July 11, 1961 L. T. WARD 2,991,917

METERING VALVE ASSEMBLY HAVING STEPPED-BACK PLUNGER

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Fig. 1.

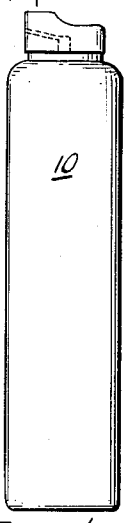


Fig. 2.

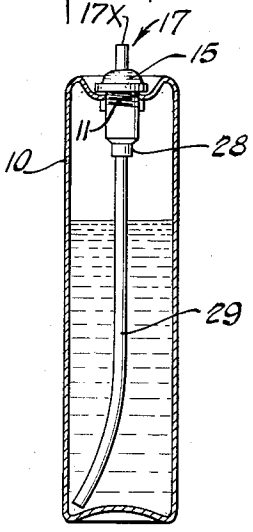


Fig. 3.

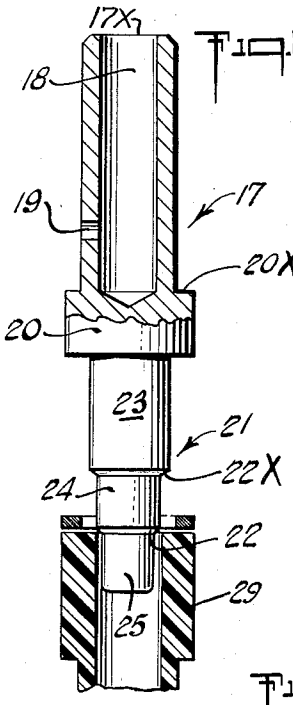


Fig. 4.

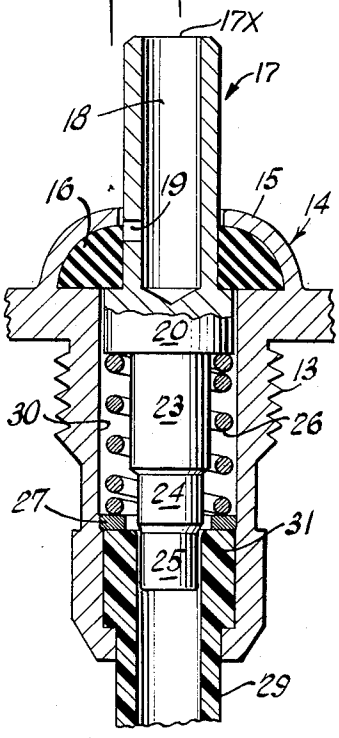


Fig. 5.

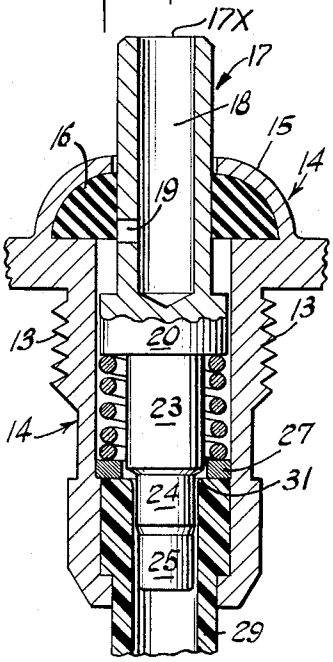
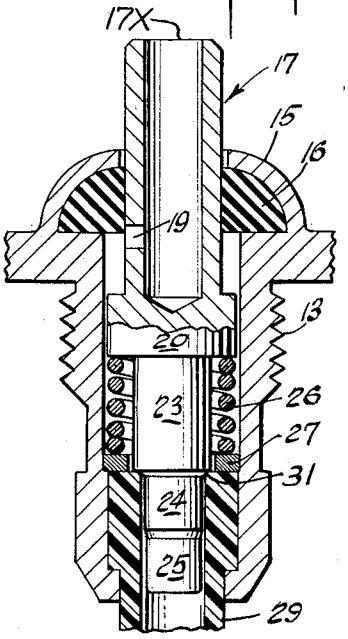


Fig. 6.



