United States Patent [19]

Birch

[11] **3,865,263**

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[54] **CLOSURE CAP**

[75] Inventor: **Ralph William Birch,** Rustington, England

[73] Assignee: **U.M.P. Plastics Ltd.,** Lancashire, England

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[21] Appl. No.: **405,083**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 140,353, May 5, 1971, Pat. No. 3,784,041.

[52] **U.S. Cl.** **215/321,** 215/341, 215/DIG. 1

[51] **Int. Cl.** **B65d 41/04,** B65d 41/18

[58] **Field of Search** 215/DIG. 1, 344, 321

[56] **References Cited**

UNITED STATES PATENTS

3,203,571	8/1965	Plunkett	215/344
3,224,617	12/1965	Hohl	215/341 X

Primary Examiner—Donald F. Norton

Attorney, Agent, or Firm—Cushman, Darby & Cushman

[57] **ABSTRACT**

This invention concerns a closure cap adapted to seal the neck of a container, the closure cap being formed of a moulding of elastomeric material and having a top portion, an annular skirt which extends from the periphery of the top portion, an abutment portion of said skirt which is adapted firmly to engage said neck to releasably retain the closure cap thereon, and an annular resilient flange portion which extends from and radially inwardly of the skirt and which is spaced from the internal surface of the said top portion by an annular groove, the resilient flange portion having a surface, at least partly convexly curved, which is remote from the top portion and which, even when the resilient flange portion is undeformed, is radially inwardly inclined towards the top portion, the resilient flange portion, when the cap is fitted to the container, effecting a primary sealing engagement with a radially outer edge of the end portion of the neck and a secondary engagement with the top surface of the end portion of the neck, and the resilient flange portion being deflectable into engagement with the internal surface of the top portion to trap a pocket of air therebetween.

6 Claims, 4 Drawing Figures

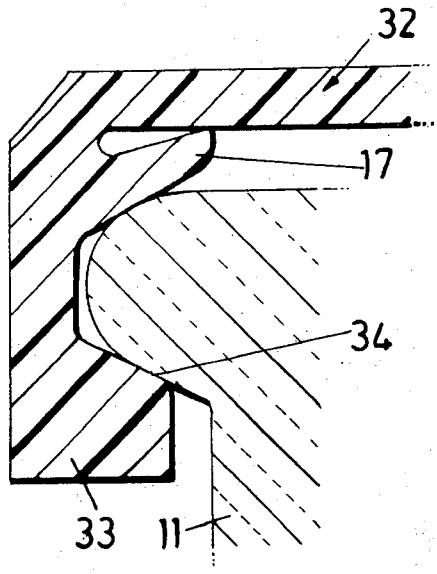


Fig.1.

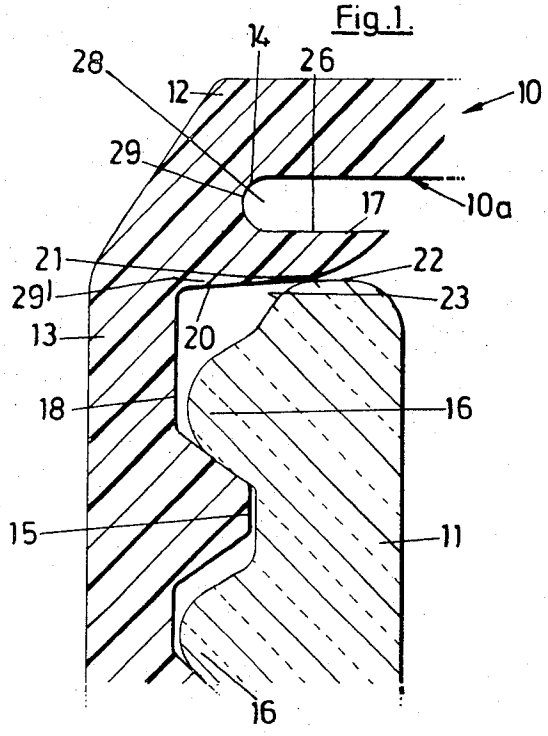
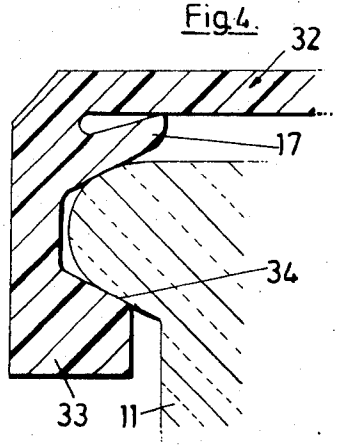


