

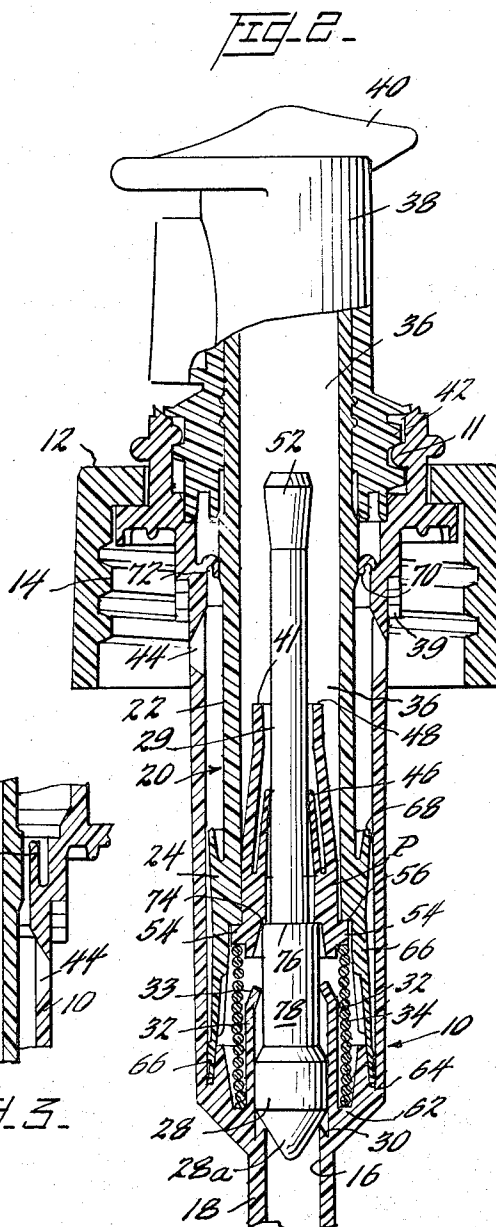
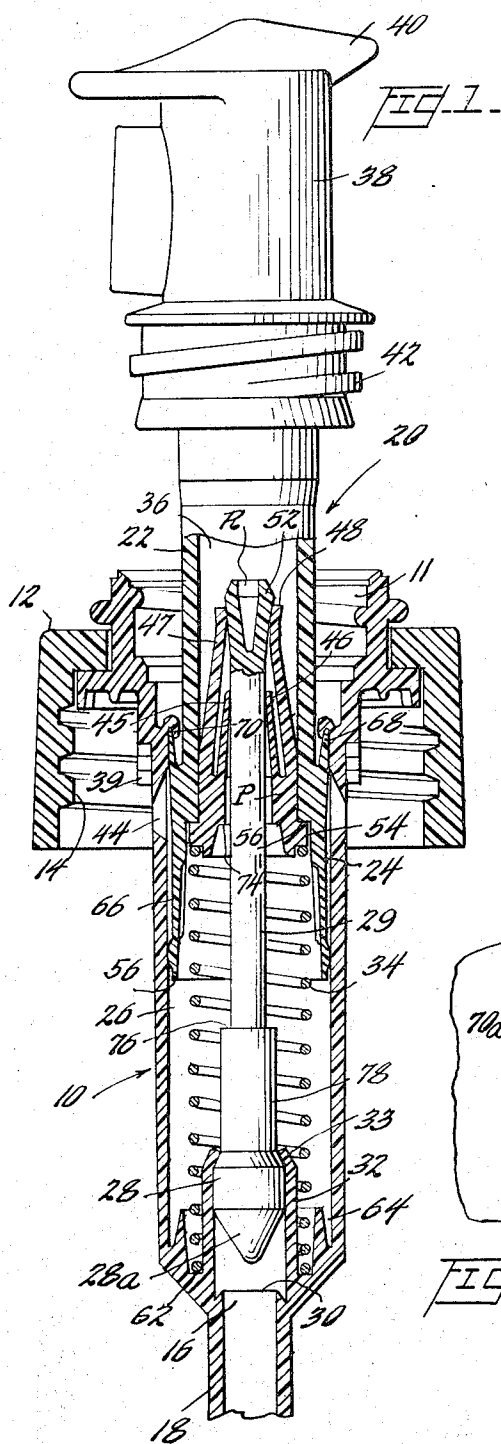
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LIQUID DISPENSER

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LIQUID DISPENSER

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ABSTRACT OF THE DISCLOSURE

The invention relates to a piston type pump having a dual valve seat structure in which the structure defines a resiliently-stretchable valve port and/or seat for cooperation with the valve stem to function as a pump outlet valve and a separate valve port having a substantially low degree of resiliency for cooperation with a sealing valve carried by the valve stem.

