Oct. 28, 1969 J. E. McDONNELL 3,474,936

SQUEEZE BOTTLE DISPENSER

Filed May 29, 1967 2 Sheets-Sheet 1

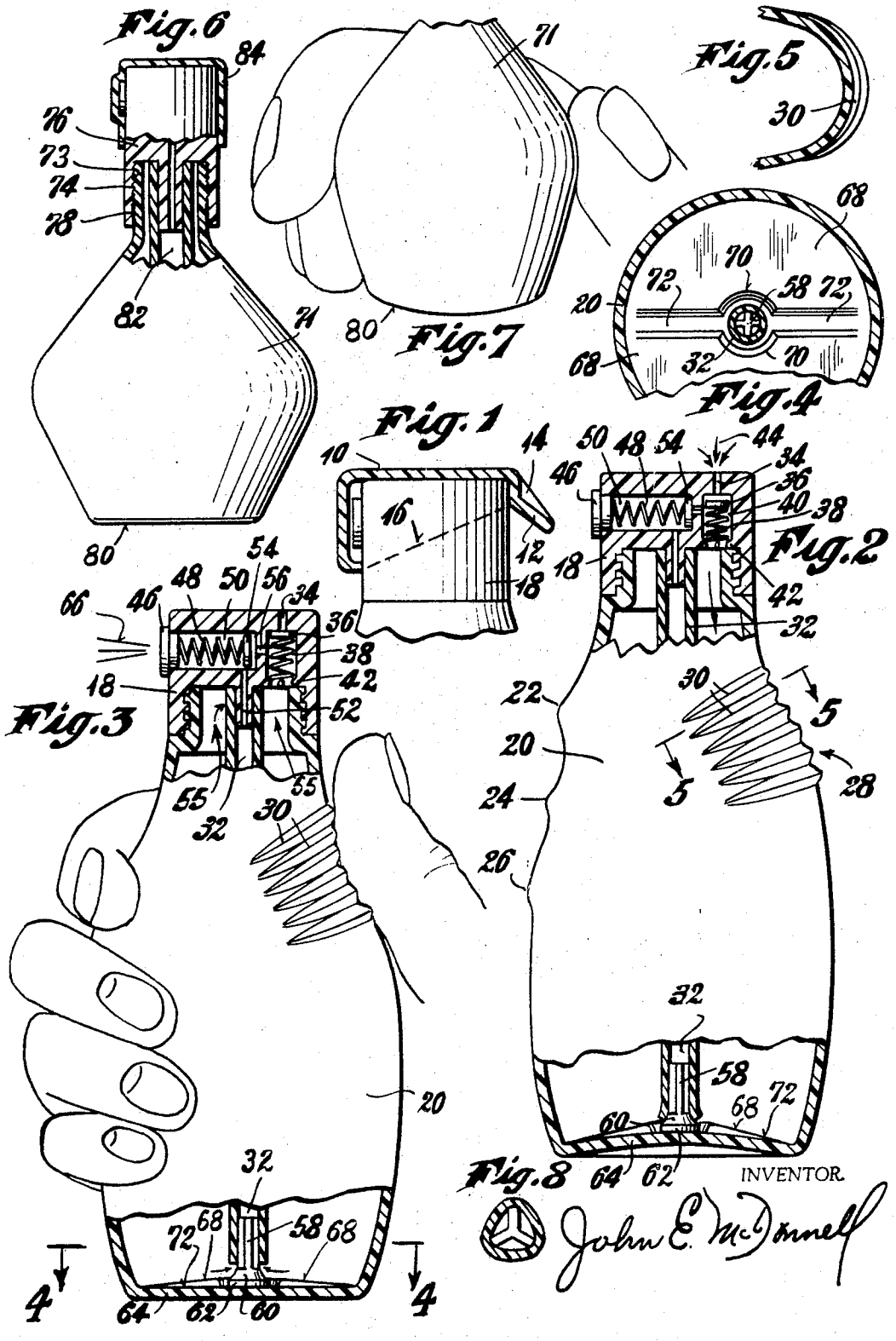

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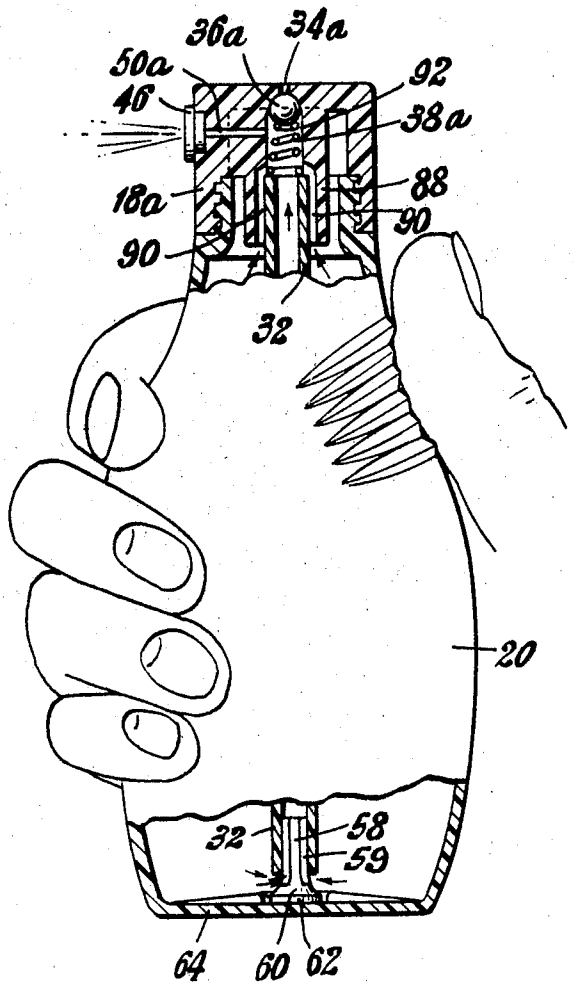
Fig. 9



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SQUEEZE BOTTLE DISPENSER

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U.S. Cl. 222—211 15 Claims

ABSTRACT OF THE DISCLOSURE

A squeeze bottle dispenser having a dispensing cap carrying a dip tube and having a valving plug movable in the bottom end of the tube by the movable bottom of the bottle. The cap carries an air inlet or relief valve which has communication with the atmosphere and with the inside upper space in the bottle. When the bottle is squeezed the relief valve is closed, the valving plug drops and opens the bottom of the dip tube, and discharge of liquid from the dip tube occurs, together with air from the upper space in the bottle. When the bottle restores, the bottom raises and closes the valving plug against the end of the dip tube, keeping liquid in the tube. Also, the relief valve opens, and air easily and quickly flows momentarily into the bottle to relieve the vacuum therein.

