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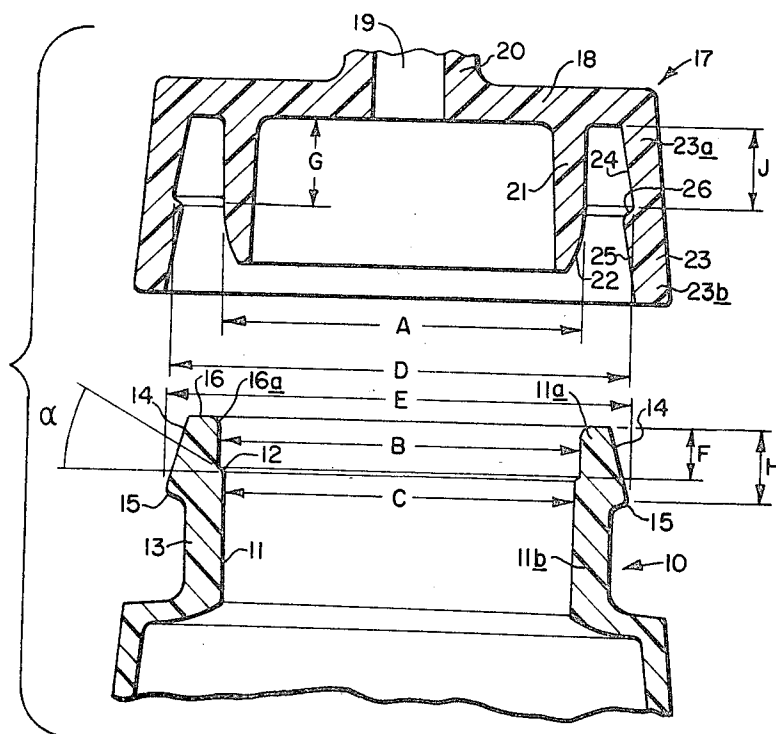
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[54] **PLASTIC CONTAINER AND CLOSURE**
9 Claims, 6 Drawing Figs.

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[51] Int. Cl. B65d 41/22,
B65d 1/02
[50] Field of Search. 215/41, 40,
43, 31; 220/60; 150/5

[56] **References Cited**
UNITED STATES PATENTS
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ABSTRACT: A container and a plastic closure therefor which provides an essentially leakproof seal. The container has an opening surrounded by a continuous sidewall defining a cylindrical neck opening at its outer end. The cylindrical opening defined by the sidewall is provided with an annular band of increased diameter adjacent its upper end. In the preferred form a closure cap for the container neck is provided which has an integrally formed, depending outer skirt providing a retention groove on the interior surface thereof. The closure cap is provided with an inner, coaxial, depending annular skirt attached to the underside of the top of the cap and spaced inwardly from the outer skirt. The inner skirt is of generally annular configuration, has a diameter slightly larger than the maximum diameter of the cylindrical neck opening and is of sufficient resiliency to conform to the interior wall of the continuous sidewall of the container neck. When the cap is snapped onto the container neck, the inner skirt is squeezed into the cylindrical opening defined by the inner sidewall of the neck and conforms to the shape of the stepped opening to control compressive engagement thereby providing a substantially leakproof closure.



