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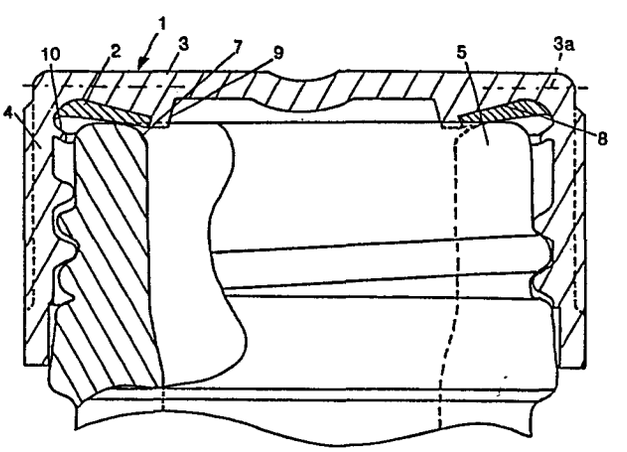
(54) Pre-threaded container closure.

(57) A container closure, in this case a bottle cap 1, has a flowed in gasket 2 which engages the neck rim 5 of a bottle to generate sealing contact over the inner corner of the neck rim, substantially without contact of gasket material with the outer corner. The co-operation of the neck rim and gasket may be by virtue of shaping of the gasket 2 and/or shaping of the bottle cap end panel 3, and/or shaping of the glass finish of the bottle neck rim.



PRE-THREADED CONTAINER CLOSURE

The present invention relates to a pre-threaded container closure, of the type serving as a screw cap for engagement on a neck of the container, for example the neck of a bottle.

Pre-threaded container closures are known in two main forms, the metal screw cap and the injection moulded plastic screw cap. Examples of plastic caps are disclosed in GB-A-2,116,529 and in WO-A-82/02182. In each case the gaskets are aimed at achieving high compression of the gasket material around the outside corner of the bottle neck rim.

This "outer corner seal" placement of the gasket has been evolved after many years of development with aluminium bottle caps and has been found to give satisfactory protection against the tendency of the cap to "dome" when subjected to high internal pressures. This doming of the cap end panel has the effect of lifting the cap top panel upwardly at the centre and hence also upwardly to lesser degrees at stations radially outwardly of the centre, but the gasket compression on the outside corner is virtually unaffected, and may even be increased slightly, as a result of this doming which is a known phenomenon in both aluminium pre-threaded caps and moulded plastics pre-threaded caps. The "outer corner seal" placement is thus highly advantageous with a good quality glass bottle.

However, problems arise with regard to the quality of the glass finish, firstly with regard to the difficulty of ensuring close tolerances on the bottle neck radius with the result that some bottles may have differing internal diameters and to some extent differing external diameters and secondly with regard to the use of returnable bottles where a re-used bottle may show signs of damage sustained during a previous "trip" (this damage manifesting itself as roughening of the outside corner of the glass, or chips on the glass, or even small cracks which have not been detected during the quality control inspection of returned bottles).

With a glass bottle neck on the limits of its radius tolerance, the sealing performance with a pre-threaded cap, as opposed to an RO (rolled-on) cap, will be disadvantageously affected because the gasket is intended to achieve a desired compression against the outside corner of the glass bearing in mind the expected gap between the outside corner and the internal surface of the cap skirt, so a larger than normal outside diameter of the bottle runs a risk of jamming of the cap during screwing-on rotation of the cap, and a smaller than normal outside diameter to the cap can result in inadequate gasket compression for sealing.

The problem of damage to the outside corner manifests itself as increased friction between the gasket and the neck during screwing-on cap rotation and hence either the use of a fixed torque applicator will result in inadequate axial compression of the gasket for sealing, or alternatively if the cap is screwed on tight enough to ensure the correct gasket compression the application torque, and hence the removal torque, will be excessively high and unacceptable for practical considerations of the need for the bottle to be opened, without the use of special tools, by the consumer. The problem of high application torque with pre-threaded caps has been tackled by ensuring lubrication between the gasket and the bottle as in EP-A-0 129,309.

The problems of bottle diameter variation and of neck damage are not so important with regard to an RO cap where threads are rolled into the unthreaded cap blank using the rigid bottle neck as a die and at the same time an axial loading and radial contraction of the corner of the cap (the "reform" step) are used to shape the cap to fit the individual bottle. Furthermore, the avoidance of any rotation of the cap during the application process has the advantageous result that the gasket composition will be pressed into any imperfections on the bottle neck rim and achieve the desired seal. With pre-threaded caps, for the reason stated above, ----------

these problems are considerable and it is an object of the present invention to provide for sealing of containers whose neck rims are damaged and/or of non-standard size.