The present application is a continuation-in-part of my copending application Ser. No. 583,236, filed Sept. 30, 1966, now abandoned, and entitled "Squeeze Bottle Dispenser."

CROSS REFERENCES

(1) Swiss Patent No. 329,477
(2) U.S. Patent No. 1,778,291
(3) U.S. Patent No. 2,113,695
(4) U.S. Patent No. 2,631,064
(5) U.S. Patent No. 2,738,107
(6) U.S. Patent No. 2,980,342
(7) U.S. Patent No. 3,154,222
(8) U.S. Patent No. 3,179,301
(9) U.S. Patent No. 3,221,945
(10) U.S. Patent No. 3,255,933

BACKGROUND

This invention relates to plastic squeeze bottle dispensers.

In prior squeeze bottle dispensers having dip tubes it is often necessary when squeezing to expel quite a bit of air before the spray starts, due to the dip tube having become emptied in large part by the inrush of air from the previous actuation. This delays the spraying and is annoying and inconvenient. Also, prior dispensers do not enable replacement air to enter quickly or easily enough, and do not minimize evaporation or loss of vapor from the product. This is also an inconvenience, and in the case of perfumes a deterioration of the fragrance results. The prior dispensers do not automatically effect a stoppering when the dispenser is not in use, but require manual stoppering and unstoppering. This is an additional drawback.