Fig.4.



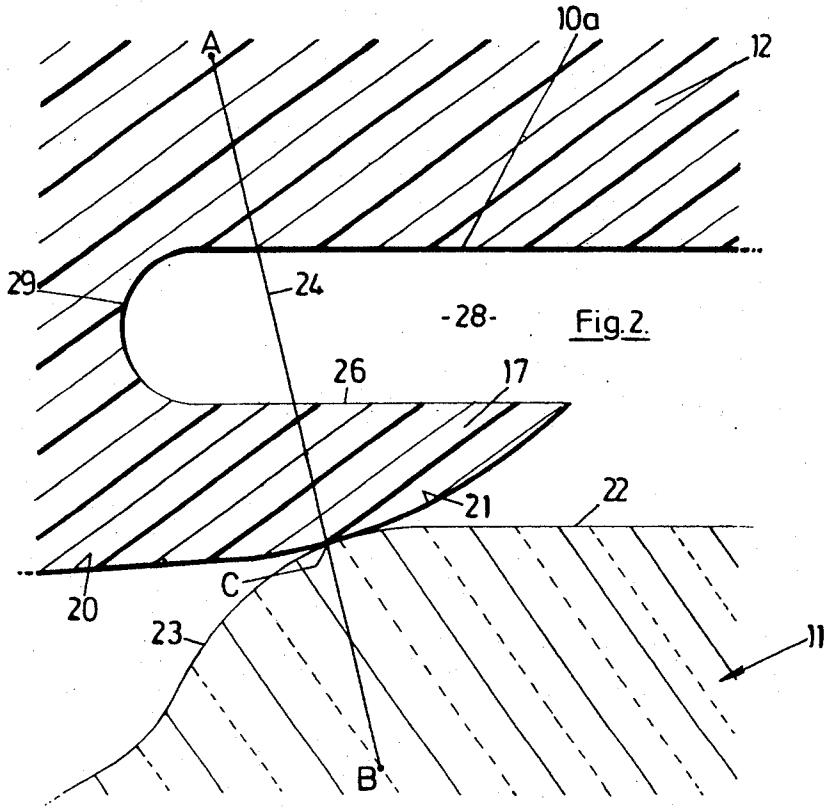

A
10a
12
29
24
-28-
26
17
21
22
20
C
23
11
B

Fig.2.

