

[54] TWO-PIECE SUCTION PUMP

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417/479, 417/566

[51] **Int. Cl.**..... **B65d 37/00, F04b 43/00**

[58] **Field of Search**..... 417/479, 566, 569,
417/570, 571, 563; 222/207, 209, 335

[56] **References Cited**

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[57]

ABSTRACT

An inexpensive, easily assembled two-piece liquid dispensing pump for a container. A relatively rigid cap member, having a central passageway into the container, is engaged to the finish or mouth portion of the container. A deformable member having a resilient dome is engaged to the cap member and cooperates therewith to define a fluid receiving chamber. The deformable member has (1) an integral check valve adapted to close the cap member's central passageway, (2) integrally molded fluid passages in a depending skirt, and (3) a fluid dispensing orifice integrally molded into the depending skirt and connected to the fluid passages. The pump, when in position on a container filled with liquid, is operated by sequential depression and release of the dome of the deformable member, thereby creating a partial vacuum to draw liquid from the container into the chamber from which it is dispensed.

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13 Claims, 6 Drawing Figures

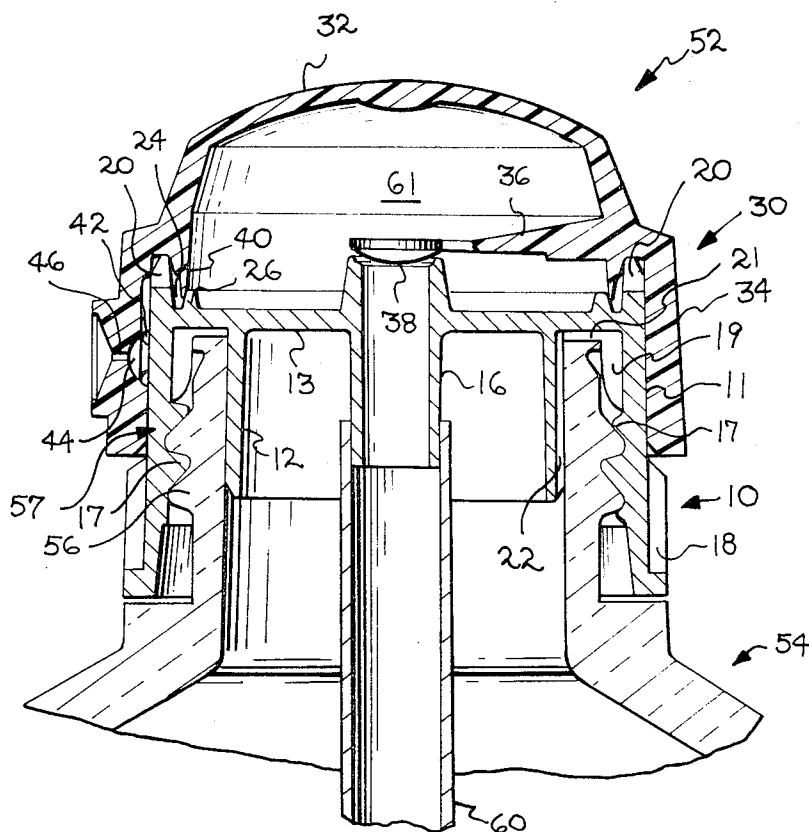


FIG. 1

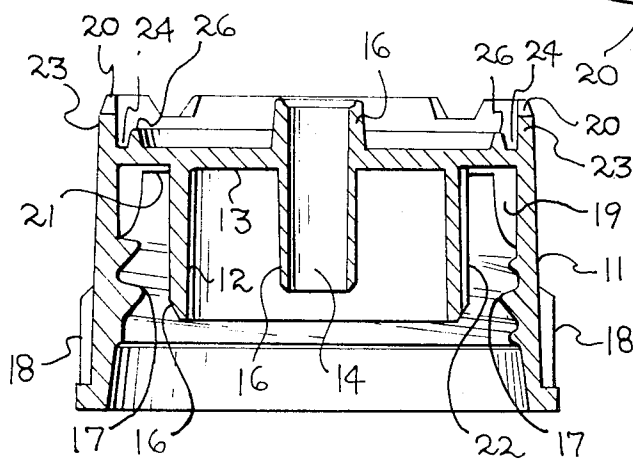
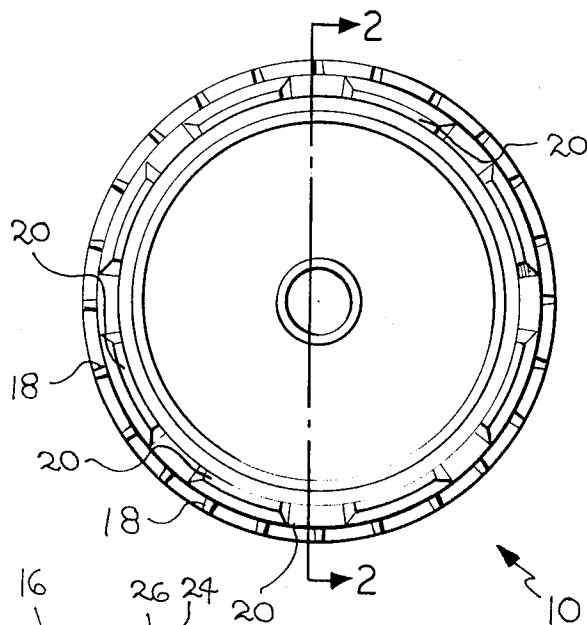


