

April 26, 1966

L. SCHULMAN ETAL

3,248,022

ATOMIZER PUMP

Filed June 21, 1963

3 Sheets-Sheet 1

FIG. 2

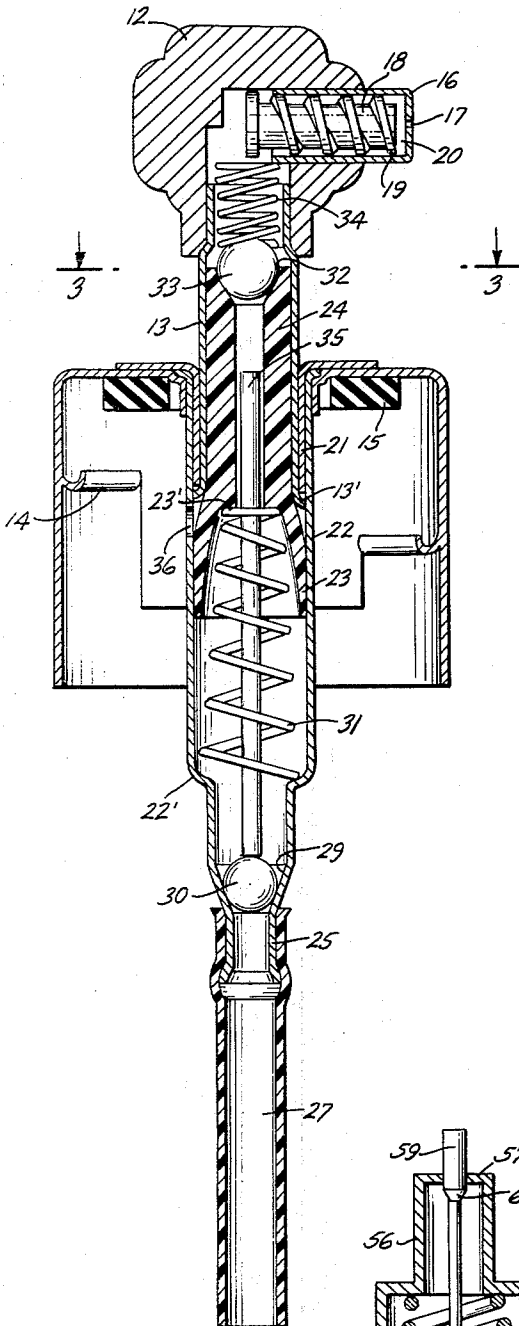


FIG. 1

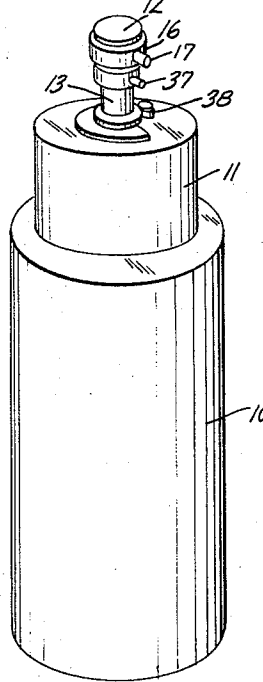


FIG. 3

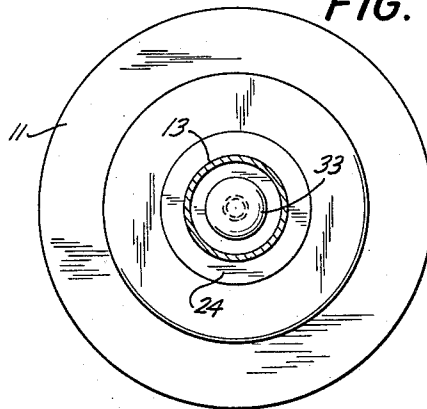
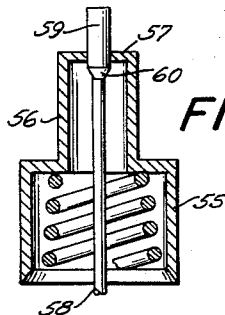