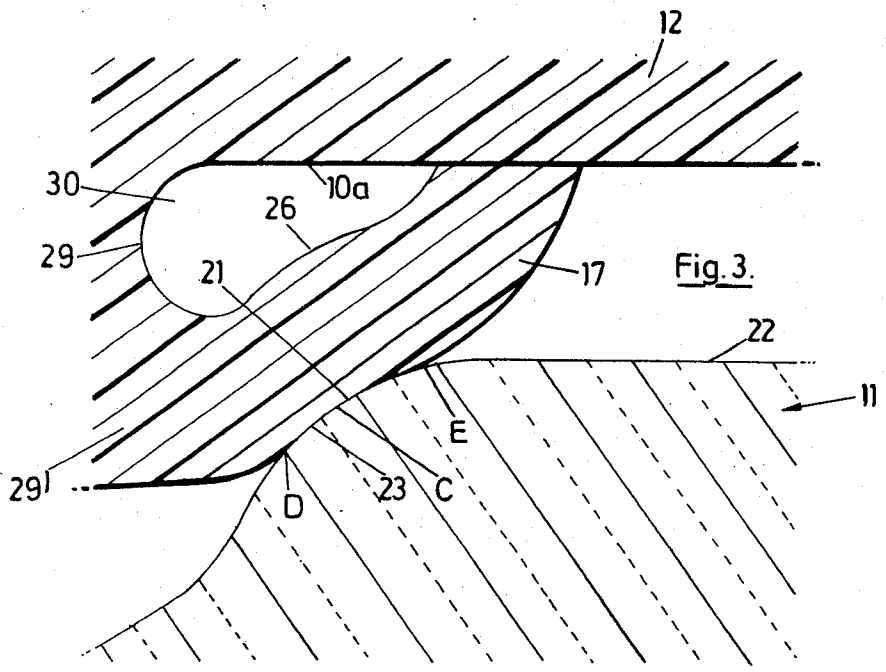

12
30
10a
26
29
21
17
22
11
E
29
D
23
C

Fig.3.

CLOSURE CAP

This Application is a continuation-in-part of U.S. application Ser. No. 140,353, filed 5th May 1971, now U.S. Pat. No. 3,784,041 by Ralph William Birch for "CLOSURE CAP".

BACKGROUND OF THE INVENTION

This invention concerns both a container whose neck is sealed by a closure cap, and a closure cap therefor.

Prior to the present invention, it has been usual to arrange that a closure cap for a container is provided with a liner, or "wad," if the contents of the container are difficult to seal. For example, it has proved necessary, in the case of a closure cap for a whisky bottle, to provide the closure cap with a liner, or "wad," in order to ensure that losses due to evaporation of the whisky in the bottle were kept to an acceptable level at all temperatures likely to be met with in practice.

Attempts have been made to fabricate a linerless or "wadless," closure cap entirely from elastomeric material such, for example as polypropylene, the closure cap having an annular resilient flange portion which extends radially inwardly from the skirt of the cap and which seals against the neck of the container. Examples of such closure caps may be seen in U.S. Pat. Nos. 3,203,571 of R. L. Plunkett and 3,224,617 of J. Hohl et al, British Pat. Nos. 1,205,887, 1,079,700, 935,574, 925,647, and French Pat. No. 1,550,358.

In contrast to the present invention, however, none of the resilient flange portions of such prior art "wadless" closure caps has previously effected a primary sealing engagement against the outside rim of the neck of the container, and consequently the sealing efficiency of commercially available prior art "wadless" closure caps has been inferior to that of the conventional "wadded" closure caps.

The present invention is based upon the appreciation that if sealing efficiency is to be maximised it is important to ensure that the primary sealing engagement is effected on a point or line contact between the closure cap and the container neck. The sealing effort is then concentrated on the smallest possible area, in contrast to the dissipation of the sealing effort over a greater area of contact.

Amongst the previous attempts which have been made to produce the required seal, use has been made of a resilient flange portion engaging the top sealing surface of the neck of the container. In the case of a primary seal effected on the top sealing surface of the container neck, however, the area of sealing contact is greater than when a point, or line, seal exists. Moreover, when relatively hard elastomeric, e.g., thermoplastics materials are employed, a low level of sealing efficiency results if attempts are made to seal on the top sealing surface of the container neck. The difficulties associated with achieving a seal on the top surface of the neck are, moreover, accentuated by surface irregularities which invariably occur, since while such irregularities may be relatively small, the thermoplastics materials lack the softness and resilience to effect a good seal.

Use has also been made in the past of an annular plug pressed into the open end, or bore, of the neck. However, such an arrangement not only does not provide the said point or line contact but, because of manufacturing tolerances required in the manufacture of glass containers, is liable to provide a very inferior seal. For example, the sealing engagement with a plug type seal can be either too loose, with resultant leakage, or so tight that it is difficult or impossible for the plug to enter the neck.

It has also been suggested to seal at the side of the container neck, but here again a point or line seal cannot be achieved when this is done.