FIG. 2

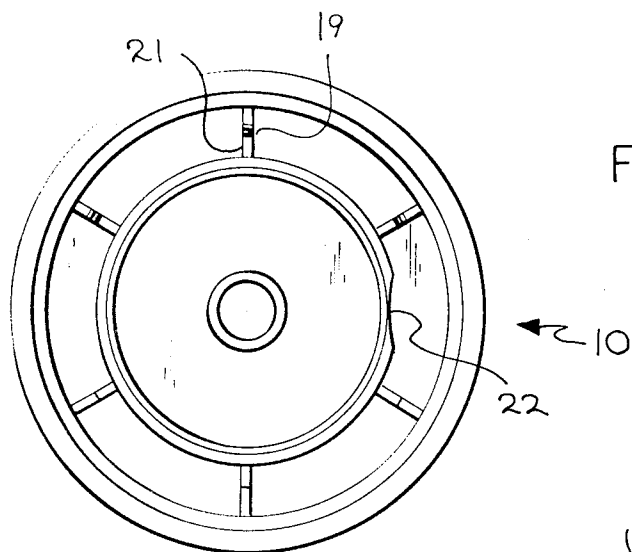


FIG. 3

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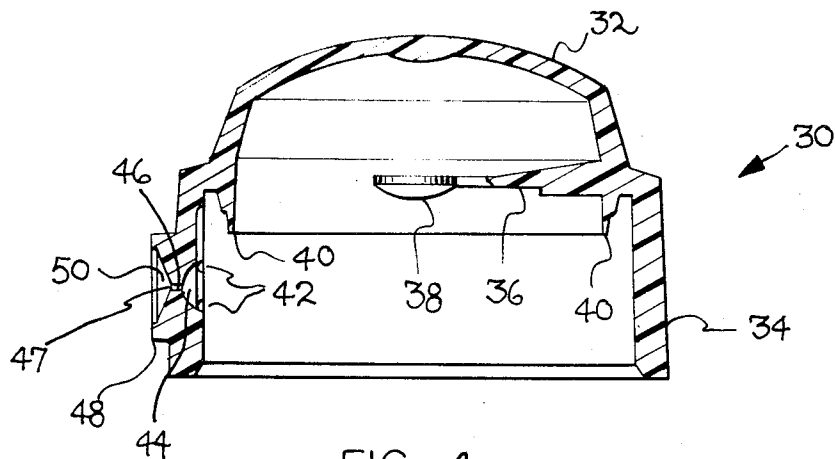


