

[54] **DISASSEMBLEABLE VALVE AND LIQUID DISPENSING DEVICE**

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[58] Field of Search 137/525, 533, 533.11, 137/533.15, 533.17, 533.19, 519.5, 539, 533.31, 543.19, 543.21; 251/360

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[57] **ABSTRACT**

A disassembleable valve is disclosed wherein a hollow glass insert having a circular sealing surface on one end for sealing the passage therethrough is positioned within a tubular plastic member, and a precision spherical ball of a diameter to establish a seal at the insert sealing surface is captured for forming the seal. A liquid dispensing device is provided with a disassembleable valve and includes a cap structure adapted to be secured onto the top of a liquid container and provided with integral tubular sleeve forming a tubular portion of the valve and with a syringe mounted on the cap for moving fluid through the valve. The syringe has a ring on the outside surface of the barrel and a shroud connected to the syringe piston movable within limits set by the ring. The cap has inserts for different shaped fluid containers and a stabilizing stand.

3 Claims, 10 Drawing Figures

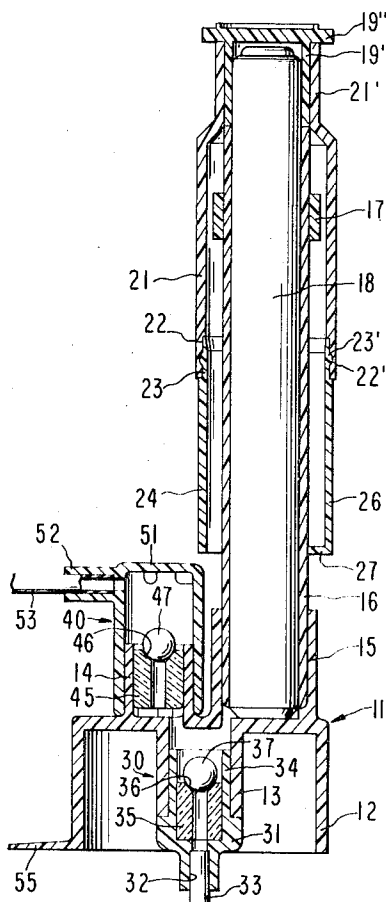


FIG. 1

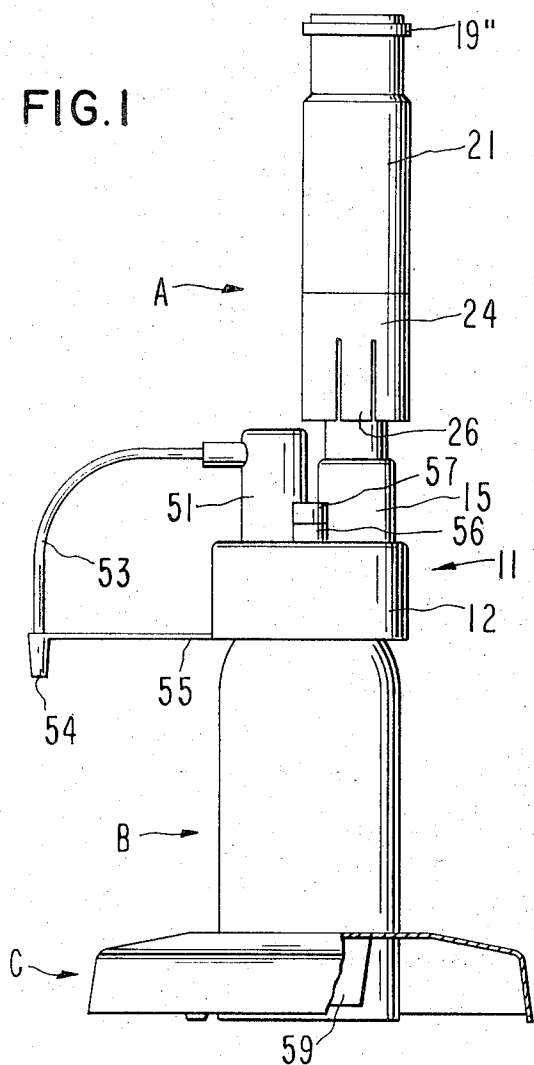


FIG. 2

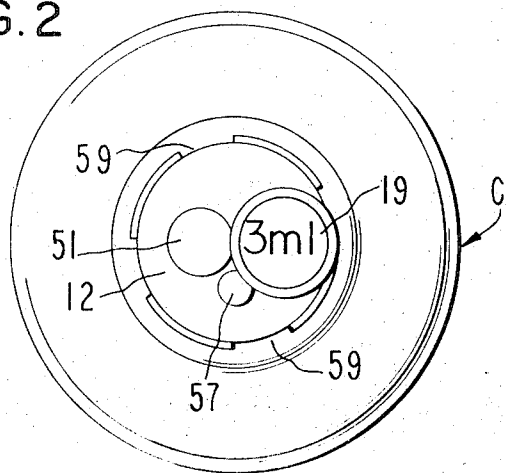


FIG. 3

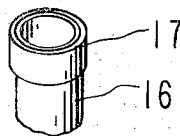
