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Cooprider

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[54] **DISPENSING PUMP**

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[51] **Int. Cl.**..... **B65d 37/00**

[58] **Field of Search**..... 222/207, 213, 382, 222/383; 251/340, 344, 353; 137/525.1, 525.3; 417/479, 566

[56] **References Cited**

UNITED STATES PATENTS

3,029,742	4/1962	Curtis	222/207
2,884,164	4/1959	Kleid	222/207
3,102,489	9/1963	Corsette et al.	222/383

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[57] **ABSTRACT**

A dispensing pump for application to a container of product to be dispensed comprising an annular housing member formed with a concentric annular recess open at one axial end thereof. A flexible bulbous diaphragm has an annular skirt received in fluid-tight manner in said recess and closing said one axial end of said annular member to define therewith a variable volume pump chamber. Entering the other end of said annular member is a fluid inlet passage. Valve means integrally carried by said diaphragm within the pump chamber function to close said passage in response to axial deformation of the diaphragm. This annular skirt has a free lower edge portion within said recess normally covering a discharge port through said annular member which communicates with the pump chamber and said lower edge portion and said recess are mutually conformed to permit radial outwardly deflection of said edge portion to uncover said discharge port in response to a given fluid pressure within the pump chamber.

15 Claims, 2 Drawing Figures

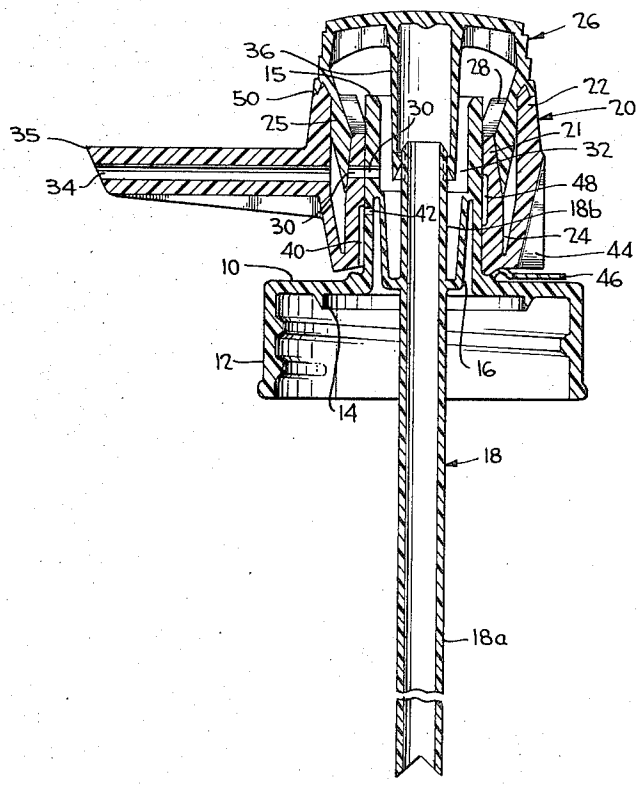


FIG. 1

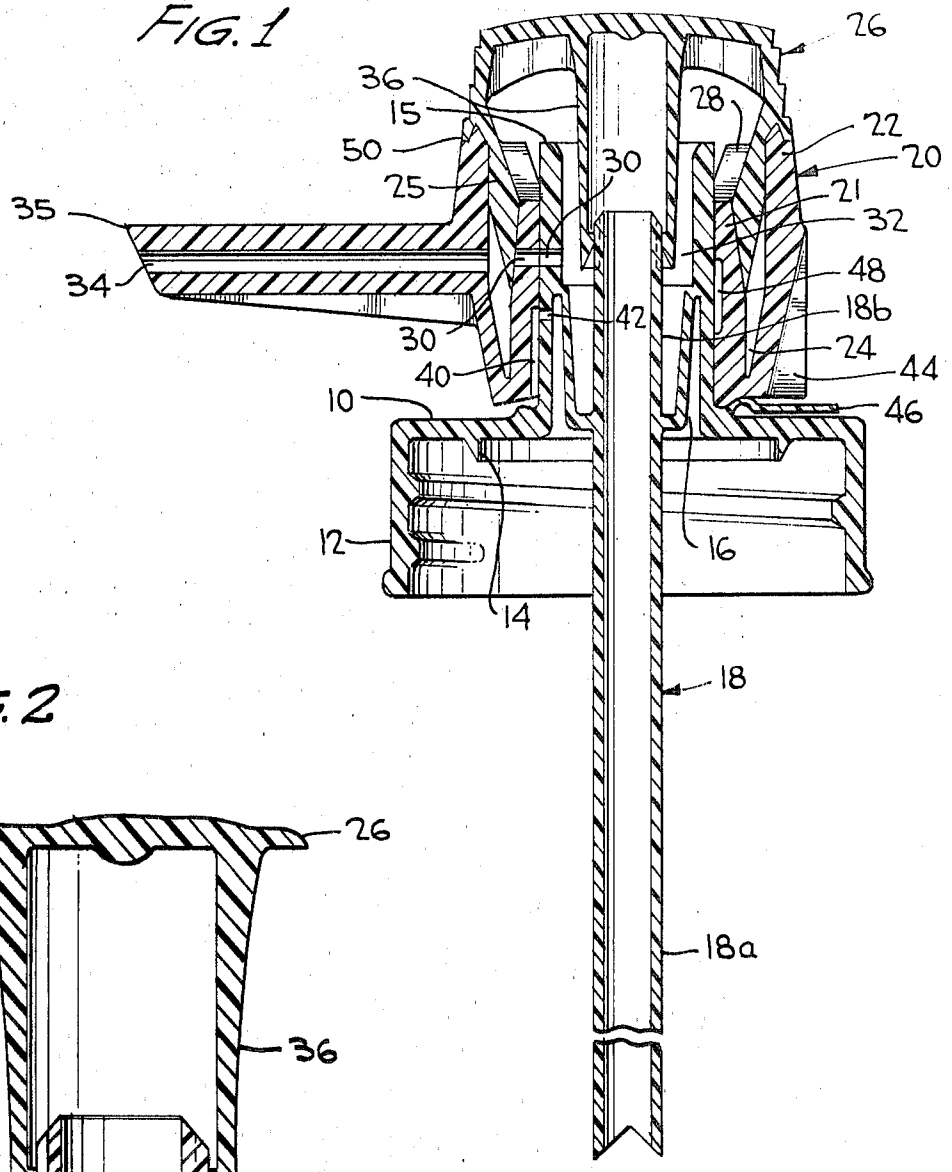
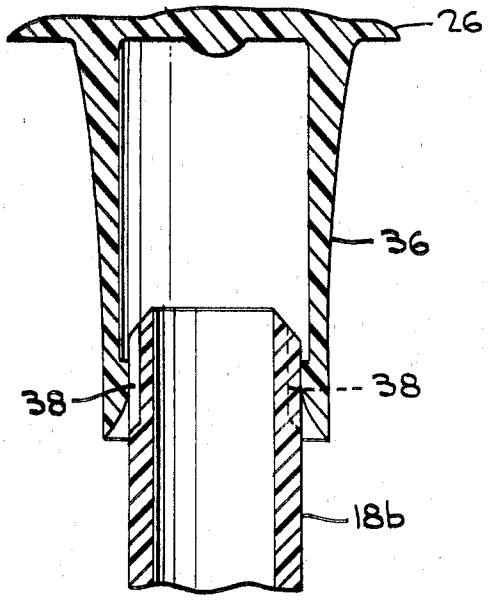

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36
