United States Patent [19]

Schultz

[11] **3,926,349**

[45] **Dec. 16, 1975**

[54] **VALVE CONSTRUCTION FOR A PRESSURE OPERATED CONTAINER**

[76] Inventor: **Robert S. Schultz,** 7 Heusted Drive, Old Greenwich, Conn. 06870

[22] Filed: **Mar. 28, 1974**

[21] Appl. No.: **455,892**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 290,977, Sept. 21, 1972, Pat. No. 3,827,607, which is a continuation-in-part of Ser. No. 175,253, Aug. 26, 1971, abandoned.

[52] **U.S. Cl.** **222/402.22;** 222/545

[51] **Int. Cl.²** **B65D 83/14**

[58] **Field of Search** ..... 85/1 L; 222/545, 402.1, 222/402.20, 402.22, 402.24, 402.21, 402.23

[56] **References Cited**

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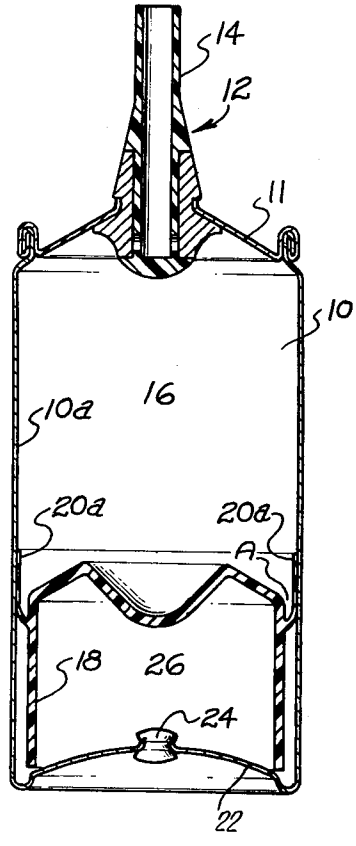
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Primary Examiner—Stanley H. Tollberg
Assistant Examiner—Hadd Lane
Attorney, Agent, or Firm—Hopgood, Calimafde, Kalil, Blaustein & Lieberman

[57] **ABSTRACT**

The invention contemplates valve structure for a pressurized container, for selective dispensing of viscous foods or other products. The valve parts per se coact with a supporting formation in the container, such that pressure within the container always develops seal-enhancing engagements both to the container and to a valve member, as long as product remains to be dispensed. The invention also lends itself to combination with a selectively removable protection screw cap, in such manner that both seal engagements are further enhanced by cap application.