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Fig. 7

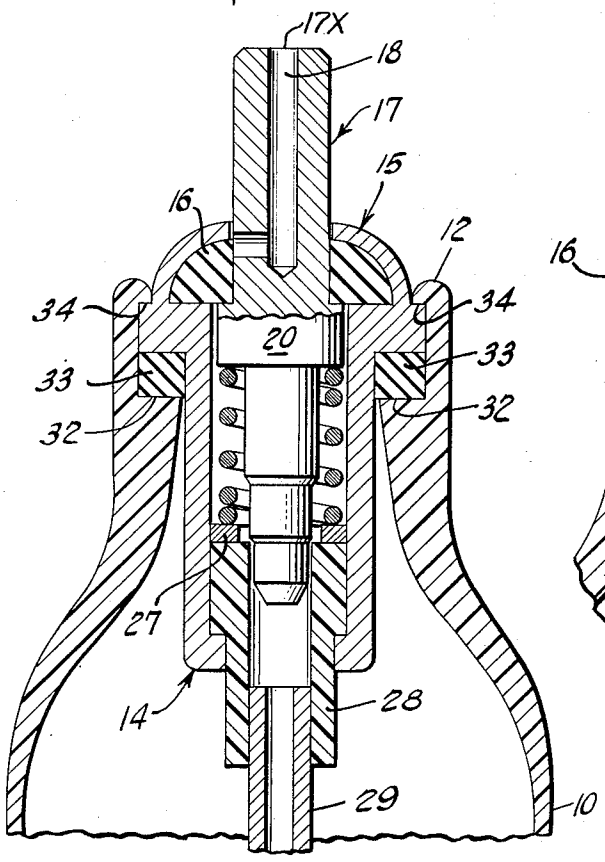
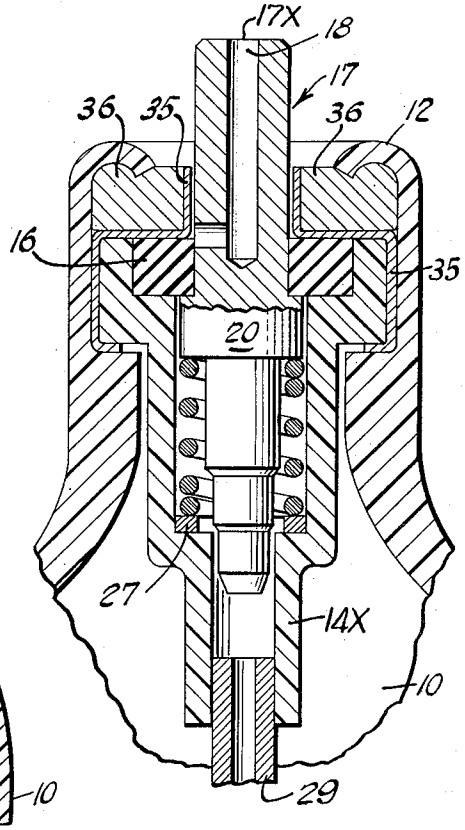


Fig. 8



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METERING VALVE ASSEMBLY HAVING STEPPED-BACK PLUNGER

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3 Claims. (Cl. 222—394)

This invention relates to a spray valve assembly or structure and more particularly to a spray valve assembly having a graduated plunger and adapted to spray a metered or measured amount of low boiling liquid propellant.

It is an object of this invention to provide a spray valve adapted to convey all the contents of a reservoir.

It is another object of this invention to provide a spray valve assembly having a reservoir and adapted to have its reservoir contents propelled completely out of the valve housing by the pressure of the mass of liquid propellant communicating with the reservoir contents.

It is another object of this invention to provide a spray valve assembly for dispensing a measured amount of a mixture of perfume dissolved in a suitable low boiling propellant solvent, said valve being constructed so as to prevent separation of the perfume substance from the liquid propellant solvent during the evacuation of the reservoir chamber of its contents.