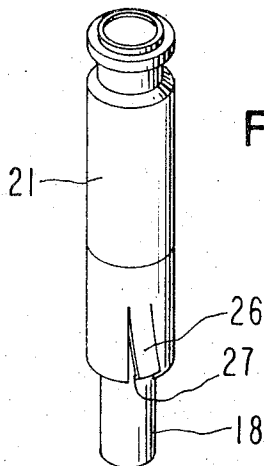
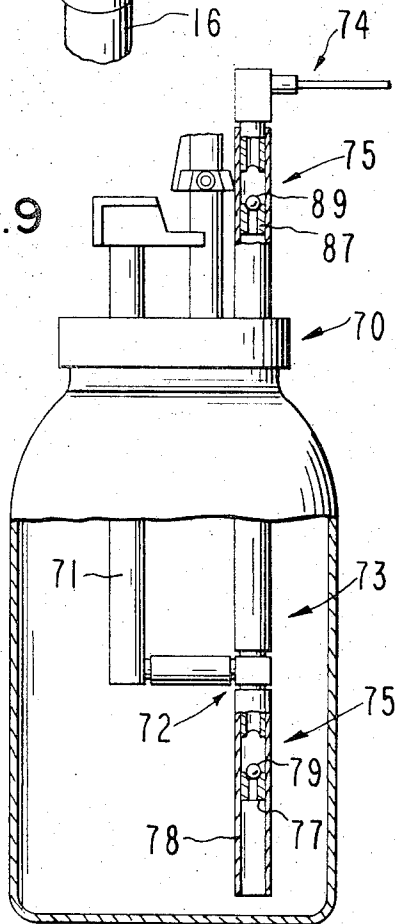


FIG. 9



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DISASSEMBLEABLE VALVE AND LIQUID DISPENSING DEVICE

The present invention relates to a disassembleable valve and, more particularly, to a liquid dispensing device employing such a valve.

Liquid dispensing devices of the pipette type have been provided heretofore using for certain portions thereof plastic members to reduce the cost of manufacture and provide a structure less susceptible to breakage. One such device is shown in my U.S. Pat. No. 3,452,901. To provide the precise control for fluid flow, such pipettes have always required precision valve assemblies necessitating fabrication of considerable glassware with the attendant manufacturing time and costs, as well as potential breakage both during manufacture and use.

The object of the present invention is to provide and inexpensive disassembleable valve that can be easily manufactured from a minimum number of precision glass elements.

In accordance with one embodiment of the present invention, a disassembleable valve is provided from a tubular plastic member, a hollow cylindrical glass insert therefor having a precision circular sealing surface on one end thereof, a precision spherical ball adapted to form a seal at said sealing surface and a ball capturing enclosure member for the tubular member.