16 Claims, 7 Drawing Figures



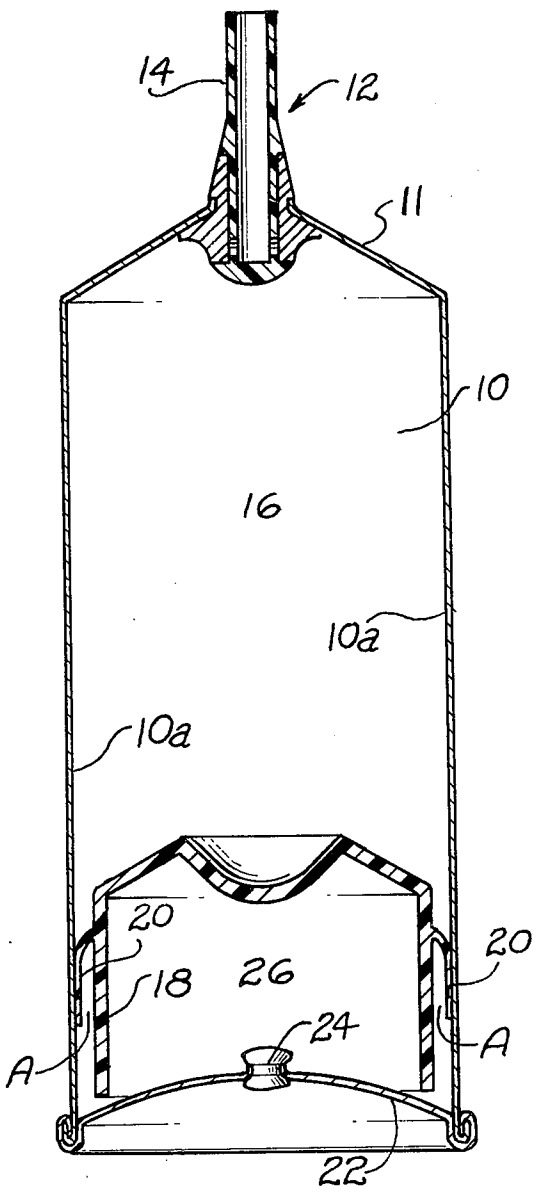

14
12
11
10
16
10a
10a
20
18
26
20
24
A
A
22

FIG. 1

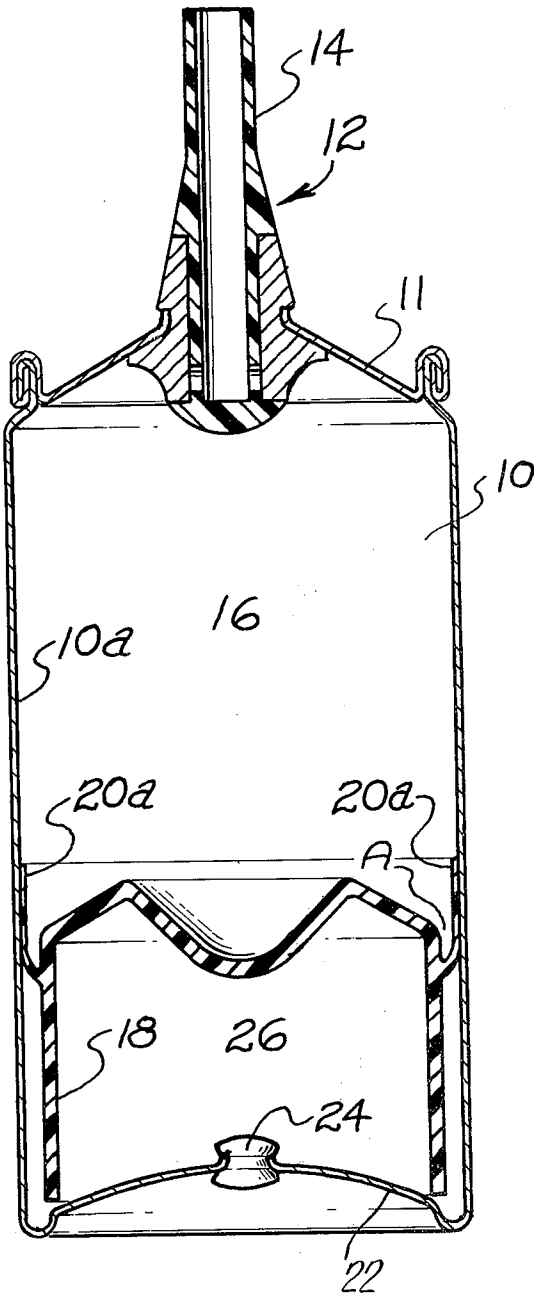

14
12
11
10
16
10a
20a
20a
A
18
26
24
22

FIG. 2

FIG. 3

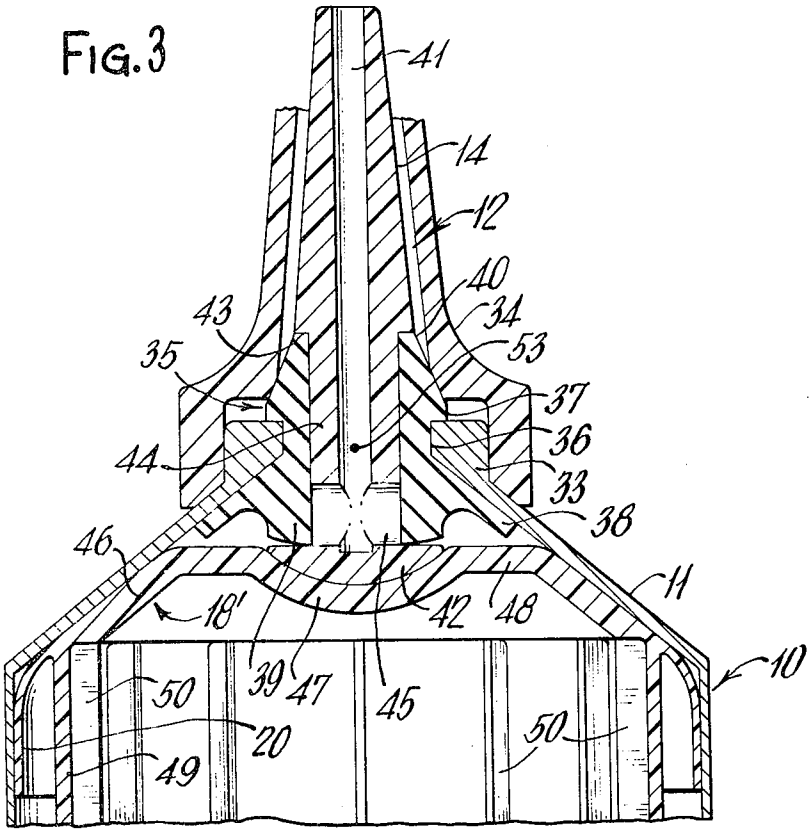


FIG. 4

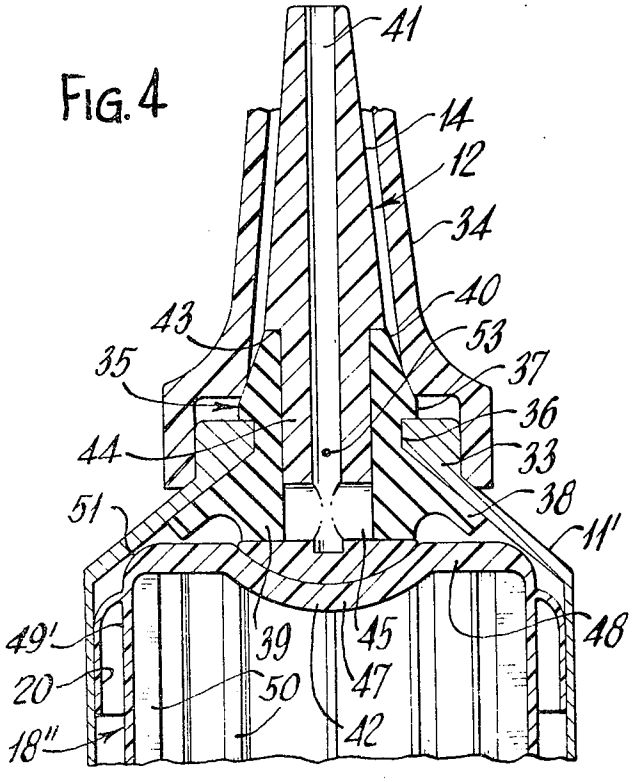


FIG. 5

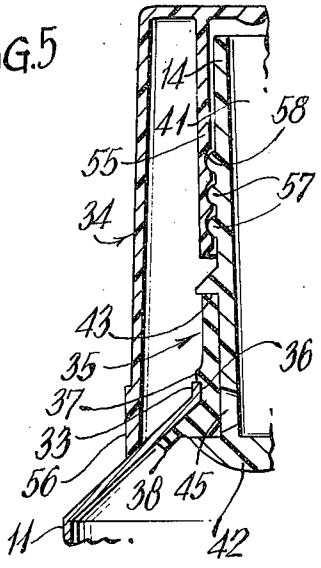


FIG. 6

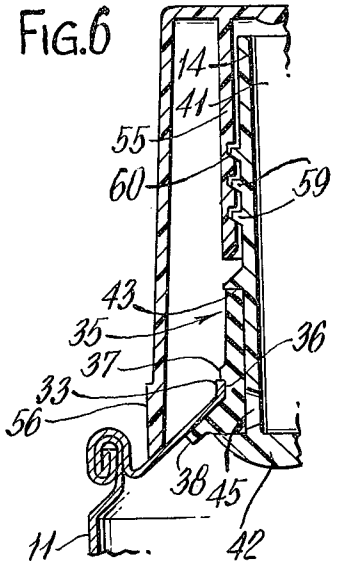
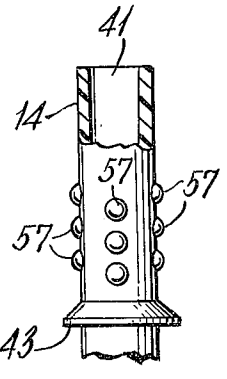


FIG. 7



VALVE CONSTRUCTION FOR A PRESSURE OPERATED CONTAINER

This application is a continuation-in-part of my co-pending application Ser. No. 290,977, filed Sept. 21, 1972, now U.S. Pat. No. 3,827,607, of Aug. 6, 1974, which copending application is a continuation-in-part of my now-abandoned parent application Ser. No. 175,253, filed Aug. 26, 1971.