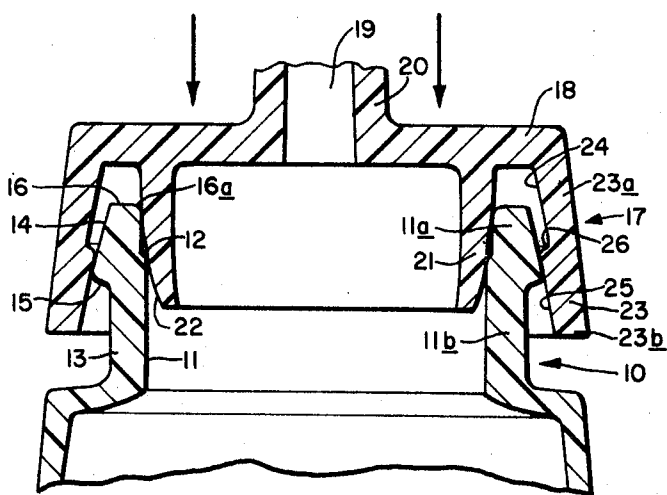
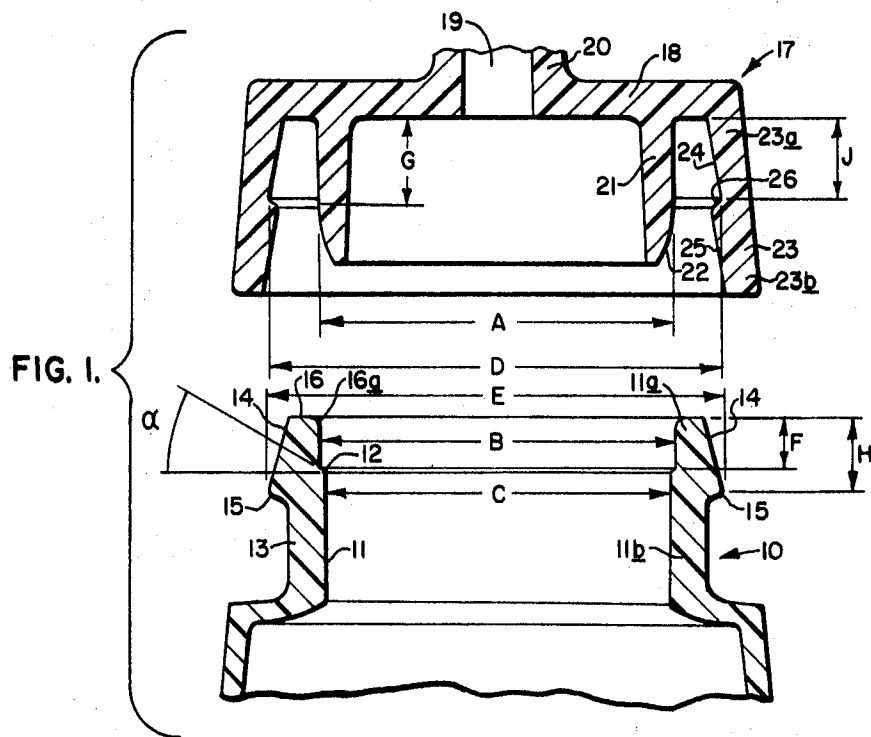


FIG. 2.

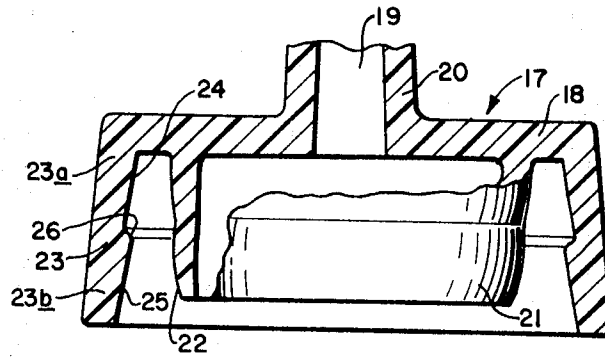


FIG. 5.

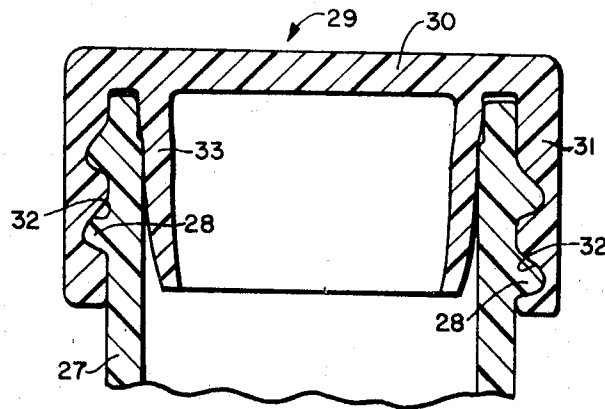


FIG. 6.

