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Schultz

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[54] **AUTOMATIC TIP-SEAL VALVE**

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[51] **Int. Cl.²** **B65D 83/14**

[58] **Field of Search**..... 222/402.22, 402.12, 402, 222/13, 402.21, 149, 493, 150, 151, 513, 407.23, 407.24; 251/351

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[57] **ABSTRACT**

The invention contemplates valve structure for a container of liquid products, for enabling selective dispensing of such products, upon tilting or tipping the dispensing axis with respect to the container axis. A closure cap has a central aperture in its closed end, for open-close tip-seal coaction with the dispensing end of the valve structure, and the closure cap is captive assembled with an exposed part of the valve structure, with the skirt of the cap abutted to the end of the container. The relationship is such that upon tilted deflection of the cap, the cap skirt fulcrums on the container end and the valve member fulcrums on its seat, both fulcrums being substantially offset, in diametrically opposite directions from the valve axis; as a result, the tip seal is relatively quick-opening and quick-closing, in phase with valve opening and closing.

19 Claims, 3 Drawing Figures

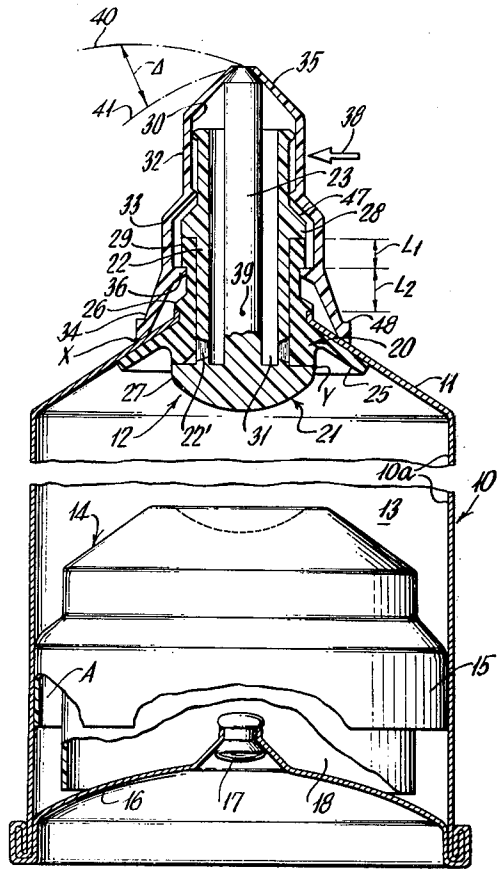


Fig.1.