The present invention relates to valve and seal aspects of a pressure packaging system for viscous products, whereby the system is characterized by improved operation.

It is an object of the invention to provide smoother discharge flow, more precisely controlled valve action, and inherently greater capacity in a given size container of the character indicated.

A specific object is to produce an improved valve and container construction of the character indicated, wherein pressure in the container inherently enhances valve-seal effectiveness both to the container and to a manipulable dispensing-valve member.

A further specific object is to provide such a valve construction with a selectively removable protective screw cap in such manner that placement of the cap inherently enhances valve-seal effectiveness both to the container and to the valve member.

A general object is to achieve the foregoing objects with a structure which inherently simplifies container assembly, which enables smooth and reliable operation, and which also ensures against product-seepage in the valve-closed condition of the valving region.

Other objects and various further features of novelty and invention will be pointed out or will occur to those skilled in the art from a reading of the following specification, in conjunction with the accompanying drawings. In said drawings:

FIG. **1** is a longitudinal sectional view of a pressurized container and valve of the invention;

FIG. **2** is a view similar to FIG. **1** to illustrate a further embodiment of the invention;

FIGS. **3** and **4** are similar enlarged fragmentary sectional views of the FIG. **1** combination, to show detail of the relation of parts for the uppermost position of the piston, in application to larger (FIG. **3**) and smaller (FIG. **4**) container bore sizes;

FIGS. **5** and **6** are similar enlarged fragmentary sectional views to show modifications; and

FIG. **7** is a fragmentary view in elevation, partly broken-away and in section, to show detail of the stem portion of the valve member of FIG. **5.**

Referring to FIG. **1,** a pressurized container or can **10** is formed with an integral conical top-end wall **11** and provided with a valve, referred to generally by the reference number **12.** The valve **12** is of the variety in which a valve stem **14** is pressed laterally in a well-known manner in order to release the valve seal and permit the viscous product **16,** which is at super-atmospheric pressure, to be expelled to the atmosphere. A generally tubular hollow piston **18,** which may be constituted of a low-density polyethylene or a polypropylene material, is used to drive product **16** through the dispensing valve **12.** Secured to or integral with the piston **18** is a relatively thin annular-shaped flange **20** provided with a depending skirt portion. In fact, the thickness of the flange **20** is less than half the thickness of the wall of tubular piston **18.** In this regard, the thickness of the flange **20** is in the order of 0.005 to 0.015 inches. Moreover, the flange **20** is provided with a large surface area for dependable but light sealing contact with the inner wall **10***a* of the container **10.**

The container **10** is closed by a bottom wall **22** having a central opening having a sealing grommet **24** through which a gas **26,** such as nitrogen, is introduced after the viscous product **16** and the piston **18** are inserted into the container. The gas **26** presses against the interior surfaces of the top of piston **18** as well as in the space A, beneath flange **20** and between the outer vertical walls of the piston and the inner wall **10***a* of the container **10.** It will be apparent that the pressure of the gas **26** present in the space A will force the thin resilient flange **20** into light sealing contact with the inner wall **10***a* of the container **10.**

It will be noted that the space A, which permits the easy loading and operation of piston **18** in container **10,** functions to provide room for the lateral expansion of the piston **18** especially when oily-type or flavored products are loaded in the container, and the piston expands due to the absorption of oils from the product. In that event, the resilient flange **20** is even further flattened against the inner wall **10***a* of the container **10;** however, the light sealing pressure created by the resilient flange continues to seal the propellant from the product, but permits the piston **18** and associated structure to move smoothly in the container **10.** The nature of the thin resilient flange **20** is to flex in and out of any indentations and over any projections or other imperfections that might be present on the interior wall surfaces of the pressurized container.

