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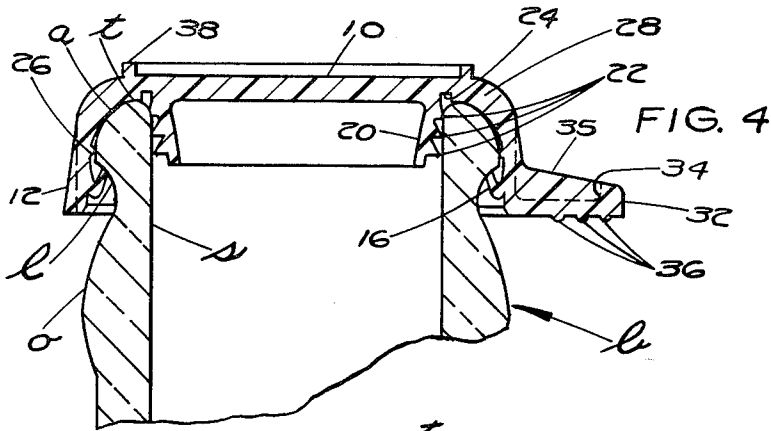
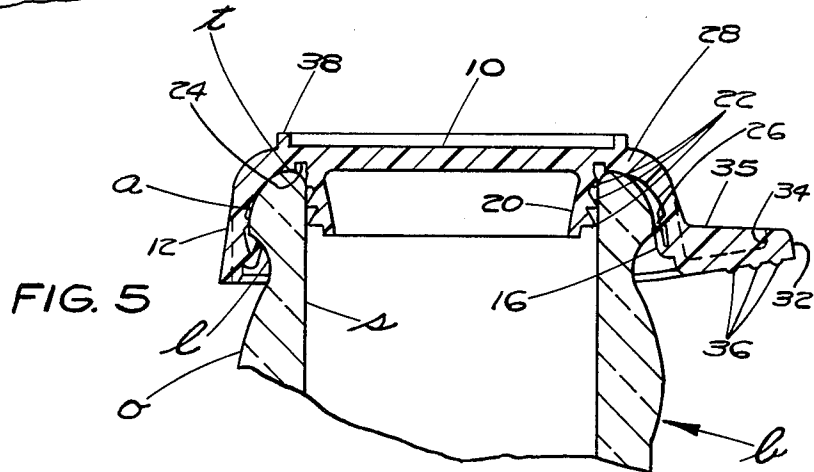
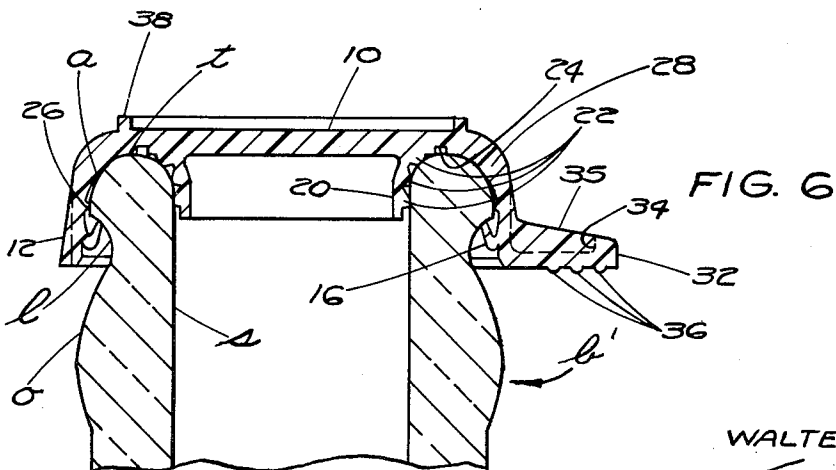
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CLOSURES

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CLOSURES

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The present invention relates to improvements in closures, particularly for beer and soft drink bottles normally sealed by a "crown" type cap or closure.