In accordance with another aspect of the present invention, a liquid dispensing device is provided of a molded plastic container cap structure having a downwardly projecting sleeve to house one disassembleable valve of the aforementioned type, an upwardly projecting sleeve to house another disassembleable valve of the aforementioned type and an upwardly projecting sleeve supporting a syringe, the three sleeves interconnected for pumping fluid from the container on which the cap is supported through the respective valves by upward and downward movement of the syringe.

In accordance with still another aspect of the present invention, the cap member is dimensioned to receive a cap insert having an inside diameter fitting the neck of an appropriate fluid container so that the same dispensing device can be mounted on a wide variety of containers merely by selection of the appropriate cap insert.

In accordance with still another aspect of the present invention, a dispensing device of the aforementioned type having an operating syringe thereon is provided with a ring member on the outside surface of the syringe barrel and a shroud connected to the syringe piston surrounding the barrel and ring. A flexible finger on the shroud limits movement of the syringe piston to a predetermined length for a selected volume, and the ring member can be moved to different positions to change the volume setting for the device.

In accordance with still another aspect of the present invention, a stabilizing ring is provided for the bottom end of a fluid container on which the liquid dispensing device is mounted giving support to the container during operation of the liquid dispensing device.

Other objects and advantages of this invention will become apparent when reading the following description and referring to the accompanying drawing in which similar characters of reference represent corresponding parts in each of the several views.

In the drawings:

FIG. 1 is an elevational view of a fluid dispensing device utilizing the present invention.

FIG. 2 is a top view of the structure shown in FIG. 1.

FIG. 3 is a perspective view, partially exploded, of a portion of the structure shown in FIG. 1.

FIG. 4 is an elevational sectional view of the dispensing apparatus shown in FIG. 1.

FIG. 5 is an elevational sectional view of a cap insert for the structure of FIG. 4.

FIGS. 6, 7 and 8 are views similar to FIG. 5 showing other insert structures.

FIG. 9 is an elevational sectional view of another fluid dispensing apparatus utilizing the present invention.

FIG. 10 is a side elevational sectional view illustrating still another embodiment of the present invention.

In its broadest sense the present invention is directed to a disassembleable valve structure and, for purposes of illustration, will be described with reference to a fluid dispensing apparatus utilizing such valve structure.

Referring now to the drawing, with particular reference to FIG. 1, there is shown a dispenser assembly A embodying the present invention mounted on top of a fluid container or bottle B which is provided with a stabilizing ring C at its lower end to stabilize the bottle during operation of the dispensing apparatus.

Now, with reference to FIGS. 1-4, the dispensing apparatus A includes a cap body 11 such as of molded plastic and including an integral downwardly projecting cup portion 12 serving as the cap holder for the bottle B. Within the cap portion 12 the body includes a downwardly projecting first hollow cylindrical valve sleeve 13 which is in fluid communication with both an upwardly projecting second hollow cylindrical valve sleeve 14 and an upwardly projecting hollow cylindrical syringe sleeve 15, both sleeves 14 and 15 also being integral with the cap body 11.

A syringe barrel 16 of ground glass is frictionally held within the syringe sleeve 15. Assembly of the syringe barrel 16 in the sleeve 15 is accomplished in the same manner as assembly of the other elements of the assembly as set forth below. A stop ring 17 of plastic is supported on the outside surface of the barrel 16 with a frictional fit, and typically, the position of the ring along the length of the barrel is factory set to control the travel of the syringe plunger as described below. A cylindrical syringe plunger 18 of ground glass slidably moves within the barrel 16 and is provided at its upper end with a cap handle 19 of plastic having a cylindrical sleeve portion 19' surrounding and frictionally engaging the outer surface of the plunger 18. A radially outwardly projecting flange 19'' is provided on the cap to better facilitate grasping the upper end of the cap for movement of the plunger. Typically, indicia molded in the top of the cap handle 19 designate the fluid volume dispensed by one stroke of the syringe within the limits of travel preset at the factory.