FIG. 7



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3 Sheets-Sheet 2

FIG. 4

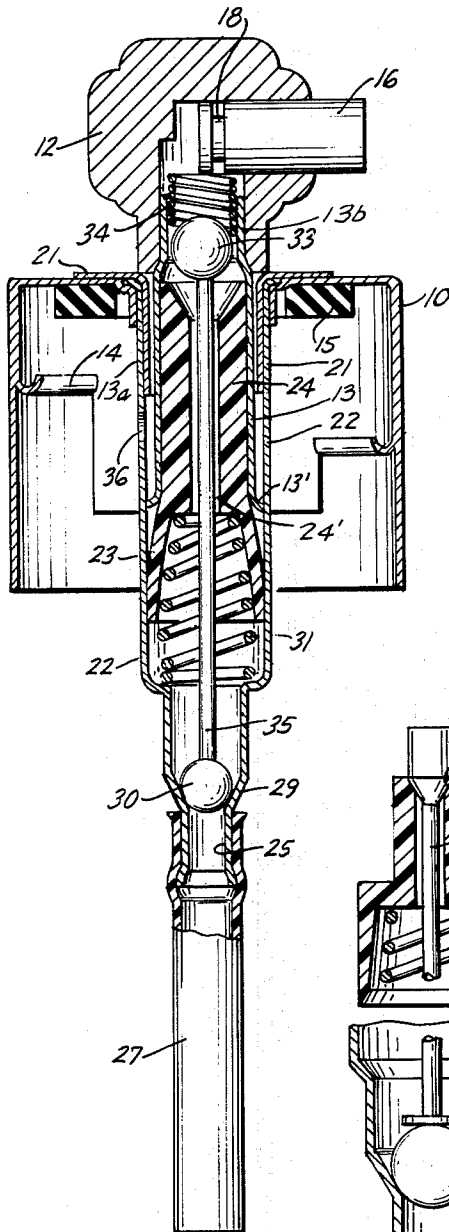


FIG. 5

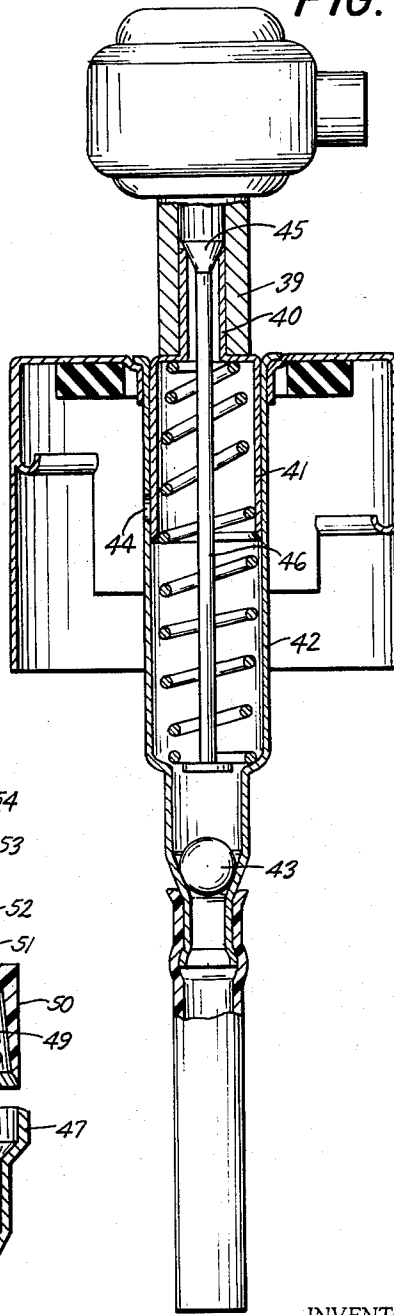
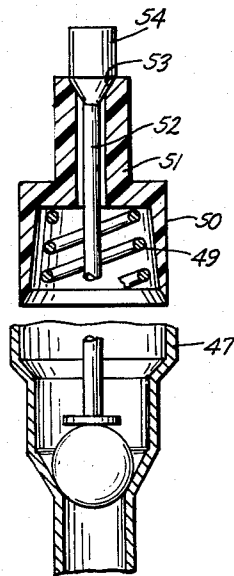


