Jan. 4, 1966 W. R. GOWDY ETAL 3,227,332

CAPTIVE CLOSURE

Filed Sept. 27, 1963

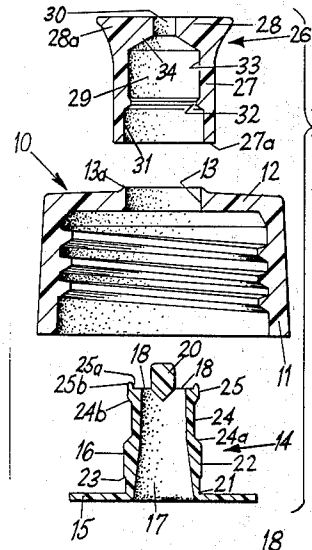


Fig.1

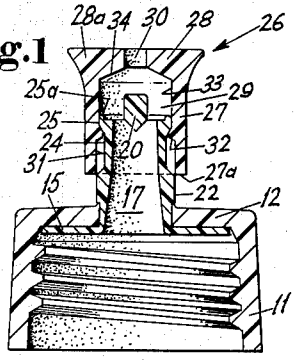


Fig.3

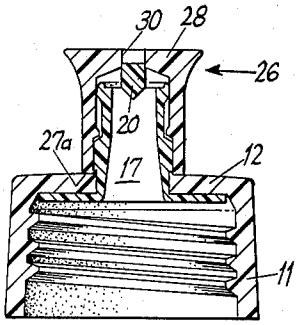


Fig.4

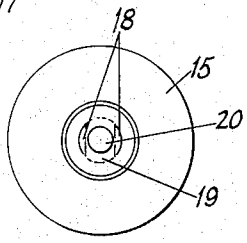


Fig.2

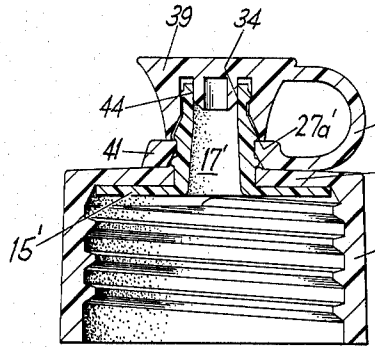
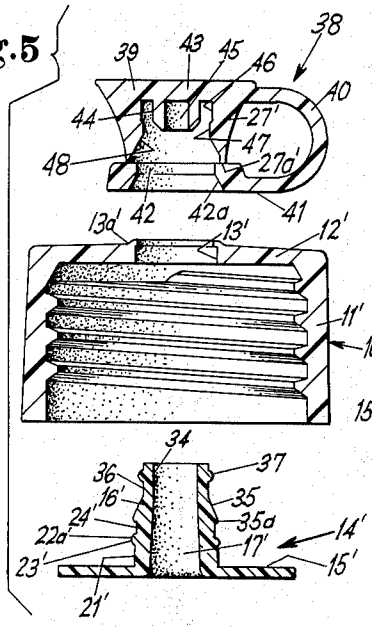


Fig.7

Fig.5



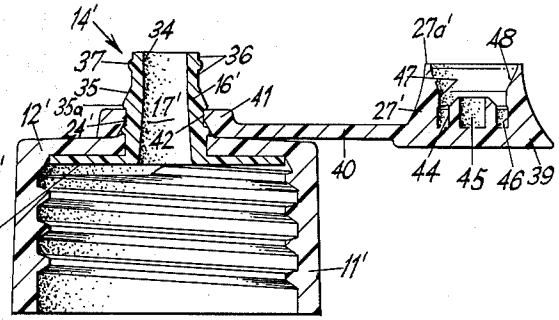


Fig.6

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CAPTIVE CLOSURE

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2 Claims. (Cl. 222—525)

This invention relates to a captive closure and more particularly to a three-piece captive closure which is well adapted for use in connection with the packaging of materials tending to function as stress cracking agents (for example, liquid detergent compositions).