In the present invention, however, the maximum sealing pressure is effected on the outside rim, i.e., the radially outer peripheral edge, of the end portion of the container neck, since it is only at the rim that it is possible to achieve a point or line contact. Thus although there will be manufacturing variations affecting the shape and disposition of the rim, such variations will not adversely affect the seal since there will, at some place or other, be point or line contact between the resilient flange portion and the rim.

By virtue of the location of the main sealing effort at the rim and its immunity to the many variations which occur in both the top, or end, surface of the neck and the bore diameter, the present invention is applicable to all standard container necks, irrespective of the source of manufacture, and does not require either that the container neck should be of special form or that the container manufacturer should have to carry out special gauging operations.

Thus since the primary seal is against the rim of the neck and is effected by a resilient flange portion which extends radially inwardly from the skirt, the resilient flange portion will initially make substantially point contact with the neck so that as the cap is screwed down on the neck, the sealing load at this point is considerable and a very effective seal is achieved. This seal, moreover, has a lateral component and is therefore substantially less likely to be disturbed than if the seal were constituted by a primary seal acting wholly in a downward direction, in which case forces would be generated which would tend to loosen the cap.

SUMMARY OF THE INVENTION

According, therefore, to one aspect of the present invention, there is provided a closure cap adapted to seal the neck of a container, the closure cap being formed of a moulding of elastomeric material and having a top portion, an annular skirt which extends from the periphery of the top portion, an abutment portion of said skirt which is adapted firmly to engage said neck to releasably retain the closure cap thereon, and an annular resilient flange portion which extends from and radially inwardly of the skirt and which is spaced from the internal surface of the said top portion by an annular groove, the resilient flange portion having a surface, at least partly convexly curved, which is remote from the top portion and which, even when the resilient flange portion is undeformed, is radially inwardly inclined towards the top portion, the resilient flange portion, when the cap is fitted to the container, effecting a primary sealing engagement with a radially outer edge of the end portion of the neck and a secondary engagement with the top surface of the end portion of the neck, and the resilient flange portion being deflectable into engagement with the internal surface of the top portion to trap a pocket of air therebetween.

According to another aspect of the present invention, there is provided a container having a neck provided with a closure cap which is formed of a moulding of

elastomeric material and which is fully seated on the neck, the closure cap having a top portion, an annular skirt which extends from the periphery of the top portion, an abutment portion of said skirt which firmly engages said neck to releasably retain the closure cap thereon, and an annular resilient flange portion which extends from and radially inwardly of the skirt and which is spaced from the internal surface of the said top portion by an annular groove, the resilient flange portion having a surface, at least partly convexly curved, which is remote from the top portion and which, even when the resilient flange portion is undeformed, is radially inwardly inclined towards the top portion, the resilient flange portion being deformed by the neck and effecting a primary sealing engagement with a convexly curved radially outer edge of the end portion of the neck and a secondary engagement with the top surface of the end portion of the neck, the resilient flange portion engaging the internal surface of the top portion and trapping a pocket of air therebetween.

The disposition of the resilient flange portion is thus such that there can be considerable variation in the diameter of the bore of the container without the quality of the seal with the closure cap being affected. Moreover, provided that the resilient flange portion extends radially inwardly to an adequate extent, variations in the diameter or shape of the rim of the container will also not affect the quality of the seal.

Indeed, a closure cap having the features set forth above is capable of effecting an excellent seal on a wide variety of different containers, whether the latter are formed of glass, plastics material, or thin metal, even if the containers have substantially varying wall thicknesses. This excellent seal can, moreover, be achieved without it being necessary to provide the said rim of the neck of the container with any particular shape, and without it being necessary to provide a closure cap having an unusual external appearance.