FIG. 6



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3 Sheets-Sheet 3

FIG. 8

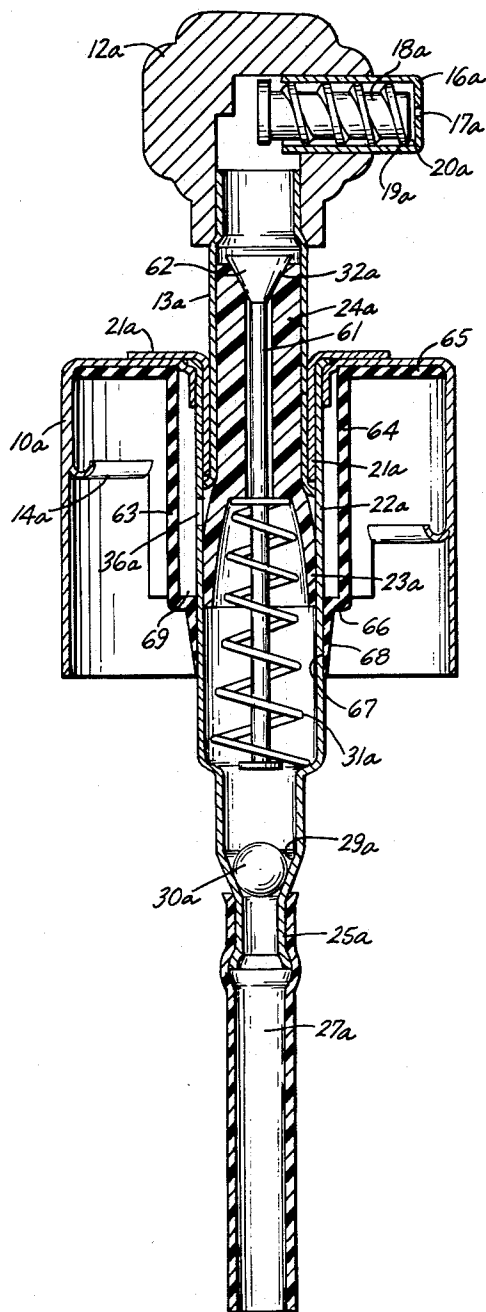
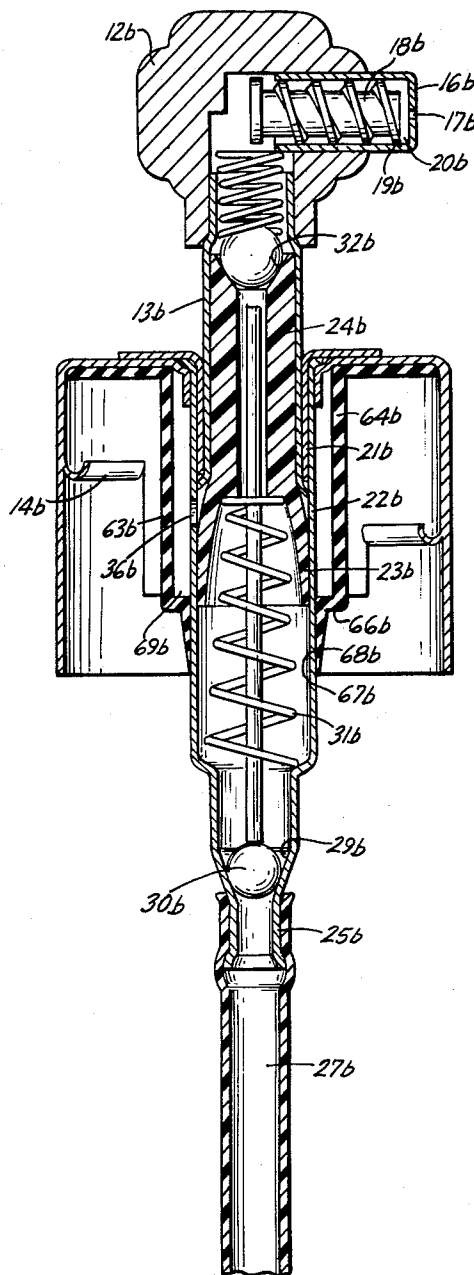


FIG. 9



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1

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ATOMIZER PUMP

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8 Claims. (Cl. 222—321)

This application is a continuation-in-part of our prior copending application for United States Letters Patent entitled "Atomizer," which was filed June 11, 1962, and which bears Serial No. 201,482; that application being now abandoned.

This invention relates to a structurally and functionally improved liquid atomizer, and especially an apparatus utilized for the dispensing of perfumes, colognes, toilet waters and the like.

It is an object of the invention to furnish a structure by means of which a desirable spray will be created with minimum effort and which when not operated will serve to efficiently seal the liquid to be atomized—free from leakage—within its container.

