Sept. 17, 1957 V. H. WALLINGFORD 2,806,637

CONTAINER AND CLOSURE FOR DANGEROUS LIQUIDS

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FIG. 2.

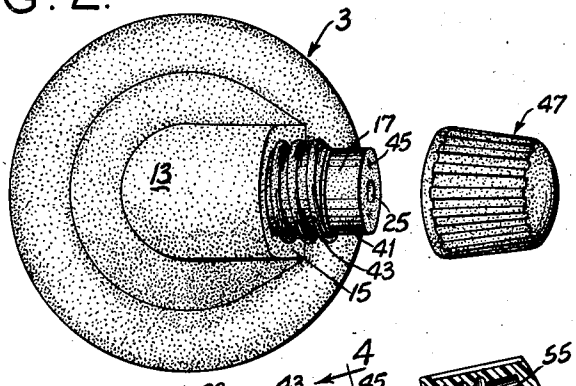


FIG. 1.

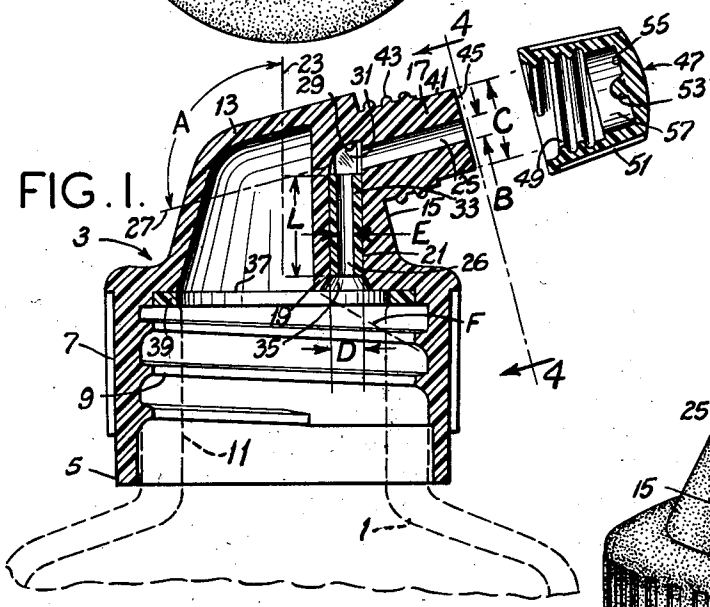


FIG. 4.

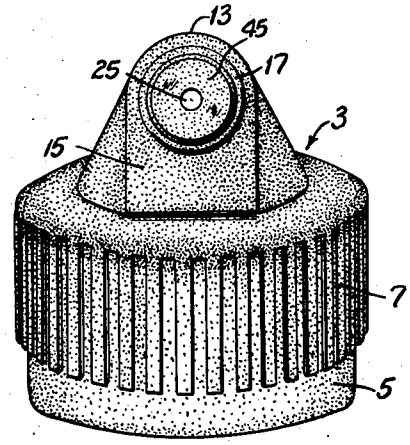
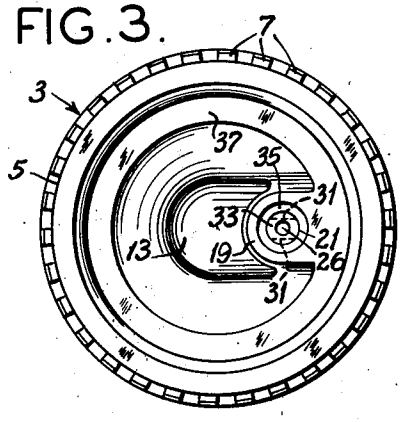


FIG. 3.



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CONTAINER AND CLOSURE FOR DANGEROUS LIQUIDS

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5 Claims. (Cl. 222—215)

This invention relates to a container and valveless closure for dangerous liquids; for example, hydrofluoric acid.

Among the several objects of the invention may be noted the provision of a container and closure for dangerous liquids, which will deliver the contents either dropwise or in a stream, at various rates in both cases, without the requirement of an air vent or valves; and the provision of an article of the class described which minimizes undesired dropping, dribbling or creeping of the liquid from the outlet after an intended discharge either by flow or drip delivery. Other objects and features will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangements of parts which will be exemplified in the structures hereinafter described, and the scope of which will be indicated in the following claims.