SUMMARY

The present invention obviates the above disadvantages, Objects are to provide an improved dispenser and automatic closure valve operated by the bottle wall; an improved dispenser with finger-grip bottle and localized "press-spot," and with improved automatic sealing that needs no stopper cap to prevent leakage or evaporation, with improved check valve arrangement in the spray cap; a dispenser which will quickly start spraying when squeezed, and wherein the dip tube will not empty due to inrush of replacement air; a dispenser wherein the replacement air can quickly flow into the bottle without annoying delay; a dispenser which minimizes loss from evaporation, and loss of fragrance of perfumes; and a dispenser like the foregoing, which is very simple, not costly to make and reliable in operation.

The foregoing are accomplished by the provision of a novel squeeze bottle dispenser having a dispensing cap carrying a dip tube and having a valving plug movable in the bottom end of the tube by the movable bottom of the bottle. The cap carries an air inlet or relief valve which has communication with the atmosphere and with the inside upper space in the bottle. When the bottle is squeezed the relief valve is closed, the valving plug drops and opens the bottom of the dip tube, and discharge of liquid from the dip tube occurs, together with air from the upper space in the bottle. When the bottle restores, the bottom raises and closes the valving plug against the end of the dip tube, keeping liquid in the tube. Also, the relief valve opens, and air easily and quickly flows momentarily into the bottle to relieve the vacuum therein.

Other objects will become apparent to those skilled in the art when the following description is read in connection with the accompanying drawings, in which:

FIG. 1 shows a top part of a squeeze bottle, and a spray cap with a removable flip-top seal.

FIG. 2 is a side view of the dispenser with upper and lower sections. A relief valve is open.

FIG. 3 shows the bottle being squeezed and discharging.

FIG. 4 is a section on line 4—4 of FIG. 3.

FIG. 5 is a section on line 5—5 of FIG. 2.

FIG. 6 is a side view of a smaller squeeze bottle dispenser for one-shot use, showing an upper section.

FIG. 7 shows the small squeeze bottle being discharged.

FIG. 8 shows a modified shank formation.

FIG. 9 is a view like that of FIG. 3, showing another arrangement of relief valve and aerating passages.

In FIG. 1 there is a flip-top seal **10** having a finger piece **12** reinforced by a rib **14**, and a novel angled bottom edge **16**. The seal **10** tightly closes the spray cap **18** to prevent leakage, but because it is yieldable it can be easily flipped off by upward finger pressure on the piece **12**. The diagonal edge **16** makes this removal easy.

The plastic bottle is **20**, being mostly smooth with finger grips **22**, **24** and **26** at one side. The pressing part or finger-press formation of the bottle is novel, at **28**. To make the pressing part quickly return after being pressed, it is made curved and uneven, with wrinkles or corrugations **30** closely spaced, extending only for a part of a circle as in FIG. 5. The corrugations are ribs and grooves. This makes a more rigid wall which tends to return more strongly to its original position, this being an important feature because quick successive operations are possbile with the rigidized wall **30**. A plain or smooth wall would not return so quickly to the original shape.

The spray cap **18** is connected with the discharge tube **32** which is of the conventional plastic material, somewhat stiff and flexible or resilient, and capable of slight

stretching or deformation within the elastic limit. The cap **18** has an air inlet **34** normally closed by a relief valve comprising a disk **36** acted on by a spring **38** in a spring chamber **40**. Drifted portions **42** hold the spring **38** in place. Air is shown entering the bottle, by means of the arrows **44** in FIG. 2, when squeezing is discontinued.

The invention provides a novel valve set-up as follows: The cap **18** has a spray orifice **46** holding a spring **48** in a mixing chamber **50** connected by a hole **52** to the discharge tube **32**. A mixing valve comprising a disk **54** is acted on by the spring **48** and closes a hole **56** in the wall between the chamber **50** and chamber **40**.

