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(54) Bottle caps.

(57) The present invention relates to bottle caps (10) for use with blow-fill-seal type bottles (18) having an upwardly removable seal (20), the caps having inwardly projecting members, at least one of which is equipped with a blade (22) and an upstanding wall (23) to engage the seal (20) of the bottle, the wall being recurved away from the seal, such caps (10) allowing thicker frangible membranes to be used in the manufacture of the bottles (18) so that there is less wastage, the caps also permitting easier end-use and a higher success ratio for seal-removal

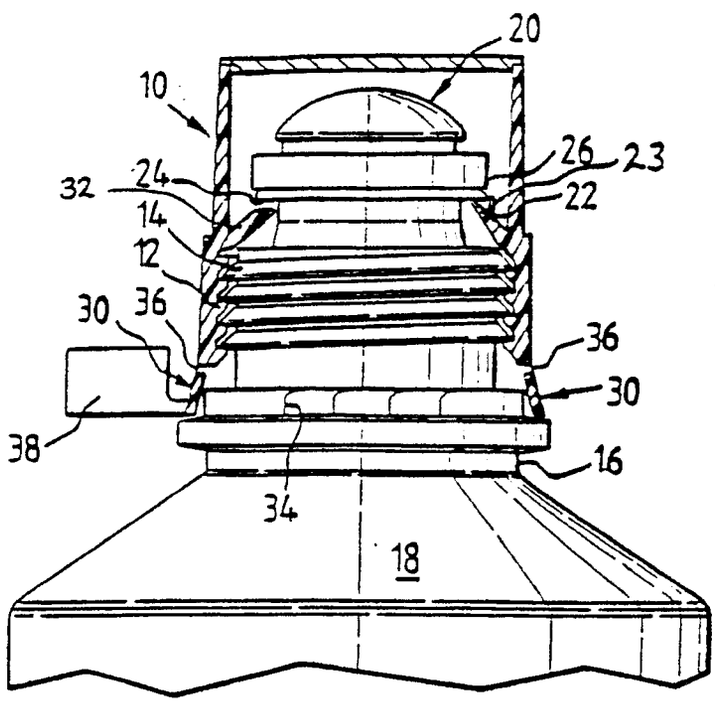


FIG.1

EP 0 421 821 A1

BOTTLE CAPS

The present invention relates to a bottle cap for use with moulded plastics bottles of the type having an integral flanged seal covering the aperture of a threaded neck;
the flange having an underface and the seal having a side,
a frangible membrane being located in the underface of the flange and joining the seal to the neck,
the cap having a complementary screw-thread to the thread of the neck and at least two inwardly projecting resilient members located above the screw-thread,
at least one of the inwardly projecting resilient members having a generally upwardly projecting blade and an upwardly projecting reinforcing wall adapted for engagement of the side of the seal,
the resilient members being adapted to pass over the seal with resilient deformation when the cap is screwed onto the bottle,
and, wherein
on unscrewing of the cap, at least one blade is adapted to engage the underface of the flanged seal.

The invention lies in the field of containers for sterile liquids. Traditionally, a bottle is filled with the relevant liquid and a lid screwed on tightly. The sealed bottle may then be autoclaved, irradiated, or similar, to ensure sterility. To maintain sterility, a sealing ring may be provided. However, such systems are prone to breakage of the seal, and such breakage can be difficult or impossible to detect in normal use

In recent years, sterile containers for medicines and the like have overcome some problems by being made from sealed plastic bottles, for example Such bottles create problems of their own with regard to opening. Using a knife is inherently dangerous, and can leave a ragged edge unsuitable for pouring.

A large variety of systems have been proposed to overcome these disadvantages.

The bottle disclosed in EP-A-50490 is representative of the early art, where a cap is provided which breaks the seal when it is screwed down. Specifically, a cover is formed over the neck during the moulding operation. During the moulding operation a V-shaped groove is formed in an annular portion situated above the thread of the neck to provide a frangible section The bottle is opened by screwing its cap downwards, thereby breaking the frangible portion. A ring inside the upper part of the cap then locates inside an annular groove in the cover so that, on unscrewing the cap, the sheared-off cover can be removed from the neck.