The trend towards the "snip-off" tip type of closure (i.e., a molded one-piece closure with a hollow nipple protruding upwardly from the top wall of the cap) eventually led to the development of a two-piece closure comprising a molded cap shell having an aperture in the top wall thereof and a molded insert having a spout designed to telescope through the aperture in the cap shell and perform the function of the nipple of the one-piece closure. The two-piece closure had certain advantages over the one-piece structure. Esthetically, for example, a combination of colors could be used—one color for the cap shell and another, and contrasting, color for the insert. With respect to performance, the seal between the container finish and the cap was improved with the two-piece closure since the insert, the liner-like skirt of which was pressed against the end of the container finish, could be made of a softer material, thereby resulting in an improved gasketing action.

There were certain drawbacks to the two-piece structure, however, including a stress cracking problem at the junction of the spout and skirt of the insert and the lack of means for reclosure (also a problem with one-piece closures). One of the principal factors in creating the stress cracking problem mentioned above was ultimately determined to be extraneous forces which acted upon the spout tip when the two-piece cap was incorporated on a package and that package stored in a warehouse, shipped, displayed and/or placed in use by the consumer. When combined with the action of stress cracking agents being packaged, these forces caused the development of cracks through which product leaked—an undesirable and costly product defect.

It is an object of the present invention to obviate the above difficulties.

Another object of the present invention is to provide three-piece dispensing caps of improved construction which are adapted to be tightly sealed both initially and for reclosure and which will not be subjected to stress cracking by reason of the application of external forces thereto.

Briefly stated, in accordance with one aspect of this invention, a closure is constructed from three-pieces comprising a cap shell, an insert and an overcap. The cap shell is substantially rigid, has a top wall with a centrally located aperture therein and a sidewall with means thereon for fastening the closure to a container. The resilient insert has a hollow spout extending therefrom which protrudes through the aperture in the cap shell and has a discharge port at its distal end. It is also provided with means for interlocking with complementary means on the cap shell to secure the insert to the cap shell. The overcap telescopes over the spout and is axially movable thereon. Both overcap and the spout have cooperative sealing means designed to coact to form a seal preventing egress from the discharge port during a finite continuous range of spout sealing positions. At least one of the cooperative sealing means is a substantially cylindrical wall which extends and is maintained coaxial of the assembled closure in the sealing

range. The other of the cooperative sealing means comprises an element adapted to press tightly against the cylindrical wall along an endless path circumscribing the wall in each position of the overcap in the sealing range so as to be maintained continuously in axially slideable sealing contact entirely throughout the range. The overcap is adapted to have the lowermost surface thereof in effective contact with the outer surface of the cap shell top wall at some point within the sealing range, thus defining the lower limits thereof in the assembled unstrained closure. Because of this arrangement extraneous forces applied to the overcap are directly transmitted to the cap shell when the overcap is placed in its bottomed position.

While the specification concludes with claims particularly pointing out and distinctly claiming the subject matter which is regarded as forming the present invention, it is believed that the invention will be better understood from the following description taken in connection with the drawings in which:

FIGURE 1 is an exploded view in vertical section of one form of the cap of the present invention;

FIGURE 2 is a plan view of the insert of the closure of FIGURE 1;

FIGURE 3 is a vertical sectional view of the cap of FIGURE 1 assembled in an open position;

FIGURE 4 is a vertical section of the cap of FIGURE 1 in closed position;

FIGURE 5 is an exploded view in vertical section of another embodiment of the present invention;

FIGURE 6 is a vertical sectional view of the cap of FIGURE 5 assembled in an open position; and

FIGURE 7 is a vertical sectional view of the cap of FIGURE 5 in closed position.

Referring to the drawings, FIGURE 1 clearly shows the three pieces comprising one embodiment of the present invention. The cap shell **10** is quite similar to the normal form of threaded closure, having a cup-like shape with an internally threaded skirt **11** and a top wall **12**. Centrally located on the top wall **12** is an aperture **13** surrounded by a raised lip **13***a*. Cap shell **10** may preferably be constructed by injection molding of a medium impact polystyrene or of other like materials which are well adapted to give rigidity and strength in use.