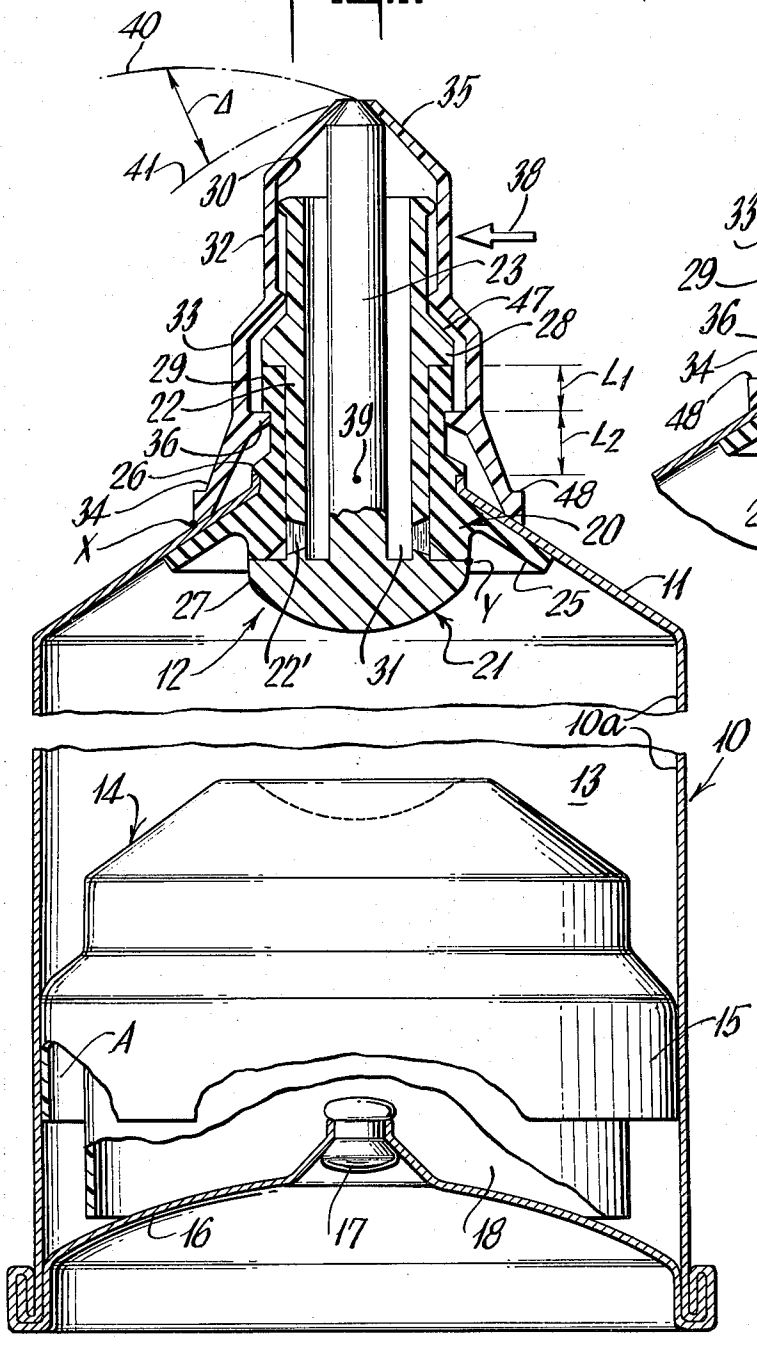


Fig.2.

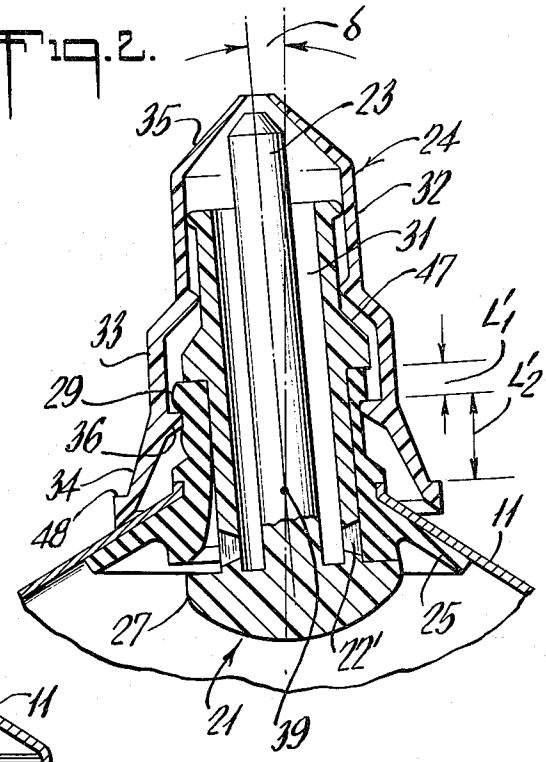
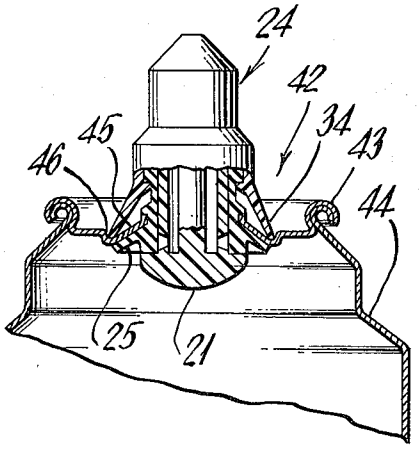


Fig.3.



AUTOMATIC TIP-SEAL VALVE

The present invention relates to valve structure for a container of liquid products, such as a pressurized container for viscous products, and the invention is particularly concerned with tip-sealing features of such valve structure.

It is an object of the invention to provide improved structure of the character indicated.

Another object is to provide rapid-opening and closing action for the dispensing end of such structure, whereby product is readily dispensed for small angles of valve tilt and whereby the dispensing end is safeguarded from contamination.

A further object is to provide in such structure improved means for automatically closing the product-dispensing opening at the point of product dispensing, when the valve is released for closure.

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, tip-seal and container-seal effectiveness.

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 fragmentary sectional view similar to FIG. **1** to show a different relation of the same parts; and

FIG. **3** is a fragmentary view similar to FIG. **1** to illustrate a modification in which the invention is applied to a different-style container.