It has long been recognized that many advantages could be gained by using resinous materials, commonly referred to as plastics, in forming bottle closures of the type referred to. All-plastic closures have been proposed in the patent art at least as early as the 1930's and many are in use today. However, such use is limited to what may be referred to as "refrigerator" closures, i.e., closures which are used to reseal a bottle after the original crown cap has been removed. The reason for this is, that to this time, all-plastic closures have failed, in one fashion or another, to fulfill all the necessary functional requirements in a manner equivalent to metal crown caps which have a plastic or cork sealing gasket. For the most part, all-plastic closures are found lacking in their ability to hold the high pressures of carbonated, bottled beverages which can generate an internal pressure of 100 p.s.i. or more.

Beyond this, there are other functional requirements which are of primary importance. For example, cases of bottles are often stacked one on top of another. This results in a considerable force on the top of the bottle, which force can be transmitted directly to the closure. Previously proposed all-plastic closures have been particularly lacking in their ability to withstand such a loading. Also, closures employed in the bottling of malt beverages must meet the further requirement of maintaining an effective seal through the relatively high temperatures of pasteurization followed by an immediate chilling. Simple substitution of plastic, in a conventional configuration, results in a pressure loss causing the beverage to be flat or spoiled.

It is conceivable that certain of today's high strength plastics might be formed into a closure with large wall thicknesses to thereby serve most, if not all of the functional requirements previously referred to. Not only is such an approach economically unfeasible, but such a cap would be difficult to remove, likely requiring a specially designed remover. This is contrary to the present demand of the market place for ease of opening and preferably a built-in opening means.

The object of the present invention is to provide an all-plastic closure suitable for the bottling of beverages, or the like, and functionally equivalent to conventional metal, crown caps for most, if not all, purposes.

Another object of the invention is to provide an all-plastic closure fulfilling the above ends, which may be economically produced at a cost equal to or less than the cost of present closures.

A further object of the invention is to further provide a built-in opening feature in such an improved closure.

In attaining these ends the invention makes available the previously recognized advantages of employing plastics for such a purpose. Thus rust and corrosion can be eliminated to improve the appearance of the bottles. Also the sharp edges normally found on metal caps are eliminated so that such a source of possible injury is eliminated. Since the present all-plastic closure can be formed by injection molding, many other benefits are obtained in manufacture and distribution. These factors result in further economies in the use of this closure.

Closures provided in accordance with the invention comprise a top portion which overlies the top of a bottle of the same type conventionally sealed by metal crown

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caps. A skirt depends from this top portion and a lip extends downwardly and inwardly from the lower end thereof. As the skirt is telescoped onto the bottle, this lip is reversely bent to an essentially upright position to lockingly engage the circumferential groove normally engaged by the crimped skirt of metal crown caps. The sealing function of this closure is provided by a thin walled, open cone on the undersurface of the top portion. This cone is dimensioned so that circumferential ridges, preferably formed thereon, will sealingly engage the interior throat surface of a wide size range of bottles.

The locking lip is purposely notched and the closure otherwise formed so that the sealing function is divorced from the locking function to prevent the buildup of a removal force on the locking lip as could happen if gases were trapped thereby. A rib is formed on the interior of the skirt to space it from the bulbous portion of the bottle over which it is telescoped. With this arrangement, the closure may be readily removed by finger pressure or the like selectively applied to an outwardly projecting lift tab formed on the skirt in the region of the spacing rib. The spacing rib permits the skirt to be tilted from the bottle as the locking lip remains in its upright position. Thus a relatively high strength material may be used where a much lower strength material would be required if the locking lip were to be reflexed in removing the closure by simple finger pressure.

In connection with the selection of materials, it has been discovered that polypropylene is to be preferred not only because of its high strength but because of its cold formability. This latter quality is of significance to both the locking and sealing functions of the closure. The locking lip is cold formed to its upright position so that it most effectively serves as a locking member. The sealing cone is cold formed into sealing engagement with the interior throat surface of the bottle to insure a proper sealing action therewith in spite of the wide tolerance ranges that are encountered.