PLASTIC CONTAINER AND CLOSURE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a container and a plastic closure therefor providing closure orientation, if desirable, and a substantially leakproof seal.

2. Description of the Prior Art

Plastic closures have been used for small containers for some time. Friction-fit, plastic, plug-type closures are commonly used for dispensing creams, lotions and detergents. Common snap-on and screw-type plastic closures are used for a wide variety of products packaged in both glass and plastic containers. One problem encountered with molded plastic caps and closures has been the tendency of the closures to leak because of the resiliency of the plastic when used on liquid-packaging containers, especially with products which generate high vapor pressure such as detergents or peroxides and products with high capillary action such as oils or inks. A normal relaxation of the plastic oftentimes results in a loosening of the closure, particularly on a screw-top container and subsequent leakage of the product occurs. Friction-fit plugs for plastic containers have been prone to leak because of the difficulty of maintaining a tight interference fit between the plug and the neck of the container.

A number of plastic closures have been developed which utilize depending internal rings, annular skirts, etc. attached to the underside of the closure top - see U.S. Pat. Nos. 3,074,579 ; 3,107,022 ; 3,255,907 . The closures disclosed in these patents overcome some of the objections to molded plastic caps. However, the limited area of contact provided by their rings, skirts, etc. with the top edge of the container neck or the interior sidewall of the neck does not, in itself, insure that leakage will not be caused by product-induced internal pressure, product capillarity and/or torque loss due to relaxation of the threaded skirt or the plastic cap.

The present invention has particular application in the area of snap-on, nonthreaded closures that are, in the preferred embodiment, substantially nonremovable, and more specifically, those that feature snap-tip, or reclosable dispensing orifices. Heretofore, no satisfactory closure of this type that is substantially leakproof for all types of products has been developed. The success that has been achieved in the subject invention is due to the fact that the degree of dimensional interference designed into the cooperating areas of bottle and closure is considerably greater than would be practical for a threaded, or substantially removable, closure system. It is the combination of this greater compressive engagement and the internal stepped configuration of the bottle neck section that causes the closure plug section to conform to said stepped area which, in turn, effects and maintains the desired seal. Certainly, as with most thermoplastic components that are assembled under compression, there is a degree of relaxation of this engagement; however, unlike prior attempts with systems not embodying the subject invention, this relaxation occurs with no detectable decrease in the effectiveness and/or permanency of the seal.

The advantages of the closure system of the present invention over the conventional screw-on type are several. First, the plastic bottle is generally considered to be primarily a one-time use package. The application of a substantially non-removable closure, therefore, discourages the refilling of the container with an alternate product which, in conceivable instances could constitute a danger to the user. This fact alone should appeal to most packagers.

Second, orientation of the closure with the bottle, when required, is accomplished easily and accurately with this type system by simply either positioning the cap in the proper location and assembling straight down, or by first assembling the closure and subsequently rotating it to the desired position. The accuracy of orientation of a threaded closure system can be maintained only as closely as the relationship of the

threaded section of the closure and the threaded neck of the bottle can be controlled. These sections of both bottle and closure are subject to commercially allowable tolerances both in the tooling and in the actual production of the components and, as a result, it is virtually impossible to maintain a desired orientation to within less than plus or minus 20° at a given application torque.

Third, the costs for molds or tooling to produce the snap-on type closure are somewhat lower than those required to produce threaded closures of comparable design. This, in some instances, applies also to the neck inserts for the bottle molds. Also the costs for producing snap-on closures are generally lower than those for producing threaded closures because of the greater simplicity of the molds and the correspondingly faster production cycles possible. These factors add up to an economic advantage for the present invention that is generally attractive to potential users.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a container and a closure therefor which provides an essentially leakproof seal.

It is another object of the present invention to provide a one-piece plastic closure for a container which sealingly contacts two relatively large areas of the interior sidewall of the container neck creating differential compressive engagement in a specific pattern to seal the opening therein.

Another object of the present invention is to provide a snap-on plastic spout-type closure for a container which may be readily assembled with normal application pressure and oriented or rotated to any desired position, while still maintaining a leakproof closure.