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28
22
50
30
20
25
21
35
32
48
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18b
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24
40
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14
18

FIG. 2


26
18a
36
38
38
18b

DISPENSING PUMP

This invention relates to an improved dispensing pump of the type in which the pumping action is achieved through deformation of a resiliently flexible bulbous diaphragm.

Such pumps are exemplified in the prior patents of Cooprider U.S. Pat. Nos. 2,815,890, Stewart U.S. Pat. No. 2,853,210 and Corsette U.S. Pat. No. 3,102,489. All of these patents disclose arrangements in which the deformable bulbous diaphragm has a depending annular skirt which is received within an annular groove in the housing, the flexible inner wall portion of the housing then being expanded into gripping engagement with the skirt by one of the pump components during assembly of the pump to securely seal the diaphragm to the housing. Such prior construction has greatly facilitated the pump assembly operation, while providing a superior seal between the bulbous diaphragm and the pump housing; however, such prior structure has employed inlet and outlet valve components which are formed separately from the other pump components and thus contribute to the number of parts requiring to be formed and assembled.

In other prior art, as exemplified by the patent to Curtis U.S. Pat. No. 3,029,742, there is disclosed an arrangement in which the pump intake and discharge valves are integral with the bulbous diaphragm, substantially reducing the number of pump components. However, such arrangement is not suitable for use in a pump of the type above described, and further it requires that the parts be relatively rotationally oriented during their assembly.