Another object of the invention is that of providing an atomizer structure which will be of simple design and capable of economical production with the units operating over long periods of time with freedom from difficulty.

With these and other objects in mind, reference is had to the attached sheets of drawings illustrating practical embodiments of the invention, and in which:

FIG. 1 is a perspective view of an atomizer mounted upon a liquid containing receptacle;

FIG. 2 is a sectional side view in enlarged scale of one preferred form of atomizer constructed in accordance with the teachings of this invention and showing that assembly in projected position;

FIG. 3 is a sectional plan view taken along the lines 3—3 in the direction of the arrows as indicated in FIG. 2;

FIG. 4 is a view similar to FIG. 2 but showing the atomizer head in retracted or depressed position;

FIG. 5 is also a view similar to FIG. 2 but illustrating an alternative form of structure;

FIG. 6 is a view corresponding to FIGS. 2 and 5 but showing a still further alternative design;

FIG. 7 illustrates in section a further preferred form of valve and piston structure;

FIG. 8 illustrates in section another form of valve and piston structure; and

FIG. 9 illustrates in section a further form of valve and piston structure.

The atomizer will normally be associated with a receptacle so as to be capable of attachment thereto rather than forming an inseparable part of the receptacle assembly. Thus, as shown in FIG. 1, the numeral 10 indicates a receptacle of desired configuration and which conveniently has its neck portion formed with screw threads (not shown) to be enclosed within a cap 11, forming a part of the atomizer proper. A nozzle head 12 is disposed above the upper cap surface and mounted on actuator stem 13b of piston assembly 13. The interior of the cap is conveniently provided with inwardly extending portion 14 furnishing an interrupted screw thread for cooperation with the thread of the receptacle neck. Also, the inner surface of the upper cap portion preferably has associated with it a sealing ring 15 of rubber or other suitable material. This ring may be retained in position in any desired manner and will bear against the pouring lip of the receptacle neck to prevent an escape of liquid past its surface.

Extending from the nozzle head 12 in a lateral direction, is a shell 16 conveniently formed of metal and provided with an orifice 17 at its outer end. Disposed within

2

the shell is a stem 18 conveniently provided with a spirally extending fin 19, and spaced from the inner surface defining the orifice 17, so that air may flow between the convolutions of the fin and intermingle with liquid passing through a bore (shown in phantom in FIG. 2) of stem 18 in the mixing chamber 20 intervening the outer surface of the stem and the opposed inner face of shell 16. If no bore is provided through the stem, then both air and liquid will flow between the fin convolutions. Both the shell and stem project into a vertically extending bore formed in head 12, for a purpose hereinafter brought out.

The upper portion of the piston assembly 13 conveniently includes a metallic tube 13a. This tube is flared in an outward direction adjacent its lower end as indicated at 13'. A bushing 21 is interposed between the tube and an outer tube 22 which latter provides a cylinder. The assembly moreover includes member 24 having a flexible skirt portion 23, having wiping engagement with the cylinder wall; the upper end of this skirt being continued in the form of a bored extension. This part of the piston assembly is preferably formed of a material having inherent resiliency.

Cylinder 22 may be reduced adjacent its lower end as indicated at 25 and mount a flexible tube portion 27 which will conveniently have a length such that it will extend adjacent the lower end of a receptacle with which the atomizer structure is associated. A flared surface 29 intervenes the main body 22 of the cylinder and its reduced lower portion 25. It is apparent that the latter might be extended downwardly any desired distance if it is preferred not to attach a flexible tube 27 thereto. In any event, flared surface 29 provides on its inner face a seat for a valve structure which will also include valve member or body 30. Member 30 is the familiar ball check valve known in the art and is normally maintained on this seat by the force of gravity or the weight of material above it.

A spring 31 is provided within cylinder 22 and confined in the space between shoulder 23' formed in skirt 23 and shoulder 22' in cylinder 22. A second valve structure is provided adjacent the upper zone of the atomizer. That structure conveniently includes a flared portion 32 defining the upper end of the bore extending through member 24. This furnishes a seat for valve member or body 33. The latter is normally maintained on its seat by virtue of the fact that the lower end of a spring 34 bears against it. The upper end of the spring conveniently thrusts against the inner end of shell 16 and/or stem 18.