It is still another object of the present invention to provide a screw-type plastic closure for a container which can be readily sealed by a normal amount of torque and still readily removed by a consumer to provide easy access to the container while still maintaining a leakproof closure.

The foregoing and additional objects are realized in a container and a closure therefor wherein the container has a uniform, continuous sidewall surrounding and defining an opening provided in the container with the opening having an increased diameter adjacent the outer end of the sidewall. A plastic cap is provided with a top portion having attached thereto a first flexible, uniform, continuous skirt matching at least a portion of the contour of the continuous sidewall of the container. The first skirt has an outside diameter slightly larger than the maximum diameter of the opening in the container, whereby the first skirt will conform to the shape of the continuous sidewall of the neck opening in the container when inserted in the opening to provide a substantially leakproof seal.

BRIEF DESCRIPTION OF THE DRAWINGS

Exemplary embodiments of the invention are shown in the accompanying drawings in which:

FIG. 1 is an elevational, sectional view of the neck of a container and a closure cap therefor embodying the present invention with the cap separated from the container;

FIG. 2 is an elevational, sectional view of the container and cap of FIG. 1 showing the cap being pressed onto the container;

FIG. 3 is an elevational, sectional view of the container and cap of FIG. 1 with the cap in the final locked position on the container;

FIG. 4 is an enlarged, elevational, sectional view of a portion of the cap and container of FIG. 3;

FIG. 5 is an elevational, sectional view of the cap after removal from the container; and

FIG. 6 is an elevational, sectional view of a container having a threaded neck and a cap having matching threads.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As seen in FIGURES 1—3, the neck, designated generally by the numeral 10, of a container (not shown) is generally cylindrical in shape and has a vertical interior sidewall 11. The upper portion 11a of the neck is shown as having an inside diameter designated B and may be formed by counterboring the neck to a depth F. This diameter is slightly larger than the inside diameter C of the lower portion 11b of the neck. As more clearly seen in FIG. 4, the increased diameter upper portion 11a of the neck merges into the decreased diameter portion 11b of the neck by means of an inclined shoulder 12. The inclined shoulder as seen in FIGURES 1 and 4 is inclined at an angle α from the radial axis of the container.

The exterior sidewall 13 of the neck is vertical over the major part of the lower portion 11b of the neck and has an inwardly converging, inclined sidewall surface 14 over the major part of the upper portion 11a of the neck. The sidewall surface 14 has a height H. The inclined surface 14 merges at its lower end into the vertical portion of the exterior sidewall 13 by means of a downwardly facing, slightly radiused shoulder 15. The neck has an outside diameter E at the shoulder 15. The top surface 16 of the upper portion 11a of the neck is generally flat and has a slightly radiused surface 16a where it joins the enlarged diameter portion of the inner wall of the upper neck portion 11a.

As seen in FIGS. 1—3, a snap-on closure cap, designated generally by the numeral 17, is provided with a top wall 18. An axial opening 19 is defined by a spout 20, only a part of which is shown, that is attached to the upper surface of the top wall 18 of the cap. A flexible inner or corking skirt 21 is attached to the underside of the top wall of the cap and projects downwardly therefrom. In the form illustrated in FIGURES 1—5, the inner skirt 21 is generally cylindrical with an outside diameter A and has vertical interior and exterior sidewalls. The lower end of the inner skirt 21 is preferably provided with a radiused surface 22 to permit insertion of the inner skirt 21 into the neck opening of the container. The vertical portion of the exterior sidewall of the skirt 21 has a height G. The closure cap is provided with a flexible outer, or snap-on, skirt 23 which depends from the periphery of the top wall 18. The outer skirt is concentric with and spaced outwardly from the inner skirt 21. The upper portion 23a of the outer skirt 23 has an inwardly converging, inclined interior sidewall surface 24 having approximately the same slope as does the inclined surface 14 on the upper portion 11a of the neck 11. The sidewall surface 24 has a height of J. The lower portion 23b of the outer skirt 23 also has an inwardly converging, inclined interior sidewall surface 25. The two interior sidewall surfaces are joined by means of an upwardly facing shoulder 26. The shoulder 26 is preferably slightly radiused. The outer skirt has an inside diameter D at the location of the shoulder 26.