FIG. 4

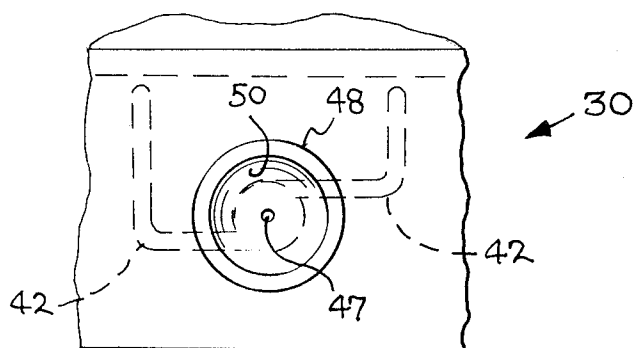


FIG. 5

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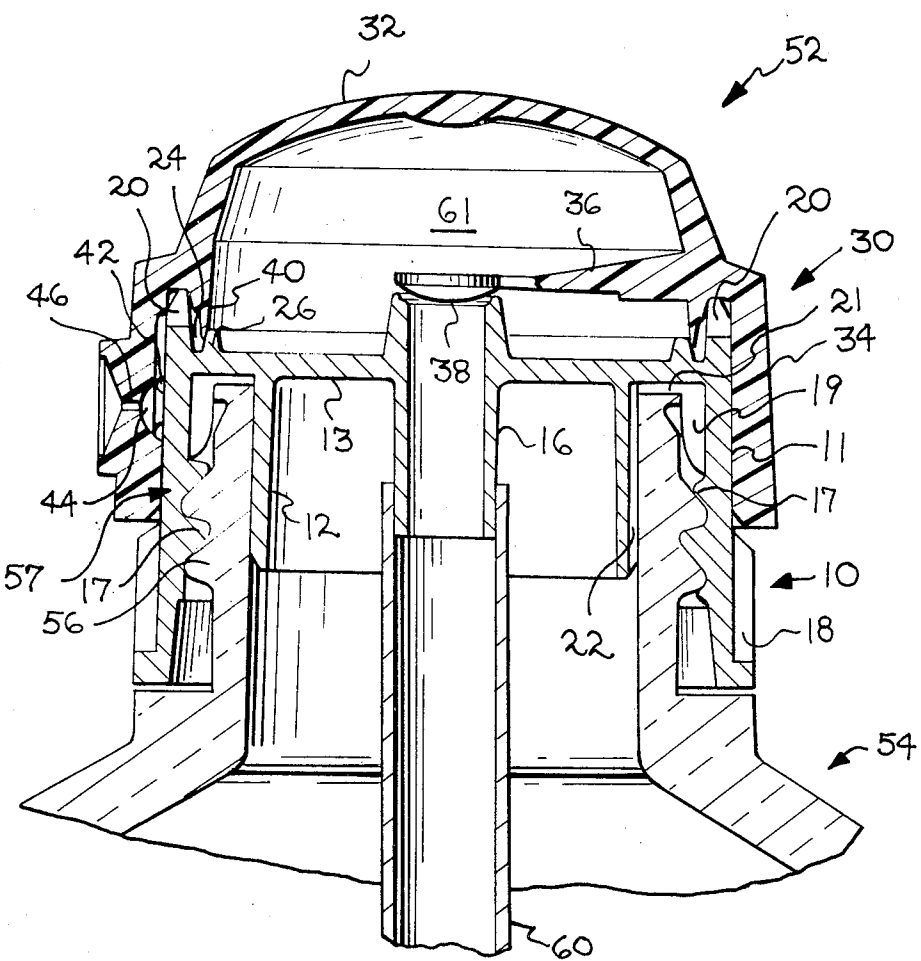


FIG. 6

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TWO-PIECE SUCTION PUMP

BACKGROUND OF THE INVENTION

This invention relates generally to a liquid dispensing pump. More particularly, the invention relates to an inexpensive two-piece dispensing pump adapted for use with a suitable liquid container. It is frequently desirable to provide a container filled with liquid with a pump for dispensing the liquid. These pumps have taken a variety of forms such as the spring-loaded type shown in U. S. Pat. No. 3,162,333, the external squeeze bulb type such as that shown in U. S. Pat. No. 3,090,529, and the resilient dome type such as that shown in U. S. Pat. No. 2,562,317. Examination of these patents will show the common flaw in the prior art which the present invention overcomes. Namely, all of the cited pumps are multiple part assemblies. The multiplicity of parts leads to a relatively complex assembly process, thereby making the completed pump an expensive device. The present invention, to the contrary, is a two-piece assembly which is assembled by simply sliding one part onto the other; there are no critical alignment steps, nor are there components to be inserted into the pump interior. The net result is an effective yet inexpensive dispensing pump.

SUMMARY OF THE INVENTION

This invention relates generally to liquid dispensing pumps. More particularly, this invention relates to an inexpensive two-piece liquid dispensing pump adapted for use with a suitable liquid container.

One of the two pieces of the pump is a relatively rigid cap member which is adapted to fit over the finish portion of a liquid container. The cap member has a central passageway which connects to the interior of the container.

The upper portion of the cap member is provided with a series of spaced apart vertical projections which cooperate with the second part of the pump to form a seal when it is desired to prevent liquid dispensing.