In GB Patent 2080775, a closure element, formed separately from the bottle, is heat sealed onto the neck of the bottle. The line where the closure is sealed onto the bottle is weaker than the rest of the bottle so that the closure can be broken off, and this is achieved by a jacking ring located in the cap. The jacking ring comprises fingers which snap into a recess above the heat seal and, as the jacking ring is unscrewed upwards, the cover is removed.

Unfortunately, both of the above systems are prone to a large proportion of wastage, as the seal will often distort, rather than break at the weakened area. The system disclosed in EP-A-194068 seeks to overcome this problem and, likewise, has a seal over a screw-threaded neck. The seal comprises a downwardly facing abutment portion in which a frangible membrane is located. Fingers in the cap directly engage the abutment portion, limiting the possibility of deformation of the seal without breaking.

In Figure 2 of EP-A-194068 (reproduced herewith as Figure A), the fingers 9 are intended to act to break off the seal 6 when the cap 7 is unscrewed. The fingers 9 have horizontal upper surfaces which abut the undersurface of seal 6 at the annular portion 4. Thus, the unscrewing of the cap gives rise to a jacking action, intended to stretch the membrane 5 and prise off the seal 6 from the remainder of the cap

Nevertheless, there are still problems in producing in high volume the bottles of the art, primarily arising from difficulties in reproducibly moulding the bottle itself in a manner such that the frangible portion is strong enough to resist fracture during handling but weak enough to be stretched and broken by the jacking action upon unscrewing the cap. Thus, wastage continues to be a problem, as the frangibility of the weakened portion is remains critical.

Further, problems also arise because of the flexibility of the fingers, especially in warm climates, when they tend to buckle and fail to remove the seal

U.S. Patent No. 4,526,279 seeks to tackle the above problems by providing a reinforcing wall on the finger. A flat portion of the finger engages the underside of the seal whilst an upwardly projecting wall engages the side of the seal. The edge of the seal is thus caught in a cleft of the finger, making it that much more difficult for the finger to buckle. Despite this apparent advantage, there is no noticeable improvement in performance over earlier bottles.

Accordingly, there is currently no bottle-and-cap combination on the market which overcomes

the inherent problems associated with upwardly removable seals, performance being little better than for those bottles employing downwardly removable seals. All variations currently available have a wastage rate of up to about 25% at the factory alone, a rate still further increased at the point of use. None of the variations described above overcome the requirement for the thinnest possible frangible membrane to be provided for the seal to be removable.

The problem is exacerbated by it not being possible to accurately establish whether any given bottle has a membrane of suitable thickness when it comes off the machine. Manual checks are constantly necessary, as a hairsbreadth change in the thickness can result either in leakage, or a membrane which simply cannot be ruptured. Such measurement is necessarily empirical, as rupturability of the membrane by the existing methods worsens after the subsequent processing.

Subsequent processing will usually include autoclaving as, although most applications use the blow-fill-seal method, constant adjustment of the cutters to ensure correct membrane thickness means that the cutters are not sterile. The autoclaving leads to a change in the crystalline structure of the plastic, which is not understood, but which makes the plastic less easy to rupture.

Attempts to allow the use of thicker membranes, therefore, have come to naught. Such attempts include those described above, as well as the use of a blade in the rupturing members of the cap. In EP-A-326592, there is disclosed a system similar to that of EP-A-194068, but wherein at least one blade is provided on a finger so that, when the cap is unscrewed, the blade cuts into the membrane and the jacking or cutting action of the remainder of the fingers lifts off the seal. These blades could also possess a wall, as described in US-A-4526279, for strengthening.

This system does not solve the problem, as the blade either bends or, when reinforced sufficiently, tends to deform the seal or, when a wall is buttressed against the seal, tends to bind to the seal, thereby defying even the efforts of a strong man to turn the cap and remove the seal.

Accordingly, there is still a need to replace bottles with downwardly removable seals, and to provide bottles with a lower degree of wastage.