In the embodiment of the invention shown in FIGURE 6, the container neck 27 is provided with helical threads 28. A screw-on closure cap 29 has a top wall 30 and a skirt 31 depending from the periphery thereof. The skirt is provided with helical grooves 32 in the interior sidewall that mate with the threads 28 on the neck of the container. The upper portion of the neck is counterbored to provide an upper portion having a slightly larger inside diameter than does the lower portion of the neck, in the same manner as described hereinbefore regarding the embodiment shown in FIGS. 1—5. The screw-on cap has an inner, or corking, skirt 33 of a shape similar to that of the snap-on cap and functions in a similar manner.

The cooperation between the closure cap and the neck of the container of the present invention will now be described with particular reference to FIG. 1. The inner or corking skirt 21 diameter A is designed to be a nominal interference fit in neck counterbore diameter B. Nominal interference being established ideally as from about 0.008 inch to about 0.014 inch total interference. Neck orifice diameter C is preferably bored to 0.010 inch to 0.020 inch smaller than counterbore diameter B. The transition from diameter B to diameter C may

be in any form from a 90° shoulder to a double blending radii. The optimum transition configuration is approximately 30° for the angle α as shown in FIGS. 1 and 4.

The neck counterbore depth F should be from about 0.065 inch to about 0.100 inch with the optimum at approximately 0.085 inch. The length of the straight portion of the closure-corking section, indicated as G, is made to a minimum of 1.5 times the counterbore depth F. This is to provide an adequate length of substantially greater interference fit below the shoulder in the container neck. The differential interference causes deformation of the skirt 21 to occur, thereby effecting the primary seal. The 0.065-inch to 0.100-inch limits for the container counterbore F were selected because if the depth were less than 0.065 inch, the primary seal would be adversely affected by the virtual rigidity of the corking section at its juncture with the top wall, and, conversely, if this depth were greater than 0.100 inch, too much of this rigidity, or resistance to collapse, would be forfeited.

The inside diameter D of the closure 17 at the shoulder 26 is designed to be a minimum of 0.005 inch smaller than the neck shoulder 15 diameter E, thus providing for external interference in addition to that internally of the container neck. At assembly, this external interference is increased even beyond that designed into it by virtue of the partial collapse of the corking section of the closure as it is driven into the container opening. These external and internal compressive engagements combine to render the closure substantially nonremovable after assembly.

It will be noted that the height H of neck surface 14 and the height J of cap surface 24 are such that clearance is maintained between the top surface 16 of the container neck and the inside of the top wall 18 of the closure. This clearance is provided to assure that the closure retention shoulder 26 will be free to snap over and recover under the neck shoulder 15 completely for substantially nonremovable retention as seen in FIG. 3.

It is to be understood that any and all dimensional ranges or limits specified above are established as preferred ranges or limits only and are not to be construed as limits beyond which the principle herein embodied ceases to be functional or effective.

To apply the snap-on closure cap 17 to the container neck 10, a uniform force is applied in the direction of the arrows to the top wall 18 of the cap as seen in FIG. 2. The radiused surfaces 16a and 22 on the top interior corner of the neck and the lower outer surface of the corking skirt 21 permit the cap to be pushed a considerable distance over the upper portion 11a of the neck before the friction increases appreciably. Additionally, the increased diameter B counterbore provided in the upper portion of the neck permits the corking skirt 21 to extend appreciably into the neck opening before frictional engagement of the skirt by shoulder 12 occurs. Increased pressure causes the outer cap skirt 23 to flex outwardly to permit the upwardly facing shoulder 26 on the cap to snap over and engage firmly with the downwardly facing shoulder 15 on the neck. As seen in FIGS. 3 and 4, the shoulder 12 on the inner wall 11 of the neck causes a noticeable deformation of the outer wall of the corking skirt 21 at the point of contact. This point of contact between the neck and cap, and the contacting area immediately below, are primarily responsible for the very tight seal developed in the closure system of the present invention.