The above and other related objects and features of the invention will be apparent from a reading of the following description of the disclosure found in the accompanying drawings and the novelty thereof pointed out in the appended claims.

In the drawings:

FIG. 1 is an elevation, partly in section, of an all-plastic closure embodying the present invention;

FIG. 2 is a bottom view, with portions broken away and in section, of this closure;

FIG. 3 is a view, in cross section, showing this closure partially mounted on a bottle;

FIG. 4 is a view, in cross section, showing the closure fully mounted on the bottle;

FIG. 5 is a view, in cross section, illustrating the manner in which the closure is removed; and

FIG. 6 is a view, in cross section, showing the same closure fully mounted on a bottle having a smaller interior throat.

Referring first to FIGS. 1 and 2, the present closure comprises a top portion 10 having a depending peripheral skirt 12. The upper surface of the top portion 10 may be printed, or formed with raised letters, to identify the product in the bottle and provide whatever advertising or other information is desired. The outer surface of the skirt 12 is fluted as at 14, for ornamental purposes. These flutes may be eliminated if it is desired to use a very minimum of material.

A locking lip 16 projects downwardly and inwardly from the base of the skirt 12. The locking lip 16 is concentrically disposed relative to the skirt and is relatively thin. Notches 18 are formed in the lip 16 for purposes later discussed. FIG. 2 shows that the lip 16 may be preferably formed compositely by segments, all of which

are integral components of the closure, but in the present terms of description, reference is made to a single lip 16.

A sealing cone 20 depends from the undersurface of the top portion 10 and is disposed concentrically of the locking lip 16. The sealing cone 20 is open ended and formed with a relatively thin wall to be somewhat flexible. A series, preferably three, of circumferential ridges 22 are formed on the outer surface of the sealing cone 20 and are of progressively smaller diameter due to the conical configuration involved. Preferably the ridges 22 are sharp edged and undercut as illustrated in FIGS. 1 and 3. A circumferential groove 24 is formed in the top portion 10 at the outer base of the sealing cone 20.

It will also be seen that a circumferential spacing rib 26 is formed intermediate the height of the skirt 12 on the inner surface thereof, where the skirt blends with the top portion 10 through a curved section 28. The spacing rib 26 is interrupted along its length, as indicated at 30 so as not to provide a seal with the bottle at this point.

A lift tab 32 projects laterally and outwardly from one side of the base of the skirt 12. A reinforcing flange 34 extends upwardly from the marginal edges of the lift tab, with the opposed side portions of said flange and a central rib 35 being angled upwardly to the point where they join the skirt 12. Transverse ridges 36 are formed on the undersurface of the lift tab 32 to facilitate gripping that surface when the lift tab is used in removing the closure from a bottle.

The present closure is so formed that it may be, and preferably is, manufactured as an injection molded item. The described configuration provides further advantages in that closures may be economically produced at high production rates in multi-cavity dies of relatively simple construction. The preferred material used in forming these closures is polypropylene, for reasons hereinafter discussed. However, in certain instances other materials may be employed, particularly materials which would be considered functionally equivalent to polypropylene.

FIG. 3 shows the present closure positioned to be mounted on a bottle *b* which is of conventional construction. (One of the advantages of this closure is that it may be used on existing bottles without any modification thereof.) The closure coacts only with the illustrated upper end of the bottle which comprises an interior throat *s* which blends into a top surface *t* that may have an annular width of variable dimension. The diameter of the interior throat *s* also varies widely with a tolerance range of .150 inch or more. The bottle seen in FIGS. 3-5 illustrates a maximum interior throat diameter. From the top surface *t* an annular bulbous surface *a* extends to form a circumferential undercut locking ledge *l* above the remainder of the outer surface *o* of the bottle *b*.