As an alternative to the "outer corner seal" placement of the gasket it is known from GB-A-1148089 to position a moulded annular gasket on the end panel of a tin-plate rolled on closure of the "twist-off crown" type where it will contact the inside corner of the container neck.

Accordingly, the present invention envisages the surprising step of using a flowed in gasket and achieving a seal which requires no gasket composition in contact with the outer corner of the container rim, and instead employs a particular profile to the container, and/or the gasket, and/or the closure to provide for adequate sealing action on the inner corner of the container neck as the closure is screwed on.

One aspect of the present invention provides a process of closing a container having an externally threaded neck, comprising: taking a container closure of a first plastics material, having an end panel, an internally threaded skirt, and a separately formed gasket of a softer second plastics material on the end panel and screwing that pre-threaded closure onto the container neck to close the container neck, to achieve sealing contact of the end of the container neck rim without contact of the material of said gasket against the outer corner of the bottle neck rim, characterised in that the gasket is a flowed in gasket applied to the pre-threaded closure without moulding, before the closure is itself applied to the container.

A second aspect of the present invention provides a plastic pre-threaded container closure having a separately formed gasket of a plastics material softer than that of the closure, the gasket having a surface configuration such that its surface is further from the median plane of the end plane

of the closure at a radially inner location than it is at a radially outer location, whereby the gasket seals against the inner corner of the container neck rim without contact of gasket composition against the outer corner of the container neck rim, characterised in that the gasket is a flowed-in gasket formed without moulding.

Yet a third aspect of the present invention provides a pre-threaded plastic container closure having an internally threaded skirt, an end panel, and a separately formed gasket, characterised in that the gasket is a flowed in gasket applied to the closure without moulding; and in that the end panel includes a rib embedded in the flowed in gasket to generate localised increased compression of the gasket material in an annular region thereof adjacent to the location of the internal corner of the neck rim of a container on which the closure is to be used, so the flowed in gasket seals against the internal corner of the container neck rim substantially without contact between the gasket and the outer neck rim corner.

A fourth aspect of the invention provides, in combination, a container having a threaded neck; and a plastic closure having an end panel bearing a separately formed plastic gasket of a material softer than that of the closure, and an internally threaded skirt joined to said end panel for engaging the container neck; the end of the container neck being shaped to encourage movement of the gasket composition radially inwardly of the end panel during closing of the container using that cap, to effect a seal on the inside corner of the container neck, characterised in that the gasket is a flowed in gasket applied to the closure without moulding.

Preferably the flowed in gasket is formed of a hot melt composition applied to the closure in molten form and allowed to solidify quickly on cooling.

The step of relying on sealing at the inside corner of the container neck is a very surprising one to take

unless the material of the cap is relatively rigid, or the cap end panel is very thick, because of the natural expectation that the "doming" of the cap will have the effect of relaxing gasket compression where the compression arises at the inside corner, despite the fact that gasket compression at the outside corner is substantially unaffected by doming. The dangers of such doming are discussed in WO-A-82/021282, on page 2, lines 7 to 30. Furthermore, an accurately moulded gasket would be expected to be necessary in order to ensure the precise placement of the gasket and the accuracy of engagement of the gasket into the container neck. However, we have found that the quality of the seal achieved using this "inside corner sealing" placement of the gasket does not give rise to unacceptable problems through "doming" but does overcome the independent problems due to wide tolerances on the container neck diameter, including the internal diameter, and damage of the rim of a returnable glass container on a previous trip (because most of the damage will be experienced on the outside corner and the inside corner is therefore relatively unharmed). Indeed, the use of a flowed in gasket allows for wide tolerances on the "inside corner sealing" surface of the container neck by virtue of the resilience of the gasket composition.

In order that the present invention may more readily be understood the following description is given, merely by way of example, with reference to the accompanying drawings in which:-

FIGURE 1 shows a diametral cross-section of the closure, with a partly sectional illustration of the container neck, in this case a glass bottle neck to which the cap is to be fitted, but illustrates the prior art form of cap with an"outer corner seal" placement of the gasket;

FIGURE 2 is similar to Figure 1 and shows a first embodiment of the container closure in accordance with the

present invention, with the gasket just in contact with the container neck but before any appreciable compression of the gasket during the screwing-on process;

FIGURE 3 is a view, similar to Figure 2, but showing a different embodiment of cap and gasket in accordance with the invention; and

FIGURE 4, again similar to Figure 1, shows a view of a further embodiment of the present invention.