To assure an unseating of valve 33 each time head 12 is retracted against the compression of spring 31, a rod 35 is provided within bore 24' of member 24 and freely movable longitudinally therein when the head 12 is in the non-depressed or raised position shown in FIG. 2. The lower end of rod 35 extends downwardly within cylinder 22. The diameter of this rod is such that it extends with ample clearance within the bore 24'.

Its length is proportioned to the movement of the head so that when the latter is depressed the upper end of the rod bears against valve body 33 with its lower end against valve body 30 to cause body 33 to be displaced from its seat 32 as seen in FIG. 4.

Finally with regard to the form of structure shown in FIGS. 2, 3 and 4, it will be observed that a venting opening 36 is formed intermediate the ends of cylinder 22. The proportioning of the parts is such that with the nozzle head in an upper position, as in FIG. 2, this opening is unobstructed by tube or shell 13. As shown in FIG. 4 when the head of the assembly is depressed then the flared portion 13' of tube 13 will extend below opening 36. Upward movement of the member 24 under the influence of spring 31 is limited by the lower edge zone 13' of tube 13 engaging the lower edge of bushing 21.

3

The piston assembly which consists of member 24 and tube 13a has a sliding fit with the upper portion of the closure so as to prevent the escape of liquids therethrough under normal operating conditions.

In operation it will be understood that the atomizer may be applied to a receptacle such as 10 by having cylinder 22 or any extension thereof disposed within the receptacle, and engaging the mounting cap 11 with screw threads of the receptacle neck to furnish a sealed structure.

In FIG. 4 the device of FIG. 2 is shown with head 12 in depressed position.

Upon head 12 being depressed against the action of spring 31 the assembly will be shifted to the retracted or depressed position shown in FIG. 4 wherein the lower end of rod 35 is maintained adjacent valve 30 with the upper end of rod 35 adjacent valve 33 and spring 34 compressed. Upon release the head 12 will rise under the combined action of springs 31 and 34 and the piston will exert a suction effect to draw liquid through tube 27 into cylinder 22. A return flow of liquid is prevented by valve 30.

A second depressing of head 12 will compress the air within the cylinder 22. This will displace liquid within cylinder 22 upwardly into the bore of extension 24. In that position the lower end of rod 35 will engage ball 30 and the upper end of rod 35 will engage ball 33 of the upper valve structure displacing it from its seat 32 and against the action of spring 34. Accordingly, fluid within the bore of extension 24 will not have to overcome the seating pressure of the valve body in order to flow towards the nozzle. The liquid together with the air passing through the bore of the piston assembly will move into the nozzle. An atomized mixture will be discharged through orifice 17 from chamber 20. If desired and as indicated in FIG. 1 the nozzle may also carry a pin 37 extending outwardly therefrom and capable of being engaged by a latch extension 38 carried by the cap. Thus, a detent structure is feasible to maintain the nozzle head and piston assemblies in retracted positions if this is desired.

In devices of this type it is necessary that air be permitted to enter the container or receptacle 10 from the exterior in order to replace the fluid which is being discharged. This is often referred to as a venting action. Prevention of leakage upon inverting the container when not in use is a critical consideration. However, often in providing a structure having provision for satisfactory venting the result is an ineffective seal allowing leakage of liquid from the container when it is inverted.

In the present invention this difficulty is overcome and satisfactory venting as well as prevention of leakage has been accomplished.

The seal provided herein between the receptacle and the outside atmosphere is of such construction that upon the creation of suction and the movement of liquid from the container proper into cylinder 22 the pressure within the container goes below atmospheric forcing replacement air to enter the container through the seal members, between cylinder wall 22 and upper end 13, and vent hole 36. When the bottle is inverted, however, the gravity pull upon the liquid therein and the pressure within the container do not develop a force great enough to move the liquid out of the container.

In other words, in the retracted position of the piston device as shown in FIG. 4 flared portion 13' is below vent opening 36 allowing exterior air to pass through the cylinder and vent opening into the receptacle but when the piston device is in the projected position shown in FIG. 2 flared portion 13' is above the vent opening 36 preventing the passage of the receptacle content out of the receptacle through the vent opening and the cylinder. Skirt 23 is between the vent opening 36 and the cylinder inlet at flared surface 29 in both the projected and retracted positions of the piston device, preventing passage of the content of the receptacle through the cylinder into vent opening 36.