This invention relates to improvements in liquid dispensing reciprocating pumps such as are commonly used for dispensing liquids from the containers in which they are sold. Since such pumps are customarily applied to the liquid containers at the manufacturing or bottling plant, it is desirable that some suitable shipping seal be provided in order to prevent leakage of liquid in the event of rough treatment or partial inversion of the containers, changes in atmospheric, and/or vapor pressure within the containers during shipment to distributors and during storage.

In particular, the present invention has for its primary object to provide such a liquid dispenser of a type such as disclosed in U.S. Patent 3,228,347 of Jan. 11, 1966, to Douglas F. Corsette.

In the said patent, there is disclosed a form of dispensing pump in which the inlet valve for admitting fluid into the pump chamber has its valve stem slidably disposed through a resiliently-expandable port in the plunger from a portion of the discharge passage which leads through the plunger to the atmosphere. The discharge port is normally of a diameter to frictionally grip and to maintain a fluid-tight seal around the inlet valve stem when the plunger is at rest and throughout the plunger suction stroke. An increase in liquid pressure in the pump chamber will thus open said port to provide clearance for the passage of liquid from the pump chamber into and through the discharge passage. A sealing valve carried by the inlet valve stem cooperates with the same valve seat or port in the fully-projected position of the plunger to define the above-mentioned shipping seal.

It has been found that such a dual functioning of the valve seat defining portion of such a valve subjects it to conflicting requirements in that it must have sufficient elasticity or yieldability to open under fluid pressure on the one hand; and on the other hand must, when functioning as a component of a sealing valve, afford a reasonable degree of resistance to fluid pressure.

With this in mind, it is a primary object of the present invention to improve upon such prior type of structure to provide a pump having a dual valve seat structure in which the structure defines a resiliently-stretchable valve port and/or seat for cooperation with the valve stem to function as the pump outlet valve, and a separate valve port and/or seat having a substantially-lower degree of elasticity or resiliency, or none at all, for cooperation with a sealing valve carried by the valve stem.

Such improved structure retains substantially all of the advantages of simplicity and economy of structure of the said patented device while, at the same time, affording an improved more positively and reliably operating shipping seal.

In addition, it is a feature of the present invention to

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provide an improved arrangement for preventing leakage or seepage of liquid from the plunger chamber upwardly or outwardly between the plunger and cylinder wall when the plunger is in its fully-projected position.

A preferred pump structure incorporating the foregoing features and advantages of the invention is illustrated by way of exemplification in the accompanying drawings in which:

FIGURE 1 is a view partly in axial cross section and partly in elevation of a pump structure in accordance with the invention, showing the plunger in its fully-projected position to establish the shipping seals;

FIGURE 2 is a view similar to FIGURE 1 but showing the plunger retained in its fully-depressed position in which shipping seals also are established; and

FIGURE 3 is a fragmentary section showing certain details of the cylinder structure at an intermediate stage of its assembly with the plunger.

Referring now in detail to the accompanying drawings, there is illustrated a dispensing pump, including a pump barrel 10 which, in the present instance, extends through and is supported by a radially-enlarged and internally-threaded collar portion 11 within the central opening of a container closure 12 which is adapted by internal threading 14 or otherwise for application to a container. The specific form and construction of the closure 12 and collar 11, and the manner in which they are interconnected, is fully disclosed in said Patent 3,228,347. It will be seen that the cylinder 10 has an inlet port or passage 16 opening axially through its otherwise closed inlet end. The port is defined by an upward extension of the suction tube 18 which depends from the pump cylinder 10 and is of sufficient length that its lower end will normally be disposed closely adjacent the bottom of the container in which the pump is employed, so that the container contents may be sucked upwardly through the tube 18 and into the pump cylinder.

