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(54) **CLOSURE FOR A CONTAINER, ESPECIALLY A BOTTLE**

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(57) **ABSTRACT**

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(2), (4) Date: **Jan. 23, 2007**

The invention relates to a closure for a container, especially a bottle, comprising an upper covering panel and a circumferential collar adjoining the panel on the outside, wherein a scaling insert is arranged on the underside of the covering panel which has a circumferential profile seal on the outside. The upper covering panel has at least one partly circumferential embossing which interacts with the profile seal forming a valve.

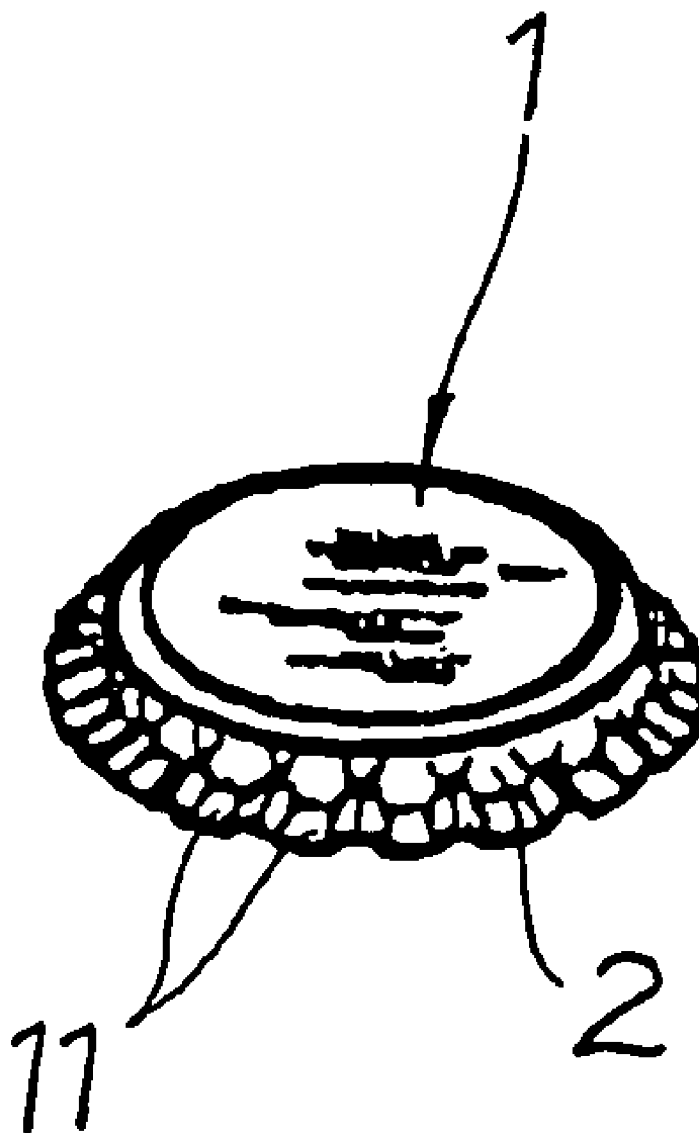


Fig. 1

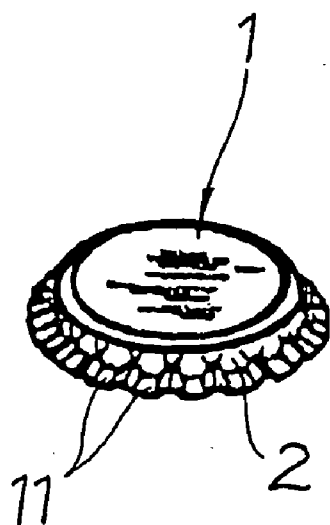
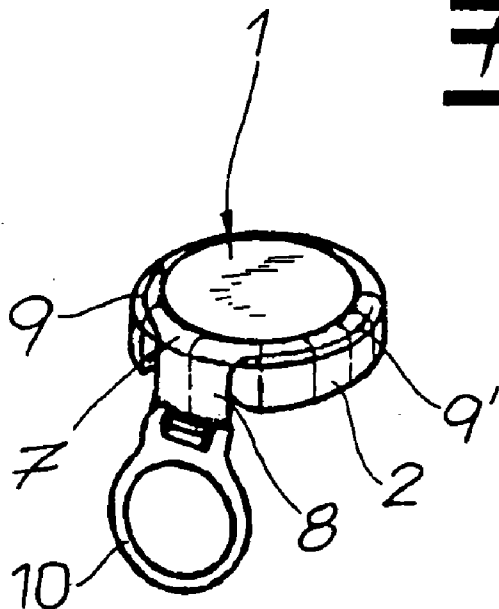


Fig. 2

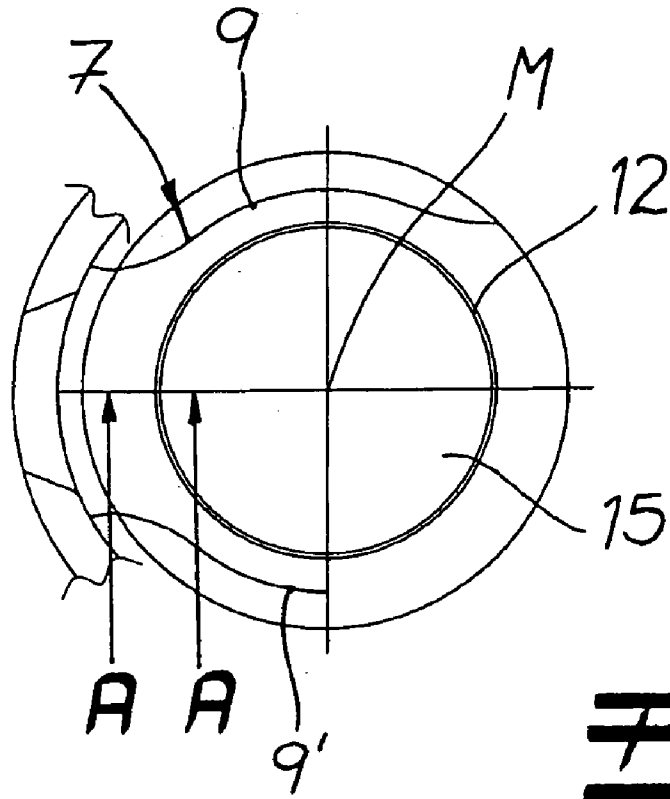


Fig. 3

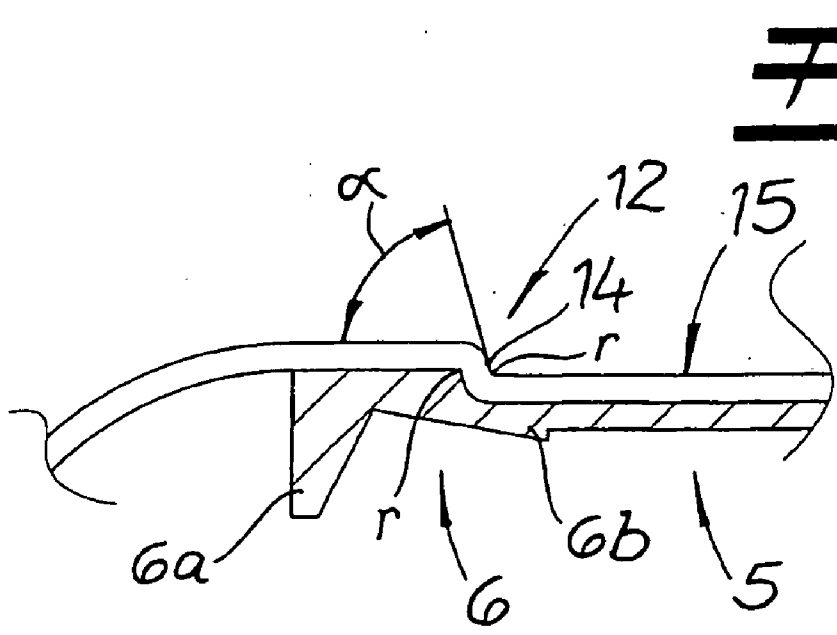


Fig. 3a

Fig. 4

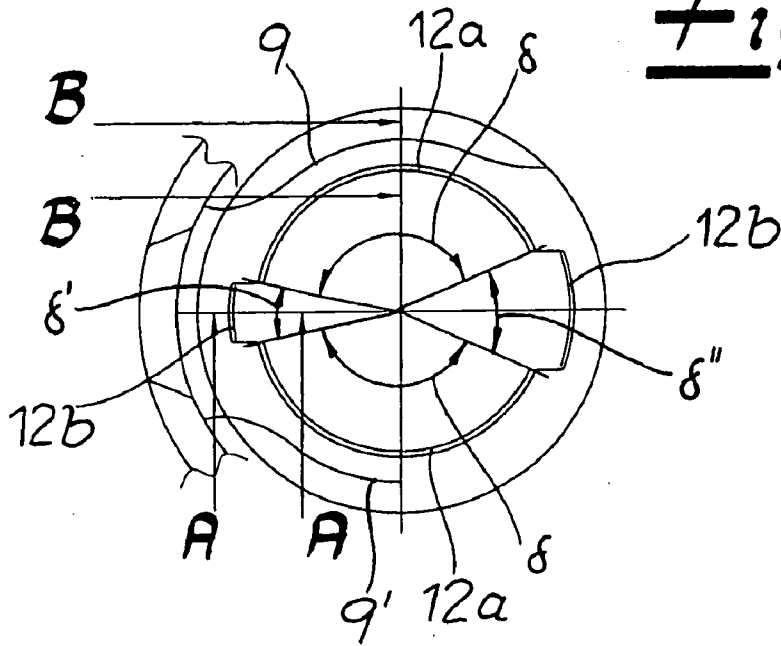


Fig. 4a

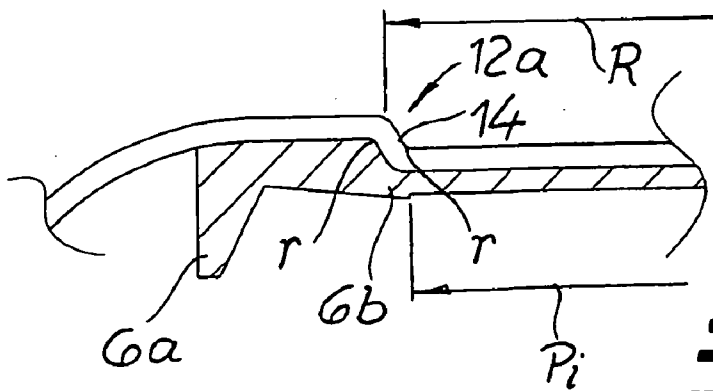
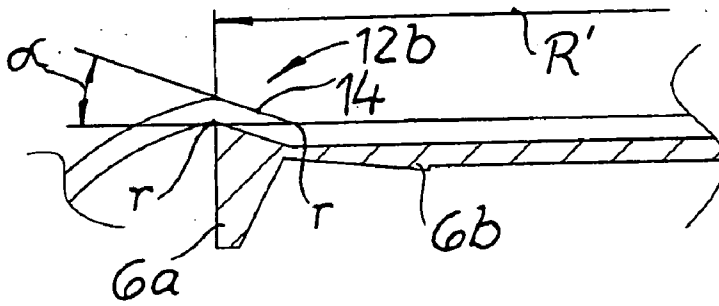