It has now been now been found that bottles having substantially thicker frangible membranes than were heretofore of practical application can be used with bottle caps of the present invention.

In accordance with a first aspect of the invention, there is provided a bottle cap for use with moulded plastics bottles of the type having an integral flanged seal covering the aperture of a threaded neck;

the flange having an underface and the seal having a side,

a frangible membrane being located in the underface of the flange and joining the seal to the neck,

the cap having a complementary screw-thread to the thread of the neck and at least two inwardly projecting resilient members located above the screw-thread,

at least one of the inwardly projecting resilient members having a generally upwardly projecting blade and an upwardly projecting reinforcing wall adapted for engagement of the side of the seal,

the resilient members being adapted to pass over the seal with resilient deformation when the cap is screwed onto the bottle,

and, wherein

on unscrewing of the cap, at least one blade is adapted to engage the underface of the flanged seal,

characterised in that the reinforcing walls are recurved from the side of the seal.

Thus, the present invention provides bottle caps for use with blow-fill-seal type bottles having an upwardly removable seal, the caps having inwardly projecting members, at least one of which is equipped with a blade and an upstanding wall to engage the seal of the bottle, the wall being recurved away from the seal. Such caps allow thicker frangible membranes to be used in the manufacture of the bottles so that there is less wastage, and also permit easier end-use and a higher success ratio for seal-removal.

The frangible membrane may take any suitable form. In one simple embodiment, the frangible membrane is formed in the final stage of moulding by using a cutter to form a weakened, or thinner, line in the underface of the flange. Such a technique is typically employed in the art.

Another suitable embodiment of frangible membrane is where all, or a portion, of the underface is rendered thinner during moulding. This embodiment has the advantage that it is less crucial where the blades are located within the cap, but was not previously possible because of the critical importance of membrane dimension to function.

Thus, it is a particular advantage of the present invention that thicker membranes oan be used. The failure rate of opening a bottle is drastically reduced, and bottle manufacture is made considerably easier with a further concomitant reduction in wastage. Using the systems of the art, when a cap engages the seal, if the user fails to open the bottle first time, screwing the cap down and trying again almost invariably fails With the system of the present invention, the situation is reversed and, even where the first attempt proves unsuccessful, the second will usually work. Accordingly, the present invention provides for economies of up to

about 50%, as well as providing a system operable by people of only average strength.

Preferred bottles for use in accordance with the present invention are those which are manufactured, filled and sealed in a single operation (blow-fill-seal bottles).

The term 'recurved' is used to indicate that the inner face of a wall adapted for engagement of the side of the seal does not have the same curvature as that portion of the side of the seal engageable by the wall. Accordingly, the recurved wall does not contact the side of the seal flat along its length, just for a part of it. Thus, the walls will generally be curved away from the side of the seal

In general, it will be appreciated that the recurved wall may be curved just marginally away from the side of the seal, eccentrically away, straight so as to define a tangent, or be curved in the opposite sense. Any curvature of the wall may be in the form of a regular arc having a single focus, or it may have two or more foci, or may have no effective focus. The wall may be a simple upstanding rod, for example, or may even be a short wall following the curvature of the side of the seal and being recurved in the sense of having rounded edges. This latter embodiment is not a preferred embodiment, as the more wall that engages the side of the seal, the greater the binding, or drag, and the more difficult it becomes to unscrew the cap.

It is particularly preferred to provide low walls, so as to minimise binding, or friction. The walls may be as low as possible, provided that they still serve to engage the side of the seal Alternatively, the walls may be vertically displaced from the side of the seal to achieve the same effect, or the seal itself may be dented or curved inwards to achieve the effect as required

It is also particularly advantageous for that portion of the seal for engagement with the wall to fit snugly into the angle defined by the wall and the blade, or blade support, so as to provide good leverage.

The wall may be formed integrally with the blade, or provided separately, such as in the case of a metal rod, for example. In such a case, the rod may also be designed to rotate in its socket to reduce friction yet further but, for simplicity and ease of manufacture, integrally formed blades and walls are preferred and tend to be just as, or more, effective.