Referring to FIG. **1**, the invention is shown in application to a pressurized container or can **10** 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 is pressed laterally in a well-known manner in order to release the valve seal and permit container contents, which may be a viscous product **13,** under super-atmospheric pressure, to be expelled to the atmosphere. As disclosed in detail in my copending application, Ser. No. 290,977, filed Sept. 21, 1972, a generally tubular hollow piston **14,** which may be constituted of a low-density polyethylene or a polypropylene material, may be used to drive product **13** through the dispensing valve **12.** As also disclosed in said application, piston **14** includes a relatively thin annular-shaped flange **15** provided with a depending skirt portion having a large surface area for dependable but light sealing contact with the inner wall **10***a* of the container **10.**

The container **10** is of the bottom-fill variety, being closed by a bottom wall **16** with a central opening having a sealing grommet **17** through which a gas **18,** such as nitrogen, is introduced after the viscous product **13** and the piston **14** are inserted into the container. The gas **18** presses against the interior surfaces of the top of piston **14** as well as in the space A, beneath flange **15** 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 **18** present in the space

A will force the thin resilient flange **15** into light sealing contact with the inner wall **10***a* of the container **10,** and that the nature of the thin resilient flange **15** 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.

More specifically, the valve **12** of FIG. **1** is shown to comprise three parts, namely, an elastomeric bushing **20,** a valve member **21** with an integral valve-stem body portion **22** and a central-pin portion **23,** and a captive automatic closure cap **24.** Bushing **20** has a central bore communicating between the inside and outside of the container. A flared inner flange **25** of bushing **20** resiliently seats upon and is conformed to the concave conical shape of the end-closure member **11,** and a circumferential bead **26** is the means of completing axial location of bushing **20** at the central opening of member **11.** The valve member **21** has a truncated spherical lower surface which nests in the spherical concavity of the closed end of piston **14,** as product **13** nears complete expulsion from the container. The outer diameter of valve member **21** is such as to define a lower radial flange **27** presenting a flat annular sealing seat to the inner axial end of the bushing bore, sealing contact being normally urged by the pressure charge upon product **13.** The valve-stem body portion **22** is annular, extending integrally upward from and coaxial with valve member **21.** Portion **22** is cylindrical and of reduced thickness within the bushing bore, and it includes an upper radial flange **28** engaging over the upper radial flange **29** of bushing **20,** for axial retention in the bushing bore. Stem portion **22** is thus resiliently suspended by bushing **20** and may be tilted to locally unseat the valve member **21,** and to allow product **14** to pass via one or more local ports **22** to the interior of stem **22.** The axially outer end of stem portion **22** projects beyond flange **28,** for longitudinally slidable guided coaction with a suitably formed upper part **30** of the inner surface of the cap **24.** Within the bore of stem **22,** the pin portion **23** extends integrally from the valve-member lower-flange region in such radial clearance as to define an annular passage **31** for produce dispensing. Pin **23** extends beyond the outer end of stem portion **22** and is preferably conically formed at its end, for a tip-sealing purpose to be explained.

The closure cap **24** is shown as comprising first, second, and third skirt portions **32–33–34** which are stepped or flared outwardly, and the upper or closure end **35** is centrally apertured and characterized to define a conical seal for coaction with similarly formed end of pin **23.** The upper skirt portion **32** is devoted to guided coaction with the upper end of stem body portion **22.** The second and enlarged skirt portion **33** enables definition of a skirt flange **36** which engages under the upper flange **29** of the bushing **20.** And the third and lower most skirt portion **34** is outwardly flared for relatively wide-based abutment with the end-closure member **11** of the container. The parts are preferably so proportioned that, for the erect and valve-closed relationship depicted in FIG. **1,** the upper resilient flange **29** between stem and cap flanges **28–36** is under a residual compressive stress or preload, by reason of pin **23** abutment with the cap end wall **35,** thus effectively preloading the closed condition of the tip-seal at **23–35.** This being the case, any tendency of pressure within the container to elevate valve member **21** may relieve skirt portion **34** from contact with the container

end wall **11** but it can have no deleterious effect upon the tip seal at **23–35**, or upon the effectiveness of valve closure, or upon the effectiveness with which bushing **20** is sealed to the container end **11** or to the valve-stem portion **22**; if anything, such pressure can only improve the effectiveness of such seals and closures, it being recalled that sealed closure at the tip seal provided by pin **23** assures that neither air nor contaminant dust or the like have any chance of degrading product within the dispensing channel, or otherwise within the total described valve structure.

The described valve parts are basically simple and are manufactured by well-understood techniques. The valve member **21** with its integral stem and pin projections **22–23** may be a single piece of injection-molded plastic. Similarly, cap **24** may be a single injection-molded part. The material of bushing **20** should be relatively soft, the particular durometer being dictated by the product visocity and by the desired valve action; in general, the durometer is selected in the range from 40 to 80, and 60-durometer material has been found satisfactory in a hand-lotion application of a tilt-valve bushing as at **20**.