With the foregoing in mind, it is the primary object of the present invention to achieve an improved and simplified dispensing pump of the type above described, in which the intake and discharge valves constitute integral portions of the resiliently deformable diaphragm, but are so arranged that they require no rotational orientation with respect to the other pump components during their assembly.

It is a further object to provide a construction in which the bulbous diaphragm may be assembled to the pump housing in sealed relation in the same advantageous manner as disclosed in the prior patents to Cooprider, Stewart, and Corsette above identified.

Further, it is an object to provide in such an improved pump structure a specifically new and advantageous arrangement of valves which may readily be incorporated as integral portions of the other pump components for assembly coincident with the assembly of the other components.

It is still a further object to provide an inlet valve which, in addition to its valving function, also acts as an auxiliary pump to draw flowable product from the container up to a level above the inlet port on each suction stroke of the bulb diaphragm to release it for flow through the port by gravity and suction into the main pump chamber for expulsion through the ensuing compression or discharge stroke of the diaphragm.

A further feature of the invention is to provide such a pump which, in addition to attaining the above specified objects, also is capable of incorporating venting and return flow function substantially in the manner disclosed in the prior Stewart U.S. Pat. No. 2,853,210.

The preferred embodiment of the invention is illustrated in the accompanying drawing and described with particularity in the detailed description which follows, it being understood that such drawings and detailed descriptions are by way of ememplification of the invention and not by way of limitation.

In the accompanying drawing:

FIG. 1 is an axial vertical cross sectional view on an enlarged scale through a dispensing pump incorporating the several improvements of the present invention;

FIG. 2 is a magnified detail section, in the same plane as FIG. 1, through the inlet valve portion of the pump dispenser.

Referring now in detail to the accompanying drawings, the pump structure of the invention is adapted to be operatively supported on a conventional product container such as a bottle, jar, or can, by means of a conventional closure cap having a top wall **10** and a cylindrical skirt **12** which is internally threaded or otherwise adapted for application to the neck or dispensing opening of the container. The closure cap is adapted for formation from a suitable resilient plastic material such as linear polyethylene, and is provided with an annular sealing rib **14** on its under surface for sealing engagement with the upper end of the container neck all in accordance with usual practice.

The inner member **15** of the pump structure is preferably formed as an integral portion of the closure cap, being in the form of a generally vertical sleeve having its upper end open. Its lower end is closed by an integral cup-like web **16** through the bottom of which extends a tube **18** which is molded integrally with the remainder of the cap structure and includes a depending portion **18***a* of sufficient length to reach nearly to the bottom of the container with which the pump is associated, for communication with the product therein. Also it will be seen that in this embodiment, the tub **18** has an upward extension **18***b* disposed coaxially within the sleeve or innter member **15** and spaced from the wall thereof for a purpose hereinafter apparent. Manifestly the dip tube **18** and more particularly the upper extension **18***b* thereof define the product intake passage for the pump.

Encircling and preferably rotatably embracing the inner member **15**, is a generally annular outer member or valve housing **20** having inner and outer annular portions **21** and **22** interconnected at their lower edges to define between them an upperwardly opening annular recess **24** in which is received the depending annular skirt **25** of an elastic resiliently flexible bulbous diaphragm **26**.

As in each of the prior patents of Cooprider, Stewart, and Corsette heretofore identified, the outer portion **22** of the valve housing is comparatively rigid and circumferentially continuous to receive and confine the depending annular skirt **25**, while the inner portion **21** of said housing is circumferentially expansible, preferably being subdivided by a plurality of axial slots into an annular series of upwardly directed radially deflectible fingers **28**. The arrangement is such that after the bulbous diaphragm **26** has been applied to the valve housing, with its skirt **25** received in the recess **24**, the housing **20** is press fitted on to the inner member **25** which passes upwardly through the inner member and deflects its fingers **28** outwardly to clamp the skirt **25** in fluid-tight manner against the inner surface of the outer

casing member **22** in an annular zone adjacent to the mouth of the recess and axially upwardly displaced from the free lower end of the skirt.

It will be noted that the skirt **25** is of downwardly decreasing thickness towards its lower edge. Thus, it is of substantially smaller radial dimensions adjacent its lower edge than the corresponding axial zone of the recess and is spaced from the bottom of the recess.