The prior art form of cap 1 shown in Figure 1 (in accordance with our GB-B-2,116,529) has a gasket 2 positioned in the vicinity of the corner between the cap end panel 3 and the cap skirt 4 so that, as the cap 1 is screwed onto a bottle neck 5, the gasket 2 becomes pressed into sealing contact with the outside corner 6 of the bottle neck. As explained above, imperfections in the glass and in particular damage caused by previous "trips" of a returnable bottle, cause problems with regard to this corner placement which is conventional in the art.

Figure 2 shows a first embodiment of a cap, again referenced 1, in accordance with the present invention. In this case the gasket 2 is confined in a recess whose floor 8 slopes in a direction such that it is further from the median plane 3a of the end panel 3 of the cap at the radially inner portion near an inner gasket-containment bead 9 than it is at its outer portion near the corner between the end panel 3 and the skirt 4. The free surface of the gasket which contacts the bottle neck rim 5 as the bottle is closed, also slopes in the same way in relation to the median plane of the end panel 3.

In this case the gasket 2 is formed by being flowed in to occupy the space defined between the inner gasket-containment bead 9 and an outer gasket-containment bead 10, and the gasket composition adopts the illustrated profile upon cooling.

As the cap 1 is screwed onto the bottle neck 5 the gasket 2 initially makes contact with the top of the bottle neck rim but the inclination of the surface of the gasket 2----------

is such that the gasket composition moves down onto the inner corner 7 of the bottle neck to provide the required "inner corner seal" action. In this case the slope of the floor 8 of the gasket-receiving groove of the cap, and the shape of the gasket 2 itself, both contribute to ensure the desired "inner corner seal" action.

Figure 3 shows an alternative form of the gasket in which the gasket 2 assumes the distinctly toroidal configuration by virtue of the high viscosity of the flowed in composition, and is held in the flat-bottomed gasket-receiving groove by means of the undercut of the inner gasket-containment bead 9 of Figure 2, and an undercut 11 in place of the outer gasket-containment bead 10 of Figure 2. The slope of the surface of the gasket 2 is entirely due to the thickness of the gasket and is such that as the bottle cap is screwed down onto the bottle neck, the shape of the gasket 2 and the shape of the bottle neck 5 co-operate to shift the gasket composition down towards the inner corner 7 of the glass neck rim. Here the neck configuration and the gasket shape co-operate to give the desired "inner corner seal" action.

Finally, Figure 4 shows a further flowed in gasket 2 in a cap 1 having a rib 13 formed in the floor of the gasket-receiving groove between the inner gasket-containment bead 9 and the outer gasket-containment bead 10 analogous to those of Figure 2.

Although in this case the gasket has a free surface which has a slight inclination in the same direction as that shown in Figure 2, this embodiment relies heavily on the rib 13, embedded in the gasket, to ensure that there will be higher compression of the gasket material between the rib 13 and the end face of the bottle neck near the inner corner 7 of the neck rim, giving the desired result of high gasket compression at the inner corner and some shifting of composition around onto the inner corner for sealing thereon.

Yet a further possibility (not illustrated) is for

the gasket to have a relatively flat configuration and for at least part of the profiling to give the desired "inner corner seal" action to be derived from the shape of the glass finish itself.

It will of course be understood that each of the embodiments of Figures 2 to 4 has a configuration in which there is contact of the gasket with part of the end face of the bottle neck but pronounced sealing contact around the inner corner 7 of the bottle neck without, in any of these embodiments, any substantial contact between the gasket 2 and the outer corner (referenced 6 in Figure 1) of the neck rim. Hence if there is any roughening of the outer corner 6, or the evidence of chipped regions of that corner, there will be no appreciable increase in application torque and removal torque.

EXAMPLE 1

In order to illustrate the fact that the sealing performance is independent of the quality of the glass finish, tests were carried out using 28 mm plastic caps on readily available samples of returnable glass bottles. Ten examples of the bottle were used, and the second column illustrates the condition of the bottle, e.g. "chipped and cracked", "rough", and "OK".