A particularly preferred form of wall is only about 1mm high and has faces formed from two sectors. Thus, it may only have two faces in plan section. This format provides for maximum strength in the central section of the wall where the side of the seal is to be engaged.

Unscrewing of the cap causes upward movement of the blade(s) to cut into the underface of the seal, while prising the seal from the bottle, giving a more efficient severance of the seal. The reinforcing wall functions by acting against a side of the seal when upward pressure is applied, preventing buckling of the blade support. Not all of the walls in any one cap will necessarily act against the side of the seal, and it may be that none does unless the blade buckles slightly, bringing the wall into contact with the side of the seal. However, it is generally the case that a majority of walls will act against the seal during unscrewing of the cap and consequent removal of the seal

A particular and surprising advantage lies in the fact that bottles with relatively thick frangible membranes can be used with the caps of the invention. It is now essentially possible to provide a production line for the bottles which does not have to be continuously checked, not because the production line has been in any way improved, but because there is greater tolerance in the usable thickness of the membrane. Thus, the machine can be tooled to provide thicker membranes, as variation in thickness is considerably less important. Accordingly, it is now easier to keep the entire operation sterile, thereby reducing or eliminating the need for autoclaving.

Preferably at least two, and ideally 3, of the inwardly projecting resiliently deformable members comprises an upwardly directed blade.

In practice, even where 3 blades are provided, it has been observed that the seal is engaged by just one blade which proceeds to tear the membrane.

It has been found to be particularly efficient to provide 3 blade members, especially spaced in only one semicircle defined by the inner side of the cap. Any more or less may be used, but a noticeable drop in efficiency results, with more blades leading to extra binding.

It is preferred to also employ seal retaining means in the cap. Suitable for this purpose are non-cutting, cleft members, such as are desoribed in US Patent No. 4,526,279 Any number may be employed as required, but a total of three is preferred, especially arranged in a semicircle opposite the blade members. Other suitable means include baffles. The retaining means may be placed in any suitable position, provided that the purpose is served, and cutting is not hindered. In particular, it is preferred that the retaining means is located such that the blades will engage the underface of the seal first. Subsequent engagement of the underface by the retaining means may serve either to force up the seal and assist in removal, or to retain the seal in the cap, or both.

The blade and retaining means may be fused, or formed, directly into the cap, or be connected

via one or more support arms. While the latter method tends to be weaker, it may be preferable in some circumstances.

The blades may be in any form suitable for achieving the purpose of the invention. A square edge has been found to be satisfactory, but curved edges may assist in avoiding catching in the cut surface.

In particular, it is advantageous to present a cutting point to the seal underface to puncture the seal. Once punctured, the seal becomes easier to sever, and may be cut by a wedging action using a blunt edge, an embodiment which works well and is easiest to form in practice.

The cap may also be provided with a tamper-proof ring below the thread, designed to engage a complementarily-shaped part on the container. Such tamper-proof rings are known in the art. For example, the tamper-proof ring can comprise a series of internal teeth or ratchets which engage with complementary teeth or ratchets on the bottle neck, making it impossible to remove the cap from the bottle until the tamper-proof ring has itself been removed, for example by rupture of the ring. To this end the ring can comprise a pull-tab and a line of weakness, such that grasping and pulling of the pull-tab leads to breaking away at the line of weakness of the ring from the rest of the cap.

The caps of the present invention may be made from any suitable material, but preferably from plastics, especially thermoplastics. Particularly preferred is tough, pharmaceutical grade polypropylene

The caps may be made integrally or piecemeal. If the latter, then it is usual for the top of the cap to be snap-fitted, glued or heat-welded into place, and the blade members may be provided on an annular member adapted to seat above the screw-thread.

The latter can be particularly advantageous in that the blades may be formed from metal. There is then less chance of their buckling. The necessary resilience may be a quality of the metal itself, or the blade(s) may be seated in a plastics annulus, for example. The annulus may be inserted in the cap and seated in a convenient groove or upon a suitable shoulder or abutments. However, metal blades are generally potentially more dangerous and also lend complexity to cap manufacture, so that they may be less preferable.

