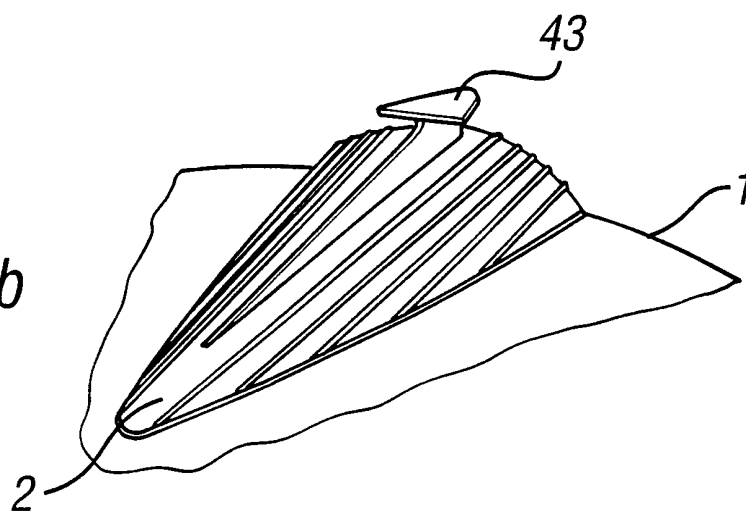
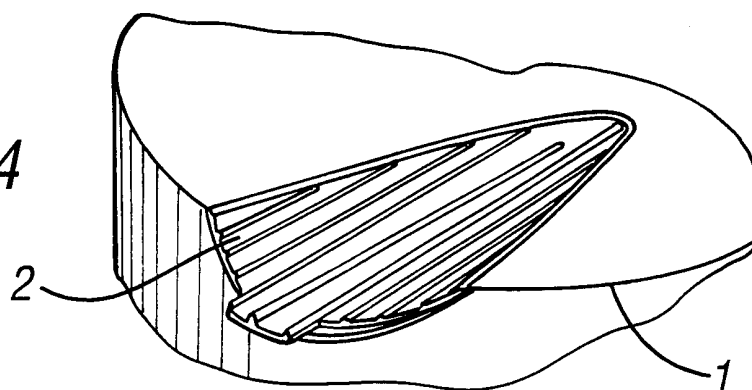