The hot melt composition used for forming the gasket was placed in two alternative placements in identical caps, one corresponding to the "outer corner seal" action illustrated in Figure 1, and the other corresponding to the "inner corner seal" action typical of Figures 2 to 4. The venting pressure values as tested by means of an Owens Illinois "Secure Seal Tester" are set out in the third column for the "outer corner seal" placement of Figure 1 and in the fourth column for the "inner corner seal" placement in accordance with the present invention. The venting pressure values quoted are measured in pounds per square inch but with the "S.I." value measured in KPa shown in brackets alongside

the imperial value.

The bottom line of the table quotes the average film weight of the gasket and shows that a slight reduction in the film weight was acnieved with the "inner corner seal" placement shown in the fourth column despite the fact that the venting pressure results were more consistent in that case.

TABLE 1

BOTTLE NO	GLASS CONDITION	OUTER CORNER	INNER CORNER
1	OK	150+(1034+)	150+(1034+)
2	OK	150+(1034+)	150+(1034+)
3	OK	150+(1034+)	150+(1034+)
4	CHIPPED & CRACKED	0	150+(1034+)
5	ROUGH	65(448)	150(1034)
6	OK	150(1034)	150+(1034+)
7	OK	75(517)	150(1034)
8	NUMEROUS CHIPS	0	150+(1034+)
9	OK	150+(1034+)	150+(1034+)
10	OK	150+(1034+)	150+(1034+)
AVERAGE FILM WT. (mg)		252	246

As can be seen from the results quoted, bottles numbers 4 and 8 were so badly damaged that there was no seal achieved with the "outer corner seal" placement of Figure 1. Furthermore, bottles 5 and 7 achieved only a low venting pressure result (bearing in mind that venting pressures in excess of 150 lb/in^2 (1034 kPa) are considered acceptable for pressure holding applications).

With the damaged samples numbers 4 and 8 with which no sealing was possible on the "outer corner seal" placement, acceptable venting pressure values were obtained with the "inner corner seal" placement, and with damaged sample

number 5 where only a partially effective seal was obtained on the "outer corner seal" placement a venting pressure equivalent to the limit of acceptance was obtained. With the other samples numbers 6 and 7, on which values which were not clearly above the limit of acceptance were achieved with the "outer corner seal" placement, in each case the values are improved in the "inner corner seal" placement of the gasket.

EXAMPLE 2

To show that the present invention is not limited to glass containers, the test of Example 1 was used with a set of ten polyethylene terephthalate plastic finish samples. Because plastic bottles are not normally reusable, only the inner corner placement was used and, as shown from Table 2 below, the results were acceptable. The normal criterion for commercially acceptable plastic bottles is for the closure to hold a pressure of at least 100 lb/in^2 (689 kPa) and for the closure not to be ejected from the container neck at a pressure of 150 lb/in^2 (1034 kPa). All ten samples listed in Table 2 below satisfy this requirement.

TABLE 2

BOTTLE NO	INNER CORNER
1	150+(1034+)
2	150+(1034+)
3	150+(1034+)
4	150+(1034+)
5	150(1034)
6	150+(1034+)
7	150(1034)
8	150+(1034+)
9	150+(1034+)
10	150+(1034+)
AVERAGE FILM WT.(mg)	246

It will of course be understood that the gasket can be formed by any one of several different methods, many of which are illustrated in the drawings.

For example, a hot melt composition in accordance with our EP-A-0,129,309 and EP-A-0,129,310 may be flowed into the gasket-receiving groove of the pre-formed cap and distributed throughout the groove by spinning of the cap and whereupon the cooling of the composition causes it to adopt the desired configuration of the finished gasket. Such a gasket may, if desired, be formed using the method of our GB-B-2,051,660 relating to microwave heating of the plastisol to form the gasket with separate non-microwave heating of the closure to enhance uniformity of heating of the plastisol.

The flowed in gasket may, if desired, be of a foamable composition so that the gasket material can be caused to foam upon heating, for example as disclosed in published GB-A-2,116,473.

The configuration of Figure 3 may be formed by flowing in a high viscosity thermoplastic melt whose viscosity will then cause the resulting bead of the melt

to adopt the Figure 3 generally toroidal configuration which it will retain on cooling.

As indicated above, we have surprisingly found that if the natural prejudice against "inner corner seal" action is overcome the use of such a sealing action results in the cap which has a much better sealing performance with damaged bottles than can be achieved with the conventional "outer corner seal" action of Figure 1 (see the third column in the Table), even with a flowed in gasket when the dimensional control of the gasket profile cannot be so accurately controlled as with alternative gasket manufacturing processes such as moulding or stamping from a flat sheet. This improved performance is especially advantageous. There is not even any need to thicken the cap end panel excessively to resist doming; although the cap domes under internal pressure, the gasket is understood to lift slightly but the resilience of the flowed in gasket is such that it is nevertheless able to keep the bottle sealed even after such doming deformation of the cap end panel.