In spite of the indicated effectiveness of multiple seals and closures, the described article remains in instant readiness for dispensing use. To dispense product, cap **24** is subjected to a lateral displacement, as by manual actuation in the direction suggested by the arrow **38** in FIG. **1**, so that th parts are tilted about an instantaneous center (suggested by a heavy dot **39** in FIG. **2**), causing the valve and its dispensing axis to shift to an angular extent. In the course of such tilting, a diametrically opposite point X on the bottom edge of the cap skirt becomes the fulcrum about which cap **24** is bodily displaced in rotation, as suggested by the phantom-line arc **40**, representative of the path of such movement for a part of the edge of the cap aperture; at the same time, a point Y on the lower end of bushing **20** becomes the fulcrum about which valve member **21**, with its integral parts **22–23**, is bodily displaced in rotation as suggested by the phantom-line arc **41**, representative of the path of such movement for a corresponding part of the tip of pin portion **23**. Now, since the longitudinally guided relation of parts **22–32** assures that they will remain substantially coaxial regardless of tilt, the difference between arcs **40–41** as observed about the instantaneous center **39** is a measure of the extent to which pin **23** "retracts" from the cap aperture, as a function of the degree of tilt; in FIG. **1**, the symbol suggests such extent for one tilt angle and, of course, in FIG. **2** the physical opening for a tilt angle is readily apparent.

In the course of tilting, flanges **28–36** necessarily approach each other, thus increasing the compressional stress in the bushing flange **29**, i.e., over the region designated L_1 in FIG. **1**; at the same time, the reduced region of the bushing is axially and elastically stretched, over the region designated L_2. Both these stresses are illustrated by changes to dimensions L_1 and L_2 in FIG. **2** and will be understood to aid the restoration of all parts to the closed and sealed condition, once force **38** is removed.

The arrangement of FIG. **3** is illustrative of use of the invention in application to a separate end-closure member **42**, for chimed connection at **43** to a container **44** of the top-fill variety. Again, a conical shape **45** is provided for reception of the bushing flange **25**, and the lower portion **34** of the skirt of cap **24** has abutment reference to the container-end member. FIG. **3** also shows that the container-end member may have a shoulder, bead or the like formation **46**, surrounding the lower edge of the cap skirt and concentric with the container opening for more positively establishing the effective radius of fulcrum action X in the course of tilt actuation.

The described structures will be seen to have achieved all stated objects with a basic economy of parts and fabrication cost. The three parts are easily assembled by first assembling bushing **20** between stem flanges **27–28**, the sloping cam surface **47** of flange **28** being an aid to such assembly; next, the resulting subassembly is assembled to end member **11** via the concave side, using the cam surface **47** again for piloting purposes through the container aperture; finally, cap **24** is assembled over the upwardly projecting parts and cam surface **47** is seen once more to aid in piloting the assembly, namely flange **36** past flanges **28–29**. The cap **24** is never disassembled from, and indeed coacts to perform an important functioning part of, the valve and its operation. It will be noted that to produce the indicated quick tip-seal open-closed action, it is significant that fulcrums X and Y are at diametrically opposite offset locations which are effectively additive in creating a fast axial separation of pin **23** from the cap aperture. A preference is indicated that these combined offsets, i.e., the "diametrical" distance X–Y shall be a substantial fraction of the distance between the tip-seal and valve actions (i.e., effective length of pin **23**); as shown, this fraction is substantially two thirds.

While the invention has been described in detail for preferred forms, it will be understood that modifications can be made without departure from the invention as defined in the appended claims. For example, the lower skirt portion may be specially reinforced with a peripheral rim **48** (FIG. **1**) for better sustaining the forces focused at X when the cap is tilt-actuated.

What is claimed is:

1. In combination, for use as an automatic tip-seal valve for a pressurized container, a rigid centrally apertured container-closure member, an elastomeric bushing fitted to said member and having a reduced portion extending through the aperture, said bushing having a lower radial flange beneath and retained by said closure member, and an upper radial flange at a location above said closure member, said bushing having a longitudinal bore extending axially through the aperture region of the closure member; a valve member having a lower radial flange normally seated in axial abutment with said bushing and including a dispensing stem with an outer annular body portion fitted to and extending through and beyond the outer end of the bore of the bushing, said stem including an upper radial flange in overlapping adjacency with the upper radial flange of said bushing, said stem further comprising a pin portion projecting axially beyond the end of said body portion, and said body portion being apertured to permit valve-admitted container contents to flow into the inner volume of said body portion and into surrounding relation to said pin portion; and a closure cap having a centrally apertured end and a skirt surrounding exposed parts of both said stem and said bushing, said skirt having an internal flange engaging the underside of the upper flange of said bushing and having a lower peripheral edge in circumferential abutment with said container-closure member, said bushing via its upper flange normally resiliently loading the lower peripheral edge of