Provided, moreover, that the resilient flange portion is adequately spaced from the internal surface of the top portion it is possible, if desired, to introduce a liner to cover the said flat internal surface. Although the present invention is primarily concerned with containers having linerless or "wadless" closure caps, i.e., those which do not employ a liner, and although the closure cap is preferably made of a material such as polypropylene which is inert to most contents of such containers, nevertheless if the contents are of such character that they would otherwise attack the material of the closure cap, it is convenient to form the closure cap such as to be capable of accepting a liner which resists such attack. If this is done, the same closure cap may be employed both for the generality of uses in which the contents of the container will not attack it, and (when provided with a liner) for the minority of uses where such attack may occur.

The risk of the cap being unsealed is, moreover, reduced, in the case of the present invention, by virtue of the fact that a secondary engagement is effected between the resilient flange portion and the top surface of the neck. This ensures that there is a very large area of the resilient flange portion which frictionally engages the neck and therefore frictionally resists loosening. At the same time, this secondary engagement between the resilient flange portion and the top surface of the neck forces the resilient flange portion into engagement with the internal surface of the top portion so as to trap the said pocket of air therebetween. This pocket of air resiliently forces the resilient flange portion against the top surface of the neck so as to enhance the seal. Moreover, if the outside diameter of the annular groove between the resilient flange portion and the top portion of the closure cap is less than the major internal diameter of the skirt, there is available a mass of material at the radially outer end of the resilient flange portion to assist in sealing at the rim.

The internal surface of the top portion may be flat and where this is so the annular groove between the resilient flange portion and the internal surface of the cap can be provided by moulding with the use of collapsible cores. Furthermore, the provision of a flat internal surface is of value where the cap is liable to be used with an internal liner, (e.g., because the contents of the container are corrosive) since it is important that such a liner should make good contact with the whole of the internal surface of the top portion.

The trapped pocket of air resiliently resists but does not prevent deformation of the resilient flange portion by the neck.

The abutment portion may be adapted to be both snapped over and to be removed from an abutment on the neck of the container.

Alternatively, the abutment portion may comprise an internally threaded part of the skirt which is adapted to be screwed onto an externally threaded portion of the neck.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a partial section of a first embodiment of the present invention in which a closure cap is shown as seated on, but not fully screwed down on, the neck of a container,

FIG. 2 is a vertical section showing part of the structure of FIG. 1 on a larger scale, the closure cap being shown in the position adopted when the resilient flange portion of the closure cap just contacts the rim of the neck of the container,

FIG. 3 is a view similar to that of FIG. 2 but showing the position of the closure cap when the latter is screwed fully down on the neck of the container, and

FIG. 4 is a partial section of a second embodiment of a closure cap according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIGS. 1 to 3 there is shown a closure cap **10** for sealing the neck **11** of a glass or other container, the closure cap **10** being an integral moulding of an elastomeric material. The closure cap **10** has a top portion **12**, the whole of whose internal surface **10***a* is flat, and an annular skirt **13** which extends from the periphery **14** of the surface **10***a*. The skirt **13** is provided with an internally threaded part **15** which is firmly engageable with an externally threaded portion **16** of the neck **11** on being screwed onto the latter.

The closure cap **10** also has an annular resilient flange portion **17** which extends from and radially inwardly of the skirt **13**. The resilient flange portion **17** has an inner surface **20** which is remote from the top portion **12**. Even when the resilient flange portion **17** is undeformed as shown in FIG. **1**, the surface **20** is radially inwardly inclined towards the top portion **12**. At least a part **21** of the surface **20** is convexly curved, the convexly curved surface **21** having, for the particular

vertical section shown, a centre of curvature A which is disposed within the top portion **12.**

The neck **11** has an end or top surface **22** having a convexly curved radially outer edge, or rim **23.** The radially outer edge **23** has, for the particular vertical section shown, a centre of curvature B which is disposed within the neck **11.**

As the closure cap **10** is screwed downwardly on the neck **11,** the part of the convexly curved surface **21** of the resilient flange portion **17** shown in FIG. **2** first contacts the radially outer edge **23** at a point C which is located on a line **24** joining the centres of curvature A, B. As will be appreciated, the position of the point C is not greatly affected by the accuracy to which the neck **11** has been formed, i.e., by the position of the point B or the radius of curvature. Thus whatever the form of the radially outer edge **23,** there will be a point C at which the convexly curved surface **21** and the radially outer edge **23** are tangential to each other. In other words, whatever variation there may be in practice in the disposition of the radially outer edge **23,** point contact still occurs at, or very close, to the point C, which is thus the point of maximum sealing contact.