In the accompanying drawings, in which one of various possible embodiments of the invention is illustrated,

Fig. 1 is a vertical section of a closure made according to the invention, illustrated as applied to one of various possible shapes of squeeze-type containers shown in dotted lines;

Fig. 2 is a top plan view of the closure parts of Fig. 1, omitting the container;

Fig. 3 is a bottom plan view of Fig. 1, omitting the container; and,

Fig. 4 is an oblique elevation viewed from line 4—4 of Fig. 1, omitting the container.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

There are various corrosive or otherwise hazardous liquids, including hydrofluoric acid, which are extremely difficult to store without destroying their containers and which are difficult to deliver from their containers without danger to the handler. Moreover, it is required in many cases that such liquids be delivered dropwise or in a stream at various rates, as circumstances may require. It is important after delivery that all, or as much as possible, of the liquid be prevented from dripping, dribbling or spreading on or over its container or the closure therefor. It is also important that the container for carrying out these objects shall not be complicated by an air vent in addition to the liquid outlet or the valves often used in addition to the liquid outlet for controlling flow; because such vents are themselves a source of danger to the handler and the valves are a source of unreliability in operation. Either or both of them also complicate the structure required.

Referring now more particularly to the drawings, there is shown at numeral 1 a molded, flexible-plastic, so-called squeeze bottle which may be composed of material such as polyethylene which is outstandingly resistant against attack by many dangerous liquids, including hydrofluoric acid. This material is of advantage to the invention since it can be molded and machined to accurate dimensions, both small and large. It is also flexible, so that the walls of bottle 1 may be squeezed.

At numeral 3 is indicated a molded closure or spout for the squeeze bottle 1, also composed of polyethylene. This is formed with a circular skirt 5, provided with outside corrugations 7 to provide a frictional finger grip. The skirt is internally threaded, as shown at 9, for cooperation with suitable threads on the neck 11 of the squeeze bottle 1.

The upper end of the skirt 5 is enclosed by a hollow dome 13, on one side of which is a sloping face 15 from which extends a nipple 17. Inside the dome 13 and adjacent to the nipple 17 is a ridge 19 in which is located a cylindric hole 21. The axis of the hole is preferably parallel to the axis 23 of the bottle and skirt 5.

In the nipple 17 is a cylindric hole 25, formed on an axis 27. The axes 23 and 27 are preferably located at an angle of approximately 75°, with a range extending from 70° to 80°. The holes 21 and 25 are connected by a knee passage 29, containing internally raised side flats 31. Pressed into the hole 21 is a tubular bushing 33, the inner end of which has a position determined by the flats 31. The outer end of the bushing is at the inner end of a chamfer 35 formed around the bottom of the hole 21. Below the dome 13 is a flat 37, between which and the top of the bottle 1 is located a suitable resilient washer 39, composed, for example, of 50% polyethylene and 50% polyisobutylene.

The outside of the nipple 17 is formed for a short distance from its end as an uninterrupted cylinder, indexed 41. Between the cylinder and the face 15 the nipple is provided with threads 43. The end of the cylinder 41 is formed with an accurately flat face 45, located at right angles to the axis 27. This constitutes a right section of the cylinder 41.

At numeral 47 is shown a truncated conical screw cap having internal threads 49 for cooperation with the threads 43, external serrations 51, and an internal protrusion 53. The latter is adapted upon threading the cap home on the nipple 17 to extend into the hole 25. Around the protrusion 53 is a flat 55, engageable with the flat 45. Around the flat 55 is cylindric portion 57 forming a close fit over the cylindric portion 41 of the nipple.