The other part of the pump assembly is a relatively flexible deformable member having a depending skirt portion, an interior check valve, and an upper dome-shaped portion. Integrally molded with the depending skirt is a fluid dispensing orifice. Two spaced apart fluid conducting passageways connect the fluid dispensing orifice with the interior of the dome-shaped member. The check valve takes the form of a cantilevered flap which can close the central passageway of the cap member. To assemble the pump, the deformable member is simply slipped over the cap member until it seats on vertical lugs provided for that purpose on the exterior of the cap member. There is no need for alignment. If the pump is assembled such that each of the two fluid passages is in alignment with one of the vertical projections of the cap member, it will not be possible to dispense fluid. To make dispensing possible, the dome-shaped member is rotated, without removal, relative to the cap member, until the two fluid passages align with two of the spaces between the spaced apart vertical projections on the cap member. The upper dome-shaped portion of the deformable member and the cap member cooperate to form a fluid receiving chamber.

In operation, the top of the deformable member is manually depressed by, for example, a person's thumb. This action expels air from the fluid receiving chamber (it being assumed that no fluid is initially present in the

chamber) and seats the check valve on the central passageway opening, thus closing the opening. When the dome-shaped member is released, the check valve opens and fluid from the container rises through the central passageway into the fluid receiving chamber because of a partial vacuum created in the chamber. If the dome-shaped member is depressed again, the liquid drawn into the chamber on the prior cycle cannot return because of the seating of the check valve and such liquid will thus be forced into the fluid passages and thence out of the liquid dispensing orifice to be sprayed into the atmosphere. When pressure on the dome-shaped member is released, more fluid is drawn into the fluid receiving chamber as occurred during the first cycle.

IN THE DRAWINGS

FIG. 1 is a top plan view of the cap member portion of the pump.

FIG. 2 is a cross section of the cap member portion of the pump taken along the line 2—2 of FIG. 1.

FIG. 3 is a bottom plan view of the cap member of the pump.

FIG. 4 is a cross sectional elevation view of the deformable member portion of the pump.

FIG. 5 is a partial front elevation view of the deformable member portion of the pump.

FIG. 6 is a sectional view of the pump as assembled and placed on a container.

IN THE DRAWINGS

Referring to FIGS. 1, 2 and 3, a cap member, generally designated as 10, which forms one of the two components of the invention, is shown. As best seen in FIG. 2, the cap member has an inner annular skirt or sleeve 12 and an outer annular skirt or sleeve 11, the two skirts being connected to a common circular mounting disc or mounting plate 13 and depending downwardly therefrom. An inlet tube 16 having a central passageway 14 protrudes through and is integrally formed with the mounting disc 13. A portion of the inlet tube 16 extends above the plane defined by the mounting disc 13 and a portion extends below said plane. An extension 23 of the outer annular skirt 11 extends above the plane of the mounting disc 13 and serves to carry a series of spaced apart vertical projections 20. The arrangement of the vertical projections 20 may best be seen in FIG. 1. Adjacent the lower exterior portion of the outer annular skirt 11 are a series of spaced apart vertically extending ribs 18.

The cap member 10 is designed to fit on the finish portion of a suitable container and thus furnish means to connect the completed pump to a container for operation. The inner annular skirt 12 fits inside the finish portion, while the outer annular skirt 11 fits over the exterior of the container finish. In this respect, the inner portion of the outer annular skirt 11 is shown with threads 17 to cooperate with the threaded portion of a container finish as shown in the illustrated embodiment of FIG. 6, but the threading is an optional feature and a press-on fit is acceptable for efficient operation.

A raised ring 26 on the upper portion of the mounting disc 13 cooperates with the extension 23 of the outer annular skirt 11 to define a groove 24.

A deformable member 30 which comprises the second of the two parts which cooperate to form the pump of the present invention is shown in FIGS. 4 and 5. The