An upper cylindrical shroud 21 of plastic having a reduced diameter portion 21' frictionally engaging the cap handle sleeve portion 19' extends downwardly over the syringe barrel 16 and stop ring 17. The lower end of this upper shroud 21 is provided with a stepped diameter shoulder portion 22 to receive a complimentary stepped diameter shoulder portion 23 of a lower cylindrical shroud 24 such as of plastic. The shoulder por-

tion 23 of the lower shroud 24 has an outwardly projecting annular ridge 23' received in a complimentary groove 22' of the upper shroud shoulder portion 22. The ridge 23' and groove 22' permit the two shrouds 21 and 24 to be snapped together.

The lower shroud 24 is provided with a pair of slots 25 extending upwardly from the lower end of the shroud 24 and defining therebetween a flexible finger 26 provided with an inwardly directed flange portion 27 at the lower end thereof. This flange 27 projects radially inwardly beyond the outside surface of the stop ring 17 whereby the flange 27 engages the stop ring 17 on upward movement of the plunger 18 to limit the upward movement of the plunger stroke. Engagement of the sleeve with the top end of the barrel 16 provides the downward limit for the plunger stroke.

Both the valve sleeves 13 and 14 house valve assemblies 30 and 40, respectively, in accordance with this invention. Valve assembly 30 includes a cup-shaped housing inlet member 31 having a small diameter opening 32 at the lower end of the cup to receive a piece of tubing 33 extending to the bottom of the bottle B. The upwardly extending sides 34 of the cup frictionally engage the inside surface of valve sleeve 13 and receive therewithin a hollow cylindrical insert, such as of glass, providing communication from opening 32 upwardly to sleeves 14 and 15. The upper end of insert 35 is provided with a valve seat 36 such as in the form of a conical surface for establishing a seal with a precision valve ball 37 such as of polished ceramic.

It can be seen that only the critical sealing elements, i.e., the member having the valve seat and the valve ball, are formed of precision ground members as glass and these elements are inserted into the other parts of the assembly quickly and easily and removable for disassembly thereby providing an inexpensive but precision valve assembly.

This valve assembly permits fluid to be drawn up through tubing 33 and valve sleeve 13 when the syringe plunger is lifted and prevent movement of this fluid back down in the bottle when the plunger is moved downward. The weight of the ball 37 causes the ball to seat immediately upon reversal of direction of the plunger; however, a spring member could be added to the assembly if desired and particularly in those instances where the ball is to close against the force of gravity.

Fluid raised from the bottle by upward motion of the plunger is forced out through valve assembly 40 on downward motion of the plunger. The valve assembly 40 is similar to assembly 30 and includes an insert 45 in the sleeve 14 having a valve seat 46 for fluid sealing engagement with ball valve 47. An outlet cap 51 such as of plastic frictionally sits over the outside of sleeve 14 to capture the ball 47 and is provided with an outlet spout 52 receiving a piece of delivery tubing 53 from the end of which the fluid is dispensed.

To prevent unnecessary contamination of fluid in the delivery tubing 53, a tube cover 54 is provided on the end of a tube cover holding tab 55 molded integrally with the cap body 11.

The cap body 11 includes one other upwardly projecting hollow cylindrical air filter sleeve 56 communicating with the central portion of the cap body portion and receiving an air filter plug 57 such as sintered polypropylene.

A valve assembly of the type described above is desired for dispensing various different fluids and must be inert. Consequently, the precision element controlling the metered amount of fluid are of glass and the outer elements described as of plastic are typically made of polypropylene.

