

[54] SAFETY-CLOSURE DEVICE

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 [51] Int. Cl. A61j 1/00
 [58] Field of Search 215/9, 44

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[57] ABSTRACT

The invention contemplates selectively openable closure means that is tamper-proof, in the sense that a correct sequence of two deliberate and independent movements of two parts is necessary in order to achieve access to the contents of the bottle or the like which is protected by the closure.

The specific construction that is described involves a bottle with a neck having a circular opening, and a closure cap having a cylindrical wall to overlap and lock to the outer surface of the neck. The closed end of the cap has an axially tapering yieldable section which engages the circular neck opening in the course of closing the bottle. The nature of the lock is such as to preload the yieldable engagement and to utilize the resilient action to retain the lock and to establish a liquid seal of the bottle contents.

21 Claims, 10 Drawing Figures

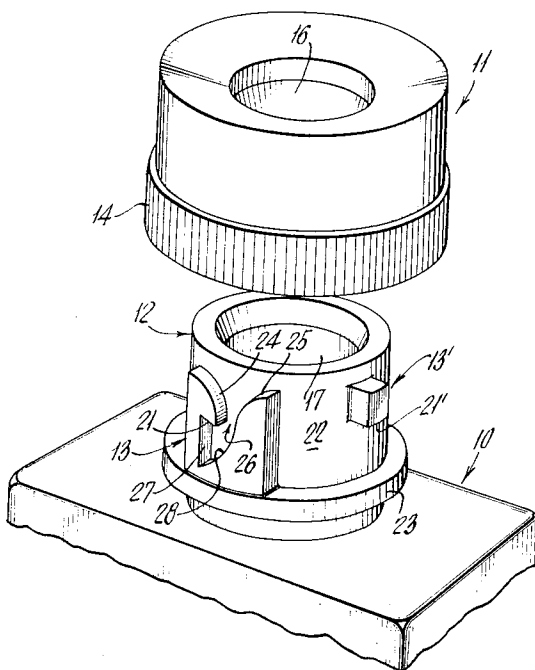
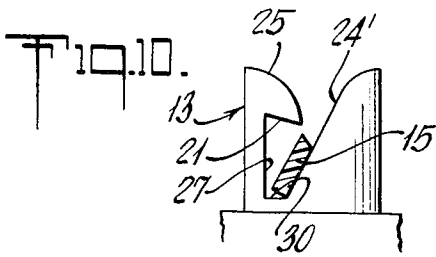
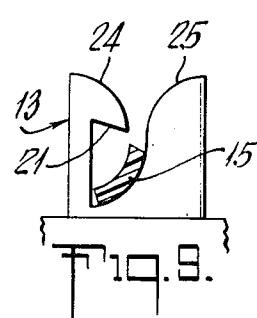
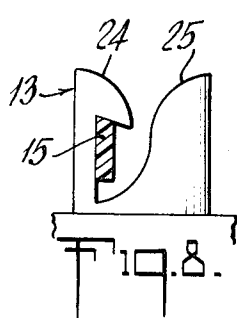
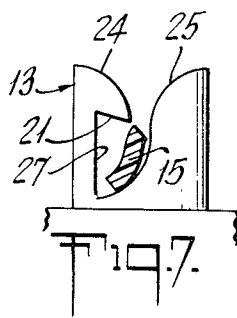
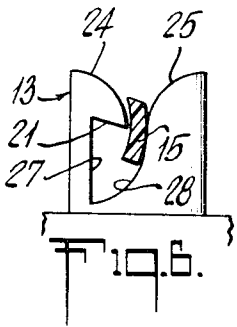
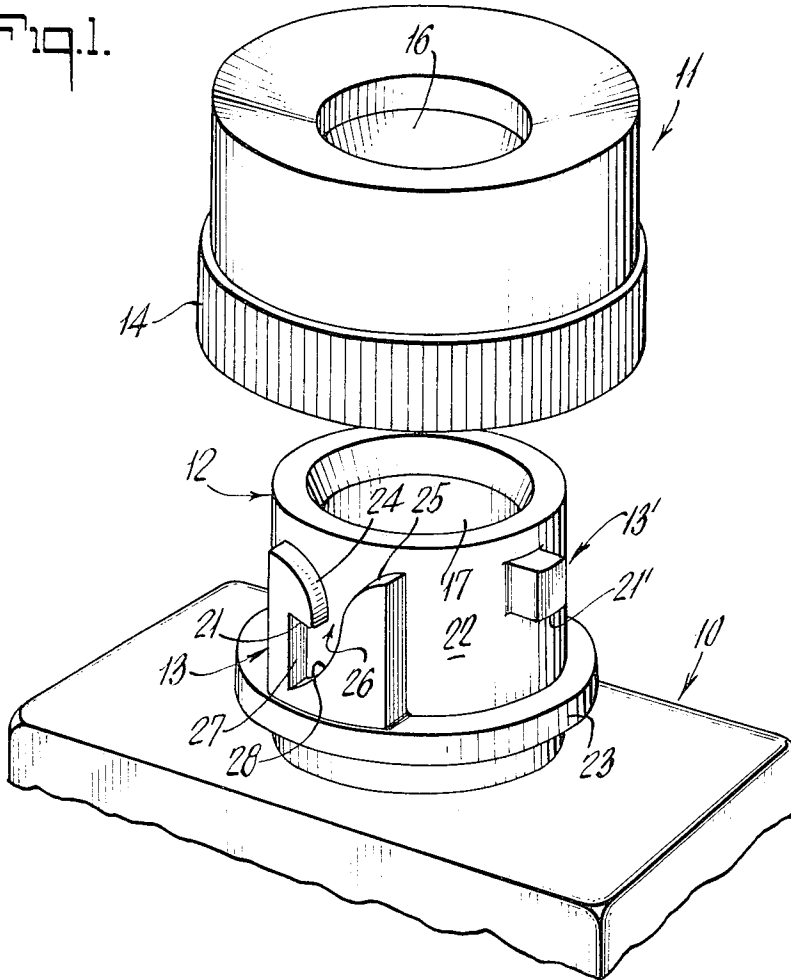


