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Landen

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[54] **BOTTLE CLOSURE**

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[52] **U.S. Cl.** ..... **215/43 R,** 215/47

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

[58] **Field of Search** ..... 215/43 R, 44, 47

[56] **References Cited**

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[57] **ABSTRACT**

The invention contemplates a single-piece molded-plastic screw cap for secure liquid-sealing of the contents of a bottle, which may be of glass or molded-plastic construction. The seal action is established at a non-plugging interference between (a) an annular flange within the cap and (b) a flared mouth or tapered counterbore in the bottle opening. The cap arrangement is such, in relation to bottle-neck dimensions, that a strong axial force is generated by local deformation of the cap, to increasingly load the seal contact in the course of threaded advance of the cap to its fully set position; at the same time, local resilient deformation of the flange at seal contact expands the seal action from essentially a circle of contact to an annulus of contact.

8 Claims, 3 Drawing Figures

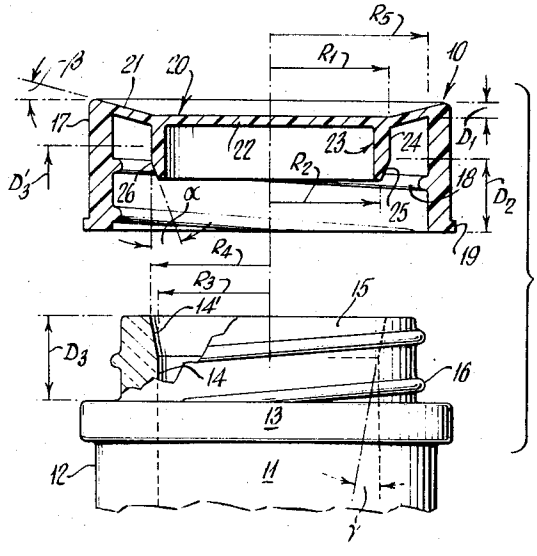


Fig. 1.

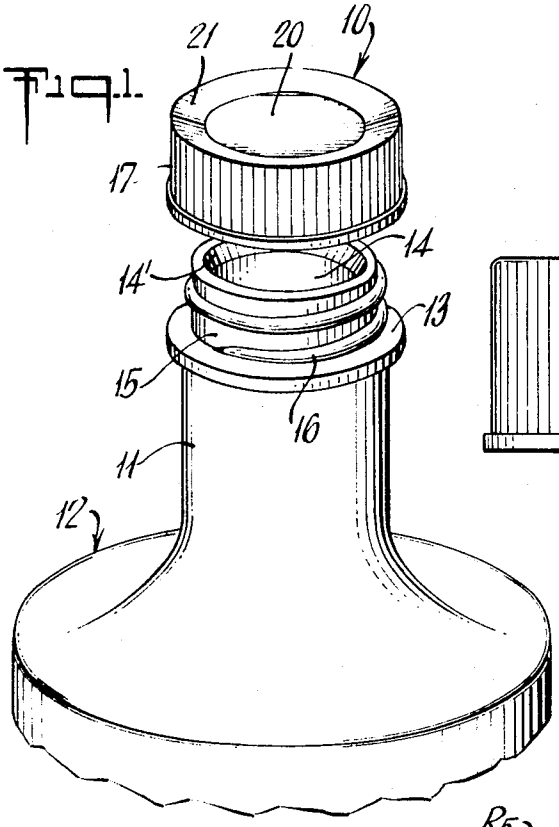


Fig. 3.