Fig. 4b

Fig. 5

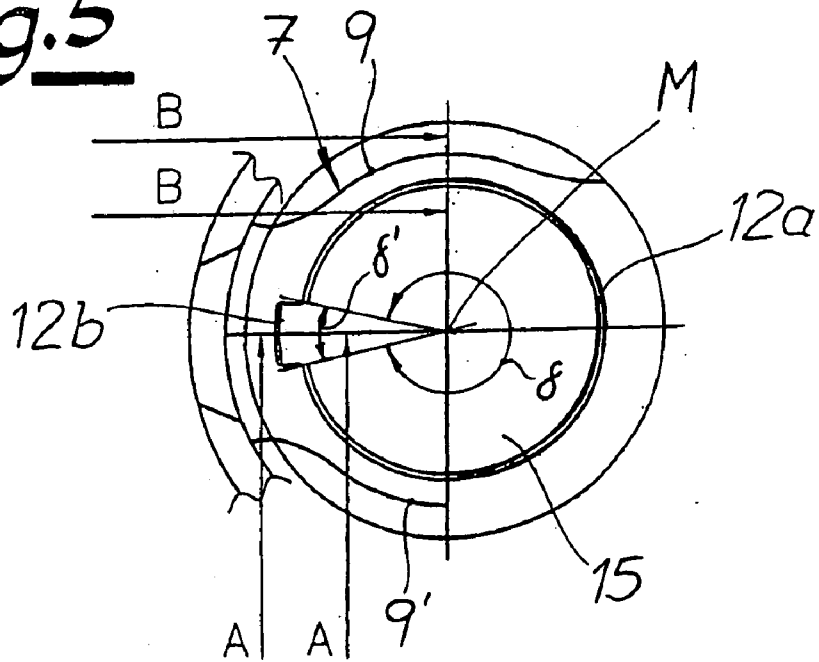


Fig. 5a

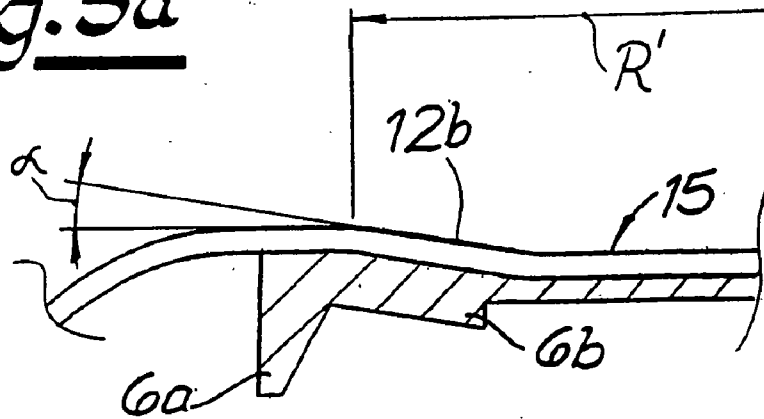


Fig. 5b

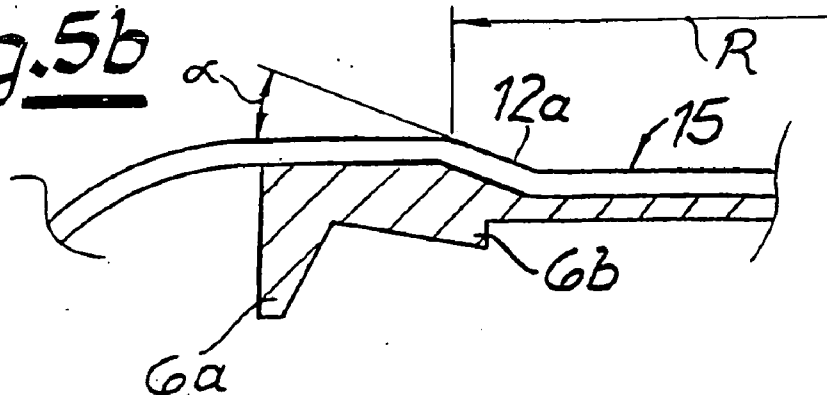


Fig. 6

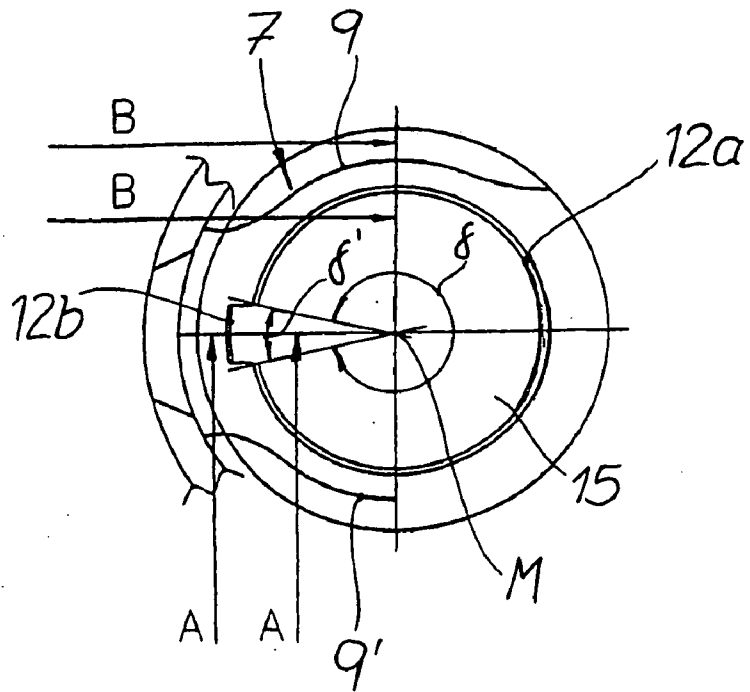


Fig. 6a

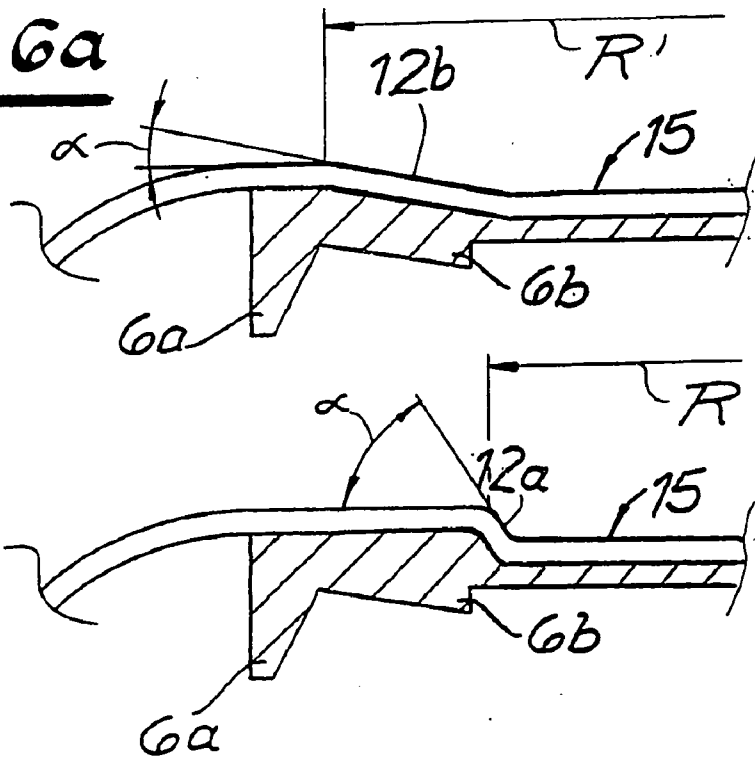
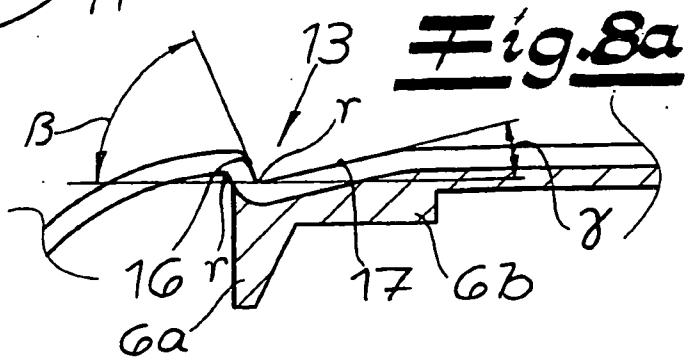
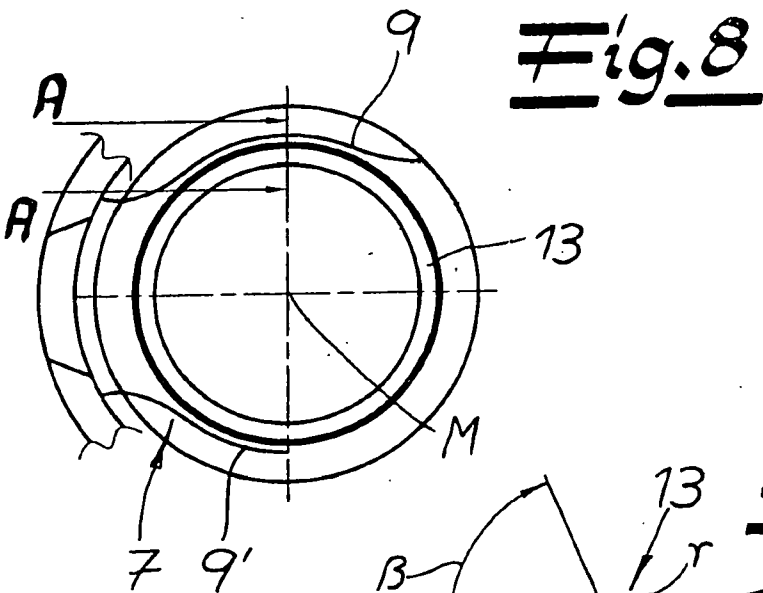
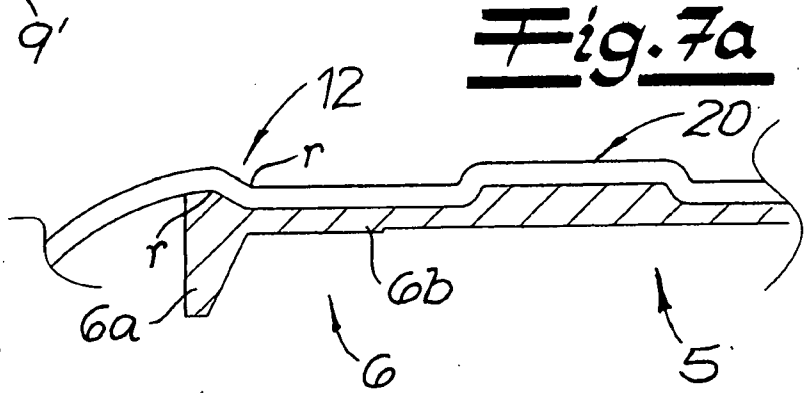
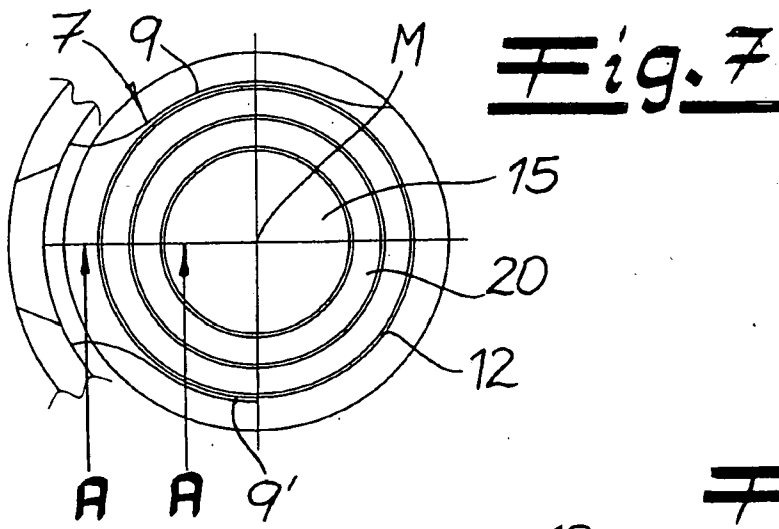