The point C of initial contact between the convexly curved surface **21** and the radially outer edge **23** remains the point of maximum sealing pressure when the closure cap is screwed down into the position in FIG. **3.** That is to say, in the FIG. **3** position the resilient flange portion is deformed so that contact between the convexly curved surface **21** and the radially outer edge **23** is no longer confined to the point C but extends throughout the region defined by the point D which is further round the rim and the point E at the top of the neck **11.** Notwithstanding the extent of the said region, however, the maximum sealing pressure remains at the point C and therefore is maximised for any given application torque. The seal thus in effect remains a point seal at the point C, the secondary contact throughout the region DE primarily providing frictional resistance to the loosening of the closure cap during transit of the respective container.

It should be stressed that if the surface **20,** instead of being radially inwardly inclined towards the top portion **12** and instead of having at least a part which is convexly curved, were a flat surface extending parallel to the surface **10***a* or sloping radially inwardly downwardly away from the surface **10***a*, then it would be possible for the point contact to occur at the rim when the resilient sealing flange **17** contacted the neck, and consequently the sealing efficiency would be very much impaired. That is to say, in the latter case the resilient sealing flange **17** would contact a wide region of the top surface **22** and/or of the bore **19.**

The resilient flange portion **17** has an outer surface **26** the whole of which, in the undeformed state, is spaced from the surface **10***a* by an annular groove **28** whose outside diameter **29** is less than the major internal diameter **18** of the skirt **13.** This construction provides a mass of material in the region indicated at **29'** to assist in sealing. Thus when the closusre cap **10** is screwed down from the FIG. **1** to the FIG. **3** position, an air pocket **30** is created which is defined in part by the surfaces **26, 10***a*. When the closure cap **10** is screwed fully down into the FIG. **3** position, the consequent deformation of the resilient flange portion **17** is resisted, but not of course prevented, by the resilience provided by the air pocket **30,** thus improving the seal. It will be noted that in the FIG. **3** position, the resilient flange portion **17** is forced into sealing engagement with the surface **10***a*.

Since the maximum sealing pressure is concentrated at the point C and because of the shape and disposition of the resilient flange portion **17,** the quality of the seal is not affected by manufacturing variations which occur on the top surface **22,** the thickness of the wall of the neck, the size of the bore **19** in the neck, nor by manufacturing variations in the external diameter of the end portion of the neck **11.** In particular, it is of advantage that the resilient flange portion **17** does not effect a seal within the bore **19** of the neck **11** since manufacturing variations in the size of the bore are often, in practice, considerable.

The space constituted by the annular groove **28** between the surfaces **26, 10***a*, when the resilient flange portion **17** is undeformed, permits a liner (not shown) to be inserted therebetween and in contact with the surface **10***a*. Such a liner may be of a material to prevent the surface **10***a* from being attacked by the contents of the container.

In order to illustrate the sealing efficiency of the container-closure cap construction shown in FIGS. **1** to **3** in comparison with that of a container sealed by a conventional "wadded" closure, an independent laboratory filled a number of containers of each type with a toilet cream and then tested them for weight loss after a period of **4** weeks. Their results are indicated in the Table below.

TABLE

Containers sealed by conventional "wadded" closures				Containers sealed by a "wadless" closure as shown in FIGS. 1 to 3			
Range of weight loss		Mean Weight loss		Range of weight loss		Mean weight loss	
(a)	at room temperature	(a)	at room temperature	(a)	at room temperature	(a)	at room temperature
(b)	at 46°C	(b)	at 46°C	(b)	at 46°C	(b)	at 46°C
(a)	0.13 – 0.19%	(a)	0.15%	(a)	0.00 – 0.07%	(a)	0.02%
(b)	0.92 – 1.66%	(b)	1.23%	(b)	0.00 – 0.27%	(b)	0.19%

It will be noted that both at room temperature and at 46°C the container - closure cap construction of the present invention provided very much superior sealing to that provided by a conventional "wadded" closure. This is by no means what one would normally expect, since a conventional wadless closure of elastomeric material has a sealing efficiency substantially less than that of a "wadded" closure.