The caps of the invention may be provided separately, together with a suitable bottle, in packs, or in other suitable methods of packaging. Although it is preferred that the bottles to be used are hermetically sealed, any bottle having a suitable upwardly removable portion on a screw-threaded member may be employed in conjunction with the caps of the present invention. Accordingly, the present invention also provides a cap, as defined, in association with a suitable bottle, especially as defined in the preamble.

The bottles for use with the caps of the invention may also be made from any suitable material, such as polypropylene, polystyrene or polyethylene. Traditionally, polypropylene has been used for such bottles, and this material is suitable for the bottles of the invention. Polyethylene is a generally more desirable material, but has not found much application in the area of the invention owing to the necessity of autoclaving, which tends to melt and deform polyethylene. However, with modern autoclaving techniques, it has become possible to use polyethylene, and such bottles are preferred for use with the present invention.

Choice of bottle material may also affect the make-up of the cap, which may be made of the same material, but will normally be of a suitably hard material. Polypropylene is particularly prone to binding, and a preferred cap format has three blade members adjacent one another and opposite three support members. Polyethylene, on the other hand, is less prone to binding, and the generally less preferred format of 6 blade members has been found to work well, although 4 or 5 equally spaced blade members may also work well, or an interspersed form of the 3+3 format, but the 3+3 format, as described for polypropylene, is most preferred.

The present invention will now be described by way of example with reference to Figures 1 to 3 of the accompanying drawings, in which:

Figure 1 is a vertical cross-section of a cap of this invention when threaded on the neck of a bottle;

Figure 2 is a plan showing the spatial arrangement of the blades and baffles of the cap of Fig. 1; and

Figure 3 is a vertical section on the line 3-3 of the cap of Figure 2.

The moulded plastics cap 10 of this invention has a thread 12 complementary to the thread 14 of the neck 16 of a bottle 18. The bottle 18 has an integral seal 20 formed during the moulding and filling of the bottle. Three internal, inwardly- and upwardly-directed blades 22 are provided in cap 10 and engage with an underface 24 of an annular portion 26 of the neck 16 of the bottle 18 The blades 22 are just sufficiently flexible to slide over the seal 20 when the cap is screwed on to the thread 14 of the bottle 18. Wall 23 engages the side of the annular portion of the seal 26 to strengthen the blade 22 and to help to provide leverage.

The cap 10 is provided with a tamper-proof ring 30 below the thread 12 with a series of internal ratchets (not shown, being of conventional design)

which engage with complementary ratchets 34 on the bottle neck 16, making it impossible to remove the cap from the bottle until the tamper-proof ring has itself been removed. The ring 30 is joined to the rest of the cap 10 by a line of weakness 36, and has a pull-tab 38.

Grasping and pulling of the pull-tab 38 leads to break away of the tamper-proof ring 30 at the line of weakness 36, allowing unscrewing of the cap 10. This tamper-proof ring is useful to prevent premature unscrewing of the cap. With previous designs, it was also useful to prevent any pressure being placed on the seal which might cause rupture It will be appreciated that, with the present invention, this latter use is of substantially diminished importance.

Unscrewing of the cap 10 causes upward movement of the blades 22 to cut in to the underface while the area 21 between blade 22 and wall 23 helps to lift the seal 20 from the bottle, giving an efficient severance of the seal. Bending of the blades is prevented by the presence of walls 23. In order that the seal 20 is securely retained within the cap 10, the blades may be supplemented by baffles 32 in the opposite half of the cap 10 as shown in Fig. 2.