The diameter D of the hole 21 is not critical, since it simply forms means for a press fit for the bushing 33. The inside diameter E of bushing 33 is critical, particularly in relation to the dimension of the hole 25. The diameter of the latter is indexed B. Thus the inside bushing diameter E of the hole 26 in the bushing 33 should be approximately .052 inch, with a range extending from .042 inch to .062 inch. Its length L may be on the order of 7/16 inch, but shorter or longer for the smaller or larger parts, respectively, of its range of inside diameter E. This is for the reason that frictional resistance against flow through the bushing 33 increases with increased length, and decreases with increased diameter. Thus in order to approximate uniformity of frictional resistance in the bushing 33, its inside diameter is decreased with decrease in length and increased with increase in length. The outside unthreaded part of cylinder 41 should be accurately concentric with the hole 25, and its diameter C may be approximately .312 inch, with a range of ±.010 inch. The diameter B of hole 25 may be .085 for example.

It will be understood that, although the hole 26 is in the bushing 33, it could be obtained by drilling or otherwise forming the opening of appropriate diameter without the use of the bushing. The bushing is employed as a convenience in manufacture, since the opening of diameter D may be conveniently molded and the bushing cut from extruded tubing of appropriate inside diameter, and

of outside diameter for a proper press fit in the hole **21**.

The dimensions given for the holes **26** and **25** have the following functions: Upon tilting the bottle, without squeezing it, the hole **25** completely fills with liquid as liquid is fed to it from hole **26**. A limited number of drops may then issue slowly from hole **25**. By slightly squeezing the bottle, more liquid advances from the hole **26** to hole **25**. Drops then continue to fall from the end of **25**. By squeezing the bottle with more pressure, the rate of flow of liquid to the passage **25** is increased, so that drops fall faster. Upon squeezing with still more pressure, drop flow from the end of hole **25** is incapable of removing liquid from hole **25** at the rate supplied from hole **26**. In such event, a continuous stream occurs from the hole **25**. The rate of continuous flow increases with increased squeezing pressure.

Either dropwise or continuous flow may be stopped instantly by stopping the squeezing action, whereupon reactive expansion of the squeeze bottle will draw air back into the passage **25**. Further dropping or dribbling is thus avoided. Any liquid which has wetted the inside of the passage **25** and the surface **45** tends to be drawn in. It will therefore be seen that there is not sufficient liquid remaining at the surface **45** to allow any dropping or dribbling of liquid from the nipple **17** when the bottle is upright. When the screw cap **47** is reapplied, there is an insufficient amount of liquid between surfaces **45** and **55** to allow any substantial creep past the threads **43**, **49**.

Substantially the entire contents of a bottle may be removed because, upon sufficient tilt, the liquid therein can descend to very low levels, as suggested by line F in Fig. 1. It will be observed in this connection that no liquid is trapped in the dome **13**, since it can run out of the dome around the ridge **19**.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. A valveless container for fluids, comprising a squeeze bottle having a neck, a closure member, means adapted to form a fluid-tight connection between the neck and

closure member, an extension on the closure member beyond said connection having a first unobstructed cylindric passage therein of substantially constant diameter throughout its length, a nipple projecting laterally from said extension at an angle other than a right angle and having a laterally directed second unobstructed cylindric passage therein of substantially constant diameter throughout its length, said second unobstructed passage terminating in a flat end surface on the nipple, said surface being normal to the axis of the second passage and of a diameter several times that of said second passage, said second passage also communicating directly with said first passage through an unobstructed knee passage therebetween, the diameter of the second passage being larger than the diameter of the first passage, all of said passages being small enough to prevent continuous outflow of liquid through them when, without squeezing it, the bottle is inverted.

2. A valveless container for fluids made according to claim 1, wherein the axis of said first passage lies to one side of and substantially parallel to the axis of said bottle neck and the axes of said first and second passages and of said neck lie in a common plane, the outlet of the second passage extending away from the neck axis.

3. A valveless container for fluids made according to claim 2, wherein said extension is hollow and includes a ridge located on one side of its interior and containing said first passage, said ridge being located adjacent to said nipple.

4. A valveless container for fluids made according to claim 3, wherein the means providing said first cylindric passage is constituted by an elongated bushing of relatively small bore press-fitted into a larger passage provided for it in said ridge.

5. A valveless container for fluids made according to claim 4, wherein said knee passage between said first and second passages includes at least one inwardly protruding portion adapted to be engaged by the inside end of the bushing so as properly to position the latter.

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