FIG. 5 shows a cross section of a closure, with a partial broken full section of the corking skirt 21, that has been forcibly removed from the container. It will be observed that, although the closure is made of a plastic viscoelastic material, the corking skirt returns only partially to its original configuration, indicating that the resulting deformation is to a degree permanent which appears to indicate that a degree of molecular realignment in the area at which the greatest stress has been induced is effected by the engagement. In the subject invention this area of greatest stress is at and immediately adjacent to the circular, inwardly extending shoulder 15 on the

inner wall of the neck opening. Further, while the effects of this phenomenon are most readily discernible on the outer wall of the closure corking skirt after removal from the container, it is altogether feasible to conclude that molecular realignment occurs as well, but probably to a lesser degree, in the area adjacent the shoulder 12 of the container neck.

In one exemplary container and snap-on closure constructed in accordance with the present invention, the container was made of high-density polyethylene. The container had an elliptical cross section and had a normal fluid capacity of about 16 ounces. The lower portion of the neck had an inside diameter C of 0.859 inch and the upper portion had an inside diameter B of 0.877 inch. The height F of the counter-bored portion of the neck was 0.080 inch. Radiused surface 16a had a radius of 0.03 inch. The inclined surface 14 on the exterior of the neck had a total height H of 0.125 and was inclined at an angle of 20° to the axis of the container. The shoulder 12 on the interior wall of the neck had a width of 0.009 inch and was radiused at 0.016 inch. The outside diameter E at the neck shoulder 15 was 1.044 inches.

The snap-on cap 17 was made from medium-density polyethylene. The outer or snap-on skirt had an inside diameter D of 1.034 inches adjacent the shoulder 26. The inner or corking skirt 21 had an outside diameter A of 0.887 inch. The inwardly inclined, upper interior sidewall surface 24 had a height J of 0.135 inch and was inwardly inclined at an angle of 10°. The angle α of the shoulder 26 was 45°. The inclined interior surface 25 of the lower portion 23b of the skirt 23 was 0.120-inch high and was inwardly inclined at an angle of 30°. The corking skirt 21 was 0.225 -inch high, 0.087-inch thick and had a 0.094-inch radiused surface 22 at its lower end. The outer skirt 23 had a height of 0.345 inch to the underside of the top wall 18. The spout 20 was provided with a snip-off tip (not shown) adapted to be closed by a small friction fit tip cap (not shown) which was attached to the snap-on cap by an integrally formed strap (not shown).

Three of the above-described containers were filled with a vegetable oil product and each was closed with a snap-on closure as described above. Container 1 was inverted and stored for 70 days at ambient temperature. Container 2 was inverted and stored for 20 days at 50° F. Container 3 was inverted and stored for 7 days at 120° F. Careful inspection of each container after the storage period did not detect any trace of leakage of the vegetable oil from the container. The test of Container 1 simulated normal temperature storage of boxed vegetable oil containers stored in the inverted position. Container 2 and 3 tests simulated similar type inverted storage, but a high-and-low-temperature extremes which might possibly be encountered in warehouse or store stock storage.

Thus it can be seen that the present invention provides maximum attainable sealing engagement between the interface of two bodies, such as the internal surface of a neck opening provided in a container and the outer surface of an internally extending skirt of a closure cap provided for sealing product within the container. Normal practice has been to provoke interference between mating parts in order to induce stress forces on the interface by means of strain between materials capable of elastic deformation.

The present invention provides differential compressive engagement on the interface of two bodies and a functional void by means of a step between the differential compressive forces to permit positive stress equalization.

The present invention also provides for alteration of internal stress of a plastic viscoelastic body by application of external forces. Stress tends to concentrate at the junction of two sections. Applied differential compressive engagement at such junction induces stress on individual particles of a body and tends to align such particles in the direction of the stress with increasing density. As density increases the resulting molecular entanglements act as knots to prevent molecular slippage in the shoulder area at the junction of maximum stress.