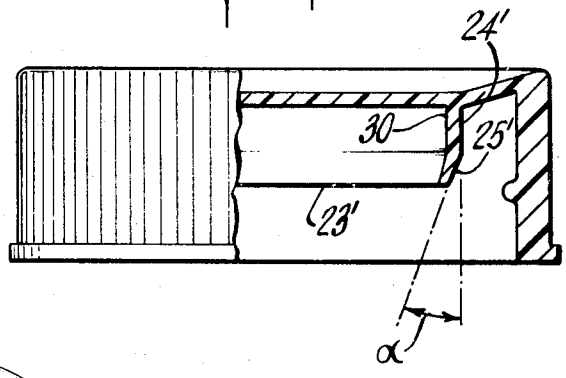
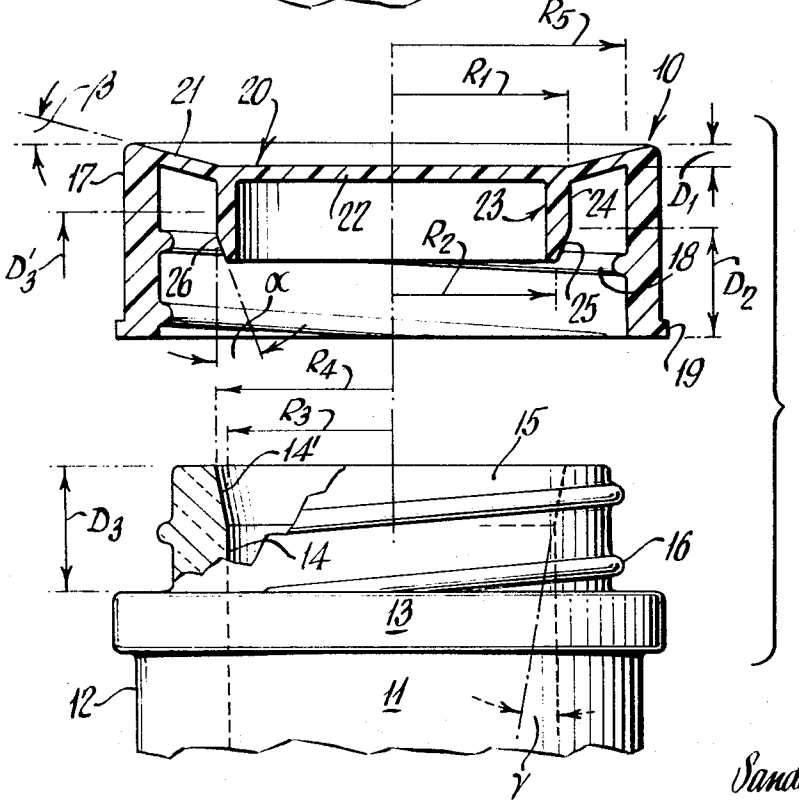


Fig. 2.



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BOTTLE CLOSURE

This invention relates to liquid-sealing bottle-closure devices, particularly those involving a threaded cap fitting over the open end of the bottle.

Bottle closures of the character indicated are commonplace, but for liquid-sealing applications, it seems to be accepted that the cap must contain a liner, be it a coating or an insert, if liquid-sealing efficiency is to be achieved. The provision of such a liner adds to the cost and inconvenience of providing and maintaining an adequate seal function.

It is, accordingly, an object of the invention to provide an improved cap and seal construction for closures of the character indicated.

It is a specific object to meet the above object utilizing a single-piece molded-plastic screw cap, having liquid-sealing properties.

It is another specific object to meet the foregoing objects with a bottle construction requiring little modification from standard designs, and no modification of existing techniques of bottle construction, be they of glass or plastic.

It is a general object to meet the above objects with a construction of elemental simplicity and low cost, and which lends itself to resealing with the same efficacy as when the bottle is initially filled and capped.

Other objects and various further features of novelty and invention will be pointed out or will occur to those skilled in the art from a reading of the following specification in conjunction with the accompanying drawings. In said drawings, which show, for illustrative purposes only, preferred forms of the invention:

FIG. 1 is a fragmentary view in perspective, showing bottle and closure-cap elements of the invention, the cap being in a separated position;

FIG. 2 is an enlarged view in elevation, partly broken-away to a vertical section, for the separated parts of FIG. 1; and

FIG. 3 is a similar view, in elevation and partly broken-away, for a modified closure cap.

In FIGS. 1 and 2, the invention is shown in application to a removable closure cap **10** for the open end of the neck **11** of a bottle **12**, which may be constructed by standard techniques, using conventional materials, such as glass or plastic. Bottle **12** may be designed for liquid contents, as for example a liquor bottle. The neck **11** is characterized by a radial flange **13**, axially offset from the end of opening **14**, by a reduced cylindrical annular portion **15** having integral threads **16**. The bottle opening **14** is circular, and its mouth is outwardly flared at a counterbore **14'**.