Although the present invention is particularly suitable with returnable glass bottles, it may be applied to other containers, for instance plastic containers such as bottles.

C L A I M S

1. A process of closing a container having an externally threaded neck, comprising: taking a container closure of a first plastics material, having an end panel, an internally threaded skirt, and a separately formed gasket of a softer second material on the end panel; and screwing that pre-threaded closure onto the container neck to close the container neck, to achieve sealing contact of the end of the container neck rim without contact of the material of said gasket against the outer corner of the bottle neck rim,characterised in that the gasket is a flowed in gasket applied to the pre-threaded closure without moulding, before the closure is itself applied to the container.

2. A process according to claim 1, characterised in that the gasket is formed of a hot melt composition which is introduced to the closure in molten form and solidifies quickly upon cooling.

3. A process according to claim 2, characterised in that the achievement of inner corner sealing is due to the configuration of the gasket.

4. A process according to claim 2 or 3, characterised in that the achievement of the inner corner seal action is by virtue of the shape of the closure.

5. A process according to claim 3 or 4, characterised in that the gasket has a container-contacting surface which is further from the median plane of the closure end panel at a radially inner part than at a radially outer part thereof.

6. A process according to any one of claims 2 to 4, characterised in that the closure includes an upstanding rib embedded in the gasket substantially in register with the internal corner of the container neck rim to increase compression of the gasket in the vicinity of the inner corner of the container neck rim.

7. A process according to any one of claims 1 to 6, characterised in that the achievement of the inner

corner seal action is due to the configuration of the container neck rim.

8. A plastic pre-threaded container closure having a separately formed gasket of a plastics material softer than that of the closure, the gasket having a surface configuration such that its surface is further from the median plane of the end panel of the closure at a radially inner location than it is at a radially outer location, whereby the gasket seals against the inner corner of the container rim without contact of gasket composition against the outer corner of the container neck rim, characterised in that the gasket is a flowed in gasket formed without moulding.

9. A closure according to claim 8, characterised in that the closure has a groove to receive the flowed in gasket and the groove has a floor configured such that at a radially inner portion it is further from the median plane of the end panel of the closure than it is at a radially outer portion.

10. A pre-threaded plastic container closure having an internally threaded skirt, an end panel, and a separately formed gasket, characterised in that the gasket is a flowed in gasket applied to the closure without moulding; and in that the end panel includes a rib embedded in the flowed in gasket to generate localised increased compression of the gasket material in an annular region thereof adjacent to the location of the internal corner of the neck rim of a container on which the closure is to be used, so the flowed in gasket seals against the internal corner of the container neck rim substantially without contact between the gasket and the outer neck rim corner.

11. In combination, a container having a threaded neck; and a plastic closure having an end panel bearing a separately-formed plastic gasket, of a material softer than that of the closure, and an internally threaded skirt

joined to said end panel for engaging the container neck; the end of the container neck being shaped to encourage movement of the gasket composition radially inwardly of the end panel during closing of the container using that cap, to effect a seal on the inside corner of the container neck, characterised in that the gasket is a flowed-in gasket applied to the closure without moulding.

12. A closure according to any one of claims 8 to 10, or a combination according to claim 11, characterised in that the gasket is formed of a hot melt composition applied to the closure in molten form and allowed to solidify quickly on cooling.