Fig. 1.



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Fig. 2.

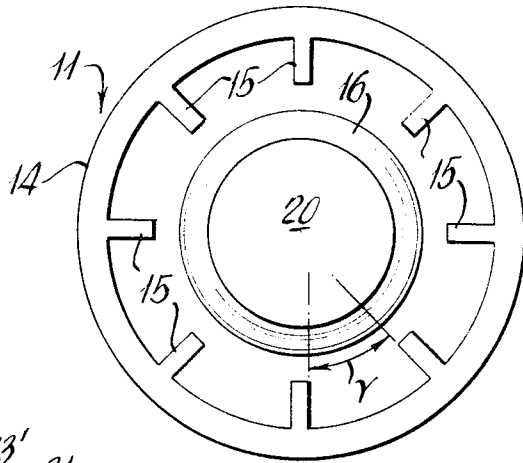
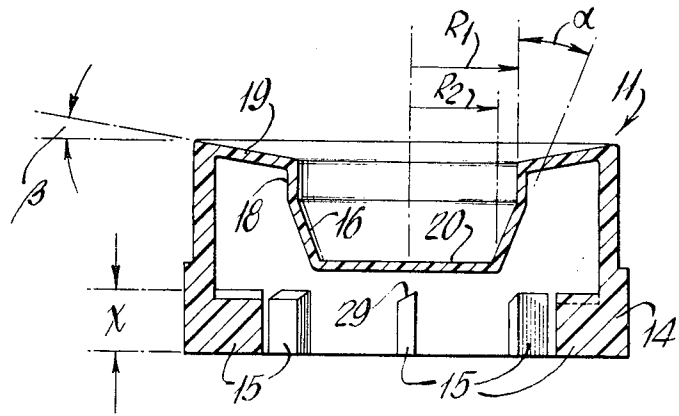


Fig. 4.

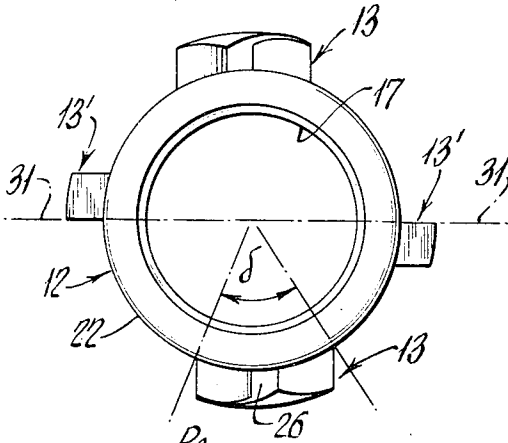


Fig. 3.