said skirt into such circumferential abutment for a valve-seated coaxial relation of said valve member and container-member aperture that said pin registers with and closes the cap aperture when the parts are in said valve-seated relation; whereby upon application of a tilting lateral displacement force to the upper end of said cap with respect to the container-member aperture, the skirt contact with the container-closure member changes from circumferential to essentially a localized single-point fulcrum contact at a first radial offset from the container-member aperture and the lower valve-member flange derives a localized fulcrum contact with said bushing at a second radial offset diametrically opposed to said first offset, as the upper bushing flange is compressed between said body-portion and skirt flanges and as the reduced portion of said bushing elastically stretches between flanges thereof, so that the combined offsets effectively add to produce rapid opening of the pin-to-cap closure while the valve member opens to admit product for dispensing, and so that the parts return to their valve-closed coaxial relation to the container-end aperture upon release of the lateral displacement force, the tip seal being automatically closed at the same time.

2. The combination of claim **1**, in which said body portion projects upwardly of said upper flange thereof and has longitudinally slidable guided relation with an adjacent portion of inner wall of said cap.

3. The combination of claim **1**, in which said container-closure member has a conical taper which terminates at the central aperature, said lower bushing flange being fitted to the concave side of said taper.

4. The combination of claim **3**, 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 container-closure member has the skirt-limiting formation projecting to limit radially outward displacement of said skirt edge.

7. The combination of claim **6**, in which said formation is a circumferentially continuous bead surrounding the skirt edge and coaxial with the container-end aperture.

8. The combination of claim **1**, in which said pin portion if formed integrally with the lower flanged end of said valve member and in radially spaced relation with said body portion, whereby dispensed-product flow is in an annulus between said body and pin portions.

9. 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.

10. 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.

11. 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.

12. The combination of claim **1**, in which said pin and cap end are tapered at their interfit for aperture closing.

13. The combination of claim **1**, in which the effective combined extent of said offsets in a major fraction of the effective longitudinal span between the regions of valve-member seating and of pin closure of the cap aperture.

14. The combination of claim **13**, in which said fraction is at least substantially two-thirds.

15. The combination of claim **1**, in which the parts are so proportioned that in their valve-closed coaxial relation with the container-end opening, the closure of said pin portion at the cap aperture is preloaded by reason of axially squeezing compressional loading of the upper flange of the bushing by the skirt flange and the upper flange of the body portion of said stem, whereby any tendency of container pressure to compress the lower bushing flange and thus to upwardly displace said valve member in closed position will not deleteriously effect either valve-clsoure or closure at the pin-to-cap engagement, even if such displacement should involve skirt lifting from container-end engagement.

16. In combination, for use in a container of liquid product, a rigid centrally apertured container closure member having inner and outer sides, an elastomeric bushing in axially-retaining fitted relation to said member and extending through the aperture and between inner and outer sides, said bushing including upper and lower radial flanges on opposite sides of the aperture and said bushing having a central longitudinal bore extending through the aperture region of the closure member, a valve member seated in axial abutment with the inner end of said bushing and including a dispensing stem with an outer annular body portion fitted to and extending through and beyond the outer end of the bore of the bushing, said stem further comprising (a) an elongate pin portion extending beyond the axially outer end of said annular portion and (b) an upper flange formation having upwardly retained engagement with the upper side of the upper flange of said bushing, and a closure cap having a centrally apertured end and a skirt surrounding outwardly exposed parts of both said stem and said bushing, said cap having an internal flange formation having downwardly retained engagement with the lower side of the upper flange of said bushing, the cap skirt abutting the closure member when thus retained, and said pin being so formed as to coact with and close the cap aperture when the cap skirt is thus retained; whereby, upon tilting the cap, said cap is caused to relieve itself from contact with said closure member and to effectively open the cap-end aperture as the valve-member seat engagement is relieved at the lower end of said bushing and as the upper flange of said bushing is resiliently squeezed by and between said flange formations.

17. The combination of claim **16**, in which the durometer hardness of the material of said bushing is selected in the range of 40 to 80.

18. The combination of claim **16**, in which the durometer of the material of said bushing is approximately 60.

19. The combination of claim **16**, in which said valve member is a single injection-molded relatively stiff plastic part which integrally includes said body and pin portions.

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