

TAMPER-EVIDENT CLOSURE WITH CAPTIVE BAND**Field of the Invention**

The present invention relates to plastic closures for containers having an externally screw threaded neck and more particularly to such closures which are formed with a tamper-evident, captive, band. When such closures are removed from the container, the tamper-evident band is ruptured but remains attached to the closure.

Background Of The Invention

Manufacturers of beverages, foodstuffs and the like are concerned with ensuring that products they place on the market are not tampered with before being opened by the ultimate consumer of the goods. For this purpose it has become conventional to include in closures for such goods means which will indicate whether the closure has been tampered with before purchase. In the case of containers having an externally screw threaded neck, it is common to provide the closure with a tamper-evident band which engages underneath a retaining flange formed on the neck of the container. The tamper-evident band is joined to a depending skirt forming part of the closure by a number of frangible bridges. On application of the closure to the container the band is forced over the retaining flange, however, when the closure is unscrewed from the container the bridges are sheared as the band is trapped underneath the retaining flange while the closure moves up the neck of the container. Tampering by unscrewing the closure will therefore be apparent.

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the band over the retaining flange at a continuously lengthening portion of the band circumference. Means are needed to prevent such tampering.

5 It also is becoming increasingly desirable around the world to recycle, or wash and refill, beverage bottles and other containers. However, various types of closures with tamper-evident bands leave the band remaining on the container when the main portion of the closure has been unscrewed from the container. As the closure is unscrewed, the frangible
10 bridges rupture and the then-detached band drops down on the container neck. This band must later be first removed from the container neck before the recycling/reuse processes are carried out on the container. Accordingly, captive tamper-evident bands have been developed which have both frangible
15 bridges but also retaining means to maintain the band attached at a portion thereof to the remainder of the closure when the closure is totally removed from the container. In certain instances, one or more vertical slots in the side wall of the tamper-evident band have been used adjacent extended bridges
20 to result in the tamper-evident band completely breaking through axially along its side wall to facilitate removal of the closure with the partially detached band. In other instances, for example, as disclosed in U.S. Pat. No. 5,246,125 (Julian) L-shaped slots have been used in the side
25 wall of the tamper-evident band, which band does not break but rather depends on substantial axial deformation of the band above the horizontal leg of the L-shaped slot in order to remove the closure with its captive band from the container.

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container without breakage of the band and/or bridges, must be tightly securable under the container flange and yet easily removed without excessive force from the container, must be completely tamper-evident, and must have a band that will consistently rupture at the same place in order to provide a captive band when the closure is removed from the container. Closures of the type mentioned above are used around the world in increasingly large numbers. To be commercially acceptable such closure must also be capable of being produced very rapidly in automated machinery. This itself may produce a conflict with the functionality of the closure and/or its tamper-evident, captive, band.

The arrangement according to the present invention is designed to provide the public with an alternative and superior form of closure having a tamper-evident, captive, band.

Summary Of The Invention

The present invention in broadest scope consists of a closure for a container having an externally screw threaded neck, the closure comprising a top portion and a depending skirt which has on its internal surface a complementary screw thread, a free edge of the depending skirt being joined by a plurality of bridges to a tamper-evident band, the band comprising a generally cylindrical body portion and a segmented rib extending inwardly of the body portion and adapted to provide a lip to engage under a retaining flange extending outwardly from the neck of the container below the screw thread thereon, the rib having an upper side facing

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both operations.

A further aspect of the present invention relates to the segmented rib having alternate projections disposed both beneath the gaps between the rib segments and also beneath the mid-points of the underside of the rib segments, said latter
5 projections abutting the undersides of the segments. Such inward projections are shown in International Publication Number WO 94/02371 published Feb. 3, 1994. The rib segments in the present invention are omitted adjacent to both sides of
10 the L-shaped slot, however, as are the above-described alternate projections. Accordingly the side wall of the tamper-evident band can more easily resiliently stretch adjacent to the L-shaped slot, and application of the closure to the container is facilitated without breakage of the band
15 or the frangible bridges. In the remainder of the circumference of the band, the rib segments and alternate projections are present. These projections are preferably inclined radially inward as they approach the rib, however they do not extend inwardly from the radially inner surface of
20 the body portion of the band as far as the rib segments do. The alternate projections make it difficult for tampering by a thin knife, etc. being inserted under the bottom edge of the band to pry the band off of the container without breaking the frangible bridges.