Fig. 6b



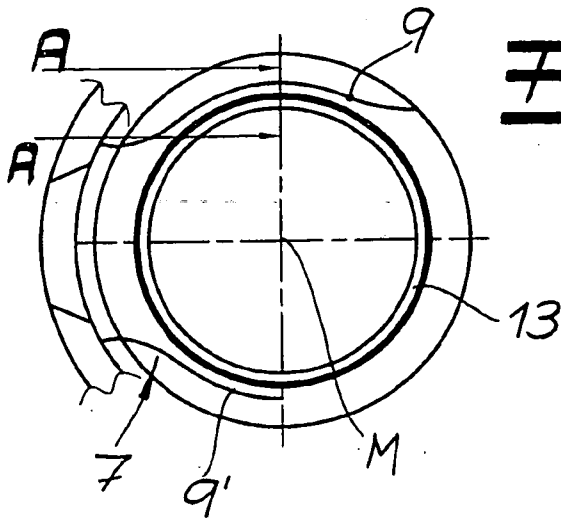


Fig. 9

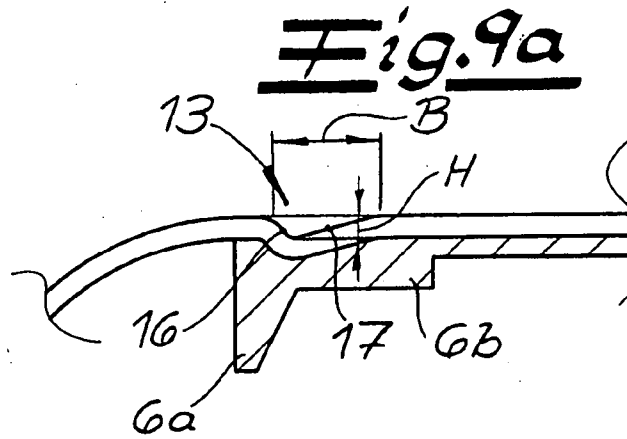


Fig. 9a

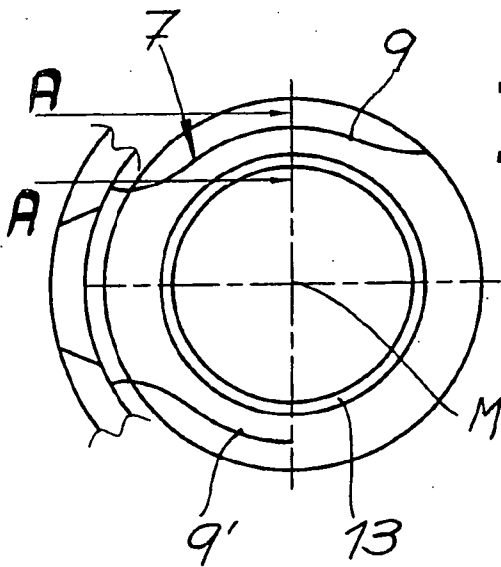


Fig. 10

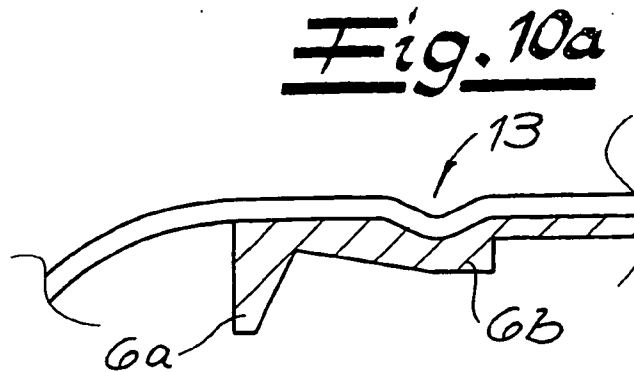


Fig. 10a



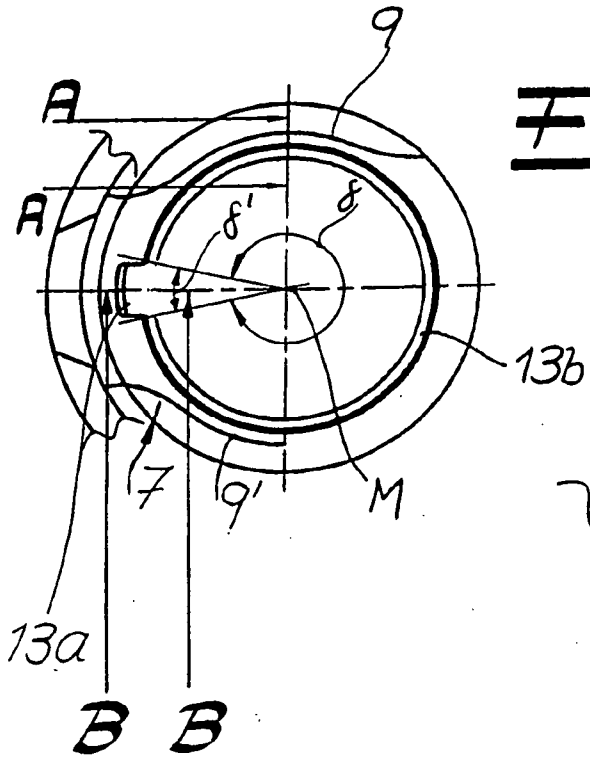


Fig. 11

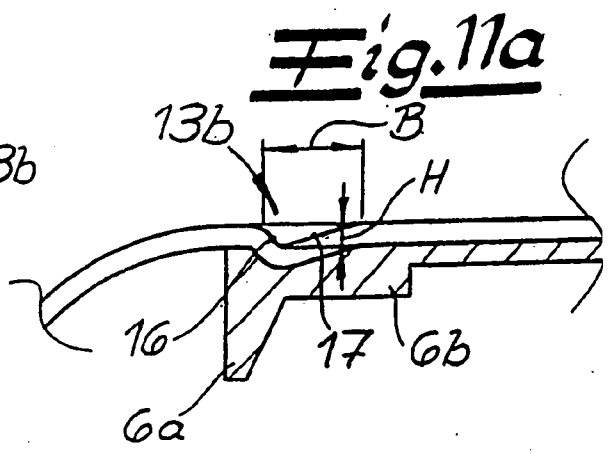


Fig. 11a

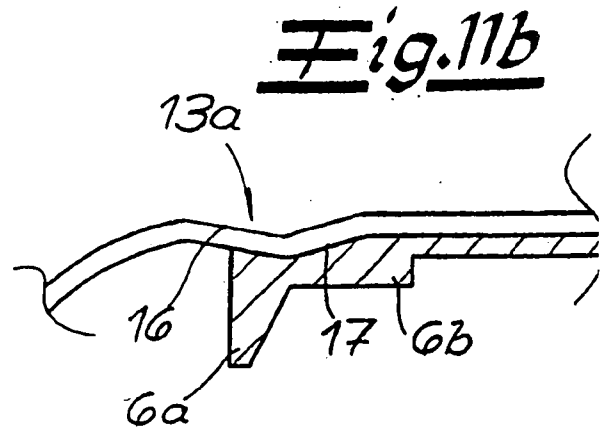


Fig. 11b

Fig. 12

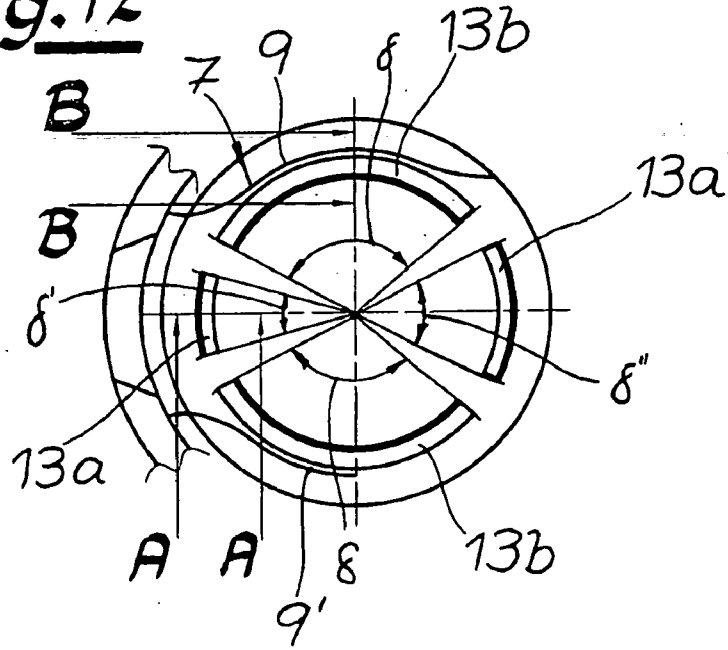


Fig. 12a

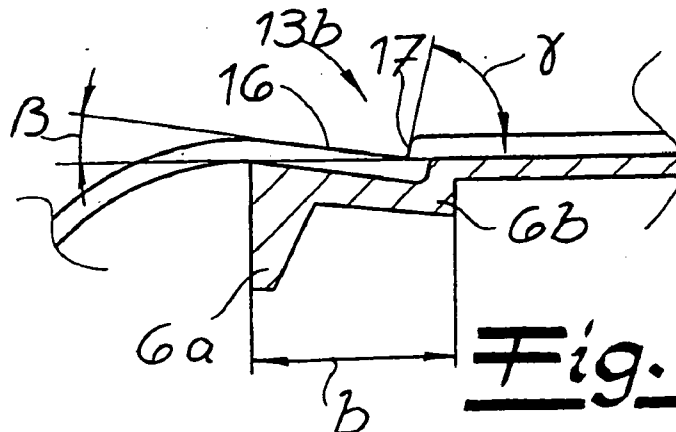
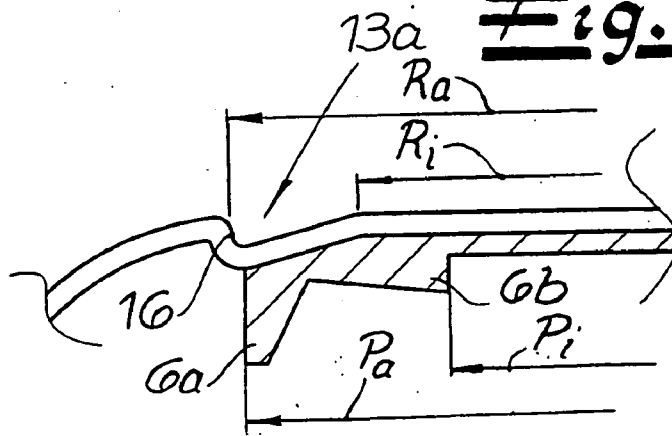