FIG. **2** shows a modification in which like parts bear the same reference numerals as applied to the structure of FIG. **1.** FIG. **2** depicts container **10** to be of the type which is loaded with the product from the top of the container; the bottom and sides of the container are integral, and the top-wall panel **11** is chimed connected, as shown. As seen in FIG. **2,** the entire top unit (**11–12**) with a valve assembly is assembled to the cylindrical can after the product is loaded through the top of the can. It will be noted that the upwardly projecting thin annular flange **20***a* provided with a depending skirt portion is normally in a position adjacent to the inner wall surface **10***a* which may include an actual light engagement of this wall surface by the flange. Thereafter, the product **16** to be dispensed forces the upwardly projecting thin annular flange **20***a* against the inner wall surface **10***a* of the container **10.** In this manner, a tight seal is achieved between the piston **18** and the product **16** to be dispensed. The propellant gas **26** present within the hollow piston **18** moves the latter upwardly when the valve **12** is opened. Thus, as seen in FIG. **7,** when the piston **18** reaches the end of its travel upwardly against the conical top part **11** of the container **10,** the flange **20***a* bends laterally to engage the undersurface of the conical top part **11,** and substantially all of the product in the container **10** is expelled therefrom.

FIG. **3** provides illustrative detail for the FIG. **1** organization applied to containers of medium or relatively large diameter. The conical end wall **11** is tapered, as in the range of 30° to 70° and, preferably, at approximately $\pi/4$ radian or 50° to the container axis, terminating at a neck bead or shoulder **33** at the central opening. Shoulder **33** serves to frictionally retain the skirt of a removal nozzle-protecting closure cap **34,** as will be understood. An elastomeric grommet-like fit-

ting or bushing **35** is locked to the reduced central end of wall **11**, and the dispensing stem **14** of the valve is, in turn, locked to the fitting **35**. More specifically, the fitting **35** is held at a reduced circumferentially continuous groove or waist **36**, between an upper shoulder portion **37** and a lower conical flange portion **38**, the latter including a substantial downwardly and outwardly projecting region that is relatively free of backup connection to the central or main generally cylindrical body portion **39**. To facilitate longitudinal assembly of fitting **35** via the interior of the container, the shoulder **37** is upwardly tapered to a reduced nose-end diameter at **40**, well within the diameter of the opening of wall **11**, the taper angle being less with respect to the central axis of the container than the slope angle of the conical end wall **11**.

To complete the description of valve structure, the stem **14** has a central product-dispensing passage **41** which terminates at, but does not extend through, an enlarged integral head **42**. Head **42** and a shoulder **43** define longitudinal limits of a reduced cylindrical body **44** which is retained by the bore of fitting **35**, and one or more radial passages **45** open the lower end of passage **41** within the bore of fitting **35** and adjacent head **42**. Preferably, the lower exposed surface of head **42** is spherical, as shown, about a center which approximates the instantaneous center **53** of tilt displacement of stem **14**.

The closed end of the body of piston **18'** (FIG. **3**) is characterized by a conical portion **46** conforming in slope to the taper of wall **11**. A spherically dished central portion **47** conforms to the exposed contour of head **42** and a flat radial annulus **48** integrally unites the portions **46–47**, in close proximity to the lower limit of flange **38**. The cylindrical body of the piston is a relatively thin peripheral shell or skirt **49**, integrally reinforced at regular angular spacings by thin elongate and radially inward stiffening ribs **50**. The juncture of the still thinner suspension and seal flange **20** may be continuous with the cone which characterizes the outer surface of portion **46**, as shown.

The arrangement of FIG. **4** illustrates how precisely the same dispensing valve and its supporting structure may be made to serve containers of smaller diameter. For this reason, the same reference numbers are used, where applicable. However, in view of the smaller container diameter, the conical upper end wall **11'** is similarly limited, to the extent that flange **38** extends so near the lower (outer) end of wall **11'** that it is impractical to form a conical portion in the closed end of piston **18''**. The end-wall portions **47–48** are thus directly connected at a rounded corner **51** to the relatively thin cylindrical skirt **49'**, backed by ribs **50**.

In the carrying out of my invention, the axial extent of the waist **36** of fitting **35** preferably exceeds, as by 0.020 to 0.030 inch, the corresponding axial extent of the bore of the can opening in which it is retained, and the unstressed conical angle of flange **38** preferably slightly exceeds, as by 5°, the conical slope of end wall **11**; thus, for a wall **11** of 45-degree slope from the container axis, the unstressed slope of flange **38** is preferably substantially 50°. This relationship will be understood to facilitate assembly of a stem **14** and its fitting **35** to the wall **11**, while assuring resiliently loaded, peripherally continuous contour-adapting fit of flange **38** to adjacent lapped areas of wall **11**.