25 A still further aspect of the present invention relates to the outside of the body portion of the tamper-evident band being provided with outward projections or other localized areas of thickening to enhance the axial stiffness of the

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along section V-V of Fig. 2;

Fig. 6 is a view of the closure shown in Fig. 1 taken along section VI-VI of Fig. 2;

5 Fig. 7 is a view of the closure shown in Fig. 1 taken along section VII-VII of Fig. 2;

Fig. 8 is a view of the closure shown in Fig. 1 taken along section VIII-VIII of Fig. 6;

Fig. 9 is a view of the closure shown in Fig. 1 taken along section IX-IX of Fig. 6;

10 Fig. 10 is a side elevational view of the closure shown in Fig. 1 rotated ninety degrees about the vertical axis of the closure;

Fig. 11 is a partial cross-sectional view in an enlarged scale of the closure of Fig. 1, shown the closure in relation to a neck of a container as the closure is being screwed onto the container;

Fig. 12 is a partial cross-sectional view showing the closure of Fig. 11 with the closure sealingly engaged with the neck of the container;

20 Fig. 13 is a vertical sectional view through a part of a mold used for the injection molding of closures according to the present invention with the area defining the rib being shown on an enlarged scale;

Fig. 14 is a side elevational view of the closure shown in Fig. 1 with the tamper-evident band being largely separated from, but still captive with, the remainder of the closure.

Detailed Description Of Embodiment

While the present invention may be embodied in various

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is known as a 28mm beverage closure, the vertical dimension of slot 17 from the bottom of the slot in Fig. 2 up to the bottom level of the bridges 13 may be of the order of approximately 4.5mm; the horizontal dimension of slot 17 from outer end 62 in Fig. 2 to the other opposite end of the slot may be of the order of approximate 3mm; the radial thickness of portion 73 may vary upwardly from the free edge of the band from approximately .4mm, the radial thickness of region 63 then being less; and the vertical dimension of region 73 in Fig. 2 may be approximately 1.4mm.

Bridges 13 attaching body portion 12 of band 11 to cap portion 14 are not all of equal circumferential length around the circumference of the closure. Referring to Fig. 2, extended non-frangible bridge 13a is of much greater circumferential length than any of the other bridges, bridge 13a for example occupying approximately thirty-two degrees around the circumference of the closure. Referring to Figs. 2 and 3, the outer end 62 of horizontal leg 61 of L-shaped slot 17, and radially-thinned region 63 of portion 73, lie under bridge 13a. Outer end 62, if not extending under bridge 13a, should lie directly adjacent bridge 13a. Outer end 62 also may extend a partial distance under bridge 13a, for example a third or so of the circumferential length of bridge 13a.

A shorter bridge 13b is positioned on the opposite side circumferentially of slot 17 from bridge 13a, frangible bridge 13b being considerably shorter circumferentially than bridge 13a, for example being approximately .81mm long in the

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shaped slot 17 in conjunction with radially-thinned region 63 of body portion 12 and extended non-frangible bridge 13a will act to rupture body portion 12 of band 11 only at region 63, between the bottom of slot 17 and the bottom of closure 10. During the removal process, the elongated bridge 13a and the wall of the band extending downwardly therefrom to the free edge of the band do not significantly deform in an axial direction. The tamper-evident band 11 will remain captive to cap portion 14 at bridge 13a, but will be otherwise detached from cap portion 14, as shown in Fig. 14. The areas 64 and 65 shown in Fig. 3 adjacent respectively to the vertical leg 60 and horizontal leg 61 of slot 17 are also progressively radially thinned toward the slot from the remainder of body portion 12 of band 11, and together with radius 66, assure that body portion 12 only ruptures at region 63 when closure 10 is unscrewed from its container. By assuring this same point of rupture, the closure 10 can be removed from the container with the same low degree of torque each time.