The introduction of additional force obtained from induced stresses between parts in compressive engagement raises the

total applied force available for sealing beyond normal attainable limits.

As mentioned previously, any suitable plastic material may be used for fabricating the caps 17 and 29; however, medium-density polyethylene has been found quite satisfactory. The container may be made of any suitable material such as plastic, metal or glass; however, for the most effective seal, it is preferred that the container be made of a thermoplastic material such as high-density polyethylene. The cap may be provided with any suitable dispensing means, for example, a spout which may be initially open at its outer end and be equipped with a small screw-on or snap-on type cap. Alternatively, the end of the spout may be closed and designed to be snipped off by the consumer.

While there has been described what is at present considered preferred embodiments of the present invention, it will be apparent to those skilled in the art that various modifications and changes may be made without departing from the essence of the invention. It is intended to cover herein all such modifications and changes that come within the true scope and spirit of the claims.

What I claim is:

1. In a container and closure therefor, the combination comprising: a container having a continuous sidewall surrounding and defining a neck opening provided in said container; said sidewall having an inner wall which includes an upper vertical section and a lower vertical section joined by a narrow shoulder section, said upper vertical section defining a neck opening of increased diameter compared to the neck opening defined by said lower vertical section; a plastic cap with a top portion having depending from the underside a first flexible wall, generally cylindrical skirt, said skirt having an outside diameter larger than the maximum diameter of said neck opening whereby said first skirt makes an interference fit with said inner wall of said sidewall in the area adjacent said shoulder section when said first skirt is received in said neck opening; and cooperating means on said neck and said cap to retain said cap on said container neck.

2. The combination of claim 1 wherein said sidewall defining said neck opening in said container is an outwardly extending cylindrical neck, and said cap includes a second annular skirt attached to and depending from the periphery of the top portion of said cap, and said second skirt being spaced outwardly from and being concentric with said first skirt.

3. The combination of claim 2 wherein said neck is provided with helical threads on the outer surface and said second skirt is provided with matching grooves on its interior sidewall to receive said threads.

4. The combination of claim 2 wherein said first skirt is shorter than said second skirt and said neck is provided with an upper portion adapted to be frictionally engaged between said first skirt and said second skirt.

5. The combination of claim 4 wherein said shoulder section is upwardly facing and the outer wall of said upper portion of said neck is provided with a downwardly facing shoulder.

6. The combination of claim 5 wherein the inner wall of said second skirt is provided with an upwardly facing shoulder adapted to make frictional engagement with said downwardly facing shoulder on said outer wall of said upper portion of said neck.

7. The combination of claim 6 wherein the maximum outside diameter of said neck occurs at said downwardly facing shoulder which diameter is slightly greater than the maximum inside diameter of said upper portion of said second skirt immediately adjacent to said upwardly facing shoulder.

8. The combination of claim 7 wherein the outer surface of said upper portion of said neck is inwardly inclined and the corresponding inner upper surface of said second skirt is inwardly inclined but at a slightly lesser angle than said outer surface of said neck.

9. In a container and closure therefor, the combination comprising: a generally annular-shaped neck on said container extending outwardly from and defining a neck opening in said

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container, said neck opening immediately adjacent its upper end having a slightly larger diameter than the diameter of said neck opening therebelow to define an upwardly facing shoulder at the point of merger; a closure cap received on said neck, said cap including, a top wall having a dispensing opening therein, an inner depending annular skirt attached to the underside of said top wall, said inner skirt having an outside diameter slightly greater than the maximum diameter of said neck opening whereby said shoulder sealingly engages the outside wall of said inner skirt, an outwardly spaced, coaxial,

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outer flexible skirt attached to the periphery of said top wall, said outer skirt having an upwardly facing shoulder on the inner wall thereof and an inside diameter at this shoulder slightly smaller than the diameter of said neck at said upwardly facing shoulder whereby when said cap is forced onto said neck said inner skirt makes an interference fit with at least a part of the interior wall of said neck portion and said upwardly facing shoulder and said downwardly facing shoulder engage to hold said closure cap tightly on said neck.

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