Fig. 12b

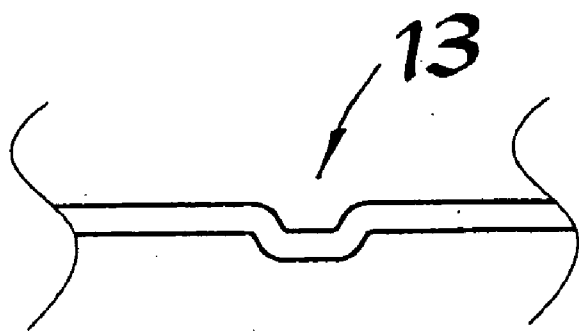


Fig. 13

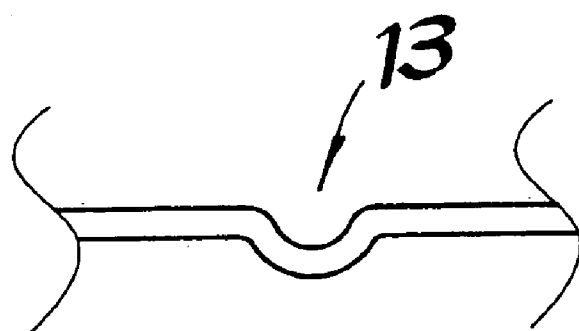


Fig. 13a

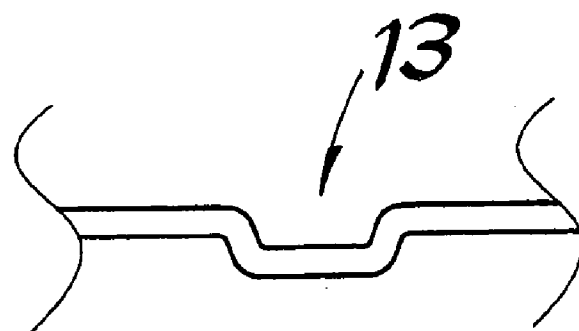


Fig. 13b

Fig. 14

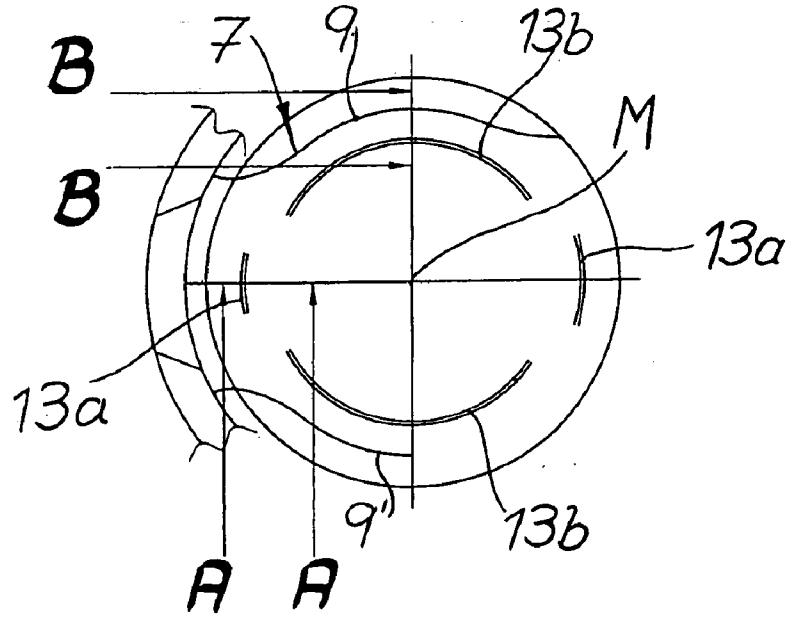


Fig. 14a

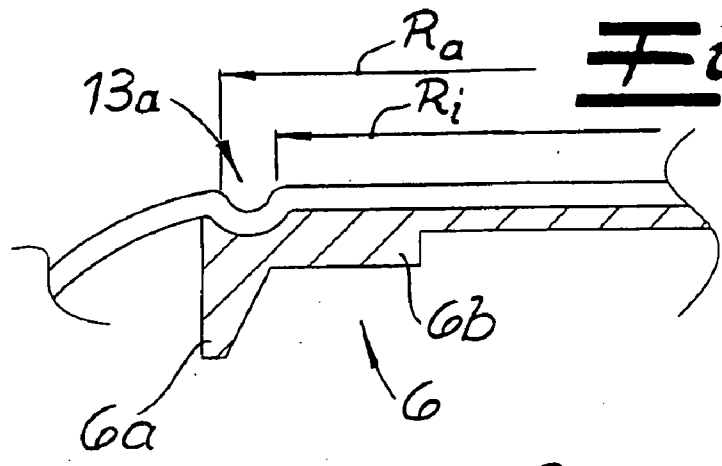
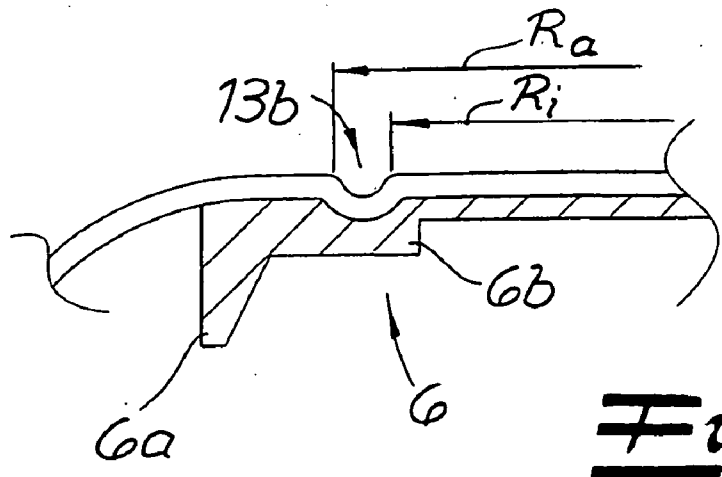


Fig. 14b



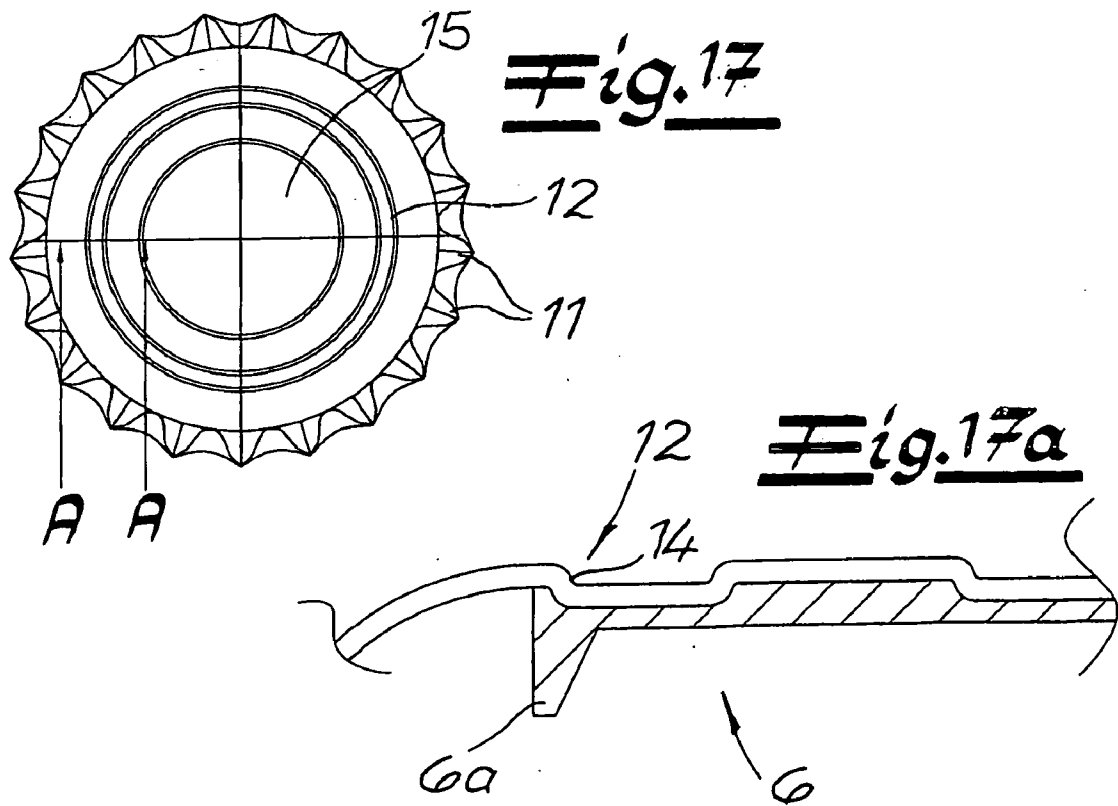
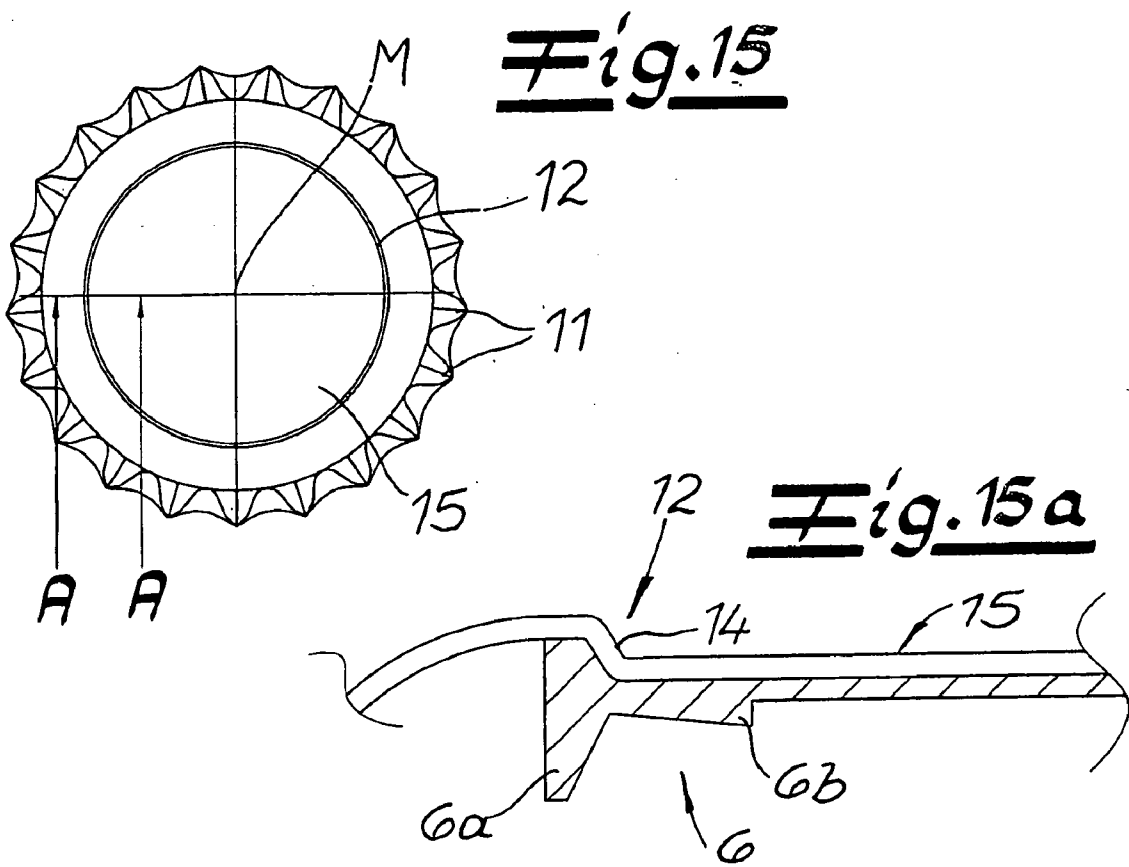