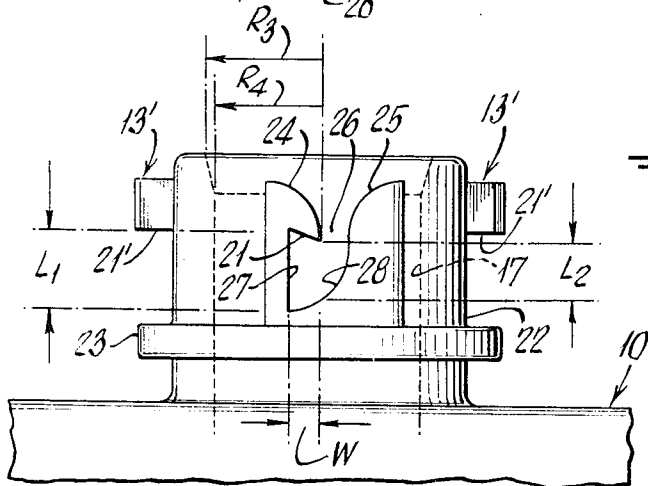


Fig. 5.

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SAFETY-CLOSURE DEVICE

This invention relates to tamper-proof selectively openable closure devices, as for closure of bottles containing liquid or solid matter that might be injurious when in unauthorized hands.

With recent growth in the use of drugs, pills, and the like, each with its specific prescribed purpose for a particular member of the household, there has been a corresponding increase in the chances for unauthorized access, particularly access by small children. And it has become increasingly difficult, if not impossible, to supervise children enough to assure against their access to materials that can be harmful to them.

Accordingly, it is an object of the invention to provide a tamper-proof feature in containers for materials of the character indicated.

A specific object is to achieve the above-stated object with a construction in which a correct sequence of independent motions of two parts is a pre-requisite for access to the contents of the container.

Another object is to achieve the foregoing objects with a simple construction, involving the addition of no parts, beyond the container and its closure.

A further object is to provide a closure meeting the above objects and establishing a liquid seal.

A specific object is to provide a bottle and cap with integral locking and sealing formations which inherently achieve all the foregoing objects.

Another specific object is to achieve the stated objects using resilient deformable action of one of the parts to establish both a resiliently pre-loaded seal and resiliently pre-loaded lock retention.

It is also a specific object to provide a closure of the character indicated, wherein sealed closure is established by essentially only axially driving the cap onto the neck, and yet wherein a specific combination of further axial drive and correct rotation are needed in order to release the closure.

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 an exploded fragmentary view in perspective showing the neck region of a bottle, above which closure-cap means of the invention is poised for application;

FIG. 2 is a vertical sectional view of the cap means of FIG. 1;

FIG. 3 is an end view of the cap means of FIG. 1;

FIG. 4 is a fragmentary view in elevation of the neck region of FIG. 1;

FIG. 5 is a top view of the neck region of FIG. 1;

FIGS. 6 to 9, inclusive, are simplified views to illustrate a series of parts relationships in the course of operating the closure means of FIG. 1; and

FIG. 10 is a view similar to those of FIGS. 6 to 9, to illustrate a modification.

Referring to the drawings, the invention is shown in application to a bottle 10 and to a selectively removable closure cap 11 therefor. The bottle 10 may be of any suitable material but is conveniently of glass, being integrally formed with a reduced neck 12 having a circular axial-end opening to be selectively opened and closed by the cap 11. The bottle 10 is shown to be further integral with locking formations 13-13' which project radially outwardly at angularly spaced locations on the neck 12.

The cap 11 is of deformable material such as a plastic having good memory, good flexural properties, a low coefficient of friction and relative inertness to most household chemicals; such materials include polypropylene and polyethylene, each of which lends itself to injection-molding of the cap 11.

The cap 11 is generally cup-shaped, comprising an outer cylindrical wall portion 14 which is relatively thick (and therefore relatively rigid) and which telescopically overlaps the

neck 12. The portion 14 includes angularly spaced integral inwardly projecting lugs 15, for locking engagement with the neck formations 13-13'. The closed end of the cap is preferably relatively thin, to permit local deformation at a converging taper zone 16, as will be explained in detail.

In the form shown, the converging taper 16 is generally frusto-conical, having limiting radii R_1 - R_2 (FIG. 2) which straddle the radii R_3 - R_4 (FIG. 4) of the chamfered circular opening of the bore 17 of neck 12. Taper 16 is integral with a short cylindrical portion 18 which is integrally connected to outer wall 14 by a short annulus 19, dished slightly inwardly; and the inner end of taper 16 is integrally closed by a flat circular panel 20. In FIG. 2, α marks the angle of taper 16, and β marks the flare or dished angle of the annulus 19.