Several important advantages will be seen to flow from the described cone-to-cone fit at **38–11**, quite aside from the assembly feature just noted. For example, valve operation is more easily controlled, and the precision of valve actuation is enhanced. In operation, the fitting **35** serves as a resilient pivotal suspension, stem **14** being tilted about an instantaneous center (suggested by point **53** in FIGS. **3** and **4**) within the waist region **36**. Initial tilting movement is not stiffly opposed, since the root end of flange **38** is in slight clearance relation with the wall **11** near the central opening thereof; furthermore, flange **38** can be said to have a somewhat tangential connection to body **39** (in the sense about the instantaneous pivot center **53**) so that flange **38** is either locally pulled down or pushed outward along wall **11**, in the course of its sliding adaptation to the magnitude of tilt actuation. Stated in other words, for normal desired extents of valvestem tilt, there is no substantial shear-force development between body **39** and flange **38**. Additionally, the employment of a small-diameter container (e.g., a one-inch diameter container, as in FIG. **4**), or of a larger-diameter container (e.g., a 1.5-inch or larger diameter container, as in FIG. **3**), both with conically tapered end walls **11** (**11'**), means greater facility for index-finger actuation of stem **14** while grasping the container body with the remaining fingers of the same hand. Still further, the use of a conical end wall (**11**) inherently provides more extensive area, within a given limiting container diameter, to accomplish extensive resilient overlap of a seal flange, such as the flange **38** of fitting **35**.

As to the piston **18** (**18'–18''**), the employment of a conical tapering portion (for the larger sizes), and the use of the particular spherical-surface relationship described in connection with **42–47–53**, means less axial draft in the formation of the piston end wall, while achieving a contour which can assuredly expel virtually all the viscous product. The piston advances with uniform ease and smoothness, even though it may have cause to tilt or slightly misalign, in the course of its travel. The lower end of the piston body shell (**49**) always provides a limit to the possible tilt, and throughout the range of tilt angles, the seal flange **20** maintains a smoothly continuous circumferential seal between the gas-pressure region **26** and the viscous-contents region **16**. Also, the spherical conformity of the convex and concave surfaces **42–47** and their relation to the instantaneous center **53** for stem (**14**) tilt will be seen as assuring no interference with smooth control of tilt of stem **14** (with related smooth control of discharged product flow) upon approach to final discharge of the container, and regardless of whether or not piston **18'** (**18''**) may have been slightly tilted in the course of such approach.

It will be noted that by reason of equilibrium between hydrostatic pressure in the product region and gas pressure in the pressure region **26**, in conjunction with the convergent resilient conical annulus (e.g., at **38–39**, in bushing **35**) between the conical end wall **11** and the valve stem **44**, a residual pressure loading is automatically established in the upward direction and over the inwardly exposed effective area at **38–39–42**, resulting in a strong axially upward wedging force on bushing **35**, such that substantially continuous and highly effective seal action exists as between bushing **35** and container end **11**, and between bushing **35** and stem **44**. This strong and effective seal action is achieved as long as valve **12** is closed and as long as product remains to be dispensed, and regardless of the fractional extent to which product may have been dispensed; such seal

action is a direct result of the indicated geometry of structural relation and of the indicated method steps which result in pressure-loading of the product.

FIGS. 5 and 6 show modifications of the cap 34, in application to valve structure 12 which may be incorporated in the conical top wall 11 of bottom-loaded (FIG. 1) or top-loaded (FIG. 2) containers. The point of FIGS. 5 and 6 is that an integral downward tubular projection 55 (or other bore formation in cap 34) has removable threaded engagement with an upwardly projecting portion of the valve-member stem 14, and the bottom or skirt edge 56 of cap 34 makes direct abutment with wall 11 for the cap-secured position. In FIG. 5, the "thread" formations on stem 14 are spaced rounded bumps 57, in suitably angularly and axially staggered array, for multiple local engagement with a continuous thread formation 58 in the bore of projection 55 (see also FIG. 7); in FIG. 6, the thread formations on stem 14 are interrupted wedge-shaped bumps 59 for multiple local engagement with a continuous wedge-shaped thread formation 60 in the bore of projection 55. In both cases, in the cap-secured position, the lower end of projection 55 axially clears the local radial flange by which shoulder 43 is defined; also it will be understood that if desired, and for either of the rounded or wedge-shaped thread styles of FIGS. 5 and 6, the bump threads may be in the bore of projection 55 while the continuous threads are on the stem 14.