Fig. 16

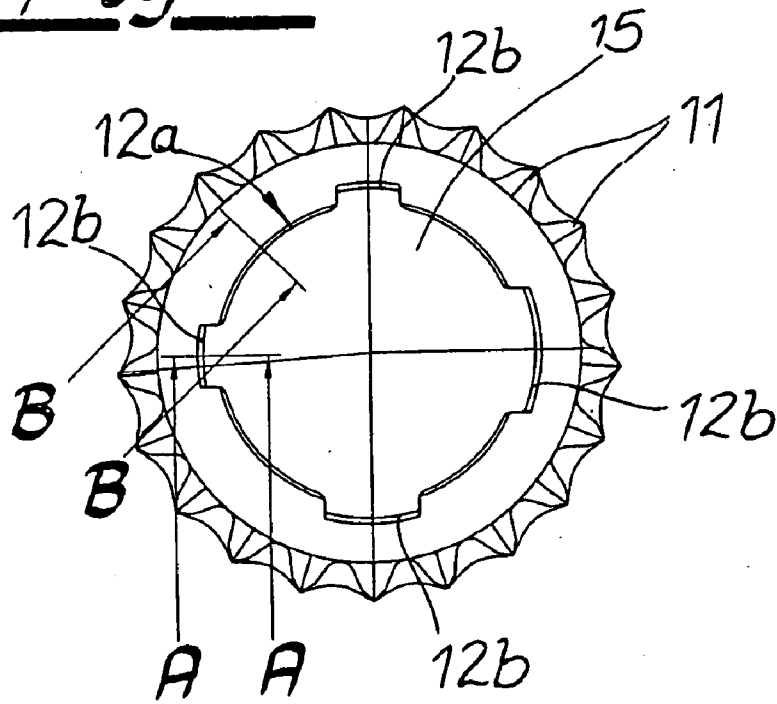


Fig. 16a

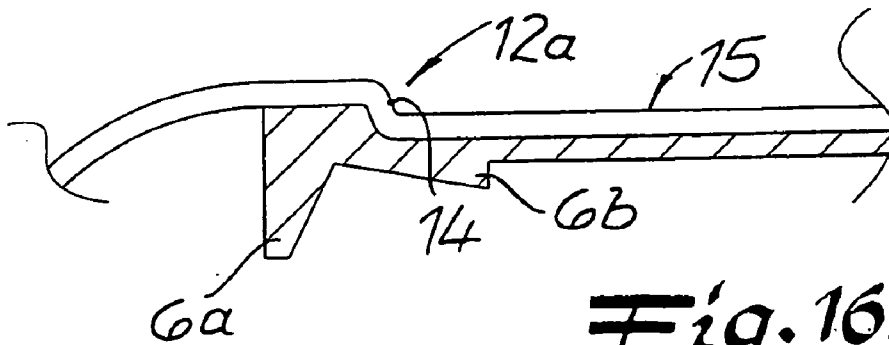
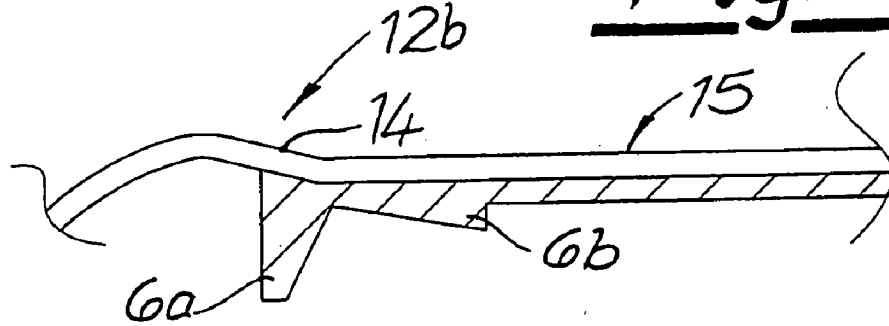