Mounting of the present closure simply requires a downward, plunging force, once it is properly aligned with a bottle, as shown in FIG. 3. This brings out a further advantage of this closure in that simple and inexpensive equipment may be employed to utilize it in existing bottling lines.

FIG. 3 illustrates how the downwardly canted lip 16 is cammed or bent upwardly by engagement with the bulbous surface *a*. FIG. 4 then shows the mounting operation completed by a continued downward force on the closure which folds the lip 16 to an essentially upright position wherein it lockingly engages the undercut ledge *l*. As the lip 16 is bent to this locking position, it is cold formed so that it no longer tends to return to its originally molded position, but instead its strength is focused to resist, primarily in compression loading, removal forces generated by gas pressure in the bottle. Polypropylene is preferred as a closure material because of its high strength and equally because of its ability to be cold formed (this is akin to forging), thereby enabling the use of a locking lip of minimum dimensions which is effective in contain-

ing the gas pressures existing in bottled carbonated beverages under all conditions normally encountered.

As the closure is mounted on the bottle *b*, the sealing cone 20 is also cold formed. By proper selection of dimensions, firm sealing engagement is made by at least and preferably one of the ridges 22 without substantial deformation thereof. No real problem exists in obtaining sealing engagement with an interior throat *s* of maximum diameter (FIG. 4). However cold formability enables the same cone 20 to be swaged without wrinkling so that the smallest ridge 22 may effectively provide uninterrupted sealing engagement with a bottle *b'* having a minimum throat diameter as illustrated by FIG. 6. In further connection with the cold formability of the cone 20, it will be noted that by cold forming the ridges into sealing engagement, an effective sealing action is obtained even when the throat is substantially eccentric or out of round. In connection with the wide tolerance range that it is adapted to accommodate, the upper portion of the interior throat may be substantially straight or even undercut. The groove 24 at the base of the sealing cone is of importance in obtaining an effective seal where such bottles also have a minimum throat diameter.

The sealing action provided by the cone 20 is of the internal pressure assist type, which is effected through substantially line contact, regardless of the interior throat diameter of the bottle. Thus if there is an increase in the internal pressure, there is a corresponding increase in the sealing pressure exerted by the ridge or ridges 22. The wall thickness of the cone 20 is sufficiently thin to insure obtaining the pressure assist seal. It will also be pointed out that the cone 20 provides the sole sealing action and while the drawings might indicate that there is a sealing contact on the bottle surfaces *t* and/or *a*, the parts are dimensioned so that this does not occur. Emphasis is placed on this point, because it is of significance in explaining many of the advantages of the invention whereby an effective sealing action is obtained where others have failed.

Not only are bottled beverages subjected to a wide range of ambient temperatures from warehouse storage to refrigeration, but even more severe heat cycling is encountered in the pasteurization of most malt beverages. After applying a closure to a bottle containing a malt beverage, the bottle is heated to approximately 140° F. for an extended period and then usually cooled immediately. All plastic materials have a relatively high coefficient of thermal expansion, including polypropylene. The described combination of the locking lip 16 and the sealing cone 20 is particularly effective in maintaining an effective seal at elevated temperatures. Among other things, growth of the lip 16 is largely compensated for by growth of the skirt 12 to preserve the locking function, while the open end of the sealing cone 20 permits it to grow without any substantial "forming" effect which would impair its sealing function, either at the elevated temperature or when subsequently cooled. The cold forming of these components, previously discussed, is further believed to be a factor in preserving these locking and sealing functions because of the molecular reorientation which is involved.

An annular bearing ridge 38 is provided on the upper surface of the top portion 10. The diameter of the ridge 38 is greater than the base of the sealing cone 20 and the ridge itself is disposed to overlie the top surface *t* of the bottle. Thus when any articles, such as bottle cases, are stacked on this closure, the ridge 38 takes the full bearing load, transmitting it directly to the bottle surface *t* with little or no effect on the locking and sealing functions. It would be pointed out that the groove 24 assists in isolating the sealing cone 20 from such bearing loads.