Insert **14** is integrally molded from a resilient material, for example from a polymer such as medium density polyethylene. While the selecting of the exact material to be used will depend upon the nature of the product to which the insert will be exposed, any suitable chemically resistant resilient material possessing properties permitting elastic deformation comparable to that permitted by polyethylene would be acceptable. The lower portion of the insert **14** is in the form of a thin disc-like liner **15**. A hollow spout **16** projects from the central portion of the liner **15**, extending upwardly in a direction normal to the plane thereof. Passageway **17** passes through the liner and axially within the spout **16**, terminating at discharge ports **18** located in the distal end of the spout **16**.

As shown in FIGURE 2, a narrow wall **19** stretches diametrically across the distal end of passageway **17**, therewith forming the discharge ports **18** mentioned above. From the center of the wall **19** extends an integrally molded cylindrical plug **20** the purpose of which will hereinafter be made clear.

The exterior surface of the spout **16** comprises a multiplicity of surfaces of varying size and shape. At the lower end of the spout an undercut **21** is provided which has an outside diameter approximately identical with the diameter of the aperture **13** in the cap shell top wall **12**.

The width of the undercut **21** is substantially the same as the thickness of the top wall **12** along the side of the aperture **13**, thereby making it equal to the combined height of the top wall **12** and the raised lip **13***a*. Directly above the undercut **21** is a ring-like band **22** of material which is slightly greater in diameter than the undercut **21** (for example, about .006 inch larger when the undercut has a diameter of about three-eighths of an inch), thereby forming an annular shoulder **23** circumscribing the spout **16** and defining the upper limit of the undercut **21**. The central neck portion **24**, in the form of a cylindrical recess coaxial with the axis of the spout **16**, is located above the band **22**, being connected therewith by the frusto-conical wall **24***a*. At the top end of the central neck portion **24** the contour of the spout changes again, forming an annular wiping surface or wiper **25**, also appropriately connected with the central neck portion **24** by means of a frusto-conical surface **24***b*. The distal end of the spout is somewhat depressed, as illustrated at **25***a*, and the top side of the wiper **25** is rounded to thereby form the upwardly projecting bead **25***b*.

The overcap **26** is substantially bell-shaped, having a depending cylindrical sidewall **27** and a top wall **28**, the exterior surfaces of which merge into the outwardly flaring configuration shown at **28***a*. Axially oriented within the overcap **26** is a passageway **29** extending from the base of the sidewall **27** to the interior surface of the top wall **28** and in communication with a centrally located aperture **30** extending therethrough. The lowermost section of passageway **29** is in the form of a circular bore **31** having a diameter approximately equal to that of the band **22** of insert spout **16** so as to form a loose sliding fit therewith. An annular internally projecting rib **32** is located above the bore **31** and has an internal diameter which approximates that of the central neck portion **24** of the insert spout. Immediately above the rib **32** lies a recess **33** in the form of a coaxial cylindrical wall having an internal diameter about 5% smaller than the outside diameter of the annular wiping surface **25** of the insert spout when the wiper is about one-third of an inch in diameter, whereby a tight sliding seal may be obtained therebetween. A frusto-conical surface **34** interconnects the recess **33** and the aperture **30** in the top wall **28**. The aperture **30** has an inside diameter which is smaller than the outside diameter of the plug **20** by approximately 6% or so when the plug measures about one-sixth of an inch across, whereby a tight seal is obtained if the plug **20** is pressed into the aperture **30**. Overcap **26** is also desirably formed by injection molding of a material such as that of which the insert **14** is constructed, preferably a medium density polyethylene material.

The portions of the closure described above are assembled as shown in FIGURES 3 and 4. First, insert **14** is interlocked with the cap shell **10** by projecting the spout **16** through the aperture **13** from the interior of the cap shell **10**. The insert **14** is pressed upwardly, forcing the band **22** through the aperture so as to engage the undercut **21** within the aperture **13** sidewalls. Thus, the shoulder **23** will rest on top of the sharp edge located at the top of raised lip **13***a* of the cap shell, forming an interference fit therewith and preventing the withdrawal of the insert in the absence of the destruction of the material comprising the shoulder **23** and/or the raised lip **13***a*.