Fig. 16b

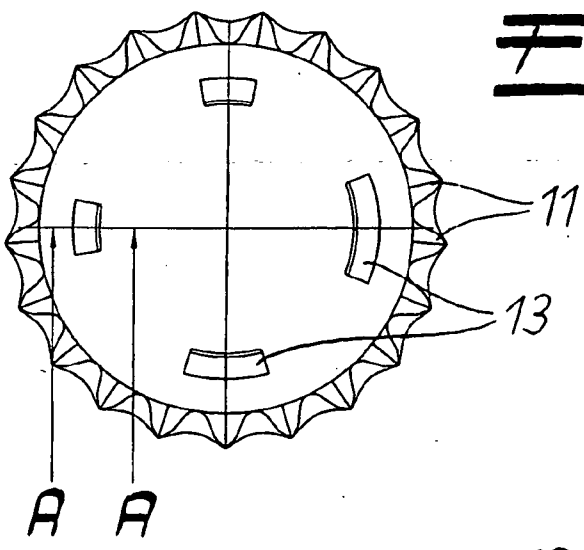


Fig. 18

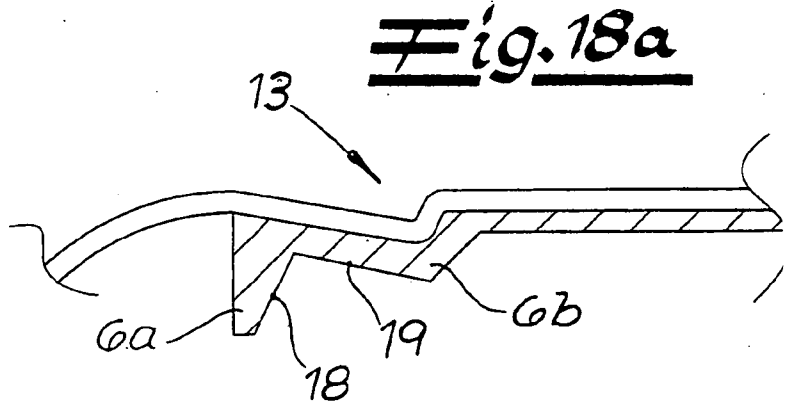


Fig. 18a

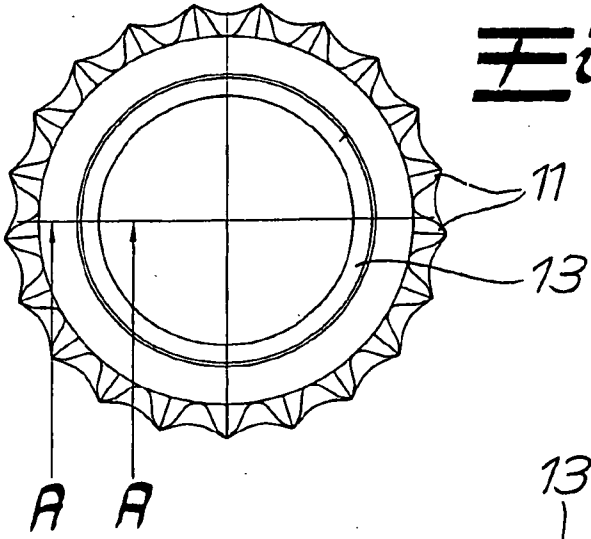


Fig. 19

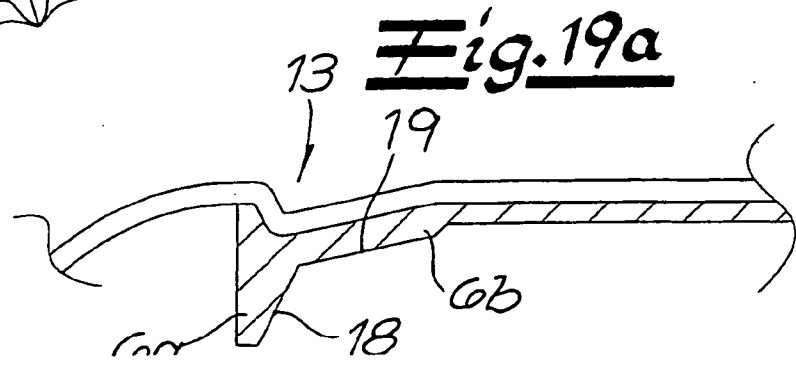


Fig. 19a

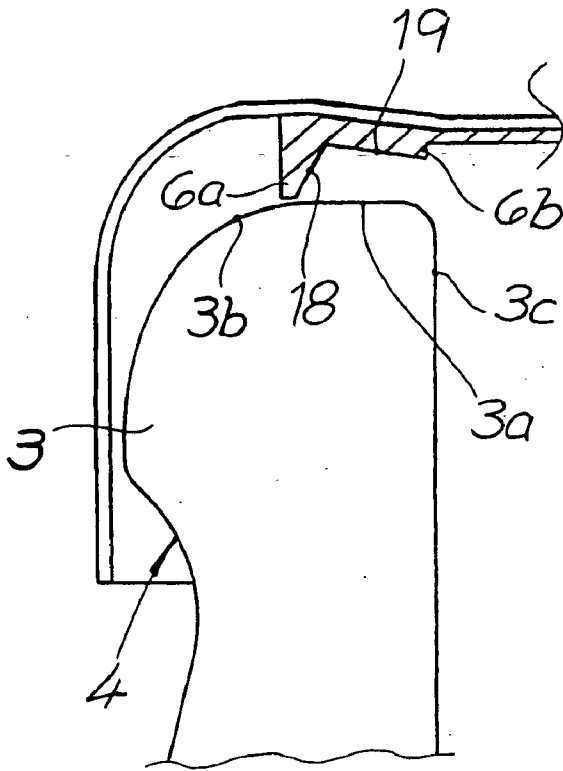


Fig. 20

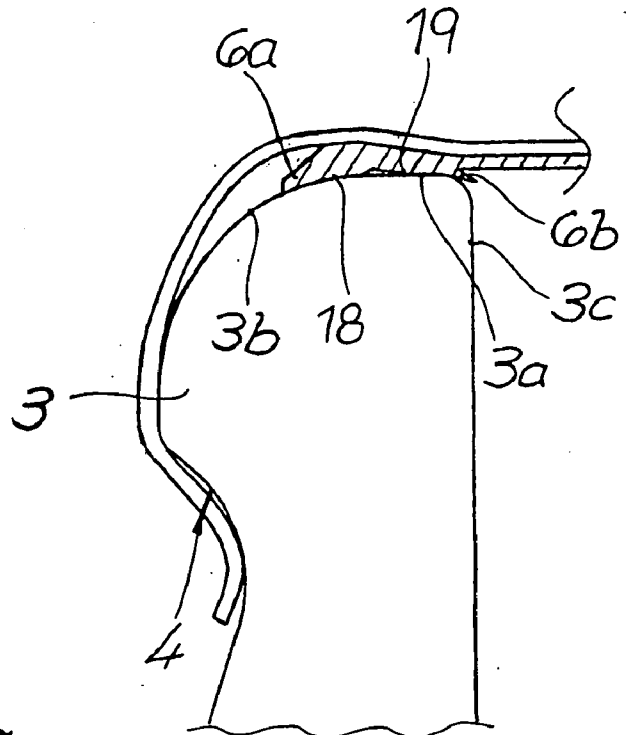


Fig. 20a



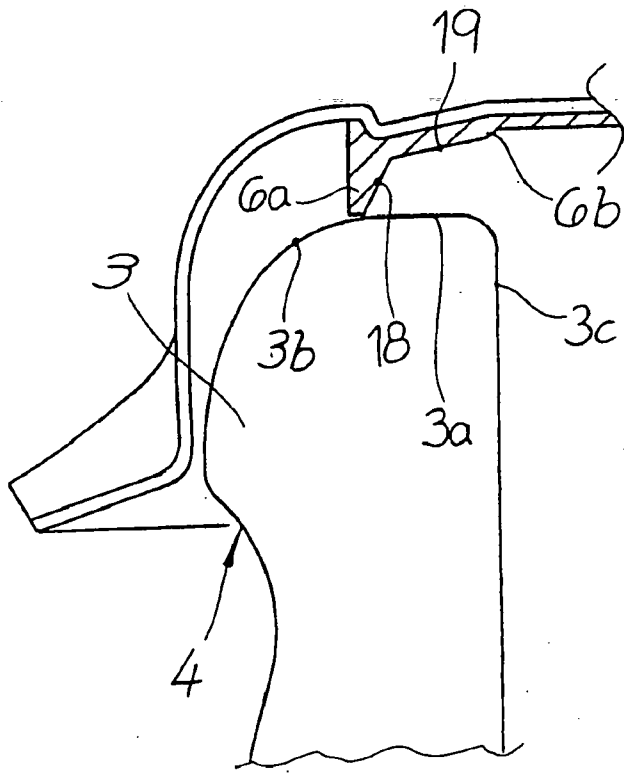


Fig. 21

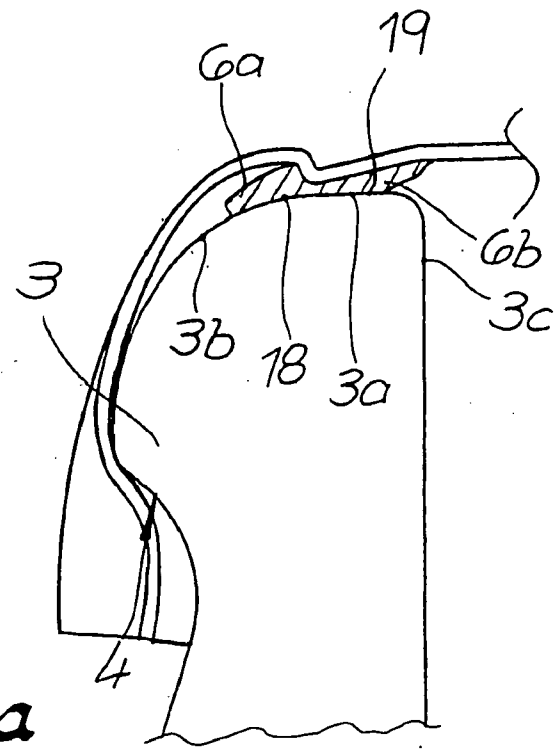


Fig. 21a

### CLOSURE FOR A CONTAINER, ESPECIALLY A BOTTLE

[0001] The invention relates to a closure for a container, especially a bottle, comprising an upper covering panel and a circumferential collar or skirt adjoining the covering panel on the outside, wherein a sealing insert or liner is arranged on the underside of the covering panel which has a circumferential profile seal along the outside periphery. Such a closure is also known as (closure) lid or (closure) cap. The closure within the scope of the invention is especially a bottle closure which can be constructed for example as a crown cork closure or a tear-off closure. These closures are sealed to the container by a crimping operation. In both cases, the upper covering panel of the closure incorporating the profile seal is pressed against the bottle top at the sealing of the closure on the bottle. The circumferential band or collar which forms a cylindrical closure skirt, embraces the bottle neck bead after sealing and the lower part of the skirt provides a firm grip under the bead ring. In the embodiment as a crown cork closure, the skirt is provided with the usual crown cork stamping or teeth with the corrugations pressed against and slightly in under the bead ring, giving the appropriate grip. Crown cork closure means standard crown corks to be opened with a tool as well as twist crown corks that can be unscrewed by hand at opening or bent off with tool like standard crown cork. In the case of a tear-off container closure, the skirt is crimped in under the bead ring and a tear-off strip is provided, which is defined by score lines in the covering panel and the skirt wherein this tear-off strip continues as a tongue protruding beyond the skirt and a pulling member, e.g. a pull-ring, is connected to this tongue.

[0002] Bottle closures are known in a wide range of embodiments both as crown-cork closures and as tear-off closures. A constant problem is the handling of carbonated liquids in bottles. In order to ensure a high and constant quality of carbonated beverage for example, the bottles must be securely closed with the provided closures eliminating leakage of carbonisation. In this case, there is the problem that considerable internal pressures can occur in bottles filled with carbonated liquids. Such high internal pressures can especially occur when the filled and closed bottles are exposed to high temperatures and/or violent movements, e.g. during transport. Considerable problems can arise therefrom since at such high pressures there is the risk that the bottles, whether these are made of glass or plastic, will explode or burst. A considerable risk of injury is associated therewith for the user or neighbouring third parties.

[0003] The same applies if in the case of a closure sealed by crimping, e.g. a crown cork closure, the closure is caused fiercely leaving the bottle top by such a high inner pressure. For the manufacturers of bottle closures and for the beverage manufacturers or bottlers, such risks are already barely acceptable because of the risk of any liability associated therewith. However, in spite of this it must be taken into account that the filled and closed bottles must easily be able to withstand pressures of 6 bar without any significant pressure loss since beverages are exposed to such pressures for example during pasteurisation processes. For this reason crown corks and other closures are constructed to stay firmly on the bottle top at inner pressures below 10 bar.

[0004] Basically, there is thus a need to create bottle closures which minimise the problems explained and make it possible for pressure to be released via the closure at such

high internal pressures. In this connection, it is known to use seals made of particularly resilient PVC or the like wherein these soft-elastic PVC seals make it possible to release pressure at high pressures. For various reasons however, PVC should no longer be used as a sealing material for foodstuffs, especially beverages. However, the PVC-free sealing materials having a fairly high molecular density used in practice have the disadvantage that they are less elastic or resilient and cannot ensure a release of pressure at such high inner pressure and "resealing" during a subsequent drop in pressure.

[0005] Already 1956 the need for releasing pressure for bottles sealed with crown corks was recognized. Special liner configurations made of soft-elastic sealing materials was combined with closures made of resilient metal, making the upper covering panel bulging or booming (see U.S. Pat. No. 2,739,724).

[0006] In tear-off container closures it is known to render possible a release of pressure in the case of carbonated beverages by arranging a type of pressure-release valve in the region of the tear-off strip or the connecting section or pulling member connected thereto, in which the adhesion or grip of the cap skirt to the bottle is reduced in this region (see DE 37 37 467 A1 or U.S. Pat. No. 4,768,667). Such measures have basically proved effective. However, they are depending on soft-elastic linear materials like PVC, and are not applicable to other types of closure, such as crown cork closures for example.

[0007] US 2003/0127421 A1 discloses a venting plastic closure comprising an outer plastic cap having a top wall portion and annular skirt portion. The skirt portion includes at least one internal thread formation, so that the closure is constructed as a screw cap to be screwed onto a threaded container. In order to effect the desired sealing corporation with an associated container, venting plastic closure includes a disk-shaped sealing liner positioned adjacent the inside surface of the top wall portion of the closure cap. The sealing liner can be compression moulded within the outer closure cap during closure manufacture and is configured for effecting a so-called "top/inside seal" with the associated container. To this end the sealing liner includes a depending annular sealing bead portion having a generally downwardly and outwardly facing sealing surface. The outer closure cap includes an annular liner support element depending from the inside surface of the top wall portion. The liner support element is positioned within the annular sealing bead of the liner and defines a liner support surface positioned inwardly of and generally parallel to sealing surface of the liner. The liner support element cooperates with the sealing bead of the sealing liner to effect sealing engagement of the sealing bead with the surface of the associated container and also desirably reduced the quantity of relatively expensive liner material employed in the closure. Moreover the outer closure cap includes positive stop elements depending from the inside surface of the top wall portion. The stop elements can be positioned radially outwardly of sealing liner. The closure should facilitate removal and venting of internal gas pressure by obviating problems associated with over-application of the screw cap closure.

[0008] GB 960 296 discusses a very special ventable milk bottle cap moulded of thin, sheet plastics material for application to milk bottles having an external bead at top edge thereof.

[0009] GB 958 417 A shows a cap closure for the neck of a bottle or similar container, which cap closure is moulded from

synthetic thermoplastic material as a unitary structure. It is used for gas producing liquids like bleach.

**[0010]** U.S. Pat. No. 3,741,423 A discloses a special type of closure cap for food products to be kept under vacuum. The closure cap includes an annular container engaging gasket applied over a substantial portion of the cap skirt and extending inwardly over the bottom cap cover beyond the inner edge of the container rim. When the cap is applied to the container finish a portion of the skirt portion of the gasket is caused to bulge inwardly into a number of slots in the glass finish thereby forming lug-like cap anchoring projections to retain the closure cap on the container.

**[0011]** The object of the invention is to provide a closure for a container, especially a bottle closure, which can not only be used universally on conventional bottle neck beads and is simple and cheap to manufacture and seal but in addition, on reaching a predicted inner pressure makes it possible to achieve a specific release of pressure and subsequent problem-free reclosure.

**[0012]** In order to solve this problem, in a generic closure for a container, especially a bottle, the invention defines and instructs that the upper covering panel has on its underside (facing the sealing insert) at least one projection, e.g. embossing, extending at least over a predefined angular region, which projects in the area of or close to the profile seal and interacts therewith forming a venting valve. According to the invention the upper covering panel has on its underside an annular sealing liner located peripherally with an outer protrusion adjoined inside with a lower and wider ring, in combination, constituting a liner configuration ("profile seal") being designed to interact with a defined embossing, stamping or shaping of the upper covering panel, thereby forming a venting valve.

**[0013]** In this case, the invention starts from the knowledge verified by experiments that the function of the seal can be specifically influenced if the covering panel is provided with an underside projection, e.g. embossing, stamping, moulding in connection with the area of the profile seal and constructed to interact with the profile seal. By selecting a suitable combination between the profile seal and the embossing, a closure can thus be provided which allows a release of pressure at a predetermined inner pressure of 7 bar to 10 bar, for example and after a predetermined reduction in pressure of 2 bar for example, automatically seals again. The risks for injuries and associated liabilities described initially can thus be eliminated in a simple and cheap fashion without any need to accept loss of quality in the filled beverages. Position, shape, height and width of the embossing are to be combined in such a way that the closure starts to release pressure at a predetermined inner pressure level and that a problem-free reclosure or re-sealing takes place at a predetermined reduction in pressure. In this case, the solution according to the invention functions in the same way in tear-off closures as in crown cork closures. The performance of the closure is not influenced, for example, by score lines provided with tear-off closures. There is no need to adapt the bottles, the conventional standard bottle necks of crown cork type can be used. This is valid for all known bottle neck standards including the European, the American (GPI), the Japanese and similar, all having slightly different neck profile or configuration. The bottles can be made of glass or plastic. "Profile seal" means a seal with a "step-like" cross section.

**[0014]** In a preferred embodiment, the profile seal is constructed as substantially L-shaped in cross-section with an

outer first (lip-type) sealing ring and an inner second (flat) sealing ring or sealing surface, wherein the outer sealing ring has a greater height and/or a smaller width than the inner sealing ring. In this case, the invention starts from the knowledge that such a profile seal in interaction with the projection or embossing according to the invention makes it possible to achieve a particularly specific and above all reproducible release of pressure. The seals known from practice having a substantially C-shaped liner cross section comprising a high outer lip-type sealing ring, a low and rather flat middle sealing surface and a high lip-type inner sealing ring do not provide any specific release of pressure below 10 bar. Of particular importance regarding the invention is that there is no longer any need to accept or provide any bulging or even lifting of the closure covering panel as the profile seal together with the embossing form a degassing or venting valve, which operates without any bulging or lifting of the upper covering panel.

**[0015]** According to one embodiment of the invention, the projection or embossing is constructed as a circumferential step with a side descending steeply downwards, forming for example a lower central plate of the covering panel. This step can, for example, be constructed as a completely circumferential step with completely identical radius, forming a circular cap central region when viewed from above. It is to be understood that the step itself is located radially to interact with the profile seal, forming a valve. The desired venting effect can be adjusted by tuning the various parameters. In a modified embodiment the circumferential step can have a plurality of step sections with different radii which each extend over a predetermined angular region. It is thus possible that the step is arranged over a predetermined circumferential region in such a radius which fulfils a stronger venting valve function together with the profile seal whilst the other regions of the step are arranged on a different radius which merely possess a small valve-forming function. Thus, the desired pressure release or venting effect can be further specified by selecting the corresponding circumferential regions.

**[0016]** The radius of the step or at least of a step section can be smaller than or equal to or slightly greater than the outer radius of the profile seal and/or greater than or equal to or slightly smaller than the inner radius of the profile seal, thus including that the radius of the step can be of any size greater than the inner radius of the inner sealing ring up to the outer radius of the outer sealing ring. In addition the venting valve constituted by the interaction between the profile seal and the embossing possibly can be given a form extending to a radius greater than the outer radius of the profile seal or smaller than the inner radius of the profile seal. However the step or step section is close enough to the profile seal to interact with the sealing ring or the sealing rings and thereby to influence the sealing properties of the profile seal.

**[0017]** The side angle of the step or of a step section with respect to the horizontal or with respect to the upper covering panel is for example 40° to 90°, e.g. 60° to 80°. Here also the choice of angle offers a sensitive parameter for setting the desired venting function. By means of a steep angle of approximately 90°, e.g. 80°, the seal can be especially strongly influenced and thus a stronger venting valve effect can be achieved. However, it is also possible to work with flat angles of 10° to 40°.