It was also found that, both at room temperature and at 32°C, the cream in the containers sealed by the closure of the present invention showed slightly less yel-

lowing than that in the containers sealed by the conventional "wadded" closures.

FIG. 4 illustrates another embodiment of the present invention which is generally similar to that of FIGS. 1 to 3 and which will not therefore be described in detail. In the case of the FIG. 4 construction, however, a closure cap 32 is provided which, instead of being internally threaded, has an abutment portion 33 which is adapted to be snapped over and to be removed from an abutment 34 on the neck 11 of the container. The design of the abutment portion 33, in relation to the abutment 34 is of course such that when the closure cap 32 is fully seated on the neck 11 of the container, the force retaining the closure cap 32 in the fully seated position is greater than the recovery force of the deformed resilient flange portion 17.

Closure caps normally either rely on being provided with a liner or "wad," or alternatively are such as to be incapable of being provided with such a liner or "wad." In the case of the embodiments shown in the drawings, however, the construction is such that the closure cap may be employed either as a "wadless" or as a "wadded" cap.

If desired, a closure cap as described above could itself form the inner member, or liner, of an outer closure cap, the latter being for example, a metal crown cap. In this case, the top portion of a closure cap as described above might be made very thin, e.g., of the order of 0.01 inch.

I claim:

1. A closure cap adapted to seal the neck of a container, the closure cap being formed of a moulding of elastomeric material and having a top portion, an annular skirt which extends from the periphery of the top portion, an abutment portion of said skirt which is adapted firmly to engage said neck to releasably retain the closure cap thereon, and an annular resilient flange portion which extends from and radially inwardly of the skirt and which is spaced from the internal surface of the said top portion by an annular groove, the resilient flange portion having a surface, at least partly convexly curved, which is remote from the top portion and which, even when the resilient flange portion is undeformed, is radially inwardly inclined towards the top portion, the resilient flange portion, when the cap is fitted to the container, effecting a primary sealing engagement with a radially outer edge of the end portion of the neck and a secondary engagement with the top surface of the end portion of the neck, and the resilient flange portion being deflectable into engagement with the internal surface of the top portion to trap a pocket of air therebetween.

2. A container having a neck provided with a closure cap which is formed of a moulding of elastomeric material and which is fully seated on the neck, the closure cap having a top portion, an annular skirt which extends from the periphery of the top portion, an abutment portion of said skirt which firmly engages said neck to releasably retain the closure cap thereon, and an annular resilient flange portion which extends from and radially inwardly of the skirt and which is spaced from the internal surface of said top portion by an annular groove, the resilient flange portion having a surface at least partly convexly curved, which is remote from the top portion and which, even when the resilient flange portion is undeformed, is radially inwardly inclined towards the top portion, the resilient flange portion being deformed by the neck and effecting a primary sealing engagement with a convexly curved radially outer edge of the end portion of the neck and a secondary engagement with the top surface of the end portion of the neck, the resilient flange portion engaging the internal surface of the top portion and trapping a pocket of air therebetween.

3. A container as claimed in claim 2 in which the whole of the internal surface of the top portion is flat.

4. A container as claimed in claim 2 in which the abutment portion is adapted to be both snapped over and to be removed from an abutment on the neck of the container.

5. A container as claimed in claim 2 in which the abutment portion comprises an internally threaded part of the skirt which is adapted to be screwed onto an externally threaded portion of the neck.

6. A container as claimed in claim 2 in which the outside diameter of the annular groove is less than the major internal diameter of the skirt.

* * * * *