In the structure shown in FIG. 5, the nozzle head is

4

continued downwardly in the form of a tube 39, conveniently enclosing a second tube portion 40. The latter forms a part of the piston assembly and is continued in a downward direction by a skirt portion 41, preferably integral therewith. That skirt slidably wipes against the inner face of a cylinder 42. The latter, adjacent its lower end, embraces a valve structure indicated at 43 and corresponding to the parts heretofore described in connection with numerals 29 and 30.

As will be seen in this form of device it is in many instances feasible to dispense with the portion 23-24 of the assembly previously described. Instead, the skirt 41 will itself wipingly engage the bore face of cylinder 42, so that during reciprocation air will be compressed within cylinder 42 or vented through opening 44. Adjacent the upper end of tube or neck 40, an upper valve structure is disposed which in this embodiment embraces the seat defined by the upper edge zone of the neck and with which a valve member 45 cooperates. That valve will have secured to it the upper end of rod 46.

The parts shown will function in a manner similar to the like parts of structure heretofore described. Again, liquid within cylinder 42 will not have to overcome the seating pressure of valve body 45 as the nozzle head is depressed. Rather the instant a retractive movement occurs, the structure of the upper valve will be open for the free flow of liquid and air to the nozzle of the unit. In the raised position of the nozzle head as shown in FIG. 5, valve body 45 will seat against the upper edge of the tube 40 and thus maintain any liquid above the valve structure in the passage extending towards the orifice of the nozzle.

An alternative form of valve structure has additionally been shown in FIG. 6. In that view the numeral 47 indicates the cylinder provided at its lower end with a valve structure 48 as heretofore described. Spring 49 has its upper end thrusting against the inner or lower face of piston element 50, corresponding to the unit 23-24 of FIG. 4 or the unit 41 of FIG. 5. A bored extension 51 preferably forms an integral part of the piston proper and the piston assembly.

The bore of that extension is of such a diameter that a rod 52 may slidably extend therethrough with ample clearance. The upper end of extension 51 provides a valve seat 53. Rod 52 is connected at its upper end with a valve body 54 which may simply be defined by a flared extension of rod 52. Again it will be seen that with the other parts of the apparatus heretofore described combined with the structure of the type shown in FIG. 6, that the advantages heretofore outlined are again present.

Referring to FIG. 7, a form of an upper valve assembly has been shown. It includes a piston conveniently formed of metal embracing a skirt portion 55 and an upper tubular extension 56 terminating in transverse wall 57. A rod 58 corresponding to rod 52 will have its lower end preferably secured to the body of the adjacent valve. Its upper end will fixedly carry a cylindrical member 59 having a lower tapered face 60. Upper wall 57 is formed with an opening of a diameter such that just enough clearance exists for the slidable accommodation of body 59.

The edges defining the opening will be reduced due to the fact that wall 57 is quite thin. Therefore, the danger of the valve body binding in this opening will be minimized. When its main portion fills the opening an effective control of flow is achieved. When the tapered face 60 is in line with the opening of wall 57 then a substantially unrestricted flow will occur. The operation of this form of unit in the atomizer assembly will otherwise be the same as previously described.

In FIG. 8 an alternate embodiment is shown and in this figure the parts which are identical to parts shown in FIG. 2 are given the same numbers as in FIG. 2 with a lower case "a" following. It is noted that the device of FIG. 8 has a rod within the bore of part 24a which is given the number 61 and which resembles the rod 45 of

5

the embodiment of FIG. 5. The operation of rod 61 in FIG. 8 is as previously described so that depressing of member 12a causes the parts to move downwardly against the action of spring 31a and causes the lower portion of rod 61 to move adjacent ball 30a, resulting in the unseating of the head portion 62 of rod 61 thereby allowing liquid to flow from chamber 22a. It is noted, however, that in the embodiment of FIG. 8 a rubber sealing member 63 is provided. Member 63 has not been shown in previous embodiments and consists of a cylindrical body portion 64, a peripheral outwardly directed flange 65 adjacent the upper surface of container 10. Member 63 also has a lower inwardly directed shoulder 66 joining portion 64 and a portion of member 63 adjacent the outer wall of cylinder 22a. The portion of member 63 in adjacency with the outer wall of cylinder 22a is indicated by the numeral 67 in FIG. 8 and the outside surface thereof is indicated by a numeral 68. The surface 68 is exposed to the contents of container 10 and is angularly formed so that the portion bounded by surfaces 67 and 68 continually decreases in thickness as it moves away from the main body of member 63 providing a membrane. It is noted that central portion 64 of member 63 provides with the outer wall of cylindrical member 22a a chamber 69. It has been found that this structure results in a very effective seal preventing leakage of liquid from within container 10 and allowing the satisfactory venting of the container to allow air to replace the liquid removed therefrom. Upon the extraction of liquid from the container and into cylinder 22a air is allowed to enter the container by being forced by the higher atmospheric pressure external of receptacle 10a between bushing 21a and the adjacent surfaces, through vent hole 36a into chamber 69 and into the container by passage between surface 67 of the membrane which expands under the operative pressure and the portion of cylinder 22a adjacent thereto; permitting air to flow into the receptacle 10a.