This free lower edge of the diaphragm skirt is so proportioned that normally it snugly encircles the inner annular portion **21** of the pump housing **10** to close the discharge valve port **30** extending through the inner member **15** and the inner portion **21** of the pump housing into the recess **24.**

As above described, the depending lower edge of the diaphragm skirt **25** is proportioned to snugly encircle the inner annular portion of the valve housing, thus to close the discharge port. But it is of a material such as natural or artificial rubber which has sufficient flexibility and elasticity so as to be resiliently outwardly deflectible away from the port **30** by pressure within the pump chamber **32** so as to admit liquid into the recess **24** for discharge to the atmosphere through a discharge passage opening through the outer portion of the pump casing into the recess and preferably defined by a discharge spout **35** formed integrally with the pump housing **20.** The discharge valve **25** thus constituted by the annular diaphragm skirt requires no angular orientation with respect to the housing **20,** but is operative in all positions of rotation on the housing.

It will be readily observed that the bulbous diaphragm **26,** together with the pump housing **20** and inner body **15,** jointly define the pump chamber **32,** the volume of which may be readily varied by deformation of the bulbous diaphragm, preferably by downward finger pressure on its upper end wall.

Inlet valve means formed integrally with the bulbous diaphragm **26** is operatively associated with the inlet passage defined by tube **18** for permitting unidirectional flow only of product through said passage toward the pump chamber **32.** Thus the inlet valve means of the invention comprises the stationary valve body provided by the upward extension **18*b*** of the dip tube **18** within the pump chamber **32.** The inlet valve per se comprises a movable valve element in the form of a generally cylindrical sleeve **36** carried by and preferably formed integrally with the top wall of the bulb for axial displacement therewith. This sleeve **36** is in fluid-tight telescoping relation with the dip tube extension **18*b*** for axial movement with the diaphragm top wall, between a fully raised position of rest as shown in FIG. **1,** and a depressed position (not illustrated) which will occur at the end of the compression or discharge stroke of the pump, as caused by downward finger pressure on the top wall of the bulb **26.**

One of the cooperating discharge valve elements, in the present instance the upward extension **18*b*** of the dip tube, is formed with one or more ports **38** (FIG. **2**) positioned to establish communication between the inlet passage defined by said tube and the pump chamber **32** only in the fully raised position of the movable valve element or sleeve **36.** By reference to FIG. **2** it should be noted that in the preferred embodiment there are provided a multiplicity of such ports **38** in the form of longitudinally extending grooves each extending from the free upper end of the extension downwardly for a uniform limited distance such as to establish communication between the interior of the cooperating sleeve like valve element and the surrounding pump chamber **32,** only when the movable valve element **36** is in substantially its fully raised position, with the bulbous diaphragm and pump chamber fully expanded.

With the foregoing arrangement it is desirable that the outer member **20** be relatively rotatable on the member **15,** so that the two might cooperate as a valve mechanism operable when in the dispensing portion of FIG. **1** to permit venting of air from the atmosphere into the container interior as necessary to replace the product withdrawn therefrom by the pump. To this end the inner portion **21** of the outer member is provided along its inner surface with a vertical groove or slot **40** positioned to register with a vent **42** opening through the inner member as in FIG. **1.** To facilitate determination of this dispensing position, the outer member is preferably provided with a suitable pointer **44** angularly positioned for registry with a pointer or other indicia **46** affixed to the closure cap and positioned to register angularly with the pointer when the outer member is rotated to an operative position in which the groove **40** and vent **42** are in communication with each other.

In general the arrangement is substantially similar to that disclosed in the prior Stewart et al. U.S. Pat. No. 2,853,210, and further incorporates the feature substantially disclosed in that patent in accordance with which the inner wall portion of the outer member is provided with the vertical groove **48** or passage way which normally is isolated from the discharge port **30** and the vent opening **42,** but which establishes communication between the discharge port **30** and the vent opening **42** in a further nonoperative position of rotation of the parts. In the event of inadvertent depression or deformation of the flexible bulb **26** while the parts are in this nondispensing position, the product discharged through the discharge port **30** will simply be returned through the return passage **48** and vent opening **42** back into the container, to avoid unduly stressing and/or possible rupturing the bulbous diaphragm or forcing the latter lose from its sealed connection to the outher pump member **20.**

It is particularly to be noted that the present invention, though incorporating the various novel features and advantages as aforementioned, uses but three separately formed parts (diaphragm **26,** outer member **20,** and inner member **15**) which may be produced by conventional plastic molding and fabricating means and methods, and may be readily assembled without necessity for relative angular orientation of the respective parts.