Next, the overcap **26** is telescoped over the protruding spout **16** of the interlocked cap shell **10** and insert **14**. In this connection, the rib **32** is forced by elastic deformation over the annular wiping surface **25** to rest within the confines of the central neck portion **24**, the wiper **25** then being in the recess **33** and the bore **31** contacting band **22**. When so assembled the overcap **26** may be moved axially up and down into the open and closed positions respectively shown in FIGURES 3 and 4. The three pairs of coacting sliding surfaces (i.e., band **22** and bore **31**, central neck portion **24** and rib **32**, and wiping surface **25** and recess **33**) lend stability to the sliding motion so that such motion is straight-line in nature.

In the open position illustrated in FIGURE 3, if the closure is affixed to the finish of a squeeze bottle and the package inverted and/or squeezed the product will flow through the passageway **17**, out the discharge ports **18** thereof, through the portion of the passageway **29** above a first seal formed by wiper **25** and recess **33** and out through aperture **30** of the overcap. Regardless of the relative vertical position in which the overcap is placed in the assembled closure, whether it is located upwardly in its open position or downwardly in its closed position, this first seal is continuously maintained. In its lowermost positions, however, a second seal is obtained by the wedging of the plug **20** into the smaller aperture **30** of the overcap **26**, providing a seal at the top of the passageway **29**. Therefore, in the lower positions of the overcap **26** the passageway **29** is sealed on each side of the discharge ports **18** of the spout **16**.

As will be noted from inspection of FIGURE 4, the lower surface **27***a* of the sidewall **27** is in contact with the top surface of top wall **12** of cap shell **10** in the fully closed position. It has been found essential in a three-piece structure of this type to have the overcap **26** in direct contact with the cap shell **10** at some point in the continuous sealing range existing between the insert **14** and overcap **26** wherein both first and second seals mentioned above are simultaneously effected. In order to accomplish this, the various portions of the overcap **26** and spout **16** must be dimensioned so that in the fully opened assembled closure, as shown in FIGURE 3, the distance from the tip of plug **20** to the aperture **30** is at least about 1/32 of an inch smaller than the height of lower surface **27***a* above the cap shell top wall **12**, and that this height, in turn, must be somewhat less than the distance between any portions of the overcap and spout which would cooperate to prevent downward movement of the cap relative to the spout. In the above described embodiment, the height of the lower surface **27***a* above the cap shell top wall **12** must therefore be less than the distance between the rib **32** and the frusto-conical surface **24***a* and also less than the distance separating the bead **25***b* of wiper **25** and the frusto-conical surface **34**. In connection with the amount by which the height of the lower surface **27***a* is exceeded by the latter mentioned distances, this difference must be larger than the amount of compression of the overcap **26** when subjected to extraneous forces typical of those expected in use. Thus, when the overcap **26** is pushed downwardly relative to the spout **16**, the plug **20** will enter the aperture prior to any contact between surface **27***a* and the top wall **12**, and there will be no axial interference between other portions of the telescoping parts prior to such contact or even after such contact when the overcap is subjected to a compressive load in the axial direction. By means of this structure, there is assurance that slight variations in the dimensions of the molded parts and/or molding tolerances will not change the necessary synchronism of the sealing of the closure with the "bottoming" of the overcap **26** on the cap shell **10**. As a result it will be recognized that any vertical force applied to the overcap **26** will be transmitted directly to the relatively rigid cap shell **10** and not affect the seals formed by means of the insert **14** or apply stresses thereto which could ultimately contribute to the development of stress cracks, fissures in the integrity of the element relied upon to seal the package.