deformable member 30 is a one-piece assembly molded from a relatively flexible material. The upper portion of the deformable member 30 is a generally dome-shaped section 32. Integrally molded with the dome-shaped section 32 is a depending skirt portion 34 projecting vertically downward from the dome-shaped section 32. Extending radially inwardly from and integrally attached to the depending skirt 34 at the junction of the depending skirt 34 and the dome-shaped section 32 is a horizontal cantilevered arm 36. The cantilevered arm 36 is at least co-extensive with the portion of the inlet tube 16 extending above the mounting disc 13. Molded onto the underside of the cantilevered arm 36 is a convex projection 38, adapted to seal the extending portion of the inlet tube 16. The cantilevered arm 36 and the convex projection 38 cooperate to form a check valve which allows liquid to flow only one way through the central passageway 14. An interior annular ring 40 projects vertically downward in radial separation from the depending skirt 34 at the juncture of the dome-shaped section 32 and the depending skirt 34. This interior annular ring 40 and the groove 24 cooperate in a manner to be herein described later. Two passage grooves 42 are molded into the interior wall of the depending skirt 34 and, when the cap member 10 and the deformable member 30 are assembled, serve to define fluid conducting passages. The two passage grooves 42 communicate with a fluid receiving cavity 44 molded into the depending skirt 34. The fluid receiving cavity in turn communicates with a fluid channel 46. The fluid channel 46 in turn empties into a circular projection 48 molded into the exterior wall of the depending skirt 32, the outlet of the fluid channel 46 thus acting as a fluid dispensing orifice 47. A conical depression 50, molded into the circular projection 48, serves to direct and control the dispersion of liquid emitted by the fluid dispensing orifice 47 which is located at the apex of the conical depression 50.

In FIG. 6 the completed pump unit 52 may be seen, the pump unit 52 comprising the cap member 10 and the deformable member 30. Although the exact sequence of assembly is not critical, most typically, the pump unit 52 would be assembled and subsequently placed on a container 54 as shown in FIG. 6. The outer annular skirt 11 of cap member 10 fits over the exterior of a finish 56 of the container 54 in threaded engagement, while the inner annular skirt 12 of the cap member 10 is inserted into an opening in the finish 56 of the container 54. As may be seen in FIG. 6, the inlet tube 16 also extends into the finish opening. For convenience in removing all of the contents of the container 54, a vertically extending removal tube 60 may be slip-fitted onto the lower portion of the inlet tube 16 before the pump unit 52 is placed on the container 54, although the inlet tube 16 may be made sufficiently long to achieve this function. The removal tube 60 would typically extend to within a short distance of the bottom of the container 54.

In the assembly of the pump unit 52 the ribs 18 of the cap member 10 serve to seat the deformable member 30 in the proper position. That is, the deformable member 30 is pushed onto the cap member 10 until its downward progress is stopped by the ribs 18. At this point, the cap member 10 and the deformable member 30 are in a proper relationship to operate as a liquid pump. It may further be noted that the mounting disc 13 and the dome-shaped section 32 cooperate to form

a fluid receiving cavity 61. FIG. 6 also clearly shows the overlying relationship of the upper portion of the inlet tube 16 and the convex projection 38 which allows the cantilevered arm 36 and convex projection 38 to act as a check valve with respect to the inlet tube 16. With the deformable member 30 in place on the cap member 10, the grooves 42 in the depending skirt 34 may be seen to cooperate with the outer wall of the outer annular ring 11 to form fluid conducting passages communicating with the fluid receiving cavity 44 and the fluid receiving chamber 61. In addition, the interior annular ring 40 is seated in the groove 24, the elements cooperating to perform a valving function to be discussed later.

Before proceeding to a discussion of the operation of the apparatus, the function of the vertical projections 20 should be explained. The extent of the grooves 42 is such that when the deformable member 30 is in position on the cap member 10, the grooves 42 terminate below the top of the vertical projections but above those portions of the extension 23 lying between the projections 20. The vertical projections 20 are so spaced that when one of the grooves 42 is in alignment with one of the vertical projections 20, the other groove 42 is similarly aligned. Since, as previously explained, the grooves 42 terminate below the top of the vertical projections 20, this alignment blocks entrance of any fluid into the grooves 42 from the fluid receiving chamber 61. To allow liquid to be dispensed, the deformable member 30 is rotated relative to the cap member 10 to align the grooves 42 with the spaces between the vertical projections 20, thus allowing fluid to flow from the fluid receiving chamber 61 since the grooves 42 project above the spaces between the vertical projections 20.