At its opposite end, the pump cylinder 10 opens through the radially-enlarged collar 11 for reception of various portions of the pump assembly, including a pump plunger 20 which is disposed for reciprocation in the cylinder. This plunger 20 includes a hollow tubular plunger rod portion 22 having a piston 24 at its innermost end in fluid-tight reciprocating engagement with the interior wall surface of the cylinder 10. Preferably the plunger, including the plunger rod 22 and piston 24, is molded of a suitable plastic material to form a unitary structure. It will be seen that the piston 24 cooperates with the cylinder to define a variable volume pump chamber 26 between the piston and the closed end of the cylinder through which is formed the inlet port 16.

An inlet valve 28, which may be of any suitable type or configuration, having a rigid stem 29, is disposed in the pump chamber 26 for limited axial movement into and from seating relation with a valve seat 30 which encircles the inlet port 16. This valve serves the usual function of admitting fluid from the container into the pump chamber 26 through the inlet port 16 while effectively preventing backflow from the chamber. Preferably the valve 28 is guided for axial movement in a cage formed by a plurality of relatively-spaced fingers 32 molded integrally with the cylinder 10 in annular formation around the valve seat 30 for guiding reception of the valve 28. The outer free end portions of the fingers are resiliently radially deflectable in response to spreading action exerted thereon by the conical nose 28a of the valve to permit assembly of the valve into the case. Radially inwardly-directed free end portions 33 of the respective fingers provide detents which are adapted to snap back over the valve 28 so as to prevent its subsequent outward movement by pressure of the plunger

spring 34. The fingers 32 thus permit but a limited degree of unseating movement of the valve 28 and, together with the valve seat 30, serve as means for limiting the axial movement of the valve 28 in either direction.

The discharge or outlet passage 36 for the pump is defined by the hollow pump plunger 20 and extends completely through the plunger including both the plunger rod 22 and piston 24 to deliver liquid from the pump chamber to a suitable discharge head 38 which is affixed to and carried at the outer end of the plunger rod 22 and from which the liquid is discharged into the atmosphere in well-known manner. The discharge head 38 is provided with a finger piece 40 to facilitate actuation of the pump by intermittent finger pressure, and has an externally-threaded base 42 for reception in the internally-threaded collar 11, when desired, to secure the plunger in its fully-depressed position, as shown in FIGURE 2. The particular form of discharge head 38 illustrated constitutes no part of the present invention but is of conventional structure such as shown in various prior patents. In accordance with known practice, there may be provided a castellated skirt 39 around the upper end of the pump cylinder for supporting the pump cylinder against rotation by a conformingly-castellated sleeve-like tool (not shown) while the plunger is depressed and rotated to interengage the threaded skirt 42 within the collar 11 prior to application of the pump to a container.

Customarily, breather openings or vents 44 are provided in the cylinder wall above the piston 24 at a location to be covered by the piston only in the raised or retracted position of the plunger.

The structure as thus far described is similar to that disclosed in the earlier-mentioned Patent 3,228,347. The improvement of the present device over that of the patent is incorporated primarily in the construction and arrangement of the outlet valve means and sealing means.

Thus, within the lower or inner end of the passage 36 of the plunger is disposed a plug P of a suitable plastic such as polyethylene, synthetic rubber, or the like, having the characteristics of elasticity and resilient deformability to a degree sufficient for the purposes hereinafter described. This plug P is provided with relatively-concentric sleeves 45 and 47, the free outer ends of which terminate at different axial locations and respectively define the resiliently-stretchable outlet valve port or seat 46 for cooperation with the valve stem 29 and the sealing port 48 for cooperation with the sealing valve 52, shown in the drawings as comprising an enlarged conical plug at the free end of the valve stem 29. The plug P is inserted into the lower end of the plunger passage 36 in snug sealing relation therewith into an operative position which is determined by abutting engagement of its projecting radial sealing flange 54 with the annular shoulder 56 of the plunger.

The valve stem 29 is disposed for axial movement through the ports defined by the respective annular seats 46 and 48. The pump outlet valve seat 46, defined by the elastically-stretchable peripheral free end of the tapered sleeve 45 is of a diameter adapted for normally-snug fluid-tight engagement with the valve stem 29, it being understood that the latter is of circular cross section. Because of such relationship, it is also normally frictionally engaged with the valve stem to impart a yielding thrust or force from the plunger to the inlet valve 28 for positively seating and unseating the latter at the inception of each compression and suction stroke respectively of the plunger. The elasticity of the seat 46 is such that continued downward movement of the plunger after seating the valve 28, and the resulting pressure on liquid trapped within the pump chamber 26, will expand the sleeve 45 to move the seat portion 46 thereof radially away from the stem, thus providing a clearance space through which the liquid is free to flow upwardly into the plunger discharge passage 36.