It is another object of this invention to provide a perfume dispenser adapted to steadily dispense a metered amount of perfume containing low boiling propellant solvent having a uniform perfume concentration during the entire spray formation.

It is another object of this invention to provide a valve and a co-acting container adapted to engage said valve in a simple gas-tight manner.

These and other objects and advantages of this invention will become apparent upon reading the descriptive disclosure in conjunction with the plurality of embodiments shown in the drawing in which,

FIG. 1 is an exterior view of a purse size finger operated perfume dispenser.

FIG. 2 is a vertical section view of the container of the dispenser of FIG. 1 and showing a removably secured valve assembly having a syphon tube secured thereto, screw threaded into said container.

FIG. 3 is a detail view partly in section of the plunger having a stepped back or truncated pyramid cut-off for gradually and selectively cutting-off the mass of propellant normally in continuous pressure exerting contact with the propellant disposed in the valve reservoir.

FIG. 4 is a section view of the spray valve of this invention showing the normal non-operating position of the plunger and with the reservoir contents in continuous communication with the contents of the syphon tube.

FIG. 5 is a view similar to that of FIG. 4 but showing the plunger depressed to effect a liquid tight but not gas tight seal between the appropriate plunger surface and the interior wall of the syphon tube and permitting the reservoir contents to be propelled out of the reservoir and into the exit conduit of the plunger.

FIG. 6 is a view similar to that of FIG. 5 but showing the plunger fully inserted and seated in gas tight relationship with a top portion of the syphon tube.

FIG. 7 is a detailed section view taken through the valve and secured in a gas tight but non-screw-threaded manner to a container for liquid propellant and,

FIG. 8 is a detailed section view showing a modified manner of securing a valve assembly non-threadingly to a high pressure liquid propellant containing container.

A container **10** (FIG. 2) adapted to resist the pressure of low boiling liquid propellants such as Freon is provided with a screw threaded aperture **11** or a hawk-nosed aperture **12** (FIGS. 7 and 8). The screw threaded aperture **11** is adapted to engage the screw threads **13** (FIGS. 4, 5 and 6) of the valve assembly of this invention, while the hawk-nosed aperture (FIGS. 7 and 8) is rolled over upon the valve assembly, forming in either case a valve secured to a container in a gas tight manner with the bore aperture walls of the sealing gasket **16** yieldably gripping the plunger top section **17***x* to form a seal therewith.

The valve housing **14** is generally of tubular construction and may be provided with screw threads **13** or without screw threads (FIG. 7). In the modifications of FIGS. 4 to 7 the housing **14** is provided with a cylindrical collar **15** adapted to be turned over to form an apertured dome which latter seizes a gasket sealing ring **16**.

In FIG. 8 the valve housing **14***x* is of a modified construction being provided with a suitable recess to receive a gasket sealing ring **16**.

In the valve of this invention the plunger **17** of all the valve assembly modifications is identical and consists of a top section **17** having a tubular conduit **18** axially disposed therein communicating with a lateral branch conduit **19** leading to the outside.

A middle cylindrical plunger section **20** of larger diameter is disposed integrally with said top plunger section thereby forming a shoulder **20***x* therebetween.

The bottom section **21** of the plunger of this invention is of unique construction and is formed from a plurality of integrally united cylinders of successively diminishing diameter to give the appearance of an extended telescope, i.e. a stepped-back or truncated pyramid effect. The plunger bottom section **21** consists of three cylinders of successively varying diameter having a beveled shoulder **22** therebetween. As shown in FIG. 3, the bottom plunger section **21** consists of a depending first cylinder **23** of larger diameter integrally united to a successive depending cylinder **24** of lesser diameter which latter is in turn integral with a cylinder **25** of smallest diameter.

As shown in FIGS. 4 to 8, the plunger **17** is disposed in the tubular valve housing **14** which is provided with a well cavity of a diameter slightly larger than that of the middle section **20** so that a passageway for liquids is provided therebetween.