When the bottle discharges (FIG. 3), air passes upward (see arow **55**) and into the spring chamber **40**, then displaces the valve disk **54** and mixes with liquid in the chamber **50**. The liquid comes up through the tube **32** from the bottom of the bottle, due to the increased pressure as the bottle is squeezed.

The tube **32** is part of a novel valve cooperating with a movable wall of the bottle, but the movable wall does not need to be smooth or accurately contoured, in accordance with the invention. The bottom of the tube **32** holds an accurate molded plug **58**, which is made with a taper or a cone **60** and a head **62**. The cone **60** is slightly larger than the tube **32**, and can spread the end slightly as in FIG. 2, sealing the tube. The cross section of the plug **58**, at its shaft, has reliefs or grooves. The reliefs or grooves can extend a slight distance into the cone **60**, as shown. It can be like a cross shown in FIG. 4, or it can have a three-rib sectioning like a Y, or it can have a flat strip-like shape obtained by omitting two of the ribs from the cross of FIG. 4.

When the bottle is squeezed (FIG. 3), the bottom **64** which was always pressing upward on the plug **58**, no longer presses upward but moves away or down, and the enlarged bottom edge of the tube **32** in resuming its normal circumference squeezes the cone **60** downward so that the relieved shank of the plug is exposed. FIG. 3 shows the plug **58** in fully dropped position. The downward movement of the plug has been helped by the suction effect between the flat head **62** (normally surrounded by the liquid) and the flat bottom wall **64**. As the wall moves downward it tends to draw the head **62** and plug **58** downward. The liquid can now pass upward, past the shank, being forced up through the tube **32** and mixing with the air in the mixing chamber **50**. This achieves an important object, which is to use the tube and wall as an automatic valve without requiring the wall of the bottle to be especially tooled or made accurate.

The liquid sprays out as seen at **66**. When the bottle is released, the deformed part **28** quickly goes to its original shape, sucking in air through the valve **36**. The bottom wall **64** of the bottle has two semi-circular upwardly off-set parts **68** located inward, with opposed curved edges **70** that form a well. The well connects the grooves **72** and receives the bottom of the tube **32** to keep it confined and straight, and the grooves and well collect the last bit of liquid when the bottle empties.

When the bottle is not squeezed, the bottom of the well **70** presses the plug cone **60** into the tube **32** and closes the tube. This prevents evaporation and loss of the liquid. Also the two valve disks **36** and **54** help prevent loss. There is just the right friction between the shank of the plug **58** and the tube **32** to hold the plug against dropping out during assembly to the bottle. There is not enough friction to defeat the action of the tube in squeezing out the cone **60** when the bottle is squeezed. A Y-section shank on the plug can triangulate the tube cross section to secure only light friction as seen exaggerated in FIG. 8.

The one-shot bottle **71** in FIGS. 6 and 7 is smaller and has a novel corrugated neck **73** mating with corrugations **74** in the cap **76**. Smooth surfaces engaging at **70** provide a tight seal while the corrugations hold the cap from being removed. When the bottle **71** is squeezed (see FIG. 7), the bottom **80** bulges downward to release a plug like **58**, at the bottom of the discharge tube **82**. The bottom **80** is like the bottom of the bottle **20**. A plastic shrink seal **84** is torn off before the first use.

Another embodiment is shown in FIG. 9, wherein a different type of air inlet or relief valve is shown, and a different arrangement of aerating passages.

Similar numbers to those already mentioned indicate similar parts.

The cap **18***a* has a depending central boss **88** with air passages **90** extending past the upper end portion of the dip tube **32**, which latter is press-fitted in the boss. The cap has a central vertical bore **92** carrying a spring **38***a* engaged with a relief ball valve **36***a* cooperating with an air opening **34***a*. A horizontal passage **50***a* connects the orifice **46** with the bore **92**, and the bore **92**, which functions as a mixing chamber, connects with the upper space in the bottle **20** via the passages **90**.