The cap **10** is a single piece of injection-molded plastic. The plastic is a deformable material having good memory, good flexural properties, a low coefficient of friction, and relative inertness to the intended liquid contents of the bottle. For consumer uses, this means inertness to household chemicals, foods and liquids including liquors. Suitable plastic materials include polypropylene and polyethylene, each of which lends itself to injection-molding of cap **10**.

The cap **10** is generally cup-shaped, comprising an outer cylindrical wall portion **17** which is relatively thick (and therefore relatively rigid) and which telescopically overlaps the neck portion **15**. The outer wall portion **17** includes thread formations **18** for engagement with the neck threads **16**, and the base end of wall

17 is formed with a small outward bead of flange **19** for secure limiting-abutment footing at the shoulder **13**. The closed end **20** of the cap is preferably relatively thin, to permit local deformation at a downwardly converging annular taper zone **21**, as will be explained in detail. As shown, a circular panel **22**, within zone **21** at substantially the axial end of cap **10**, forms part of the closed end **20**. The closed end **20** also integrally includes downwardly projecting annular-flange means **23**, in concentric and radially spaced relation within the wall portion **17**.

The exterior of the flange means is sized and contoured for interference with the flare **14'** in the course of the telescoping overlap of the wall **17** and neck **15** portions, the initial interference occurring well before cap abutment with shoulder **13**. After initial interference, threaded advance of the closure, upon cap rotation, causes some local radial compressional deformation of the interfering part of the flange means, but the primary deformation is via the axially compliant nature of the annular connection **21** between the wall **17** and flange **23** portions.

The preferred characterizing of the exterior of flange means **23** is such as to establish a first and primarily cylindrically annular flange portion **24**, rooted at the inner end of connection **21**, and a second and primarily downwardly convergent annular flange portion **25**, projecting toward the neck opening **14**. As shown, the flange portions **24–25** are of substantially the same axial extent, and the outer surface of the tapering flange portion **25** converges from an outer radius R_1 to an inner radius R_2 and at a flare angle α to the axis of the cap. This angle α preferably substantially exceeds, as by a factor of two the flare angle γ which characterizes the counterbore **14'**, extending from an inner radius R_3 to an outer radius R_4. Preferably, also, the outer radius R_1 of the flange means **23** is substantially the same as the outer radius R_4 of counterbore **14'** so that, once the line **26** of intersection (between outer surfaces at **24–25**) clears the outer end of the mouth (**14'**), all subsequent interference contact involves reaction at **26** with counterbore **14'**; of course, as axial force is developed through threaded advance, the circle at **26** reduces slightly while widening to an annulus of contact with the same flared end **14'** of the mouth of the bottle.

The preferred effective radial span and slope β of compliant connection **21**, between inner and outer limits R_1–R_5, is such as to provide a range D_1 of relatively stiffly compliant axial deformation, in the direction of flattening the entire end-closure structure **21–22**. This range is available to cover tolerance variations in the coacting bottle and cap formations, while at the same time assuring notable entry of the contact line **26** axially into the counterbore **14'**. This result is achieved by selecting the axial offset D_2 between line **26** and the lower end of wall **17** to be less than the axial offset D_3 of shoulder **13** from the open end of the neck, by an amount which is in the order of magnitude of the available axially compliant accommodation D_1; the legend D_3' will be understood to suggest the location of the end plane of the neck portion **15**, in the context of cap features, when the cap is secured against shoulder **13**.

The threads **16–18** are shown to be of the single pitch variety, it being sufficient for most purposes to provide between 1.5 and 2 turns of engagement. The pitch should be such as to establish initial thread engagement

at least no later than initial interference contact at 14'–26.

In secured position, wall 17 is tight against shoulder 13, and flange means 23 has not only engaged but has been radially inwardly compressed and deformed by flare 14'. Resistance to such radial compression substantially exceeds resistance to reacting axial deflection at 21. The use of low-friction material enables a substantial balance to become established between axial force (through axially compressed compliant reaction at 21) and radial force (through reaction to radial compression at 23). These balanced axial and radial forces both compressionally load the interference-contact region, establishing a liquid seal, without requirement for a liner or other measures.