A coil spring **26** is disposed about the lower section of the plunger **17**, the top of which engages the bottom shoulder of the plunger middle section **20**. The bottom of the coil spring may rest upon a ring **27** placed directly upon the well cavity bottom of the housing **14***x* as shown in FIG. 8, upon a ring **27** disposed upon the upper part of removable insert **28** as shown in FIG. 7, or upon a ring **27** resting directly upon the upper portion of a syphon tube **29** as shown in FIGS. 2–6.

The insert **28** and syphon tube **29** may be an integral unit of plastic if so desired to give a single piece construction as shown in FIGS. 3–6. The housing and other metal parts may be of brass or preferably of aluminum for perfume mixtures. Of course other sprayable mixtures or drug applications can be sprayed in metered amounts from the valve and the dispenser of this invention. The insert **28** of FIG. 7 or the single unit syphon tube insert combination of FIGS. 3–6 is held within the valve housing **14** by conventional means such as a ledge provided therefor.

In the non-operative condition (FIG. 4) of the valve of this invention, the coil spring **26** presses the plunger **17** continuously upwardly to effect a gas tight seal between shoulder **20***x* and gasket sealer ring **16**. In this non-operative condition (FIG. 4) the smallest cylinder of the bottom plunger section cylinder **21** is disposed loosely in the syphon tube **29** thereby permitting the liquid under pressure to be forced into the reservoir

formed between the well cavity wall **30** and the surface of the cylinders **24** and **23**.

In FIG. 5 the plunger is shown in an initially depressed position. In this condition cylinder **24** has been pushed into the conduit of syphon tube **29** so that a narrow annular passageway is formed permitting propellant gas or vapor but not liquid to pass therethrough, thereby forcing the liquid contents completely out of the reservoir into the lateral exit conduit **19** before separation of the perfume substance can be effected from the liquid propellant, said propellant being cooled due to expansion effect of changing a liquid to a gas upon being forced into the atmosphere of lower pressure than the pressure present in the container **10**.

Further continued gradual movement of the finger of an operator upon the top section of plunger **17** causes the plunger beveled edge **22***x* disposed between cylinders **24** and **23** to engage the appropriate beveled or rounded annular valve seat **31** of syphon tube **29** forming a gas tight seal (FIG. 6).

The valve assembly of this invention is a subcombination unit manufactured separately. It may be screw threaded to a container **10** or secured otherwise to a container adapted to withstand high pressure.

In FIG. 7 there is shown a container **10** provided with a nozzle terminating in a beaked or hawk-nosed rim **12** having a ledge **32** adapted to engage a resilient sealer ring **33**. In this modification the valve housing **14** is provided with a circular shoulder **34** adapted to engage rim **12**. The seizure pressure of rim **12** is disposed on the housing portion and the ring **33** disposed in turn upon ledge **32** to form a gas tight pressure resistant seal.

In the modification of FIG. 8 a modified manner of effecting a juncture between the valve assembly and container **10** is employed. In this modification the gasket sealing ring **16** is disposed upon a suitably recessed ledge above the well cavity and slidingly engages the top plunger section **17***x*.

In all modifications (FIGS. 4–8) of this invention the apertured sealing gasket **16** has the bore walls thereof yieldably gripping the said top portion **17***x* of cylindrical plunger **17** to form a continuous seal therewith.

A flanged member **35** is rolled or turned about the housing **14***x* and the gasket **16** (FIG. 8) to secure the ring immovably to said housing, thereby retaining captively said plunger **17** in the well cavity. Preferably a resilient rubber or plastic securing ring **36** is disposed upon the rolled-over flanged member **35** and the beaked rim **12** is pressed over to immovably seize said ring **36**. In this modification (FIG. 8) the flanged member **35** is seized between the two resilient rings **16** and **36** to form a gas tight seal to prevent loss of propellant.

For the dispensing of drug solutions or liquid pharmaceutical solutions having propellant liquid, the container, the tube, the plunger and the valve housing may all be selectively made of glass or plastic to prevent metal contamination, particularly where the solution is corrosive to metal. The parts may optionally or selectively be made of stainless steel or other corrosion resistant metal.