As seen in FIG. 9 squeezing the bottle **20** drops the bottom **64** and valving plug **58** having the grooves **59**, thus unplugging the dip tube **32**. Liquid flows up through the tube **32**, and mixes with air flowing up through the passages **90**. A spray issues from the orifice **46**. When the bottle is released, the bottom **64** quickly raises the plug **58** to stopper the tube **32**, preventing liquid from leaving the tube. The ball **36***a* is temporarily sucked down, opening the vent **34***a*, and air now very quickly rushes down the passages **90** into the upper space in the bottle to relieve the vacuum. The bottle quickly restores itself, and liquid is always ready in the dip tube **32** to be discharged without delay at the next squeeze.

Having thus described the invention, what is claimed is:

1. A squeeze bottle dispenser which includes a resilient plastic bottle having an upper neck portion, a discharge tube which at one end is fixedly carried by said upper neck portion and which extends into the bottle with a free end disposed at a point near an outwardly movable bottom wall, and a stopper plug movable in the free end of the tube and actuated by the said bottom wall, said wall forcing the stopper plug into sealing contact with the free end of the tube when the bottle is not being squeezed, and said bottom wall moving downward and away from the plug to free it for downward movement in a direction away from the tube when the bottle is being squeezed, thereby to admit fluid into the tube past the plug.

2. The article set forth in claim **1**, in which the plug has a tapered valve part which is forced partly into the tube by the said bottom wall, said tube being resilient and at its end stretching slightly within its elastic limit and tending to force the valve outward when the movable bottom wall releases its force on the plug.

3. The article set forth in claim **1**, in which the plug has a shaft in the tube, with reliefs to pass the fluid, and there is just enough press fit to prevent the plug freely falling out during assembly of the dispenser while still permitting it to have valving movement in the tube.

4. The article set forth in claim **1**, in which there is a cup-like spray cap carrying the tube, said cap having: a relief valve for admitting air into the bottle when outside pressure is greater; a mixing chamber connected to the tube; an orifice connected to the mixing chamber, and a mixing valve between the mixing chamber and the inside of the cap, to admit pressurized air from the bottle into the mixing chamber.

5. The article set forth in claim **4**, in which the cap has a spjring chamber holding the relief valve, and in which the mixing valve controls a passage between the spring chamber and the mixing chamber.

6. The article set forth in claim **1**, in which the movable wall has a well where the plug sits.

7. The article set forth in claim **1**, in which the bottle has finger grips on one side and has an uneven curved finger-press formation on its opposite side at the neck, said formation being adapted for the application of finger pressure to it to force the formation inward, said formation tending to return quickly to its original curved shape when finger pressure is removed.

8. The article set forth in claim **7**, in which the uneven

curved formation has parallel ribs and grooves extending in general horizontally and also partly around the upper part of the bottle.

9. The article as set forth in claim **3**, in which the shaft has three ribs for engagement with the tube.

10. The article set forth in claim **2**, in which the plug has a shaft in the tube, with reliefs to pass the fluid, said reliefs extending into the tapered valve part.

11. The article set forth in claim **1**, in which there is a cup-like spray cap carrying the tube, said cap having: a valve for admitting air into the bottle when outside pressure is greater; having a mixing chamber connected to the tube; and an orifice connected to the mixing chamber.

12. The article set forth in claim **11**, in which the cap has air passages extending from the mixing chamber and communicating with the interior of the bottle.

13. The article set forth in claim **12**, in which the cap has a boss wherein the tube is press fitted, the bore of said boss having said air passages.

14. The article set forth in claim **11**, in which the mixing chamber is aligned with the top end of the tube, said

valve being disposed at the top of the mixing chamber, said cap having a vent opening cooperable with the valve.

15. The article set forth in claim **14**, in which there is a spring in the mixing chamber, engaged with said valve.

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