In the modification of FIG. 3, most of the cap features are the same as previously described, and so reference numbers are repeated. FIG. 3 differs in the region of its flange means 23', in that the bore is relieved at 30, to provide more uniform and relatively thin body. It will be appreciated that the flange means 23' is more readily compressible than that 23 of FIG. 2 and that therefore in the course of establishing a closure, the annular area of sealing contact will be greater. When the closure is set, the contact deformation will further be understood to locally converge the cylindrical flange portion 24' and at the same time to locally reduce the convergence angle α of the tapering flange portion 25'. However, even it this action were to proceed to the limit of converting both flange portions 24'–25' to a single conical shape, the resulting convergence angle thereof will never reduce to less than the flare angle γ, neither will the substantial contact zone ever leave the counterbore 14'.

In one product application of the invention, for a closure 10 of overall 1.21-inch diameter, and for a bottle opening flared to a 0.8-inch mouth (R_4), the outer body or wall 17 is about 0.055-inch thick, the flange means 23 is of about 0.040 maximum thickness, and the compliant connection 21 is about 0.030-inch thick. For the more compliant flange means 23' of FIG. 3, the thinner walls at 24'–25' may be in the order of 0.015-inch thick. In both situations, taper at α is in the range of 15° to 25°, being preferably substantially 20°; taper at γ is in the range of 7° to 15°, being preferably substantially 10°; and the dished taper at β is in the range of 10° to 20°, being preferably 15°.

It will be seen that I have described an improved closure meeting all stated objects. Important economies, convenience and sealing efficiency are realized.

While preferred embodiments of the invention have been described in detail, it will be understood that modifications may be made without departing from the scope of the invention.

What is claimed is:

1. Selectively openable closure means, comprising a bottle including a neck having a circular axial-end opening with an outward flare at the mouth of the opening, and a cap for selectively opening and closing said opening, said neck including a radial shoulder and an annular portion axially offsetting said shoulder from said end, said cap having an outer annular wall sized to abut said shoulder and having telescoping overlap with said annular neck portion, and said annular neck portion and said wall having coacting screw-thread formations at their region of overlap; said cap being of single-piece molded-plastic construction and having a closed end comprising a relatively thin and stiffly compliant deformable closure section including axially downward annular flange means radially inwardly spaced from said wall, whereby the annular portion of said closure section which integrally connects said wall to the upper end of said flange means is relatively resilient within a limited range of axial displacement of said wall and flange means; the exterior of said flange means being sized and contoured (a) for interference with the flare of the neck opening in the course of said telescoping overlap and prior to cap abutment with said shoulder and (b) for continuance of such interference with increasing deformation of said flange means in the course of threaded advance of said cap into shoulder abutment, the exterior of said flange means and its axial positioning with respect to other cooperating parts of said cap and neck being such that the range of axial displacement with such interference is less than said limited range of axial displacement, said flange means including an axially extending generally cylindrical flange portion adjacent said closure section and an inwardly tapering downwardly extending flange portion integral with and depending from said cylindrical flange portion, said cylindrical portion being sized for said interference, and the flare at the mouth of the bottle opening being a generally conical counterbore at an angle substantially less than the inward taper of said flange means, whereby said limited range of axial displacement cooperates with said inward taper to provide an essentially circular line of contact between said counterbore and the inter-section of said cylindrical and tapering flange portions.

2. Closure means according to claim 1, in which the closed end of said cap extends continuously across the axial end of said cap, said flange means being an integral annular projection depending from the central region of said closed end.

3. Closure means according to claim 1, in which the annular portion of said closure section is dished inwardly in the axially downward direction, whereby the axial-force reaction to such threaded advance increases in approach to shoulder abutment.

4. Closure means according to claim 3, in which the inwardly dished slope is in the order of 15 degrees with respect to a radial plane.

5. Closure means according to claim 1, in which inward taper of said downward flange portion is in the order of 20° to the cap axis.

6. Closure means according to claim 1, in which the axial lengths of said flange portions are substantially the same.

7. Closure means according to claim 1, in which the flare angle is in the order of 10° to the neck axis.

8. Closure means according to claim 1, in which said flange means is of substantially uniform thickness throughout the combined extent of both said flange portions.

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