In assembling these several parts, the bulbous diaphragm **26** is first assembled to the outer pump member by inserting its depending skirt **25** into the upwardly opening recess **24** of the latter member until the annular downwardly directed shoulder and sealing rib **50** of the diaphragm engages the upper end edge of the outer member. The inner member **15** is then inserted upwardly through the bottom of the downwardly opening outer member **20** whereby its upper end will expand the upper end portions of the flexible fingers **28** of the inner member radially outwardly to clamp the skirt firmly between such fingers and the encirling band provided by the outer portion **22** of the outer member. There is thus established a sealing engagement between

the skirt and portion 22 in a circular zone displaced upwardly from the lower or free edge portion of the diaphragm skirt.

The upper end of the inner member preferably is radially enlarged so that after expanding the flexible fingers 28 radially outwardly it interlocks above them in the manner of a snap fitting, to then resist disassembly as between the inner and outer members.

The dispensing pump as thus assembled is in readiness for application to a container to dispense the liquid or other flowable products therein contained. For this purpose the cap is threaded on or otherwise applied to the neck of the container with its dip tube 18 depending to a location near the bottom of the container where it is immersed in the product to be dispensed.

In order to dispense the product, the outer member 20 and spout 36 are rotated on the inner member to bring the pointers 44 and 46 into angular registry and thus to bring discharge port segments 30 0f the inner member and the outer member into registry, following which the product may be dispensed by intermittent downward finger pressure on the top wall of the bulbous diaphragm 26. As the diaphragm is depressed downwardly, the intake valve member 36 is telescoped downwardly on its cooperating dip tube extension 18*b*, while any air trapped in the pump chamber 32 is correspondingly pressurized so as to open the discharge valve defined by skirt 25 to be released through the port 30 and discharge passage 34. As the finger pressure is released and the bulb 26 is permitted to reexpand to its normal volume, the ensuing upward movement of the valve member 36 on the dip tube extension 18*b* draws the flowable product upwardly through the dip tube 18. After one or more depressions of the diaphragm 26, the product is drawn into valve member 36 to a level above the upper end of the dip tube extension 18*b*, so that when the diaphragm fully regains its normal shape, with the valve member fully raised as in FIG. 1, the product is free to escape through the grooves 38 into the pump chamber 32, both by action of gravity as well by reduced pressure within that chamber resulting from expansion of the diaphragm.

After product is received within the pump chamber 32, each depression or downward deformation of the flexible diaphragm within the pump chamber will force the product outwardly from that chamber through the discharge port 30 with sufficient pressure to open the discharge valve 25 so that the product may flow beneath the lower edge of that valve and thence outwardly through the discharge passage 34. The pump may be actuated by intermittent pressure on the flexible diaphragm to dispense as much of the product as is desired.

Thereafter, the outer member 20 and spout 36 may be rotated on the inner member to a position to which the venting groove or passage 40 is disconnected from the vent opening 42 and the latter is placed in communication with the discharge port 30 by way of the return passage 48 in the internal wall of the outer member.

It will be apparent that the pump components require no particular angular orientation incident to their assembly. They comprise but a minimum number of easily assembled parts which incorporate the discharge and inlet valves as integral molded portions of the diaphragm structure.

Although in this application there has been shown and described only a single preferred embodiment of the invention, it will be readily apparent that the invention is capable of other and different embodiments and that its several details may be varied in a number of respects — all without departing from the invention as defined in the appended claims.

What is claimed is:

1. In a dispensing pump of the type which comprises a housing of circular cross-section and a resiliently deformable diaphragm, said housing and said diaphragm jointly defining a variable volume pump chamber; said housing being formed with an inlet passage opening thereinto concentrically to its circular cross-section and a discharge port opening radially outwardly through its circular cross-section; the improvements which include:

an inlet valve carried by said diaphragm within the pump chamber to close said inlet passage as the diaphragm is deformed; and a discharge valve in the form of an annular skirt constituting an integral portion of said diaphragm, said skirt snugly encircling said housing and normally closing said discharge port, but being deflectible to uncover such discharge port in response to increased fluid pressure within said pump chamber.

2. In a dispensing pump as defined in claim 1 the further improvement wherein said housing is formed with an annular recess encircling said pump chamber and sealingly receiving said annular skirt; said discharge port communicating with the recess in the outwardly deflected position of said skirt; said housing including a radially projecting discharge spout defining a discharge passage in communication with said recess.

