Aug. 13, 1968 C. E. MALONE 3,396,874

POSITIVE ACTION DISPENSING VALVE

Filed May 15, 1967 2 Sheets-Sheet 1

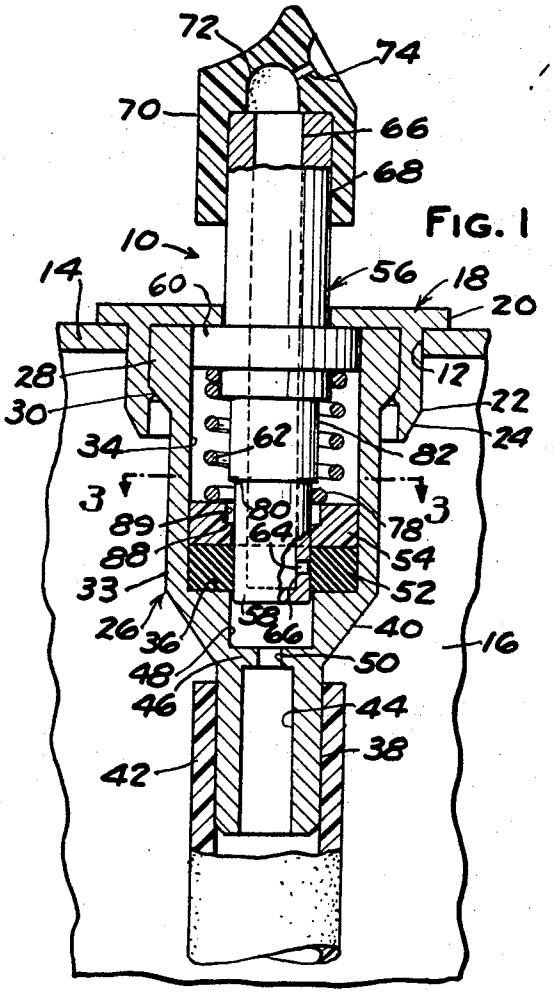

FIG. 1

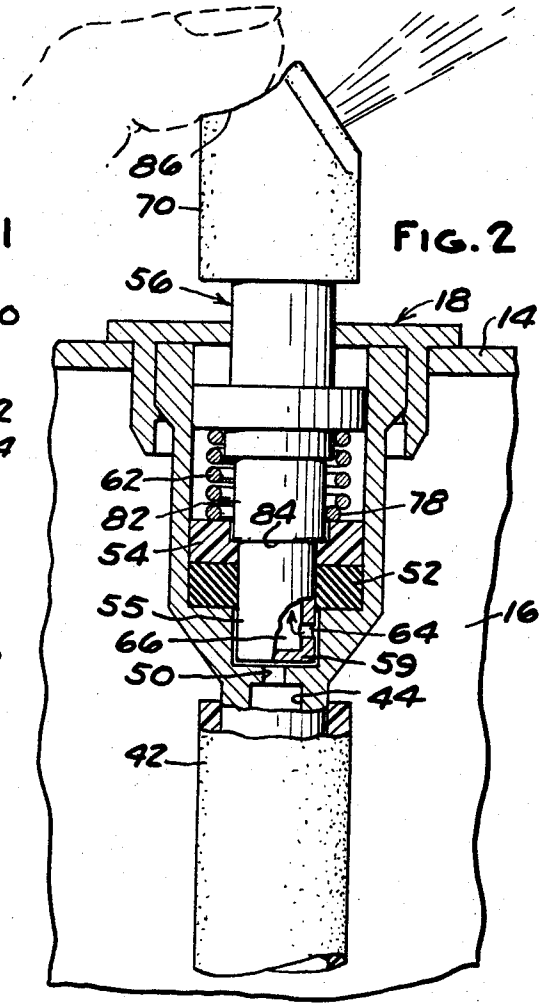

FIG. 2

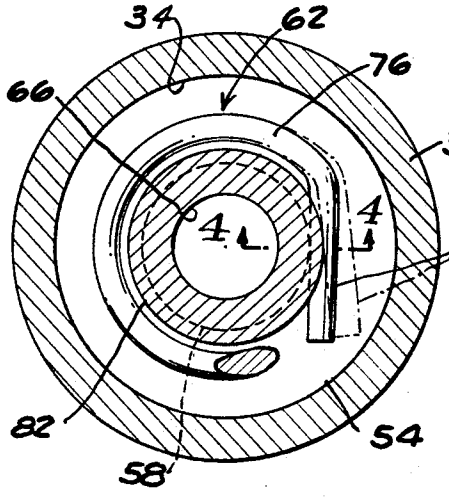

FIG. 3

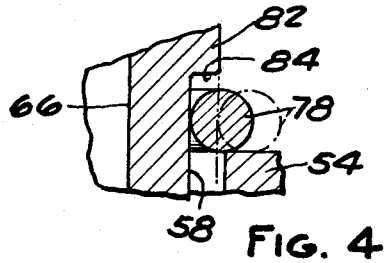

FIG. 4

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POSITIVE ACTION DISPENSING VALVE