The sleeve 47, the free end of which defines the sealing

valve seat 48, is preferably of greater wall thickness than the sleeve 45 so as to make the port 48 less capable of resiliently stretching than the port 45. If desired, the port 48 may be defined by material of such thickness as to be for all practical purposes substantially inelastic. The seats 46 and 48 are relatively axially spaced and are so positioned with relation to the sealing valve 52 that, in the fully-raised or projected position of the plunger, as shown in FIGURE 1, the sealing valve 52 is firmly received and wedged within the port 48 under the action of the plunger spring 34 to thus prevent leakage from the pump chamber into the passage 36. The annular port or seat 48, however, has a normal radius which is sufficiently greater than that of the valve stem 29 as to provide ample clearance with the stem such as will permit the free flow of fluid to passage 36 when the seat 48 is disengaged from sealing valve 52. It will thus be apparent that the port 48 is closed and sealed by the valve 52 only in the fully-projected position of the plunger, as in FIGURE 1, and that, at all other times during and throughout the plunger stroke, it will be open for the free passage of fluid.

It is desirable to provide the inner end of the cylinder 10 with an annular sealing groove 64 around the spring seat 62 for sealing reception of the free inner end of a cylindrical skirt 66 constituting part of the piston 24.

The retraction or suction stroke of the piston 24 under the influence of the spring 34 will be limited by engagement between the trailing rear end edge of the outwardly directed piston skirt 68 and an annular flange or rib 70 which is formed by a suitable swaging operation after assembly of the plunger and its associated parts within the cylinder 10 in a manner generally similar to that disclosed in the Corsette U.S. Patent 3,084,873. The rib 70 is here illustrated as defining an inwardly-directed annular groove 72 for sealing reception of the piston skirt 68. The rib 70 may be initially formed as a cylindrical sleeve 70a within the cylinder 10 in the manner shown in FIGURE 3. While it is still in this form, the plunger may be inserted within the cylinder to a position in which the piston is located inwardly of the sleeve 70a, following which, through a suitable swaging operation, the upper portion of the sleeve 70a is turned reversely inwardly to provide a cuff spaced radially inwardly of the remainder of said sleeve whereby to form the groove 72.

In order that the plunger may exert seating pressure on the inlet valve 28 in the fully-depressed position of the plunger as in FIGURE 2, the plunger includes an axially inwardly-directed shoulder 74 defined by the plug P, positioned for axial abutment with an opposing annular shoulder 76 around the valve stem.

With the structure thus described, finger pressure applied on the finger piece 40 of the discharge head will urge the entire plunger 20 inwardly on its compression stroke to expel liquid through the discharge head 38. Conversely, upon release of the finger pressure, the spring 46 will project the plunger outwardly on its suction stroke.

It will be understood that the valve stem 29 may be assembled with relation to the plunger 20 by withholding the formation of its enlarged sealing valve 52 until after insertion of the latter through the valve ports 46 and 48 and thereafter expanding same to form the valve 52 by a suitable wedge-like tool thrust into the free axial end of the valve stem 29 whereby to form the recess as shown at R in FIGURE 1 and to thus expand the material surrounding said recess radially outwardly.

In the operation of the pump, commencing with the plunger secured in its fully-depressed position, as in FIGURE 2, the plunger head 38 may be grasped and rotated to release the threaded connection between the collar 11 and the threaded base of the discharge head at 42, whereupon the plunger spring 34 will immediately expand to project the plunger outwardly on its suction stroke. At this time, the valve seat 46 will be elastically closed around the valve stem 29. At the inception of such stroke, the frictional engagement of the valve seat 46

with the valve 29 will immediately unseat the valve 28 so that subsequent outward movement of the plunger (during which the stem 29 will continue to close the port defined by seat 30) will draw fluid upwardly through the dip tube 18 and port 16 into the pump chamber.

When the plunger reaches the limit of its outer movement, the plunger skirt 68 is received within the annular sealing groove 72 of the stop rib 70. Thus, there is established a seal externally of the plunger, between the plunger and cylinder, which prevents passage of liquid upwardly between the plunger and cylinder beyond the ribs 72.