3. In a dispensing pump as defined in claim 1, the further improvement wherein said inlet valve includes a stationary tubular valve member, defining said inlet passage and extending upwardly into said pump chamber with its upper free end in spaced relation to said diaphragm, and movable valve member carried by the diaphragm in normally fluid-tight telescopic relation with the stationary valve member; one of said valve members being formed with an intake port for establishing communications between the pump chamber and said inlet passage only in the normally unstressed position of the diaphragm.

4. In a dispensing pump as defined in claim 3, the feature wherein said movable valve member is of tubular configuration snugly encircling and receiving the upper free end of said stationary valve member, said stationary valve member being provided with an intake port which is covered and closed by the movable valve member in all except the fully raised position of the latter member.

5. In a dispensing pump as defined in claim 3, the feature wherein said inlet port is in the form of a downwardly extending groove in the outer wall of said stationary valve member.

6. A dispensing pump for application to a container of product to be dispensed comprising an annular housing member formed with a concentric annular recess open at one axial end thereof, a flexible bulbous diaphragm having an annular skirt received in fluid-tight manner in said recess and closing said one axial end of said annular member to define therewith a variable volume pump chamber; means entering the other end of said annular member in sealed relation thereto to de-

fine a fluid inlet passage directed toward and spaced from said diaphragm; valve means integrally carried by said diaphragm within the pump chamber to close said passage in response to axial deformation of the diaphragm; said annular skirt having a free lower edge portion within said recess normally covering a discharge port through said annular member which communicates with the pump chamber; said lower edge portion and said recess being mutually conformed to permit radial outwardly deflection of said edge portion to uncover said discharge port in response to a given fluid pressure within said port.

7. The dispensing pump as defined in claim **6** in which said annular housing is formed with a discharge passage establishing communication between said recess and the atmosphere.

8. A dispensing pump as defined in claim **7** in which said housing is formed with the discharge spout defining said discharge passage.

9. A dispensing pump as defined in claim **6** in which said means entering the other end of said annular member comprises an inner member having a dip tube connected in fluid-tight relation thereto, and an upward extension of said dip tube within the pump chamber in axially opposed spaced relation to said diaphragm for cooperation with said valve means integrally carried by the diaphragm.

10. A dispensing pump as defined in claim **6** in which said means entering the other end of said annular member comprises an upward tubular extension of a container closure cap, said extension being closed at its lower end, the dip tube extending in fluid-tight manner through said closed lower end and projecting upwardly into the pump chamber to define said inlet passage, said extension constituting a stationary valve means telescopically associated with said valve means integrally carried by said diaphragm, one of said valve means being formed with an inlet port for establishing communication between said inlet port and the port chamber only in a predetermined position of the said diaphragm.

11. A dispensing pump for application to a portable product container comprising an inner member having a product intake passage therethrough; a resiliently flexible bulbous diaphragm having a depending annular skirt; an outer member embracing said inner member and securing such diaphragm to said members to define a pump chamber the volume of which may be varied by deformation of said diaphragm; said outer member having concentric inner and outer annular portions defining there between an annular recess in which is received the annular skirt of said diaphragm; said skirt being secured in fluid-tight manner between said inner and outer portions adjacent to the mouth of said recess, and having a free peripheral edge portion within the said recess spaced from the bottom of the recess and of smaller radial dimension than the recess; said free peripheral edge portion normally encircling said inner portion of the outer member to close a discharge valve port establishing communication between the pump chamber and the said recess, but being resiliently outwardly deflectible by fluid pressure within the pump chamber.

12. A dispensing pump as defined in claim **11** including inlet valve means carried by the said diaphragm for cooperation with said inlet passage in response to deformation of the diaphragm, to permit unidirectional flow only of the product through said inlet passage to the pump chamber.

13. A dispensing pump as defined in claim **12** in which said inlet valve means comprises a stationary valve element supported within said inner member in coaxial spaced relation thereto; said diaphragm including a top wall deformable axially into the pump chamber; a movable valve element carried by the top wall and normally in fluid-tight telescopic engagement with said stationary valve element, one of said valve elements being formed with a port positioned to establish communication between said inlet passage and said pump chamber only in the unstressed condition of the diaphragm.

14. A dispensing pump as defined in claim **13** in which said movable valve element is a sleeve integrally affixed to said top wall of the diaphragm and snugly telescopically receiving said stationary element.

15. A dispensing pump as defined in claim **14** in which the stationary valve element comprises the upper end of portion of a dip tube which extends in fluid-tight relation through the bottom of the pump chamber.

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