In operation, the pump unit 52 will be mounted on the container 54 which will be filled with a liquid whose dispensing is desired. To begin the cycle, assuming there has been no prior use of the pump unit 52, the dome-shaped section 32 is depressed, for example, by a person's thumb. It should be noted that the grooves 42 should be in alignment with the spaces between the projections 20 to allow dispensing and the fluid receiving chamber 61 is empty. Depressing the dome-shaped section 32 will cause the cantilevered arm 36 to deflect downward, thereby seating the convex projection 38 on the upper portion of the inlet tube 16 and sealing the central passageway 14. Simultaneously, the interior annular ring 40, which is normally seated in a sealing manner against raised ring 26 is deflected away from such ring and further into the groove 24, thereby allowing the air in fluid receiving chamber 61 to be expelled via the grooves 42, the fluid receiving cavity 44, and the fluid channel 46. When the dome-shaped section 32 is released, it is sufficiently resilient to return to its original shape. This action causes the interior annular ring 40 to reseat against the raised ring 26 and allows the cantilevered arm 36 to rise, thereby opening the central passageway 14. The release of the dome-shaped section 32 will allow the air trapped in the fluid receiving chamber 61 to expand and thereby create a partial vacuum. Since the pressure in the fluid receiving chamber 61 is less than atmospheric, liquid from the container 54 is forced up the removal tube 60, and through the inlet tube 16 and central passageway 14 into the fluid receiving chamber 61 until the pressure differential is balanced.

Referring now to FIG. 3, it may be seen that a portion of the inner annular skirt 12 has a flattened longitudinal panel 22 which acts as a vent means for the container 54. That is, as liquid is forced into the fluid receiving chamber 61 due to the pressure differential, air is allowed to enter the container 54 to replace the liquid displaced and equalize the pressure. The path taken by the air is first through the thread clearance between the threads 17 formed in the interior wall of the outer annular skirt 11 and the threads 57 on the finish 56 of the container 54. A series of spaced apart vertical ribs 19 molded into the inner wall of the outer annular skirt 11 adjacent the mounting disc 13 have a horizontally extending portion 21 (best seen in FIG. 2) which serve to prevent the top of the finish 56 from sealing on the mounting disc 13. This then allows the venting air to complete its path over the upper portion of the finish 56 and down the longitudinal panel 22 into the container 54.

With liquid now present in the fluid receiving chamber 61, subsequent depression of the dome-shaped section 32 will cause the liquid to be dispensed through the following steps: When the dome-shaped member 32 is depressed, the cantilevered arm 36 will again be forced down to seal the central passageway 14 with the convex projection 38, thereby preventing any of the previously obtained liquid from flowing back into the container 54. The interior annular ring 40 will be unseated from the raised ring 26, forcing fluid from the fluid receiving chamber 61 into the fluid conducting grooves 42. The liquid will then further be forced into the fluid receiving cavity 44, through the fluid channel 46 and finally dispensed to the atmosphere through the fluid dispensing orifice 47. Release of the dome-shaped section 32 will result in the operation before described, culminating in more liquid being drawn in the fluid receiving chamber 61. Rapid, sequential depression and release of the dome-shaped section will result in a pulsating spray of the liquid in the container 54 being dispensed.

It will be noted that after the initial operation of the pump unit, a certain quantity of liquid will always be left in the fluid receiving chamber 61. To prevent the accidental discharge or evaporation of this liquid during periods of non-use, the deformable member 30 is rotated relative to the cap member 10, without removal from the cap member 10, until the grooves 42 align with two of the vertical projections 20. This thereby seals the fluid receiving chamber 61 from the atmosphere and furthermore prevents any discharge of the fluid therein should the dome-shaped section 32 be accidentally depressed.

I claim:

1. A dispensing pump adapted for use with a container for fluids, said container having a finish portion defining an open mouth comprising:

- a. a cap member having a substantially horizontally disposed mounting plate and integrally molded therewith, a downwardly depending outer annular skirt adapted for attachment to said finish, said outer annular skirt having an extension portion extending upwardly beyond the top surface of said mounting plate, a raised annular ring formed on the upper portion of said mounting plate and having a radius less than the radius of said extension portion of said outer annular skirt to form therebetween an annular groove, and a dispensing tube defining a

passageway through said mounting plate communicating with the fluid contents of said container;

- b. a relatively flexible deformable member engaged to said cap member, said deformable member having an upper dome-shaped portion, said dome-shaped portion and said mounting plate cooperating to form a fluid receiving chamber, a downwardly depending annular skirt integrally molded with said dome-shaped portion, at least one fluid conducting groove formed in said downwardly depending skirt communicating with a fluid dispensing orifice in said downwardly depending skirt, a downwardly directed interior annular ring formed in the interior of said deformable member, said annular groove in said cap member and said annular ring in said deformable member being in sealing engagement to isolate said fluid receiving chamber when said dispensing pump is assembled, thereby serving as a check valve to allow fluid to pass only outwardly from said fluid receiving chamber towards said fluid dispensing orifice, and a cantilevered check valve integrally molded with said deformable member, said cantilevered check valve being adapted to close said passageway through said mounting plate when said deformable member is deflected.