Claims

1. A bottle cap for use with moulded, preferably blow-fill-seal, plastics bottles, preferably made from polypropylene, polystyrene or polyethylene, of the type having an integral flanged seal covering the aperture of a threaded neck;
the flange having an underface and the seal having a side,
a frangible membrane being located in the underface of the flange and joining the seal to the neck,
the cap having a complementary screw-thread to the thread of the neck and at least two inwardly projecting resilient members located above the screw-thread,
at least one of the inwardly projecting resilient members having a generally upwardly projecting blade and an upwardly projecting reinforcing wall adapted for engagement of the side of the seal,
the resilient members being adapted to pass over the seal with resilient deformation when the cap is screwed onto the bottle,
and, wherein
on unscrewing of the cap, at least one blade is adapted to engage the underface of the flanged seal,
characterised in that the reinforcing walls are recurved from the side of the seal.

2. A cap according to claim 1, wherein at least two, and preferably 3, of the inwardly projecting resiliently deformable members comprise an upwardly directed blade.

3. A cap according to claim 1 or 2, wherein the wall is formed integrally with the blade.

4. A cap according to any preceding claim, wherein the walls are about 1mm high.

5. A cap according to any preceding claim, wherein the walls have faces formed from two opposing sectors.

6. A cap according to any preceding claim, wherein the portion of the seal for engagement with the wall is adapted to fit snugly into the angle defined by the wall and the blade, or blade support.

7. A cap according to any preceding claim, wherein the cap further comprises seal retaining members in the cap.

8. A cap according to claim 7, wherein the retaining members are located such that the blades engage the underface of the seal first, on unscrewing of the cap.

9. A cap according to claim 7 or 8, wherein the retaining members consist of one or more cleft members having an upstanding wall for engagement of the side of the seal and an inwardly directed portion adapted to engage the underface of the seal.

10. A cap according to any of claims 7 to 9, wherein at least two, and preferably 3, resilient members, each having a blade, are adjacent each other and opposite an equivalent number of retaining members, all with regular spacing.

11. A cap as defined in any preceding claim in association with a bottle as defined in claim 1.

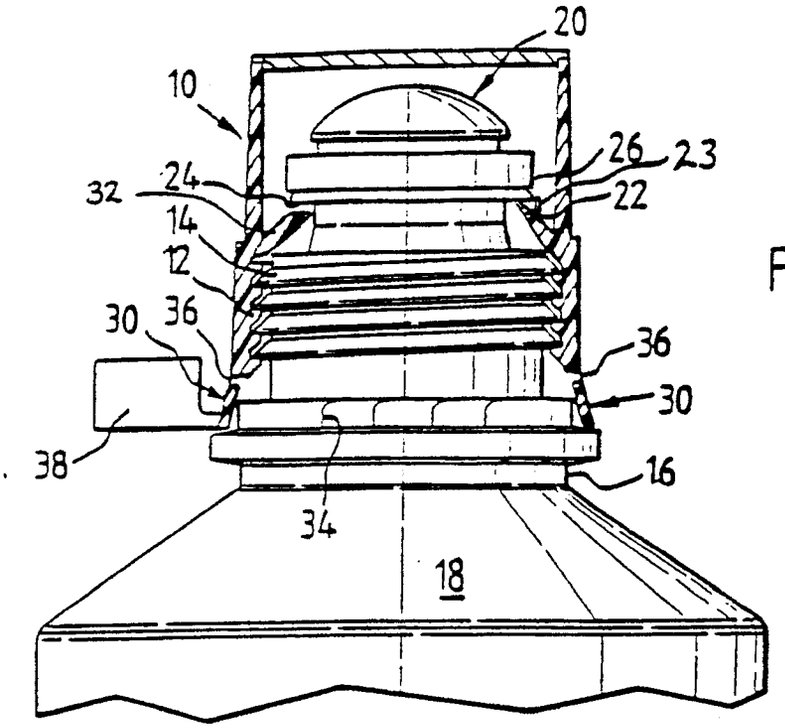


FIG.1.