Turning now to attachment of closure 10 to the container, the container 29 (a portion of which is shown in Figs. 11 and 12) includes a continuous generally annular retaining flange 30 immediately below the screw thread 31 of the container 29 so as to form an outwardly radially directed lip. The band 11 includes a rib 18 about its inside surface being sized and shaped so as to provide an inwardly extending lip which will engage under the retaining flange 30 of the container 29 once the closure 10 is fully closed onto the container 29.

The rib 18 is made up of a series of rib segments 19

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closure 10 as it prevents or a least substantially reduces the production of closures having deformed ribs 18. It also ensures rigidity of the rib 18 and thereby prevents distortion of the rib 18 as it is forced over the retaining flange 30 as the closure 10 is screwed down onto the container 29. The rib 18 is sufficiently robust that it can, on its own, withstand the forces applied to it during application to the container 29 and also prevents the cap 14 from being removed without breaking the frangible bridges 13b and 13c either by normal removal of the cap 14 or due to tampering with the container 29. It has been found that there is no deleterious effect in not having the annular surface 24 extend across the full width of the upper surface 21 of the rib 18.

Below the rib 28, and still on the inside surface of the body portion 12 of the band 11, is an arrangement shown particularly in Figs. 2, 8 and 9 of a plurality of inwardly extending projections 25 and 28, each having a long axis generally aligned with the longitudinal axis of the closure 10. The projections 25 and 28 extend radially inwardly from the inner surface of the body portion 12 sufficiently to come into contact with the retaining flange 30 during application of the closure 10 to the container 29 and once the container is capped to lie close to the outer neck surface of the container 29. Each alternate inwardly extending projection 28 is spaced below the break 20 in the substantially continuous rib 18 and is not connected to the rib 18. Each of the remaining inwardly extending projections 25 are connected at one end to the center of a rib portion 19. It will be noted

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The outer surfaces of the thickenings 26 present substantially flat lands 27 which lie radially just outside the radial extent of the rest of the closure 10 to allow the land to be mechanically gripped or otherwise contacted without necessarily contacting the skirt. It will be noted from Figs. 5, 6, 7 and 10 that reinforcements or thickenings 26 are not present at elongated region 73 under the L-shaped slot, and are absent at two diametrically opposite positions 71, 72 around the circumference of the closure, which positions 71, 72 are each spaced a quarter turn from slot 17. Unreinforced positions 71, 72 provide regions of enhanced circumferential stretching expansion when closure 10 is threaded onto container 29.

Referring to Figs. 11 and 12, the closure 10 is formed with a sealing arrangement which may take several known forms. As here disclosed, the sealing arrangement includes a concentric annular rib 32 which extends from the underside of the top portion 15 of the cap portion 14. The annular sealing rib 32 includes a first or root portion 33 which extends downwardly from the top portion 15 approximately parallel to the skirt 16 with a second portion 34 which, prior to engagement with the neck of the container 29, tapers inwardly and away from the skirt 16. Second portion 34 has annular ridge 80 positioned at its end.

The second portion 34 of the rib 32 contacts the end 35 of the container 29 as the closure 10 is being screwed onto the container 29, and the second portion 34 is caused to fold up against the surface of the first portion 33. Thus there is

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and 13c is inclined such that when seen in side elevation the upper end of each bridge 13b and 13c is inclined to the left relative to its lower end. The bridges 13b and 13c, therefore, bend as the closure 10 is screwed clockwise onto the container 29. As the rib 18 expands over the flange 30, the lower edge 42 of the skirt 16 and the upper edge 41 of the band 11 have room to flex towards each other while still having the bridges 13b and 13c therebetween. This stabilizes the band 11 and reduces the likelihood of the bridges 13b and 13c breaking during application. As the closure is unscrewed, the bridges 13b and 13c are straightened out, concentrating the forces to rupture bridges 13b and 13c.

During the above-described expanding of the ribs 18 over the flange 30 (as well as when closure 10 is removed from the mold), regions 67, 68, 69, 70 and 73 permit the wall of body portion 12 in those regions to circumferentially stretch, particularly at elongated region 73. This stretching in these regions assists in preventing the frangible bridges 13b and 13c from breaking during application of closure 10 to the container 29.