FIG. 14



13/13

FIG. 15a

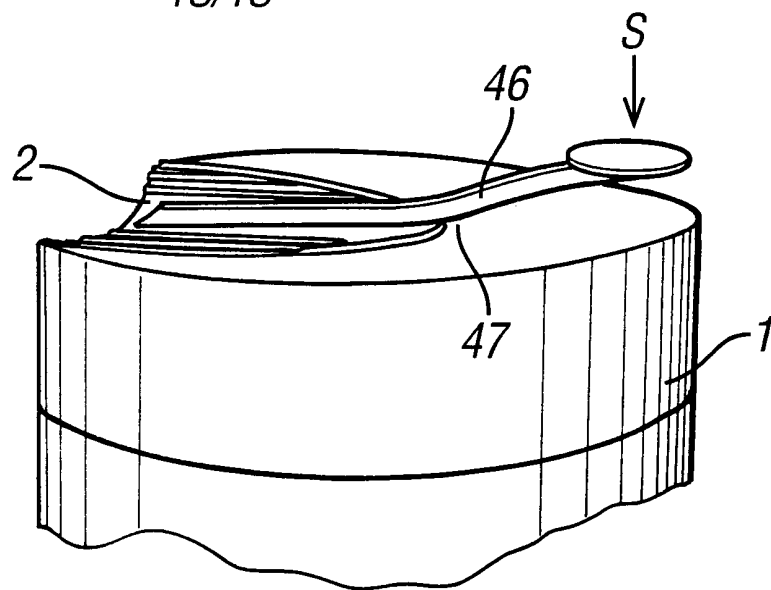


FIG. 15b

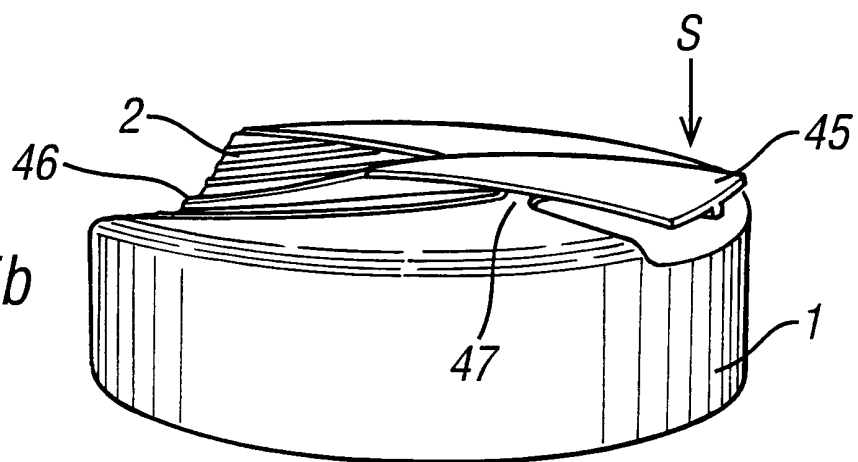
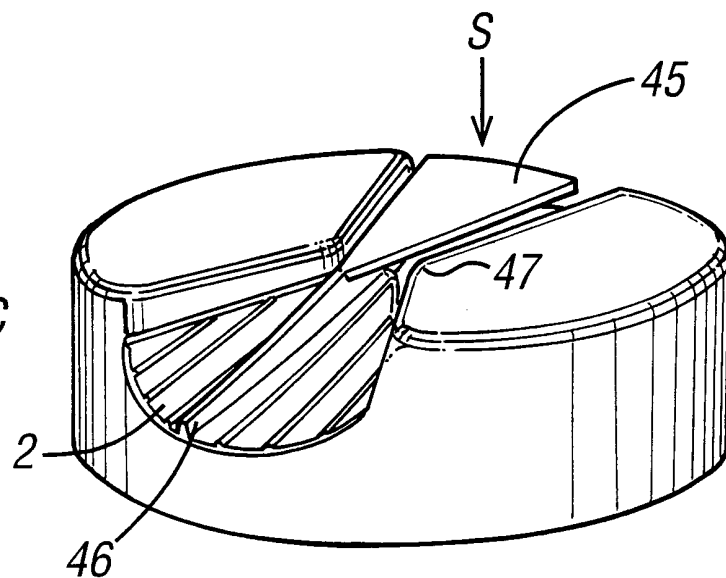


FIG. 15c



INTERNATIONAL SEARCH REPORT

Int l Application No

PCT/GB 00/04091

A. CLASSIFICATION OF SUBJECT MATTER IPC 7 B65D47/08 B65D47/20 B65D53/06 B65D25/46		
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		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 99 43243 A (KIM JONATHAN) 2 September 1999 (1999-09-02) column 8, line 20 -column 9, line 27; figures 6-8 ---	1,18,20
A	US 3 334 797 A (LATHAM PETER A. ;BREFKA PAUL E.) 8 August 1967 (1967-08-08) column 2, line 61 -column 3, line 2 column 3, line 43 -column 4, line 37 column 4, line 73 -column 6, line 49 ---	1,11, 13-16, 18,20
A	EP 0 577 397 A (MINEBEA KK ;MITSUBISHI HEAVY IND LTD (JP)) 5 January 1994 (1994-01-05) column 4, line 55 -column 5, line 12 --- -/--	1
<div style="display: flex; justify-content: space-between;"> <input checked="" type="checkbox"/> Further documents are listed in the continuation of box C. <input checked="" type="checkbox"/> Patent family members are listed in annex. </div>		
° Special categories of cited documents :		
<div style="display: flex;"> <div style="flex: 1;"> <p>*A* document defining the general state of the art which is not considered to be of particular relevance</p> <p>*E* earlier document but published on or after the international filing date</p> <p>*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>*O* document referring to an oral disclosure, use, exhibition or other means</p> <p>*P* document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="flex: 1;"> <p>*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>* & * document member of the same patent family</p> </div> </div>		
Date of the actual completion of the international search <div style="text-align: center; font-weight: bold;">30 January 2001</div>		Date of mailing of the international search report <div style="text-align: center; font-weight: bold;">13/02/2001</div>
Name and mailing address of the ISA 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		Authorized officer <div style="text-align: center; font-weight: bold;">Balz, O</div>

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International Application No

PCT/GB 00/04091

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>US 5 381 914 A (KOYAMA MASAYASU ET AL) 17 January 1995 (1995-01-17) column 8, line 28 -column 9, line 48 -----</p>	3-9

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