Also, as the plunger approaches the upper limit of its section stroke, the sealing valve 52 will be operatively seated in the port 48 to prevent upward leakage of liquid from the pump chamber to the discharge passage 36. Thus, if it is desired to leave the plunger in its fully-projected position at any time, either after use or for shipping or storing purposes, effective seals are provided for preventing loss of the liquid.

However, upon inception of each downward or compression stroke of the plunger, the frictional engagement between the port 46 and the valve stem 29 will impart a seating force to the valve 28, following which the ensuing axial movement of the plunger 20 relative to the inlet valve will unseat the sealing valve 52 from its port 48 while the elastic pump valve 46 will expand, due to the pressure of liquid within the pump chamber, providing a clearance space around the valve stem. The outlet valve 46, 29 thus being open throughout the continuance of the compression stroke, the liquid from the pump chamber is expelled upwardly through the discharge passage 36 and into the plunger head 38 for discharge into the atmosphere.

It will be particularly observed that, with such a construction of outlet and sealing valves, the pump outlet valve seat 46 may be quite thin and easily deformed or stretched to facilitate the pumping action; while the sealing valve seat and port 48 may be of substantially-heavier and relatively-unstretchable construction such as is capable of cooperating with the sealing valve 52 to resist a substantial degree of pressure of liquid within the pump chamber 26.

It will be understood that the structure herein shown and described is merely by way of exemplification of the preferred embodiment of the invention and that it is capable of various modifications of an obvious nature without departing from the invention.

Having thus described my invention, I claim:

1. In a reciprocating liquid pump, including a pump cylinder having an inlet port through one axial end thereof, an inlet valve carried by said cylinder for axial movement within predetermined limits into and from seating relation with said inlet port, and a plunger disposed for axial movement in said cylinder on suction and compression strokes respectively away from and toward said inlet port, said plunger and cylinder jointly defining a variable volume pump chamber between said plunger and the inlet port, said plunger being provided with an axial discharge passage ending therethrough from the pump chamber, the improvements comprising a pair of relatively axially-spaced valve seats defining an outlet port and a sealing valve port respectively in said passage, a sub-

stantially-rigid valve stem connected to said inlet valve and disposed for axial movement through both said ports, a tubular elastic sleeve secured within said passage, said sleeve having a free end directed axially away from said pump chamber to define said outlet port and seat and having a portion remote from said free end secured in fluid-tight relation within said passage, said outlet port normally snugly slidably receiving said valve stem in fluid-tight relation, to be closed by said stem, but being expandible radially away from said stem to open said port in response to fluid pressure within the pump chamber, and a sealing valve carried by said stem for cooperation with said sealing valve port.

2. In a liquid pump as defined in claim 1, the further improvement in accordance with which said sealing valve is on the remote side of said sealing port from the pump chamber.

3. In a reciprocating liquid pump as defined in claim 2, the further improvement whereby said outlet valve port is interposed between said pump chamber and the sealing port.

4. In a reciprocating liquid pump as defined in claim 2, the further improvement including a tubular plug snugly received in fluid-tight manner in the inner end of said plunger discharge passage, the hollow interior of said plug opening axially through the opposite ends of the plug in communication with said pump chamber and with said passage respectively, said sleeve being disposed within and forming an integral part of said tubular plug.

5. In a reciprocating liquid pump as defined in claim 4, a radially outwardly-projecting flange encircling said plug for axial abutment against the inner end of said plunger to limit the movement of the plug into said discharge passage and to define a seat for the plunger spring, and a plunger spring under compression in said pump chamber between said flange and the inner end of said chamber.

6. In a reciprocating liquid pump as defined in claim 4, the further improvement in accordance with which said sealing port comprises the free axially-outer end of said plug, same being disposed in coaxial radially-spaced relation to said sleeve.

7. In a reciprocating liquid pump as defined in claim 1, the further improvement including an annular stop rim formed within said cylinder and projecting radially inwardly from the inner wall thereof, said rim being formed to provide an annular sealing groove directed toward the inner axial end of the cylinder, said plunger having a piston thereon disposed axially inwardly of the cylinder from said rim and having an outwardly-directed piston skirt the outer edge of which is disposed for sealing reception in said sealing groove.

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