Once the rib 28 has passed over and engaged under the flange 30, the frangible bridges 13 return to their extended orientation (Fig. 12). As the closure 10 begins to be unscrewed from the neck of the container 29, the rib 18 detains the band 11 under the flange 30. As the closure 10 is unscrewed further, the bridges 13b and 13c are straightened which serves to concentrate the forces tending to rupture the bridges 13b and 13c at the point of attachment of each bridge

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such that the ends are inclined to the skirt of the closure by an included angle that is less than the included angle that the respective notional plane makes with the skirt.

5 The closure 10 is molded on a mold core which defines, inter alia, the inside surface of the skirt 16, the thread segments 51 and the grooves 43. It has been found that by forming the thread segments 51 with planar surfaces 53, damage to the thread segments 51 upon the closure 10 being ejected off the mold core has been significantly reduced as compared
10 with forming each of the thread segments with a pointed end similar to point 54.

15 Fig. 13 depicts that part of a mold 44 used to mold the rib segments 19. It can be seen that the mold defines a recess 45 corresponding in a cross-sectional shape to the desired slope of the rib segments 19 and is divided into an outer first surface 47 and an inner second surface of the band 11. This first surface 47 is inclined to a plane normal the axis of the mold by an angle of 20°. The second surface 48 lies on the plan normal to the axis of the mold.

20 It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the invention as shown in the specific embodiment without departing from the spirit or scope of the invention. Merely, as an example, a second corresponding L-shaped slot may be
25 positioned approximately diametrically across from the first L-shaped slot so that the tamper-evident band will rupture into two captive band portions retained by the closure. The present embodiments are, therefore, to be considered in all

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What is claimed is:

1. A closure for a container having an externally screw threaded neck, the closure comprising a top portion and a depending skirt which has on its internal surface a complementary screw thread; a free edge of the depending skirt being joined by a plurality of frangible bridges and at least one non-frangible bridge to a tamper-evident band, the at least one non-frangible bridge having an extended circumferential length in relation to the circumferential length of the individual frangible bridges; the tamper-evident band comprising a generally cylindrical body portion and a segmented rib extending inwardly of the body portion and adapted to provide a lip to engage under a retaining flange extending outwardly from the neck of the container below the screw thread thereon; an L-shaped slot extending radially through the side wall of the tamper-evident band, the slot having a first leg positioned adjacent the non-frangible bridge and extending in a generally downward direction from the top of the tamper-evident band, and a second leg extending generally circumferentially in the direction of the extended non-frangible bridge of the tamper-evident band; the second leg terminating at its end remote from the first leg of the L-shaped slot at a position axially under or directly adjacent to the extended non-frangible bridge; the body portion of the tamper-evident band having a frangible region extending between the bottom of the second leg of the L-shaped slot and the bottom of the body portion, such that when the closure is



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when the closure is applied to a container.

7. The invention of claim 1 or claim 6, wherein the body portion of the tamper-evident band is provided with a plurality of longitudinally extending areas of localized thickening spaced apart about the radially outer surface of the band except at positions under the second leg of the L-shaped slot and except at positions approximately a quarter turn circumferentially removed from the L-shaped slot such that the positions circumferentially removed may stretch when the closure is applied to the container.

8. The invention of claim 1, wherein some of the frangible bridges are strengthened in relation to the remainder of the frangible bridges, one of such strengthened frangible bridges being positioned on the opposite side of the L-shaped slot from the extended non-frangible bridge.

9. The invention of claim 7, wherein some of the frangible bridges are strengthened in relation to the remainder of the frangible bridges, at least one each of such strengthened frangible bridges being positioned axially above the positions approximately a quarter turn circumferentially removed from the L-shaped slot.

10. The invention of claim 1, wherein the body portion of the tamper-evident band under the second leg of the L-shaped slot has substantial circumferential length to provide substantial stretching when the closure is applied to the container.

11. A closure for a container having an externally screw threaded neck, the closure comprising a top portion and a