2. The apparatus of claim 1 further including a downwardly depending inner annular skirt integrally molded with said mounting plate and having a radius less than that of said cap member outer annular skirt, said inner annular skirt having a longitudinally extending vent means connecting the interior of said container with the atmosphere, said inner annular skirt being adapted to be placed within the opening of said finish.

3. The apparatus of claim 1, further including a plurality of spaced apart vertical projections extending upwardly from said extension portion of said outer annular skirt of said cap member for selective sealing engagement with said fluid conducting groove when said cap member and said deformable member are assembled to define said dispensing pump.

4. The apparatus of claim 1, further including a plurality of spaced apart vertical ribs integrally molded with the inner wall of said cap member downwardly depending outer annular skirt, said ribs having an upper, horizontally inwardly extending portion, integrally molded with the underside of said mounting plate, said rib horizontally extending portion serving to prevent said mounting plate from seating on said open mouth of said container.

5. The apparatus of claim 1, further including a plurality of spaced apart vertical ribs integrally molded with the exterior wall of said cap member downwardly depending outer annular skirt, said ribs serving to limit the downward engagement of said deformable member on said cap member.

6. A dispensing pump adapted for use with a container for fluids, said container having a finish portion defining an open mouth, comprising:

- a. a cap member having a substantially horizontally disposed mounting plate positioned over said finish, a dispensing tube extending through said plate and into said container, a downwardly depending outer annular skirt integrally molded with said plate and adapted for attachment to said finish having a portion thereof extending upwardly beyond the top surface of said mounting plate, a plurality

of spaced apart vertical projections around the periphery of said outer annular skirt upwardly extending portion and extending upwardly therefrom, a raised annular ring located on the upper portion of said mounting plate having a radius less than the radius of said outer annular skirt upwardly extending portion to form therebetween an annular groove, a downwardly depending inner annular skirt integrally molded with said mounting plate having a radius less than the radius of said outer annular skirt and having a longitudinally extending flattened panel coextensive with its length, said panel serving to connect the interior of said container with the atmosphere, thereby serving as a vent for said container, said inner annular skirt further being adapted to be placed within the opening of said finish;

- b. a relatively flexible deformable member engaged to said cap member, said deformable member having an upper dome-shaped portion, said dome-shaped portion and said mounting plate cooperating to form a fluid receiving chamber, a depending annular skirt integrally molded with said dome-shaped portion, at least one fluid conducting groove integrally molded into said deformable member depending annular skirt communicating with a fluid dispensing orifice in said deformable member depending annular skirt, a downwardly directed interior annular ring having a radius less than that of said deformable member depending annular skirt, said deformable member annular ring and said annular groove in said cap member being in sealing engagement to isolate said fluid receiving chamber when said dispensing pump is assembled, thereby serving as a check valve to allow fluid to pass only outwardly from said fluid receiving chamber towards said fluid conducting groove in said deformable member, and a cantilevered check valve integrally molded with said deformable member, said cantilevered check valve being adapted to close said dispensing tube when said deformable member is deflected.

7. The apparatus of claim 6, further including a plurality of spaced apart vertical ribs integrally molded with the inner wall of said cap member downwardly depending outer annular skirt, said ribs having an upper, horizontally inwardly extending portion, integrally molded with the underside of said mounting plate, said rib horizontally extending portion serving to prevent said mounting plate from seating on said open mouth of said container.

8. The apparatus of claim 6, further including a plurality of spaced apart vertical ribs integrally molded with the exterior wall of said cap member downwardly depending outer annular skirt, said ribs serving to limit the downward engagement of said deformable member on said cap member.

9. For use with a bottle having a neck portion defining an opening, said bottle containing a liquid to be dispensed, a pump comprising:

- a. a cap member having a mounting disc positioned over said opening, a dispensing tube extending through said disc and into said bottle, an outer annular skirt depending from the periphery of said mounting disc and having means thereon for engaging said neck portion, said outer annular skirt having a portion thereof extending upwardly be-

yond the top surface of said mounting disc, a raised annular ring formed on the upper portion of said mounting disc and having a radius less than that of said upwardly extending portion of said outer annular skirt to form therebetween an annular groove, a plurality of projections around the periphery of said upwardly extending portion of said outer annular skirt extending upwardly therefrom, said projections having spaces therebetween, and