**[0018]** In another embodiment, the projection or embossing is constructed not as a (single) step but as a groove or channel of predetermined width and height, which runs around or extends over a predetermined angular region, with

an outer side descending towards the centre of the cap and an inner side ascending towards the centre of the cap. The ascending inner side can directly adjoin the descending outer side. However, it is also possible to provide an, as it were, flat base region between the sides. The groove can be constructed as a circular-ring-shaped, completely circumferential groove viewed from above, which extends over the total area of the cap and thus over a full angle of 360°. However, it is also possible to provide a plurality of grooves or groove sections which each extend merely over a limited predetermined angular region. In embodiments with pluralities of grooves or groove sections all grooves can be arranged on the same radius. However, it is also possible for the grooves or groove sections to be arranged at least partly on different radii. The grooves or groove sections are embossed into the upper covering panel during manufacture of the closure. However, the invention also comprises embodiments in which the projection is constructed as a protrusion connected to or moulded onto the underside of the upper covering panel. The possible configurations described in connection with the groove equally exist here. However, the embodiment with embossed groove(s) or step(s) are all distinguished by their particularly simple manufacture.

**[0019]** In the embodiments with circumferential or partly circumferential grooves or protrusions, there are numerous possibilities for influencing the valve-forming effect by setting the desired parameters. Thus, the angle of inclination of the descending side with respect to the horizontal and/or the angle of inclination of the ascending side with respect to the horizontal can be 40° to 90°, e.g. 60° to 80°. The angle(s) of inclination can also be 5° to 40°, e.g. 10° to 40°. The groove or the protrusion can be constructed symmetrically or asymmetrically, i.e., with identical or unequal angles of inclination. Thus, it can be appropriate if the outer side is constructed as a steep side and the inner side is constructed as a flat side or vice versa. Also by selecting suitable radii of the grooves or groove sections relative to the profile seal, the desired degassing effects can be sensitively influenced. Thus, the invention proposes that the outer radius and/or inner radius of the groove or at least one groove section is smaller than or equal to the outer radius of the profile seal and/or greater than or equal to the inner radius of the profile seal. The grooves or groove sections are thus arranged at least partly in the area of the profile seal. They can be arranged completely in the area of the outer sealing ring or also completely in the area of the inner sealing ring. Furthermore, the groove or a groove section can also extend from the area of the outer sealing ring into the area of the inner sealing ring. Moreover it is possible that the inner radius and/or the outer radius of the groove is slightly smaller than the inner radius of the profile seal or that the outer radius and/or the inner radius of the groove is slightly greater than the outer radius of the profile seal. However the groove or at least one groove section must be close enough to the profile seal to interact with the profile seal and thereby to influence the sealing properties of the profile seal.

**[0020]** The width of the groove is preferably 1 mm to 4 mm, e.g. 1 mm to 3 mm. The height of the groove or step can be 0.1 mm to 0.8 mm, e.g. 0.2 mm to 0.6 mm.

**[0021]** The covering panel forming the closure together with the skirt or collar connected thereto are made, according to the invention, of metal, e.g. of tin plate, aluminium or tin-free steel as well as suitable alloys thereof and other metals. The sealing insert or liner assigned to the underside of the covering panel is preferably manufactured in one piece

and made of plastic. The sealing insert or liner is preferably made of polyethylene (PE) e.g. of low molecular density PE (LDPE) or modification thereof, with or without a scavenger agent. In any case, a PVC-free plastic is preferably used.

**[0022]** The thickness of the (metal) closure shell (covering panel and skirt) is 0.15 mm to 0.25 mm, e.g. 0.17 mm to 0.24 mm, preferably 0.17 mm to 0.21 mm. As already explained, the closure can be constructed as a tear-off closure or as a bend-off closure type crown cork. The diameter of the closure is around 18 mm to 45 mm. Crown cork closures are usually manufactured with a diameter of 26 mm to 27 mm. The sealing insert within the scope of the invention is preferably constructed as a full-area liner having a circumferential profile seal on the outside and a low central region which itself has no sealing function. Such liners are preferably formed by compression moulding directly into the prefabricated closure which already has the embossing, and moulded onto the underside of the upper covering panel. However, it is also possible for the sealing insert to be fabricated in a separate production step, for example, by being stamped out of an extruded plastic sheet and then affixed, e.g. glued, to the underside of the upper covering panel.

**[0023]** The invention is explained in detail subsequently with reference to the drawings which merely show exemplary embodiments. In the figures:

**[0024]** FIG. 1 shows a bottle closure in the embodiment as a tear-off closure,

**[0025]** FIG. 2 shows a bottle closure in the embodiment as a crown cork closure,

**[0026]** FIG. 3,3a shows a tear-off closure in plan view and in a section A-A through the subject matter from FIG. 3,

**[0027]** FIG. 4,4a,4b shows a tear-off closure in a modified embodiment in a plan view and in a section A-A, as well as a section B-B,

**[0028]** FIG. 5,5a,5b shows a tear-off closure in a modified embodiment in a plan view and in a section A-A, as well as a section B-B,

**[0029]** FIG. 6,6a,6b shows a tear-off closure in a modified embodiment in a plan view and in a section A-A, as well as a section B-B,

**[0030]** FIG. 7,7a shows a tear-off closure in another embodiment in a plan view and in a section A-A,

**[0031]** FIG. 8,8a shows a tear-off closure in another embodiment in a plan view and in a section A-A,

**[0032]** FIG. 9,9a shows a tear-off closure in another embodiment in a plan view and in a section A-A,

**[0033]** FIG. 10,10a shows a tear-off closure in another modified embodiment in a plan view and in a section A-A,

**[0034]** FIG. 11,11a,11b shows a tear-off closure in a plan view and in a section A-A, as well as a section B-B,

**[0035]** FIG. 12,12a,12b shows a tear-off closure in a plan view and in a section A-A, as well as a section B-B,

**[0036]** FIG. 13,13a,13b shows sections of further embodiments of the invention.

**[0037]** FIG. 14,14a,14b shows a tear-off closure in another embodiment in a plan view, in a section A-A and a section B-B,

**[0038]** FIG. 15,15a shows a container closure according to the invention in the embodiment as a crown cork closure in plan view and in a section A-A,

**[0039]** FIG. 16,16a,16b shows a crown cork closure in a modified embodiment in plan view and in a section A-A and a section B-B,

[0040] FIG. 17,17a shows a crown cork closure in another embodiment in plan view and in a section A-A,

[0041] FIG. 18,18a shows a crown cork closure in another embodiment in plan view and in a section A-A,

[0042] FIG. 19,19a shows a crown cork closure in another embodiment in plan view and in a section A-A,

[0043] FIG. 20,20a shows the subject matter from FIG. 6 or 6a during sealing,

[0044] FIG. 21,21a shows the subject matter from FIG. 19 or 19a during sealing.

[0045] The figures show closures for bottles or other container openings. FIG. 1 shows the basic structure of a bottle closure in the embodiment as a tear-off closure. The closure consists of an upper, round covering panel 1 adjoining which on the outside is a substantially cylindrical collar or skirt 2 which embraces the bottle neck 3 in the course of sealing and grips under a bead 4 or a flange of the bottle neck. On the underside of the covering panel 1 is a sealing liner 5 (which cannot be seen in FIG. 1) which has a circumferential profile seal the outer circumferential side. It can also be seen in FIG. 1 that the tear-off closure has a tear-off opening strip 7 with a tongue 8 projecting from the cap skirt 2, wherein the tear-off strip is defined by score lines 9, 9' arranged in the closure. The score lines on both sides are normally of the same length, but can vary from half length 9' to full length 9. The tongue 8 is connected to a pulling member 10. Different embodiments of such a tear-off closure according to the invention are shown in FIGS. 3 to 14.

[0046] In contrast, FIG. 2 shows a bottle closure in the embodiment as a crown cork closure wherein the circumferential skirt 2 is here provided with the usual embossed corrugations or teeth 11. Different embodiments of such a crown cork closure according to the invention are shown in FIGS. 15 to 19.

[0047] According to the invention, the upper covering panel 1 has one or a plurality of at least partly circumferential projections 12, 12a, 12b, 13, 13a, 13b on its underside facing the sealing insert 5, which are made of embossings and interact with the profile seal 6 forming a venting valve and for this purpose project or protrude into the area of the profile seal 6. These embossings are not shown in FIGS. 1 and 2. The profile seal is constructed as a substantially L-shaped cross-section with an outer first sealing ring 6a and an inner second sealing ring or surface 6b, wherein the outer sealing ring 6a has a larger height and a smaller width than the inner sealing ring 6b.

[0048] In the embodiments according to FIGS. 3 to 7, and 15 to 17 the projections or embossings are constructed as circumferential steps 12, 12a or 12b having a descending side 14 towards the centre M of the cap. In this way, a pressed down cap central region 15 is created in the area of the cap centre so that overall a lower central panel 15 is provided. A comparative examination of FIGS. 3 and 15, for example, clearly shows that the embossing according to the invention can be identically provided both for tear-off closures and for crown cork closures. Its functioning principle is not influenced by the score lines provided with the tear-off closures.

[0049] Whereas the step 12 in the embodiments according to FIG. 3 or 15 runs around or extends completely over a full angle of 360°, FIGS. 4, 5 and 6 for example show embodiments in which a plurality of step sections 12a, 12b with different radii R, R' are provided. According to FIG. 4, 5, 6 the step sections 12a, 12b each extend over a predetermined

angular range  $\delta$  or  $\delta'$  or  $\delta''$ . The radius R, R' of the step here means the upper radius, that is the radius in the area of the upper edge of the step.

[0050] According to FIG. 4, two circumferential steps 12a are provided, each running around over an angle  $\delta$  of approximately 150° and giving a reduced venting effect, said steps having a radius R which substantially corresponds to the inner radius  $P_i$  of the profile seal 6. Arranged diametrically opposite between these two steps 12a are valve-forming step sections 12b whose radius R' is configured such that the step 12b is arranged substantially in the area of the outer sealing ring 6a. In this case, the two valve-forming step sections are provided with different lengths, that is they cover different angular regions  $\delta'$  or  $\delta''$ . The same applies to the embodiment in FIG. 16 in which four valve-forming step sections 12b are provided, that extends over different angular regions.

[0051] According to FIGS. 5 and 6 one step section 12a runs over an angle  $\delta$  of about 320° and one step section 12b runs over an angle  $\delta'$  of about 40°. FIG. 5 shows an embodiment where the step sections 12a, 12b are partly inside the region of the profile seal 6. The (upper) radius R' of step 12b and (upper) radius R of step 12a are both smaller than the outer radius  $P_a$  and greater than the inner radius  $P_i$  of the profile seal. However the "lower" radius of the steps is smaller than the inner radius  $P_i$  of the profile seal 6. Lower radius is the radius in the area of the lower edge of the step. The flat step size 12b with an inclination  $\alpha$  of about 10° constitutes the venting valve 12b influencing the inner sealing ring 6b to release inner pressure to open the outer sealing lip 6a at a predetermined inner pressure in the bottle. This valve function is strengthened by the steeper step side 12a with an inclination  $\alpha$  of about 20° located approximately to 50% inside the inner radius of the profile seal. The step 12b of FIG. 6 corresponds to step 12b of FIG. 5. Moreover there is also a step 12a that runs over an angle  $\delta$  of 340°. The steep step 12a has an inclination  $\alpha$  of about 60° and an (upper) radius R that is identical to or slightly smaller than the inner radius  $P_i$  of the profile seal. The lower radius is smaller than  $P_i$ , however the step is close enough to influence the inner sealing ring 6b. The valve function is completed 30 by the flat step side 12b with an inclination  $\alpha$  of about 10° forming the narrow venting valve.