Leakage, however, is prevented since inverting the container results in an additional force coming into being, that is the force of the weight of the liquid against surface 68 of membrane 63 providing thereby an additional seal against leakage of liquid out of the container.

FIG. 9 is a cross-sectional view of another embodiment of the invention which substantially incorporates the invention of FIG. 2 together with the sealing arrangement of FIG. 8. In FIG. 9 parts identical to parts disclosed in the embodiment of FIG. 2 are given the same numbers as given therein with a lower case "b" following and the sealing member of FIG. 9 being identical to the sealing member of FIG. 8 is given the same numbers as given in FIG. 8 with a lower case "b" following.

Thus, among others, the several objects of the invention as specifically aforementioned are achieved. Obviously, numerous changes in construction and rearrangement of the parts may be resorted to without departing from the spirit of the invention as defined by the claims.

We claim:

1. An atomizer pump construction comprising, in combination: a pump cylinder adapted to be mounted on a container and having an inlet to enable it to receive liquid from the container, a piston assembly reciprocable in the cylinder between first and second positions to effect a pumping of liquid, said piston assembly including a hollow cylindrical sleeve with an outwardly flared lower end and a resilient member within said sleeve having a downwardly and outwardly projecting flexible skirt portion, said flared lower end and said flexible skirt portion slidable on and along the inside wall of the cylinder and engaging the cylinder at two annular areas of contact which are axially spaced apart, and further having an actuator stem portion passing out of the cylinder, positive-acting, venting valve means opened and closed by

6

the piston assembly, said valve means comprising said flared end and being opened by said piston assembly to enable exterior air to pass through the cylinder for introduction into the container when the piston assembly is in the second position, said valve means being closed by the piston assembly to prevent said passage of air when the piston assembly is in the first position, said flexible skirt portion being between said valve means and said inlet in both positions of the piston assembly with said cylindrical sleeve constituting a relatively rigid piston element holding the piston assembly and said flexible skirt portion against lateral movement in the cylinder, and means providing discharge passage from the cylinder.

2. An atomizer pump construction in accordance with claim 1 in which the means providing a discharge passage from the cylinder includes a longitudinal passage formed in said resilient member, a first check valve structure provided in said longitudinal passage, and a second check valve structure is provided at said inlet.

3. An atomizer pump construction in accordance with claim 2 in which a rod is interposed between said first and second check valves which upon abutting said first check valve opens the same, and the distance between said first and second check valves is greater than the length of said rod in the first position of said piston assembly and less than the length of said rod in the second position of said piston assembly whereby one end of said rod abuts said second check valve and the remaining end of said rod abuts said first check valve opening the same.

4. An atomizer pump construction in accordance with claim 1 in which a bearing bushing is provided in said cylinder at the uppermost end thereof for engagement with the cylindrical sleeve of said piston assembly to steady the latter.

5. An atomizer pump construction in accordance with claim 4 wherein the outwardly flared lower end of said cylindrical sleeve is engageable with the end of said bearing bushing to constitute a stop for the piston assembly in the first position thereof.

6. An atomizer pump construction in accordance with claim 1 in which a resilient sleeve is provided surrounding the pump cylinder and said vent opening, said sleeve preventing any continuous flow of fluid through said vent opening into the cylinder and yielding outward to enable opposite fluid flow through said vent opening.

7. The invention as defined in claim 6, wherein the portion of the sleeve which surrounds the vent opening is spaced from the cylinder, said sleeve having a free yieldable end snugly fitting the cylinder.

8. The invention as defined in claim 6, wherein the sleeve has a free yieldable end tapering in thickness to present an inclined outer wall and which snugly fits the cylinder.

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