In locked condition, the cap lugs 15 engage the recesses or undersides 21-21' of the formations 13-13', and in this condition the taper 16 has engaged the chamfered end of the neck bore 17, and is radially inwardly deformed thereby. Since cap 11 is of low-friction material, the compliant reaction to such deformation produces an axially separating force between neck 12 and cap 11, and this force resiliently loads and retains the engagements at 15-21 and 15-21'. The same resilient action radially outwardly loads the taper 16 in its contact with bore 17, thus establishing a liquid-retaining seal of the contents of the bottle 10.

In accordance with the invention, the lug formations 15 and the projecting neck formations 13-13' engageable therewith are such that a locked and sealed closure results from essentially only an axially depressed application of cap 11 to the bottle neck 12, and yet that a combination of further axial depression, coupled with a particular rotational torque, are necessary to achieve an unlocking access to the contents of the bottle. To achieve this result, the locking formations 13 may be repeated at each and every angular location of lug formations 15, but as shown (see FIG. 5) the neck formations 13' occur at two diametrically spaced locations; the formations 13' are of more simple nature, being relied upon only for their flat retaining undersurfaces 21' and being at opposed angular locations between the locking formations 13. The lug formations 15 are shown as eight like, equally spaced blades, extending radially inwardly and being axially elongate for the distance x from the open end of the cap 11. Due to the proportions and material of the lug formations 15, being molded integrally with cap 11, each lug formation 15 is inherently characterized by a degree of relatively stiff torsionally flexible action, about its axially central radial axis; the stiff torsional compliance of this action is relied upon to achieve a snap-action lock and seal of the bottle, upon essentially only axially depressed placement of the cap 11.

Each of the formations 13-13' projects radially outwardly from the otherwise cylindrical outer surface 22 of the neck 12. This cylindrical surface 22 extends from a base flange 23 to the open end of neck 12 and overlaps the axial span of the formations 13-13'. The formations 13 are of effective angular extent δ (FIG. 5) which preferably exceeds the effective angular spacing γ between adjacent lugs 15 (FIG. 3), thus frustrating any axial assembly of the cap 11 to the neck 12 without first achieving a substantially correct alignment, as will be explained. As shown, for the two locking formations 13 and two auxiliary retaining formations 13', the lugs 15 are provided in a plurality of eight. Thus, for any locked setting of the cap, only four lugs 15 are used for retention; however, the radially inner limits of lugs 15 preferably just clear the diameter of the neck surface 22, so that all lugs 15 provide a stabilizing action for coaxially piloting cap 12 to the neck 11. Lugs 15 also abut flange 23, to prevent excessive depression of cap 12 in the course of establishing a locked seal.

The locking formation 13 comprises a lobe or radial projection integral with the neck 12 and having a pocket which is a cul-de-sac, beneath the retaining surface 21. The pocket is open axially upward and radially outward, to receive axial insertion of a suitably positioned one of the plural lug formations 15. Basically, the pocket is defined by two spaced

sidewalls 24-25; these walls are shown flaring outwardly from the throat 26 of the upwardly open inlet passage, thus tending to "funnel" or angularly align the cap for lug entry at the throat 26; the angular gap at throat 26 is preferably slightly in excess of the effective thickness of each lug 15. Beneath the throat, wall 24 is sharply undercut, with angular and axial offset, to define the retaining surface 21, and a depending flat axial portion 27 completes the description of wall 24. Beneath the throat, the other wall 25 is sloped generally helically in the angular direction toward wall 24, and the pocket or cul-de-sac is closed by a relatively sharp intersection with the axial wall portion 27; the numeral 28 identifies this generally helical portion. As shown, the generally helical portion 28 is smoothly and tangentially faired to the throat portion of wall 25, and the advance of the helix is reduced in approach to wall portion 27, so that at their intersection the wall portions 27-28 are substantially perpendicular.