FIGURES 5–7 illustrate a modification of the inventive concept described herein, like numerals referring to like parts throughout. In this embodiment the cap shell **10'** is identical to that previously described. The insert **14'** also comprises a liner **15'**, from which projects a spout

16'. A passageway 17' extends completely through the liner 15' and spout 16' in the central axial portion thereof, terminating in an open cylindrical mouth 34. The exterior surface of the spout 16' has an undercut 21', and a central neck portion 24' similar to those described above. Intervening the two is a bead 22a' having a diameter approximately .006 inch greater in diameter than the undercut 21', forming annular shoulder 23' defining the upper limit of the undercut. Above the central neck portion 24' is a generally frusto-conically shaped surface 35, the lower end of which has a larger diameter than that of the central neck portion 24' forming a rounded shoulder 35a. The upper end of surface 35 connects with cylindrical surface 36 which is provided with a rib 37 located approximately two-thirds of the height of the surface 36 above the lower end thereof.

The overcap unit 38 comprises an overcap 39, retainer strap 40 and a retaining ring 41, all of which are integrally molded from a resilient material such as, for example, low density polyethylene.

The retaining ring 41 has an aperture 42 therethrough of a diameter slightly smaller than that of central neck portion 24'. The lower part of ring 41 surrounding the aperture 42 is chamfered as at 42a so as to provide clearance for the bead 22a' and the raised lip 13a of the insert and cap shell respectively when assembly proceeds as described below.

The retainer strap 40 is preferably rectangular in cross-section and may, for example, have a width of approximately .100", a thickness of .05" and a length sufficient to form a semicircular configuration between the retaining ring 41 and overcap 39 in the assembled condition.

The overcap 39 has generally the same outer contour described above in connection with overcap 26. Depending from the inner surface of the top wall 43 of the overcap 39 is an annular cylindrical wall 44, the outer diameter of which is approximately 6% greater than the diameter of the cylindrical mouth 34 of insert 14'; when the latter dimension is about one-sixth of an inch. The lowermost surface of the cylindrical wall 44 is tapered inwardly so as to facilitate insertion of the wall 44 in the mouth 34 when the closure is applied. The hollow interior 45 provides dimensional stability in injection molding through more uniform cooling of the cylindrical wall 44.

The balance of the interior of the overcap comprises an annular recess 46 having an inside diameter approximately equal to the outside diameter of the rib 37 so as to form a loose sliding fit therewith, a cylindrical band 47 of about the same diameter as the surface 36 on the spout 16', and a tapered lead-in surface 48 to facilitate the application of the overcap in use.

The assembly of the three parts comprising the embodiment of FIGURES 5 through 7 proceeds as follows. The insert 14' is interlocked with the cap shell 10' in substantially the same manner described above in connection with the embodiment of FIGURES 1–4. Then the retaining ring 41 of the overcap unit 38 is telescoped over the spout 16', being forced past the surface 35 and shoulder 35a to become interlocked with the insert 14' on the central neck portion 24' thereof. The assembly thus far described results in the structure shown in FIGURE 6. This is the condition in which the closure would be placed when used for dispensing.

In order to seal the closure, the flexible retainer strap 40 is bent into the semicircular shape shown in FIGURE 7 as the overcap 39 is telescoped in place over the spout 16'. The cylindrical wall 44 is forced within the cylindrical mouth 34, providing a tight plug-type seal. Then, as the overcap 39 is pressed further downwardly, the cylindrical band 47 is forced over the rib 37, which enters the recess 46. The slight interfering fit between rib 37 and band 47 retains the overcap in place and prevents accidental dislodgement thereof. It will be realized that the plug-type seal will be effective during a finite continuous range of all relatively positions of the overcap 39 and spout 16', so long as the wall 44 remains within the confines of the mouth 34.

Here, again, is shown a device having coacting sealing means thereon adapted to give a tight seal within a finite continuous range of sealing positions. As pointed out above in connection with the previously described embodiment, in the lowermost position of the overcap 39 the lower surface 27a' will be able to transmit force directly to the upper surface of the cap shell top wall. This is done by effective contact of the two surfaces through the medium of the material comprising the retaining ring 41 which lies flat on the cap shell top wall and directly contacts the surface 27a. It will also be noted that the direct contact of these surfaces occurs at some point within the finite continuous sealing range mentioned above. Here, in similarity with the first embodiment, the dimensions of the elements comprising the overcap 39 and the nozzle 16' must be such to prevent substantial axial interference during the continuous range of effectiveness of the plug type seal following the snapping of the band 46 over the rib 37 and prior to the "bottoming" of the overcap on the cap shell 10'.