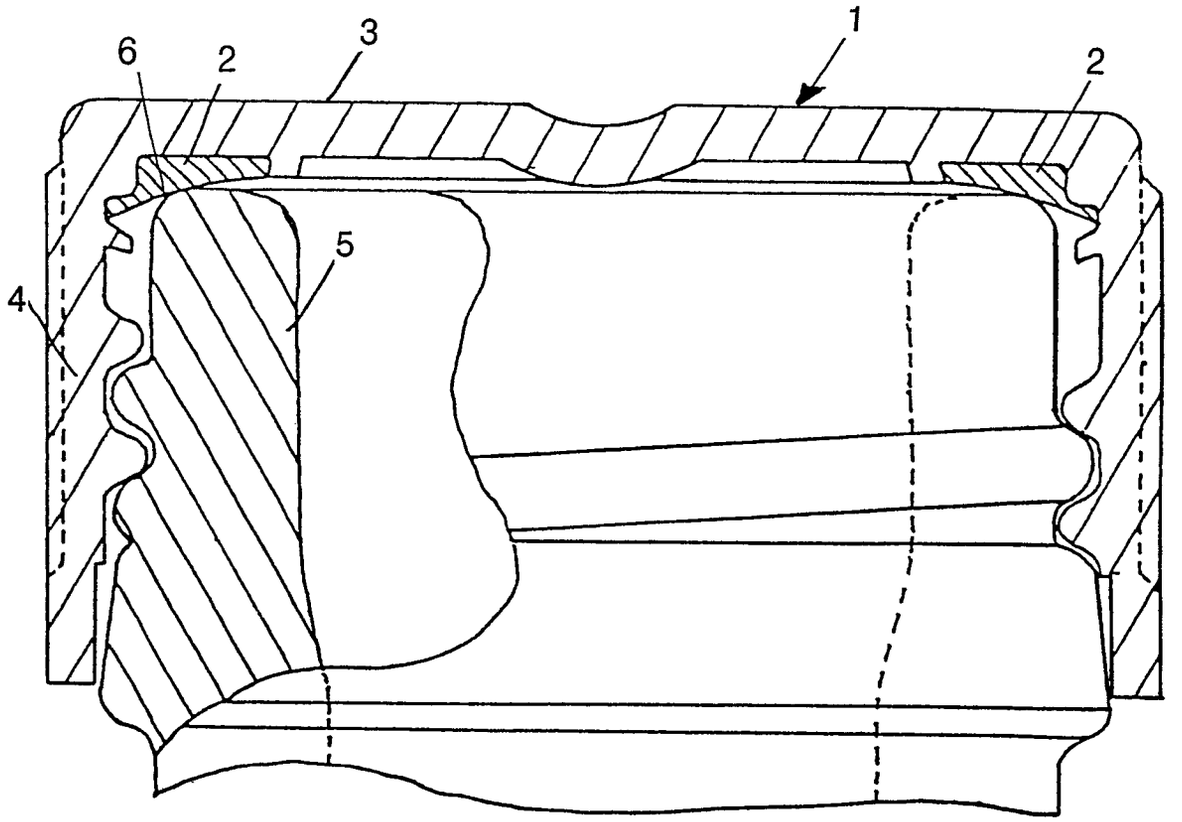


FIG. 1

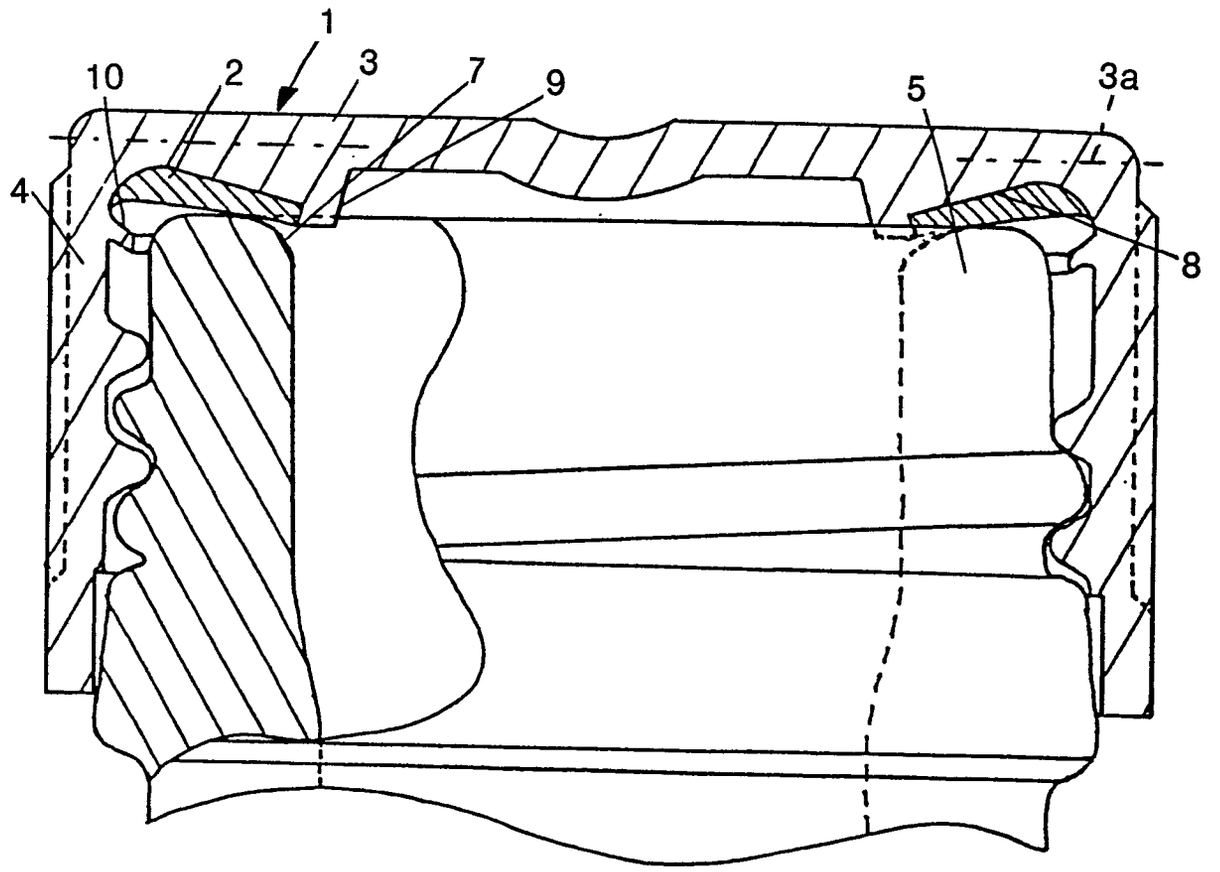


FIG. 2

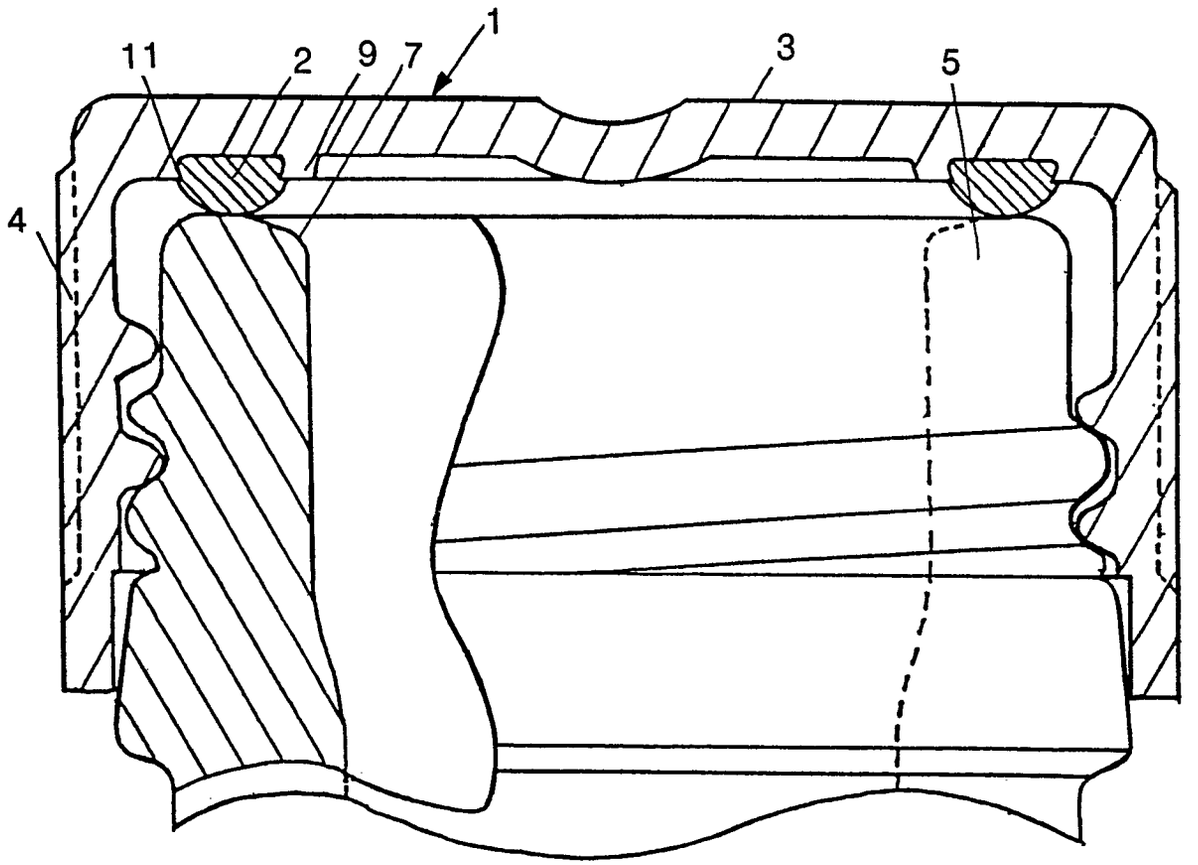


FIG. 3

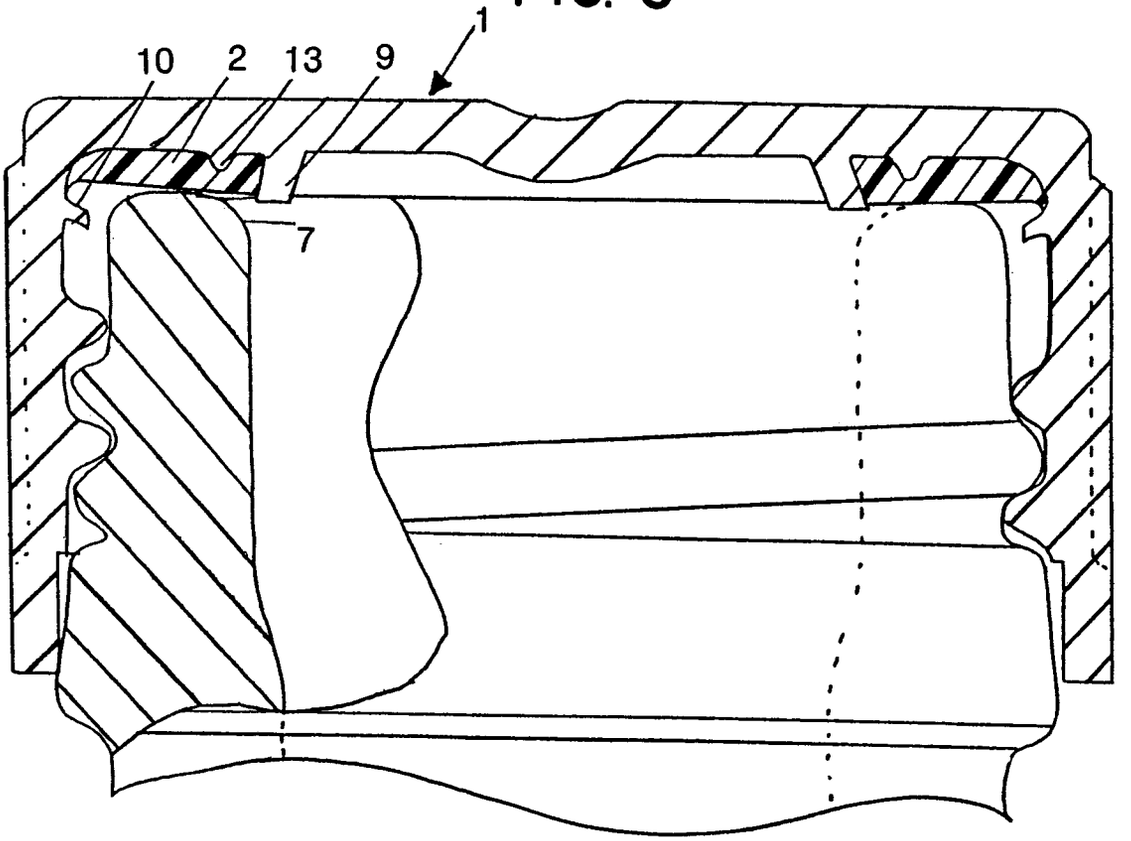


FIG. 4

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EUROPEAN SEARCH REPORT

Application number

EP 85 30 4379

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.4)
X	GB-A-1 224 733 (KORK-N-SEAL LTD.) * Page 2, lines 34-53; page 2, lines 103-111; figure 4 *	1,3,4, 7	B 65 D 41/04
A,D	GB-A-2 051 660 (W.R. GRACE) * Page 2, lines 33-63 *	2,12	
A,D	GB-A-1 148 089 (ARMSTRONG CORK CO.) * Figures 1,4 *	1,3	
A	US-A-1 920 286 (WILLIAMS) * Page 1, lines 54-58; figures 2,3 *	6	
A,D	GB-A-2 116 529 (W.R. GRACE & CO.) * Page 2, lines 51-64; page 3, lines 40-47; figures 1-4 *	11	TECHNICAL FIELDS SEARCHED (Int. Cl.4) B 65 D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	24-09-1985	BERRINGTON N.M.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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O : non-written disclosure
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