Removal of this closure simply requires an upward force on the lift tab 32. Most conveniently thumb pressure against the undersurface of the lift tab can be em-

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ployed to tilt the closure to the position shown in FIG. 5. Actually removal of the cap is essentially instantaneous and FIG. 5 should be considered as a "stop motion" view. The purpose of FIG. 5 is to show that the lip 16 remains in an upright position as the closure is removed from the bottle. The reason why this can be had is found in the provision of the spacing rib 26, particularly the portion thereof immediately above the lift tab 32. This spacing rib provides clearance for the locking lip 16 to pass over the bulbous portion of the bottle, otherwise the locking lip would have to be reversely flexed in removing the closure. If the locking lip were reversely flexed, the necessary removal force (using a material having sufficient strength to contain the high pressures of carbonated beverages) would become so great that the closure could be taken off by only the strongest of men, or else require a special opener. In this connection it will be appreciated that the lift tab 32 provides only a very small leverage advantage when initial removal movement takes place and it is at this time that maintaining the locking lip in its upright position is critical. Thereafter much greater forces are available and some reverse flexing of the locking lip may be observed at points spaced a substantial distance from the lift tab.

It will be apparent that the various novel features of the present closure enable its use in commercial bottling operations for most, if not all, products where crown cap closures are now employed. The use of this closure is the more attractive, not only because of the normal advantages found in the use of plastics, but because of its low cost and the simple modifications required to substitute its use in existing bottling operations. The extent of novelty of these features is to be derived solely from the following claims in view of the variations from the illustrated, preferred embodiment which will be apparent to those skilled in the art.

Having thus described the invention, what is claimed as novel and desired to be secured by Letters Patent of the United States is:

1. A closure for a bottle having an upper portion generally circular in cross section and comprising an interior throat extending to an annular top portion and then to a bulbous portion having an undercut locking ledge therebeneath, said closure being formed of plastic and comprising, as integrally formed components, a top portion to overlie the top portion of the bottle, a peripheral skirt depending from the closure top portion to be telescoped over the bulbous portion of the bottle, a locking lip canted downwardly and inwardly from the lower end of the skirt and terminating in a circular outline larger than the top portion of the bottle and smaller than the bulbous portion thereof, whereby the locking lip will be folded to an essentially upright position as the skirt is telescoped over the bulbous portion of the bottle, the length of said lip being such to engage the locking ledge, a converging sealing cone depending from the undersurface of the closure top portion to be inserted into the interior throat of the bottle, said cone being open ended with a relatively thin wall to provide a pressure assist seal with a wide range of interior throat diameters, a lift tab projecting laterally and outwardly of said skirt, and a spacing rib on the inner surface of said skirt adjacent said lift tab, said spacing rib being engageable with the major diameter of the bulbous portion of the bottle, whereby finger pressure or the like on the lift tab will tilt the closure from the bottle with the locking lip remaining in its upright position.

2. A closure for a bottle having an upper portion generally circular in cross section and comprising an interior throat extending to an annular top portion and then to a bulbous portion having an undercut locking ledge therebeneath, said closure being formed of polypropylene and comprising, as integrally formed components, a top portion to overlie the top portion of the bottle, a peripheral skirt depending from the closure top portion to be tele-

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scoped over the bulbous portion of the bottle, a locking lip canted downwardly and inwardly from the lower end of the skirt and terminating in a circular outline larger than the top portion of the bottle and smaller than the bulbous portion thereof, whereby the locking lip will be folded and cold formed to an essentially upright position as the skirt is telescoped over the bulbous portion of the bottle, the length of said lip being such to engage the locking ledge, a depending sealing cone on the undersurface of the closure top portion to be inserted into the interior throat of the bottle, said sealing cone being convergent and open ended with a relatively thin wall, whereby the sealing cone will be cold formed upon insertion and provide a pressure assist seal with a wide range of interior throat diameters, and a spacing rib on the inner surface of said skirt, said spacing rib being engageable with the major diameter of the bulbous portion of the bottle to facilitate removal of the closure with the locking lip remaining in its upright position.