In the design of particular lug and cul-de-sac proportions, the effective axial length x (FIG. 2) of the lugs 15 should be less than the maximum axial span L_1 of the cul-de-sac (FIG. 4), and the length x should exceed the minimum axial span L_2 thereof. Also, preferably, the upper edge 29 (FIG. 2) of each lug 15 should be sloped in accordance with that of the undercut 21; in FIG. 4, this angle or rake is identified by the symbol Δ and is shown as substantially 15° , back from a plane radially of the closure axis. Finally, the effective angular offset or width W of the undercut 21 should be such that, with a lug 15 twisted to bottom at the intersection of wall portions 27-28, the effective lug length x is just short of interference with the projecting lip or throat end of the undercut 21.

Based on relationships and properties as described, it will be helpful to consider a cycle of operation, in reference to the sequence of simplified diagrams of FIGS. 6 to 9.

FIG. 6 displays a parts relationship for a point in time when one of the lugs 15 has been caused to enter the throat 26 and in which reacting interference [(a) of the lug bottom with wall portion 28, and (b) of the lug side wall with wall 24 at the throat] have developed a lug-twisting torque. Further cap depression produces further twisting of lug 15 as it enters further into the cul-de-sac (FIG. 7). Final cap depression is limited by bottom contact at intersection of surfaces 27-28, by which time the lug 15 has cleared the projecting or throat edge of undercut 21, whereupon lug 15 resiliently restores itself to its original axial orientation, parallel to or flat alongside of the axial wall portion 27.

In the course of the axial depression which resulted in this latching or locking engagement, an initial interference developed between the neck chamfer and the conical formation 16; this interference entailed a resilient inward deformation of the cone 16 to the extent that residual axial force is exerted to axially outwardly propel the cap 11, were it not for lug 15 retention by the undercut 21. Preferably, the point of initial neck-to-cone inference occurs axially outwardly of the locked relationship (FIG. 8) so that the undercut 21 retains the assembly, with a residuum of axially outward resilient loading.

Now, if one tries to remove the cap by purely axial action, or by purely angular (e.g., the normal "unthreading") actuation, there will be nothing but frustration, because the lug 15 will jam itself between the limits of the restriction L_2 (FIG. 4). On the other hand, if the cap 11 is further displaced against its axial resilient load (to bottom at intersection of 27-28), and if the cap 11 and bottle 10 are then twisted in the "unthreading" direction, lug 15 will be caused to twist again about its central radial axis and to conform to the generally helical sidewall portion 28 (FIG. 9); the cap is then removed by axial displacement while maintaining the "unthreading" torque.

FIG. 10 illustrates a modification wherein the generally helical sidewall 24' is strictly helical, all the way from a point axially outside the throat 26, to the bottom 30, immediately adjacent the axial wall portion 27; bottom 30 is at a right angle to wall portion 27 and is substantially the effective width of lug 15. The cul-de-sac formation is otherwise as already described. The uniform helix of FIG. 10 provides uniform slid-

ing action for the twisted lug, during locking and unlocking functions, as will be clear. And the intersection between wall 24' and bottom 30 provides a discrete "corner" by which the corresponding bottom corner of lug 15 may be fulcrumed, in developing the twist needed for cap removal.

It will be seen that the invention meets all the stated objects. The two parts are readily fabricated with existing molding techniques, and liquid seal at a locked closure is repeatedly established, for each access to the container contents. The provision of lugs 13' establishes retaining surfaces for those lugs 15 which are spaced at a right angle from the lugs 15 relied upon for lock action, thereby stabilizing cap orientation when locked and sealed. Moreover, such lugs 13' are readily adapted to standard molding techniques, as suggested by identification of a parting line 31 (FIG. 5) between mold halves for the bottle 10.

In an illustrative use of my invention with materials of the character set forth above, the bottle neck surface 22 is of 1-inch diameter. The projecting throat end or lip of the undercut 21 is 0.3 inch axially in from the open end of the bottle. The lugs 15 are about 0.23-inch in axial length, 0.055-inch in thickness, and have about a 1-mil clearance with the surface 22; the formations 13-13' have a similar close clearance with the bore of cap 11, between lugs 15. The outside diameter of flange 23 is preferably slightly exceeded by the maximum outside diameter of cap 11, for appearance's sake. And the bottom surface of flat 20 has about 0.05-inch clearance with the radial plane of the upper ends of lugs 15.

While the invention has been described in detail for the preferred forms shown, it will be understood that modifications may be made without departure from the invention.