Normally a liquid propellant is about 20 percent gas phase and 80 percent liquid phase. The gas pressure in the container forces the liquid up the syphon tube into the valve housing reservoir.

Also the valve spring need not be disposed in the reservoir as it may be secured to the plunger stem protruding exteriorly from the valve housing, and the spring may then be bow-shaped in lieu of being coiled.

In the plunger of this invention, the lowermost bottom cylinder is always in the tubular orifice leading into the reservoir in the valve housing, and being of a considerably smaller diameter than the tube, the passage of liquid is rapid and substantially unhampered therebetween. But upon the successive insertion of the next larger cylinder into the tubular orifice, the clearance between the cylinder and the tubular wall is selected to be so small as to permit passage of gas molecules but not of a film of liquid, that is, the reservoir contents are under these conditions exposed to gas or vapor pressure but not to liquid pressure. Consequently the reservoir does not keep filling up with more liquid but rather the metered liquid therein is swept out of the reservoir by said gas molecules coming through the reservoir inlet orifice.

This invention was described by means of illustrative embodiments but clearly other embodiments are within the scope thereof, said embodiments falling within the ambit of the claims herein.

While this invention has been described particularly in connection with a perfume dispenser, it is contemplated that the metering valve which forms the subject thereof can be used to dispense metered quantities of a variety of other products packaged under pressure in vessels containing liquefied gas or compressed gas propellant. For example, it is contemplated that the valve of this invention can be advantageously used in the dispensing of foam products such as whipped cream, shaving cream and the like.

I claim:

1. A spray valve assembly for spraying liquid propellant, comprising a housing adapted to be secured to a container, said housing having a tubular well cavity therein; a plunger longitudinally movable in said cavity and having a bottom closure section comprising three integrally united cylinders successively diminished in diameter toward the end of the plunger, said housing having an apertured bottom wall and annular valve seat means therein, adapted to consecutively receive the cylinders of the bottom closure section of the plunger, said valve seat means having a diameter only very slightly larger than that of the middle cylinder whereby the disposition of the latter in the valve seat means effects a stoppage of liquid through the same while permitting gas to flow, and whereby the disposition of the cylinder of largest diameter in the valve seat means effects a complete stoppage of fluid through the said means.

2. The invention as defined in claim 1, in which there is a syphon tube connected with the apertured bottom wall of the housing, said syphon tube having the said annular valve seat means which is engaged by the bottom closure section of the said plunger.

3. In a metering valve structure for the closure of gas-tight pressure containers of the type including a valve body adapted to be sealed gas-tight to the container and having a channel through said body adapted to lead from the interior to the exterior of the container, a valve plunger slidably mounted in a portion of said channel, means actuatable from the exterior of the container for sliding said plunger, and a first valve means actuated by said plunger normally sealing said channel gas-tight and unsealing when said plunger is moved from a predetermined position in one direction in said channel; the improvement comprising a reservoir cavity in said channel inward of said first valve means and a second valve means actuated by said plunger normally open and sealing said channel gas-tight inward of said cavity when said plunger is moved to a predetermined position in the same direction in said channel; said second valve means being so proportioned and arranged that in passing from its open state to the state of gas-tight seal it passes through an intermediate state of liquid-tight but not gas-tight seal of appreciable duration, said second valve means comprising an annular valve seat of predetermined diameter and a three-step cylindrical rod actuated by the plunger arranged concentric with and normal to said seat with the lowermost cylindrical step within said seat when said valve means is open, said lowermost step being of smallest diameter and clearing said seat sufficiently to permit liquid passage between it and said seat, the intermediate step being of intermediate diameter and introduced within

said seat by motion of said plunger, the diameter of said intermediate step being such as to afford a gas passage but a liquid closure with said seat, and the outermost step being of largest diameter, the diameter of said outermost step being greater than that of said seat, whereby said outermost step may be pressed into gas-tight seal with said seat by actuation of said plunger.

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