Since the dispensing apparatus in accordance with this invention are utilized on top of the very container in which the material to be dispensed is sold and very often the bottle can be quite small, the stabilizing ring C is provided to prevent the bottle from tipping over during operation of the dispensing assembly. The stabilizing ring includes an outwardly downwardly projecting support surface 58 and a plurality of inwardly projecting fingers 59 at the inner periphery ring for engaging the outside surface of the bottle.

A single dispenser assembly as described above can be utilized with various different bottle sizes having different bottle top and bottle cap sizes and configurations. Accordingly, appropriate inserts for the cap body 11 can be provided to accommodate the dispenser assembly A for the different bottle.

FIGS. 5-8 illustrate a number of different inserts to accommodate the cap body to different bottles. The inserts 61, 62 and 63, shown in FIGS. 5, 6 and 7, respectively, are cup-shaped members whereas the insert 64 shown in FIG. 8 is more in the form of a disc member. Each of the inserts 61, 62, 63 and 64 include a curved surface 65 in the top thereof extending down to a central opening which permits passage of the valve sleeve 13 as well as provide communication from the filter sleeve 56 into the bottle to permit air passing through the filter plug 57 to replace the fluid as fluid is dispensed by the dispenser assembly A.

The insert 61 shown in FIG. 5 includes a reduced diameter inner surface 66 corresponding to the outside diameter of the cap or mouth of a particular bottle to be utilized with the assembly. Insert 62 shown in FIG. 6 has an inside surface 66' of a different diameter. Insert 63 shown in FIG. 7 includes a plurality of flexible fingers 67 for engaging and holding the top of the bottle, and insert 64 shown in FIG. 8 simply provides the curved surface 65 for permitting air access to the bottle where the bottle cap or bottle mouth is of a size to frictionally engage the downwardly projecting cap portion 12 of the cap body 11.

The various elements of the assembly which are frictionally engaged together are assembled by simple immersion in hot water where the elements are moved to their desired position and whereupon they frictionally engage together when removed from the water. The valve assembly can be disassembled, if desired, for cleaning by simple immersion in hot water. Similarly, the volume adjustment for the dispenser assembly can be changed by immersing the syringe barrel 16 in hot water and sliding the stop ring 17 along the length thereof to a new position.

To operate the dispensing assembly, the dispenser assembly is primed preferably before the assembly is fixed to the top of the bottle so that there is no prime waste. Priming is achieved by inserting the tube 33 in the liquid in the bottle and placing the outlet tube 53 in the top of the bottle and moving the plunger up and down a number of times until fluid is drawn into the dispenser assembly and ejected from the outlet tube 53. Once primed, the cap body is secured on top of the bottle B and the dispenser assembly is ready to operate.

As syringe plunger 18 is moved upwardly, the ball 47 is seated against the seat 46 in valve 40 and ball 37 in valve 30 is lifted from the seat 36 drawing fluid from the bottle into the syringe barrel. The plunger is free to move upwardly until the flange 27 on finger 26 engages the stop ring 17 for subsequent downward movement of the plunger. On downward movement, the ball 37 in valve 30 seats on the valve seat 36 and the ball 47 in valve 40 is unseated causing fluid to be dispensed through the outlet 53. If the dispensing unit is retained on the reagent bottle for future dispensing, the outlet tube 53 is firmly inserted in the tube cover 54.

If it is desired to clean the syringe assembly or change the setting of the stop ring 17, the finger 26 is lifted so that when the syringe plunger is raised the finger flange 27 clears the stop ring 17.

The disassembleable valve in accordance with the present invention can be made in other forms.

By way of example, FIG. 9 illustrates a liquid dispensing device constructed generally in the manner in accordance with my patent 3,542,901 but including this disassembleable valve. The dispensing device 70 includes a similar syringe structure 71, the lower end of which is connected via a T 72 to a tubular line 73 extending from the bottom of the bottle B to the outlet tube 74. This tubular member 73 includes two valve assemblies 75 and 76 in accordance with the present invention, the lower valve 75 located below the juncture with the T 72 and the other valve 76 being located above.