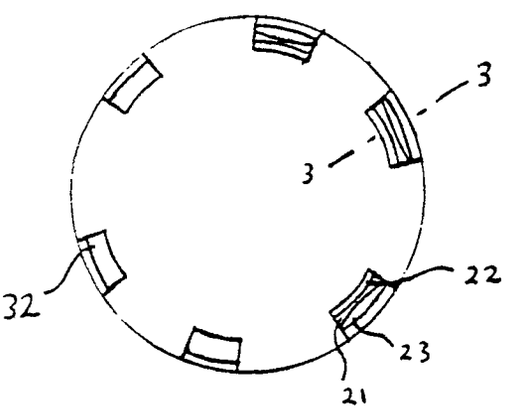


FIG. 2

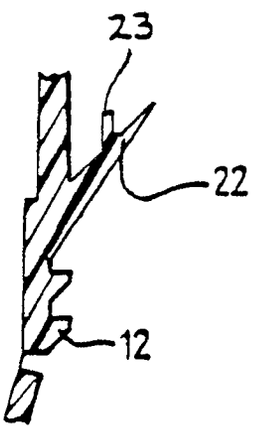
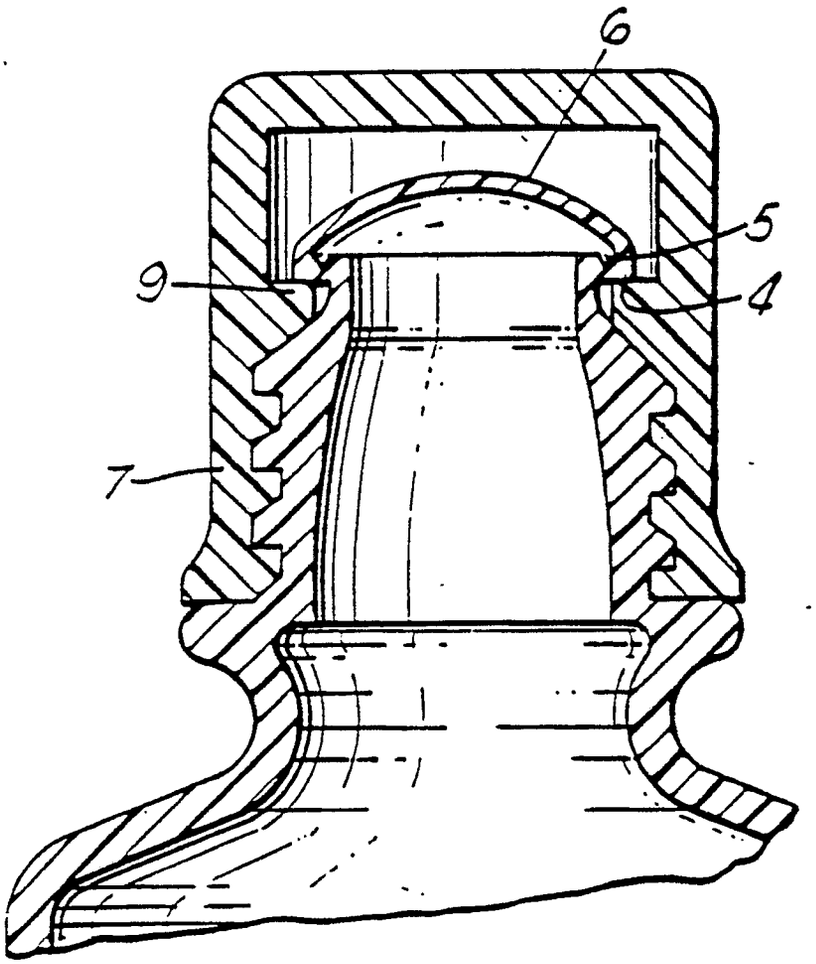


FIG.3.

Fig. A



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EUROPEAN SEARCH REPORT

Application Number

EP 90 31 0977

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	WO-A-8900534 (WAVERLEY PHARMACEUTICALS)	1-3, 5,	B65D51/22
	* the whole document *	7, 8, 11	
A		9	

D,A	US-A-4526279 (WEILER ET AL.)	1, 5, 7,	
	* the whole document *	9, 11	

A	FR-A-2150226 (MECAPLAST)	1, 11	
	* the whole document *		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B65D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	20 DECEMBER 1990	SPETTEL, J.D.M.L.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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