The arrangements of either of FIGS. 5 or 6 will be seen to provide not only for stable and positive retention of the valve member 12 as long as the cap 34 is secured but also to develop a residual axially outward force upon stem 14, thereby driving the elastomeric fitting 35 into further wedged seal-enhancing coaction with both the top wall 11 and the adjacent region of stem 14. Thus, cap placement and internal pressure both act in the same direction to assure maintenance of all seals and to prevent product loss of any kind. Also, it will be understood that the friction of bushing (35) to container-wall (11) engagement and the friction of valve member (42) and stem (14) engagement to bushing (35), all as enhanced by internal container pressure, are such that the torsional friction at the threaded engagement (57–58; 59–60) will not cause stem 14 to lock to cap 34; in other words, cap 34 is always unthreadable from stem 14, particularly when these parts are injection-molded from plastic material such as polypropylene, high-density polyethylene or the like.

It has been indicated generally above that the unstressed included effective angle of the fitting flange 38 may be greater than the effective conical angle of the top wall 11 to which it is fitted. For the preferred angular relationship, the material of fitting 35 should be relatively soft, the particular durometer hardness being dictated by the product viscosity and desired valve action. In general, the durometer is selected in the range from 40 to 80, and 60-durometer material has been found highly satisfactory in a hand-lotion application of the invention.

While the invention has been described in detail for preferred and illustrative contexts, it will be understood that modifications may be made without departure from the scope of the invention.

What is claimed is:

1. In combination, for use in a pressurized container, a rigid centrally apertured container closure member having a substantial conical taper in the direction of the aperture, an elastomeric bushing fitted to the concave taper and extending through the aperture, the lower end of said bushing being in axial proximity to the bushing fit to said taper, said bushing having a central longitudinal bore extending axially through the aperture region of the closure member, and a tiltable valve member having a substantially flat seating surface seated in axial abutment with said lower end of said bushing and including a cylindrical dispensing stem fitted to and extending through and beyond the outer end of the bore of the bushing; whereby in the presence of internal pressure within a container of which said closure member forms a part, said valve member and bushing are pressure-loaded against the convergent taper, thus enhancing seal engagement of said bushing to said taper and of said bushing to said stem.

2. The combination of claim 1, in which said closure member is the integral frusto-conical top-end wall of a cylindrical container which is open at its other end, for bottom-fill application.

3. The combination of claim 1, in which said closure member is a circular end-wall member having peripheral formations adapted for assembly to a container open at its top end, for top-fill application.

4. The combination of claim 1, in which said bushing has a conically tapering formation adapted to circumferentially continuously extensively and yieldingly engage said closure taper.

5. The combination of claim 4, in which the unstressed taper of said bushing is at a greater included angle than that of the taper of said closure.

6. The combination of claim 1, in which said bushing has a reduced circumferential waist at which it is received in the aperture of said closure.

7. The combination of claim 1, in which said stem includes a radially outward flange by which it locates against the axially outer end of said bushing, said stem projecting axially outwardly beyond said flange.

8. The combination of claim 1, in which said stem projects axially beyond the axially outer end of said bushing, and a protective cover cap having removable threaded engagement with the projecting part of said stem, said cap having a skirt extending into abutment with said closure member when secured to said stem.

9. The combination of claim 8, in which said threaded engagement is between said stem and an inner downwardly projecting tubular projection from the closed end of said cap.

10. The combination of claim 8, in which said threaded engagement involves an array of axially and angularly spaced bumps on one of said cap and stem and a continuous thread on the other one of said cap and stem.

11. The combination of claim 10, in which said bumps and thread are rounded.

12. The combination of claim 10, in which said bumps and thread are wedge-shaped.

13. The combination of claim 1, in which the durometer hardness of the material of said bushing is selected in the range 40 to 80.

14. The combination of claim 1, in which the durometer of the material of said bushing is approximately 60.

15. The combination of claim 1, in which said bushing includes a circumferentially continuous radially outward flange of greater unstressed included angle than the included angle of the taper of said closure member, said bushing being in such assembled relation to said closure member that said flange is resiliently deflected into substantial conical conformance with the

included angle of said taper.

16. The combination of claim 1, in which the effective area of said flat seating surface is of at least substantially the sectional area of said bushing at its location within the aperture of said closure member.

* * * * *