3. A closure for a bottle having an upper portion generally circular in cross section and comprising an interior throat extending to an annular top portion and then to a bulbous portion having an undercut locking ledge therebeneath, said closure being formed of polypropylene and comprising, as integrally formed components, a top portion to overlie the top portion of the bottle, a peripheral skirt depending from the closure top portion to be telescoped over the bulbous portion of the bottle, a locking lip canted downwardly and inwardly from the lower end of the skirt and terminating in a circular outline larger than the bulbous portion thereof, whereby the locking lip will be folded and cold formed to an essentially upright position as the skirt is telescoped over the bulbous portion of the bottle, the length of said lip being such to engage the locking ledge, said locking lip being notched to prevent its functioning as a sealing element, a depending sealing cone on the undersurface of the closure top portion to be inserted into the interior throat of the bottle, said sealing cone being convergent and open ended with a relatively thin wall, whereby the sealing cone will be cold formed upon insertion and provide a pressure assist seal with a wide range of interior throat diameters, a lift tab projecting laterally and outwardly of said skirt, and a spacing rib on the inner surface of said skirt adjacent said lift tab, said spacing rib being non-sealingly engageable with the major diameter of the bulbous portion of the bottle, whereby finger pressure or the like on the lift tab will tilt the closure from the bottle with the locking lip remaining in its upright position.

4. A closure for a bottle having an upper portion generally circular in cross section and comprising an interior throat extending to an annular top portion and then to a bulbous portion having an undercut locking ledge therebeneath, said closure being formed of plastic and comprising, as integrally formed components, a top portion to overlie the top portion of the bottle, a peripheral skirt depending from the closure top portion to be telescoped over the bulbous portion of the bottle, a locking lip canted downwardly and inwardly from the lower end of the skirt and terminating in a circular outline larger than the top portion of the bottle and smaller than the bulbous portion thereof, whereby the locking lip will be folded to an essentially upright position as the skirt is telescoped over the bulbous portion of the bottle, the length of said lip being such to engage the locking ledge, a converging sealing cone depending from the undersurface of the closure top portion to be inserted into the interior throat of the bottle, said cone being open ended with a relatively thin wall to provide a pressure assist seal with a wide range of interior throat diameters, said cone having a series of circumferential sealing ridges of progressively smaller diameter along its length, the diameter of the largest sealing ridge being slightly larger

than the largest throat diameter to be sealed and the smallest sealing ridge being slightly larger than the smallest interior throat diameter to be sealed, said sealing ridges being sharp edged and undercut from said sharp edges, a lift tab projecting laterally and outwardly from said skirt, and a spacing rib on the inner surface of said skirt adjacent said lift tab, said spacing rib being engageable with the major diameter of the bulbous portion of the bottle, whereby finger pressure or the like on the lift tab will tilt the closure from the bottle with the locking lip remaining in its upright position.