Many modifications of the above invention may be used and it is not intended to hereby limit it to the particular embodiments shown or described. The terms used in describing the invention are used in their descriptive sense and not as terms of limitation, it being intended that all equivalents thereof be included in the scope of the appended claims.

What is claimed is:

1. A three-piece closure for a container, said closure comprising:

(A) a substantially rigid cap shell having a top wall with an aperture therein and a sidewall with means thereon for fastening the closure to said container;

(B) a resilient insert placed in said cap shell, said insert having a liner portion substantially coextensive with the interior surface of said cap shell top wall and being provided with a hollow spout extending upwardly, protruding through the aperture in the cap shell top wall, said spout having means incorporated thereon for interlocking with complementary means on said cap shell to thereby secure said liner to said cap shell, said spout having a discharge port at its distal end and an axially outwardly extending plug attached thereto;

(C) an overcap telescoped over and enclosing said spout in relatively axially slideable engagement, the overcap having a top wall and a depending side wall and being movable outwardly to a dispensing position and inwardly to a sealed condition, a centrally located aperture in the top wall of said overcap adapted to receive said plug and having a transverse dimension slightly smaller than that of said plug whereby said plug enters and tightly seals said aperture in any position within a finite continuous range of spout sealing positions;

(D) said overcap and spout being dimensioned so that at any point in the dispensing position the distance from the top of the plug to the aperture in the overcap is less than the height of the lowermost surface of the overcap above the cap shell top wall, which in turn is less than the distance between any other portions of the telescoped overcap and spout which would cooperate to prevent downward movement of the cap relative to the spout, whereby said overcap at some point within the said range has the lowermost surface thereof in contact with the outer surface of the cap shell top wall and at said point no substantial axial interference is present between said overcap and said spout so that external forces applied to said overcap are transmitted in substantially their entirety directly to said cap shell.

2. A three-piece closure for a container, said closure comprising:

(A) a substantially rigid cap shell having a top wall with an aperture therein and a sidewall with means thereon for fastening the closure to said container;

(B) a resilient insert placed in said cap shell, said insert having a liner portion substantially coextensive with the interior surface of said cap shell top wall and being provided with a hollow spout extending upwardly, protruding through the aperture in the cap shell top wall, said spout having means incorporated thereon for interlocking with complementary means on said cap shell to thereby secure said liner to said cap shell, said spout having an annular wiper circumscribing the distal end thereof, an axially outwardly extending plug attached thereto and a discharge port intermediate said plug and said wiper;

(C) an overcap telescope over and enclosing said spout in relatively axially slideable engagement, the overcap having a top wall and a depending side wall and being movable outwardly to a dispensing position and inwardly to a sealed condition, a centrally located aperture in the top wall of said overcap adapted to receive said plug and having a transverse dimension slightly smaller than that of said plug whereby said plug enters and tightly seals said aperture in any position within a finite continuous range of spout sealing positions, an axial passageway extending within said overcap sidewall from the lowermost surface thereof to the overcap top wall and in communication with said aperture, a portion of said passageway having a diameter slightly smaller than said wiper to provide an axially slideable sealing contact therebetween in the dispensing position and in the sealed condition;

(D) said overcap and spout being dimensioned so that at any point in the dispensing position the distance from the top of the plug to the aperture in the overcap is less than the height of the said lowermost surface of the overcap above the cap shell top wall, which in turn is less than the distance from the wiper to corresponding parts of the inner surface of said top wall of said overcap and less than the distance between any other portions of the telescoped overcap and spout which would cooperate to prevent downward movement of the cap relative to the spout, whereby said overcap at some point within the said range has the lowermost surface thereof in contact with the outer surface of the cap shell top wall and at said point no substantial axial interference is present between said overcap and said spout so that external forces applied to said overcap are transmitted in substantially their entirety directly to said cap shell.

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