- b. a flexible deformable member having a dome-shaped portion with an annular skirt depending downwardly therefrom, said annular skirt of said deformable member having at least one groove formed on the interior surface thereof and aperture means extending therethrough between said groove and the atmosphere, said annular skirt of said deformable member being rotatably engaged to the outer annular skirt of the cap member, said groove in said annular skirt of said deformable member being sealed to prevent dispensing of liquid when aligned with one of said projections and open to permit dispensing of liquid when aligned with one of said spaces between said projections, said dome-shaped portion cooperating with the mounting disc to define a fluid receiving cavity communicating with the bottle interior by means of said dispensing tube, a downwardly directed interior annular ring formed in the interior of said deformable member, said groove in said cap member and said annular ring in said deformable member being in sealing engagement to isolate said fluid receiving cavity when said pump is assembled, thereby serving as a check valve to allow fluid to pass only outwardly from said fluid receiving cavity towards said aperture means, and a valve member engageable with the upper end of said dispensing tube, said valve member including an arm extending radially inwardly into said cavity and being deflectable from a sealed position engaging the dispensing tube to an unsealed position by pressure changes within said cavity.

10. The apparatus of claim 9 further including a downwardly depending inner annular skirt integrally molded with said mounting plate having a radius less than that of said cap member outer annular skirt and having a longitudinally extending venting means connecting the interior of said bottle with the atmosphere, said inner annular skirt being adapted to be placed within said bottle opening.

11. The apparatus of claim 9 further including a plurality of spaced apart vertical ribs integrally molded with the inner wall of said cap member outer annular skirt, said ribs having an upper, horizontally inwardly extending portion integrally molded with the under side of said mounting disc, said rib horizontally extending portion serving to prevent said mounting disc from seating on said bottle opening.

12. The apparatus of claim 9 further including a plurality of spaced apart vertical ribs integrally molded with the exterior wall of said cap member outer annular skirt, said ribs serving to limit the downward engagement of said deformable member on said cap member.

13. For use with a bottle having a neck portion defining an opening, said bottle containing a liquid to be dispensed, a pump comprising:

- a. a cap member having a mounting disc positioned over said opening, a dispensing tube extending

through said disc and into said bottle, an outer annular skirt depending from the periphery of said mounting disc and having means thereon for engaging said neck portion, said outer annular skirt having a portion thereof extending upwardly beyond the top surface of said mounting disc, a plurality of projections around the periphery of said outer annular skirt upwardly extending portion extending upwardly therefrom, said projections having spaces therebetween, a downwardly depending inner annular skirt integrally molded with said mounting disc having a radius less than that of said outer annular skirt and having a longitudinally extending flattened panel coextensive with its length, said panel serving to connect the interior of said bottle with the atmosphere, thereby serving as a vent for said bottle, said inner annular skirt being adapted to be placed within said bottle opening, a plurality of spaced apart first vertical ribs integrally molded with the inner wall of said outer annular skirt, said first ribs having an upper, horizontally inwardly extending portion integrally molded with the under side of said mounting disc, said ribs horizontally extending portion serving to prevent said mounting disc from seating on said bottle opening, a plurality of spaced apart second vertical ribs integrally molded with the exterior wall of said outer annular skirt, and a raised annular ring formed on the upper portion of said mounting disc having a radius less than that of said outer annular skirt upwardly extending portion to form therebetween an annular groove;

b. a flexible deformable member having a dome-shaped portion with an annular skirt depending

therefrom, said deformable member annular skirt having at least one fluid conducting groove formed on the interior surface thereof and aperture means extending therethrough between said fluid conducting groove and the atmosphere, said deformable member annular skirt being rotatably engaged to the outer annular skirt of said cap member, said cap member second vertical ribs serving to limit the downward engagement of said deformable member on said cap member, said fluid conducting groove being sealed to prevent dispensing of liquid when aligned with one of said projections and open to permit dispensing of liquid when aligned with one of said spaces, said dome-shaped portion cooperating with said mounting disc to define a fluid receiving chamber communicating with the bottle interior by means of said dispensing tube, a valve member engageable with the upper end of said dispensing tube, said valve member including an arm extending radially inwardly into said chamber and being deflectable from a sealed position engaging said dispensing tube to an unsealed position by pressure changes within said chamber, and a downwardly directed interior annular ring having a radius less than that of said deformable member annular skirt, said annular ring and said annular groove in said cap member being in sealing engagement to isolate said fluid receiving chamber when said pump is assembled, thereby serving as a check valve to allow fluid to pass only outwardly from said fluid receiving chamber towards said fluid conducting groove in said deformable member.

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