5. A closure for a bottle having an upper portion generally circular in cross section and comprising an interior throat extending to an annular top portion and then to a bulbous portion having an undercut locking ledge therebeneath, said closure being formed of plastic and comprising, as integrally formed components, a top portion to overlie the top portion of the bottle, an annular bearing ridge projecting above the upper surface of the closure top portion to be registered with the top portion of the bottle, whereby vertical loading forces on said closure will be transmitted to the top portion of the bottle through said bearing ridge, a peripheral skirt depending from the closure top portion to be telescoped over the bulbous portion of the bottle, a locking lip canted downwardly and inwardly from the lower end of the skirt and terminating in a circular outline larger than the top portion of the bottle and smaller than the bulbous portion thereof, whereby the locking lip will be folded to an essentially upright position as the skirt is telescoped over the bulbous portion of the bottle, the length of said lip being such to engage the locking ledge, a converging sealing cone depending from the undersurface of the closure top portion to be inserted into the interior throat of the bottle, said cone being open ended with a relatively thin wall to provide a pressure assist seal with a wide range of interior throat diameters, said closure top portion having an annular groove formed in its undersurface at the exterior base of said sealing cone to isolate the sealing cone from loading forces on the bearing ridge, a lift tab projecting laterally and outwardly from said skirt, and a spacing rib on the inner surface of said skirt adjacent said lift tab, said spacing rib being engageable with the major diameter of the bulbous portion of the bottle, whereby finger pressure or the like on the lift tab will tilt the closure from the bottle with the locking lip remaining in its upright position.

6. A closure for a bottle having an upper portion generally circular in cross section and comprising an interior throat extending to an annular top portion and then to a bulbous portion having an undercut locking ledge therebeneath, said closure being formed of polypropylene and comprising, as integrally formed components, a top portion to overlie the top portion of the bottle, an annular bearing ridge projecting above the upper surface of the closure top portion to be registered with the top portion of the bottle, whereby vertical loading forces on said closure will be transmitted to the top portion of the bottle through said bearing ridge, a peripheral skirt depending from the closure top portion to be telescoped over the bulbous portion of the bottle to a point below the locking ledge, a locking lip canted downwardly and inwardly from the lower end of the skirt and terminating in a circular outline larger than the top portion of the bottle and smaller than the bulbous portion thereof, whereby the locking lip will be folded and cold formed

to an essentially upright position as the skirt is telescoped over the bulbous portion of the bottle, the length of said lip being such to engage the locking ledge, said locking lip being notched to prevent its functioning as a sealing element, a converging sealing cone depending from the undersurface of the closure top portion to be inserted into the interior throat of the bottle, said cone being open ended with a relatively thin wall to provide a pressure assist seal with a wide range of interior throat diameters as the cone is cold formed in being inserted therein, said cone having a series of circumferential sealing ridges of progressively smaller diameter along its length, the diameter of the largest sealing ridge being slightly larger than the largest throat diameter to be sealed and the smallest sealing ridge being slightly larger than the smallest interior throat diameter to be sealed, said sealing ridges being sharp edged and undercut from said sharp edges, said closure top portion having an annular groove formed in its undersurface at the exterior base of said sealing cone, the diameter of said groove being no greater than the maximum diameter of the top portion of the bottle to thereby isolate the sealing cone from loading forces on the bearing ridge and to facilitate cold forming of the sealing cone to accommodate a maximum range of interior throat diameters, a lift tab projecting laterally and outwardly from skirt, and a circumferential spacing rib on the inner surface of said skirt, said spacing rib being interrupted along its length to prevent its functioning as a sealing element, said spacing rib further being positioned to engage the major diameter of the bulbous portion of the bottle, whereby finger pressure or the like on the lift tab will tilt the closure from the bottle with the locking lip remaining in its upright position.

7. A closure for a bottle having an upper portion generally circular in cross section and comprising an interior throat extending to an annular top portion and then to a bulbous portion, said closure comprising means for securing it to the bottle and having as integrally formed plastic components, a top portion to overlie the top portion of the bottle, an annular bearing ridge projecting above the upper surface of the closure top portion to be registered with the top portion of the bottle, whereby vertical loading forces on said closure will be transmitted to the top portion of the bottle through said bearing ridge, a converging sealing cone depending from the undersurface of the closure top portion to be inserted into the interior throat of the bottle, said cone being open ended with a relatively thin wall to provide a pressure assist seal with a wide range of interior throat diameters, said closure top portion having an annular groove formed in its undersurface at the exterior base of said sealing cone to isolate the sealing cone from loading forces on the bearing ridge.

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