[0052] In the embodiments from FIGS. 8 to 14 and 18 and 19, the embossings are constructed as grooves 13, 13a, 13b of predetermined width B and height H running over a predetermined angular range, wherein the grooves each have an outer side 16 which descends towards the centre of the cap and an inner side 17 which ascends towards the centre M of the cap. Width B here means the "upper width", that is the total width of the groove in the area of its upper edges. In the embodiments from FIGS. 8, 9, 10 and 19 the groove 13 is respectively constructed as a completely circumferential annular groove 13. That is, the groove 13 extends over the total angular region or over a full angle of 360°. The venting effect can be specifically set by the position of the groove 13 relative to the profile seal 6. Thus, FIG. 10 shows an embodiment with a reduced venting effect compared with FIGS. 8 and 9 since the groove according to FIG. 10 is displaced further into the region of the inner sealing ring 6b. However, the groove 13 is also constructed as a completely circumferential groove. In contrast, FIGS. 11, 12 for example show embodiments in which a plurality of groove sections 13a,b are provided which each extend merely over a limited angular region  $\delta$ ,  $\delta'$ ,  $\delta''$ .

[0053] A comparative examination of FIG. 12 and FIGS. 12a and 12b clearly shows that the individual grooves of the four grooves 13a-13b are each configured differently. For example, two grooves 13a with a very strong valve effect are provided in which the outer side 16 is arranged in the area of the outermost edge of the profile seal (or somewhat outside). The outer radius  $R_a$  of the groove approximately corresponds in this region to the outer radius  $P_a$  of the profile seal 6 or is even somewhat larger. The inner radius  $R_i$  is in this region smaller than the outer radius  $P_a$  of the seal 6 and larger than the inner radius  $P_i$  of the seal 6. Another but weaker pressure-releasing valve effect is achieved via the two diametrically opposite grooves 13b of same length where the descending outer side 16 extends over approximately the total width  $b$  of the profile seal 6.

[0054] FIG. 11 shows an embodiment with one long groove section 13b extending over an angle  $\delta$  and one short groove section 13a extending over an angle  $\delta'$  as a venting valve. The groove 13b is completely within the region of the profile seal whereas the groove section 13a is only partly in the region of the profile seal. The groove side 16 of groove 13a has flat inclination and is partly outside the profile seal increasing the venting effect.

[0055] FIG. 14 furthermore shows an embodiment in which a plurality of groove sections 13a, b are provided which all have the same shape but are arranged on different radii  $R_a$ ,  $R_i$ . Thus, the two diametrically opposite short grooves 13a are arranged on a relatively large outer radius  $R_a$  and inner Radius  $R_i$  in the area of the lip-kind outer sealing ring 6a whereas the grooves 13b which are lengthened in comparison as shown in FIG. 14b are arranged in the area of the flat inner sealing ring 6b and thus over a reduced outer radius  $R_a$  and inner radius  $R_i$ . The valve function is substantially taken over here by the two outer grooves 13a. The groove sections 13a,b here are substantially U-formed in cross section.

[0056] A comparative analysis of the various exemplary embodiments clearly shows that the geometry of the embossings 12, 12a, 12b, 13, 13a, 13b according to the invention can be adapted in many ways to the desired circumstances and especially to the sealing configuration used. Thus, the angle of inclination  $\alpha$  of the step can be constructed as relatively steep and have an angle of 45° to 90°, e.g. 60° to 80° with respect to the horizontal (see FIG. 3a). However, it is also possible to select a flat angle of inclination  $\alpha$  in the area of the step which can, for example, be 10° to 45° (see FIG. 4a). The angles of inclination  $\beta$  and  $\gamma$  of the sides 16, 17 of the circumferential grooves can be selected similarly. For example, FIG. 8a shows an embodiment with a relatively steep angle of inclination  $\beta$  of the outer side 16 wherein a relatively flat ascending inner side 17 then adjoins this side 16. An inverse arrangement is provided, for example, in the embodiment in FIG. 12b.

[0057] The figures furthermore make clear that the L-shaped profile seal 6 can also be adapted within limits to the circumstances. A substantially vertically downward-directed outer sealing ring or a sealing lip 6a is always realised, which is compressed with its inner surface 18 as shown in FIG. 20 or 21 at sealing on the outer top 3a and outside surfaces 3b of the bottle neck 3 providing a satisfactory sealing. In contrast, the inner sealing ring or surface 6b is flat so that it is softly compressed on the top surface 3a without embracing the inner surface 3c of the bottle. In this way, it is ensured that in the course of the pressure rise, the inner sealing ring 6b can yield so that a release of pressure can take place. It can also be seen

in the figures that the lower sealing surface 19 of the inner sealing ring 6b is arranged substantially horizontally. Substantially horizontally in this case also includes those embodiments in which the sealing surface 19 is inclined at a relatively small angle of 1° to 20° e.g. 15° with respect to the horizontal in the one direction or in the other. For this purpose reference should be made to FIGS. 18 and 19 which show suitably inclined sealing surfaces 19. Of particular importance however is that a true inner sealing ring of substantial height and at a distance from the outer sealing ring or lip, which inner sealing ring embraces the inner surface 3c of the bottle neck (type C-shaped profile seal) prevent or strongly reduce a release of pressure and an interaction of the profile seal with the embossings.

[0058] In each case, the thickness and sealing efficiency of the profile seal 6 is reduced in a certain degree by the embossing so that the sealing properties can be adjusted by the choice of shape and depth and position of the embossing. In addition, a quite considerable saving of material can be achieved and overall manufacture will be cheap as established conventional technique can be used with minor changes of toolings. Finally, it is possible to additionally achieve a stiffening of the cap provided by the embossing whereby the opening process can be advantageously influenced, by specifically utilising lever effects. In this respect, in FIG. 7 for example, another upwardly directed step-like shaping 20 is provided at a distance inside the inner radius of the profile seal which has no influence on the valve effect but fulfils a stiffening function. The same applies to the embodiments in FIG. 4, 12 or 14, for example. In these cases, the valve-forming effect is substantially achieved by the "short" embossing whilst the "long" shapings along the tear-off lines are only of secondary importance in connection with the valve formation but facilitate tearing off the closure by the favourable lever arrangement.

[0059] In the figures the bending radius  $r$  of the step between the covering panel and the step descending side 14 and between the step descending side and the bottom plate and the bending radius  $r$  of the grooves between the covering panel and the descending side 16, between the descending side 16 and the ascending side 17 and between the ascending side 17 and the covering panel also are indicated. At a smaller radius  $r$  a distinct embossing bend is achieved and at a greater radius  $r$  a rounder embossing bend. A distinct bend is influencing the venting valve effect more strongly than a rounder bend, increasing the flexibility of the invention.

[0060] FIG. 20 shows the tear-off closure of FIG. 6 ready for sealing. FIG. 20a shows this closure after sealing with the crimped-in skirt.

[0061] FIG. 21 shows the crown cork closure of FIG. 19 ready for sealing. FIG. 21a shows this closure after sealing with the skirt pressed to the bottle neck 3 and slightly crimped-in under the bottle neck bead.

1. A closure for a bottle for carbonated beverages, which closure is constructed as crown-cork closure or tear-off closure,

comprising an upper covering panel (1) made of metal and comprising a circumferential collar or skirt (2) adjoining the covering panel (1) on the outside,

wherein a sealing insert (5) is arranged on the underside of the covering panel (1), which has a circumferential profile seal (6) on the outside, characterised in that

the upper covering panel (1) has on its underside at least one embossing (12, 12a, 12b, 13, 13a, 13b), extending at

least over a predefined angular region, which projects in the area of or close to the profile seal (6) and interacts therewith forming a valve.

2. The closure according to claim 1, characterised in that the profile seal (6) is constructed as substantially L-shaped in cross-section with an outer first sealing ring (6a) and an inner second sealing ring (6b), wherein the outer sealing ring (6a) has a greater height and/or a smaller width than the inner sealing ring (6b).

3. The closure according to claim 1 or claim 2, characterised in that the or embossing is constructed as a circumferential step (12, 12a, 12b) with a side (14) which descends towards the centre (M) of the panel forming a, for example, pressed down cap central region (15).

4. The closure according to claim 3, characterised in that the circumferential step has a plurality of step sections (12a, 12b) with different radii (R, R') which each extends over a predetermined angular region ( $\delta$ ,  $\delta'$ ,  $\delta''$ ).

5. The closure according to claim 3 or 4, characterised in that the (upper and/or lower) radius of the step (12) or at least of a step section (12a, 12b) is smaller than or equal to the outer radius ( $P_o$ ) of the profile seal (6) and/or greater than or equal to the inner radius ( $P_i$ ) of the profile seal (6).

6. The closure according to anyone of the claims 3 to 5, characterised in that the (upper and/or lower) radius of the step (12) or at least one step section (12a, 12b) is (slightly) greater than the outer radius ( $P_o$ ) of the profile seal (6) or (slightly) smaller than the inner radius ( $P_i$ ) of the profile seal (6).

7. The closure according to any one of claims 3 to 6, characterised in that the side angle ( $\alpha$ ) of the step (12, 12a, 12b) with respect to the horizontal is about 40° to 90°, e.g. 60° to 80°, or is about 5° to 40°, e.g. 10° to 15°.

8. The closure according to claim 1 or claim 2, characterised in that the embossing is constructed as a groove (13, 13a, 13b) formed in the upper covering panel of predetermined width (B) and height (H), with an outer side (16) descending towards the centre (M) of the cap and an inner side (17) ascending towards the centre (M) of the cap.

9. The closure according to claim 8, characterised in that the groove (13) extends over the entire full angle as an annular groove (13).

10. The closure according to claim 8, characterised in that a plurality of grooves or groove sections (13a,b) are provided which each extend over a predetermined angular section ( $\delta$ ,  $\delta'$ ,  $\delta''$ ).

11. The closure according to claim 10, characterised in that all the grooves or groove sections (13a,b) have the same radius.

12. The closure according to claim 10, characterised in that the grooves or groove sections (13a,b) have at least partly different radii.

13. The closure according to any one of claims 8 to 12, characterised in that the outer radius ( $R_o$ ) and/or inner radius ( $R_i$ ) of the groove or at least one groove section is smaller than or equal to the outer radius ( $P_o$ ) of the profile seal (6) and/or greater than or equal to the inner radius ( $P_i$ ) of the profile seal (6).

14. The closure according to any of claims 8 to 13, characterised in that the outer radius ( $R_o$ ) and/or inner radius ( $R_i$ ) of the groove or at least one groove section is (slightly) greater than the outer radius ( $P_o$ ) of the profile seal (6) or (slightly) smaller than the inner radius ( $P_i$ ) of the profile seal (6).

15. The closure according to any one of claims 8 to 14, characterised in that the side angle ( $\beta$ ) of the descending side (16) with respect to the horizontal and/or the side angle ( $\gamma$ ) of the ascending side (17) with respect to the horizontal is about 40° to 90°, e.g. 60° to 80°.

16. The closure according to any one of claims 8 to 15, characterised in that the side angle ( $\beta$ ) of the descending side (16) with respect to the horizontal and/or the side angle ( $\gamma$ ) of the ascending side (17) with respect to the horizontal is 5° to 40°, e.g. 10° to 15°.

17. The closure according to any one of claims 8 to 16, characterised in that the width (B) of the groove is 1 mm to 5 mm, e.g. 1 mm to 3 mm.

18. The closure according to any one of claims 3 to 17, characterised in that the height (H) of the groove or step is 0.1 mm to 0.8 mm, e.g. 0.2 mm to 0.6 mm.

19. The closure according to any one of claims 1 to 18, characterised in that the shape, position, height and if appropriate the width of the groove(s) or step(s) are set depending on the profile seal such that the valve opens at a predetermined inner pressure of, for example, 6 bar to 10 bar and then closes again after the pressure has fallen by a predetermined difference of, for example 0.5 bar to 3 bar.

20. The closure according to any of claims 1 to 19, characterised in that the bending radius (r) of the step is made to 0.2 to 1.5 mm, e.g. 0.3 mm to 1.0 mm, or that the bending radius (r) of the groove or groove section is made 0.2 mm to 1.0 mm, e.g. 0.3 mm to 0.8 mm.

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