The lower valve assembly 75 includes an insert 77 such as glass frictionally held within a tubing member 78 extending downwardly from the T 72 to the bottom of the bottle. The insert 77 is provided with a conical valve seat surface 79 at its upper end to receive a sealing ball 79 as of glass or ceramic. The tubing 78 slidably fits over the downwardly projecting end of the T 72 to capture the balls therebelow and above the insert 77.

Valve 76 includes a similar insert 87 and ball 89 captured by a hollow cylindrical plug member inserted in the end of tubing 73 and to which the outlet tube is connected.

It will be appreciated from the above that a valve assembly can be quickly, easily and inexpensively assembled by sliding the hollow cylindrical insert into the tubing, placing the sealing ball therein for engagement with the valve seat surface on the insert, and closing the other end of the tubing with a member to capture the ball.

As set forth above with reference to the embodiment of FIGS. 1-4, a spring member for biasing the ball in intimate contact with the valve seat is sometimes desirable. A valve assembly in accordance with the present invention employing a spring member is shown in FIG. 10. With reference to FIG. 10, the valve assembly 80 permitting fluid to be drawn in from a source S and dispensed through a dispensing conduit to a dispensing assembly D includes a tubular housing 81 closed at one end provided with an outlet aperture 82 opening upwardly and a downwardly opening reservoir aperture 83. The open end of the tubular housing 81 is provided with internal threads 82' cooperating with external threads on a hollow cylindrical plug 83' provided with

an outwardly projecting hollow tubular conduit 84 for connection to the source S. The plug 83' includes a hollow cylindrical sleeve portion 85 projecting inwardly from the conduit 84 and receiving a hollow cylindrical sleeve 85 such as glass provided with a conical valve seat 86 on the inner end thereof. A spherical ball 87 such as of ceramic seating on the valve seat 86 is held in place by a ball retaining sleeve 88 slidably supported within the tubular housing 81 and spring biased toward the plug closed end of housing 81 by a glass spring 89 having its one end bearing against the closed end of the tubular housing 81 and its other end bearing against a radially outwardly projecting flange 90 on the ball retainer sleeve 88. A ball capturing cylindrical sleeve 91 projects from the sleeve 88 toward the valve seat to hold the ball in place when the valve assembly is first assembled. The sleeve 88 is provided of such a length that when the plug 83 is inserted in the housing 81 the sleeve is only able to move a specified distance X against the spring when reduced pressure is established in the housing 81 to open the valve, and this distance X is small enough so that the ball 87 will lift from the valve seat but will be retained sufficiently close thereto so as not to drop from position. The glass spring 89 can increase the precision of the valves in accordance with the present invention, as well as prevent siphoning in the system when outlet delivery positioning is in a plane lower than the fluid reservoir. Since the spring is made of glass and is inert, the spring is compatible with any reagent that can possibly be used in the dispensing device.

What is claimed is:

1. A disassembleable valve comprising, in combination
 - a tubular plastic member having a uniformly cylindrical inside wall surface for a length,
 - a hollow, cylindrical, glass insert slidably inserted into said tubular member with the outside surface of said insert in tight frictional engagement with said length of the inside wall surface of said plastic member for normally holding the glass insert and the plastic member together,
 - said insert having a precision circular sealing surface on one end thereof for sealing the passage through said insert;
 - a precision spherical ball of diameter to establish a seal at said insert sealing surface when positioned thereon; and
 - a ball capture and closure member sealingly engaging said tubular member and positioned at the end of said insert having said sealing surface.
2. The valve of claim 1 wherein
 - said closure member is a second hollow cylindrical insert slidably inserted into said tubular member with the outside surface of said second insert in sealing engagement with the inside surface of said tubular member,
 - said first and second inserts trapping said ball therebetween within said tubular member.
3. The valve of claim 1 wherein
 - said closure member is a second hollow tubular member sealingly engaging the outside surface of said first tubular member.

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