What is claimed is:

1. Tamper-proof selectively operable closure means, comprising a body including a neck with a circular axial-end opening, and a cap for selectively opening and closing said opening, said cap and the exterior of said neck having coacting telescoping parts for removably securing the same, and said cap and the bore of said neck having coacting telescoping parts including axially yieldable means having circumferentially continuous resiliently loaded contact with said opening when said cap is in secured position, said securing means including removably engageable bayonet lug and bayonet cul-de-sac formations; said cul-de-sac formation being characterized by a pocket having a restricted entrance which is axially open in one direction and radially open in one direction, said formation being further characterized by opposed angularly spaced sidewalls which are converged to a throat at said entrance, one of said sidewalls within said pocket being generally helically sloped from said throat and in the direction across said entrance, the other of said sidewalls within said pocket being angularly undercut in the direction away from said wall at the region of said helical slope; said lug formation extending radially and axially and being torsionally flexible about a generally radial axis through said lug formation, said lug formation being of thickness to pass said entrance, and the axial extent of said lug formation being at least no greater than the minimum axial span of said undercut portion of said other sidewall.

2. Closure means according to claim 1, in which said lug formations extend radially inwardly of said cap.

3. Closure means according to claim 1, in which said lug formations are integrally formed with the material of said cap.

4. Closure means according to claim 3, in which said cap and lug formations are a single molded piece of plastic material.

5. Closure means according to claim 1, in which said cul-de-sac formations are integrally formed with the material of said neck.

6. Closure means according to claim 5, in which said body and neck and cul-de-sac formations are a single molded piece of glass.

7. Closure means according to claim 1, in which said sidewalls at the axially open end of said entrance converge in the direction of approach to said throat.

8. Closure means according to claim 1, in which said lug formations are provided in plurality, equally angularly spaced about the central axis of said cap, and wherein said cul-de-sac formation is a recess within a radially outwardly extending arcuate lobe on said neck, the effective arcuate extent of said lobe exceeding the angular space between adjacent lug formations, whereby telescoping overlap of said cap and neck can only proceed when a lug formation enters said cul-de-sac formation.

9. Closure means according to claim 8, in which said lobe is provided in plurality about said neck at such effective angular spacing between adjacent entrance throats as to be an integer multiple of the angular spacing between adjacent lug formations.

10. Closure means according to claim 9, in which the plurality of said lobes is two, in which the number of lug formations is an even number, and in which said lobes are diametrically opposed.

11. Closure means according to claim 8, in which a radial lug integral with said neck and having a cap-lug retention surface substantially in the radial plane of said undercut is angularly offset from said undercut, substantially to the extent of an integer multiple of the angular spacing between adjacent lug formations of said cap.

12. Closure means according to claim 9, in which two diametrically opposed radial lugs project integrally from said neck at locations intermediate said lobes, said last two lugs having cap-lug retention surfaces substantially in the radial plane of said undercuts and being on a diametrical alignment that is angularly offset from the diametrical alignment of said undercuts, substantially to the extent of an integer multiple of the angular spacing between adjacent lug formations of said cap.

13. Closure means according to claim 12, in which the number of cap-lug formations is eight and in which the alignment of said neck-lug formations is substantially perpendicular to the alignment of said undercuts.

14. Closure means according to claim 1, in which the effective angular extent of said undercut is at least as great as the thickness of said lug formation.

15. Closure means according to claim 1, in which said one sidewall is substantially axially oriented at said throat and is smoothly and continuously faired to said generally helically sloped portion of said one sidewall.

16. Closure means according to claim 1, in which said cap is of single-piece molded-plastic construction, the securing telescoping portion of said cap including a relatively thick and rigid annulus with which said lug formations are integral, the yieldable telescoping portion of said cap being relatively thin and flexible and being of inwardly tapering configuration at the region of contact with said opening.

17. Closure means according to claim 16, in which said lug formations are in a general radial-plane location that is axially displaced from the general axial region of the yieldable telescoping portion of said cap.

18. Closure means according to claim 1, in which said one sidewall is a substantially continuous helix for substantially its length, spanning said throat and pocket regions.

19. Closure means according to claim 1, in which said undercut includes axial and angular components of offset from the throat region of said other sidewall.

20. Closure means according to claim 1, in which within said pocket said other sidewall includes a substantial axially extending wall portion of length greater than the effective axial length of said lug formation.

21. Closure means according to claim 1, in which said cap has a closure wall which includes a radially yieldable tapering section having initial interference with the circular neck opening prior to achieving the ultimate axial overlap which represents full securing of the cap to the neck, whereby when fully secured the tapering section is resiliently stressed into closing and sealing contact with said neck.

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