Filed May 15, 1967 2 Sheets-Sheet 2

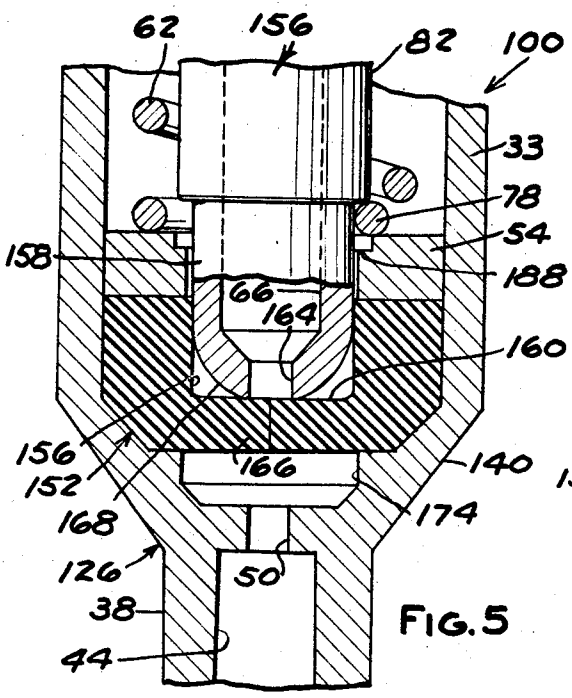

FIG. 5

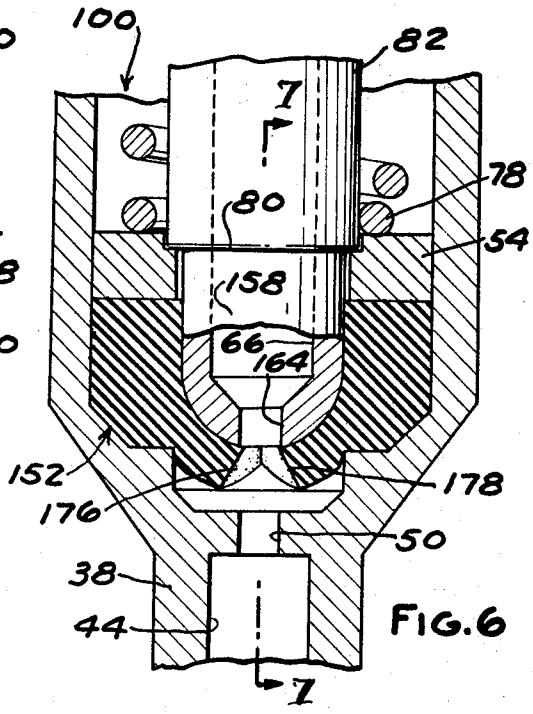

FIG. 6

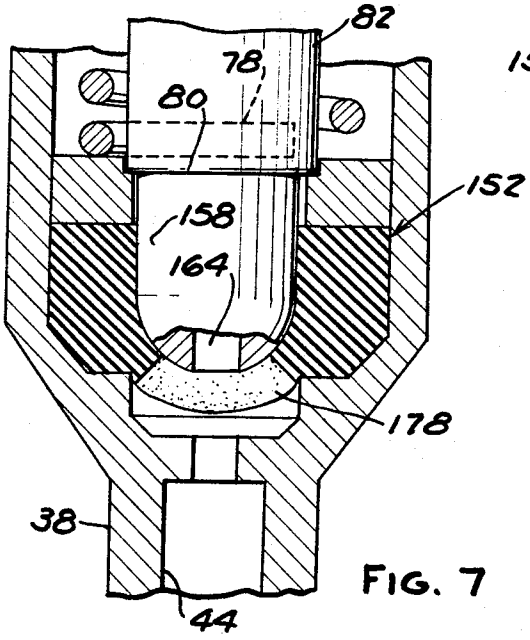

FIG. 7

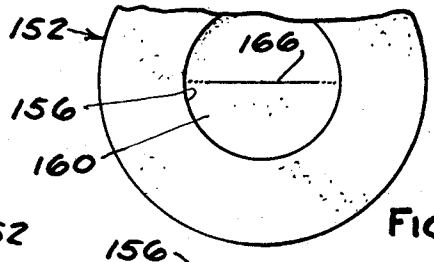

FIG. 8

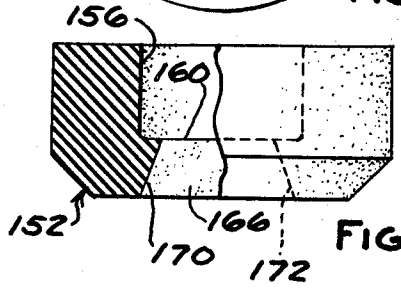

FIG. 9

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POSITIVE ACTION DISPENSING VALVE

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Filed May 15, 1967, Ser. No. 638,313
8 Claims. (Cl. 222—402.1)

ABSTRACT OF THE DISCLOSURE

A dispensing valve for dispensing of various liquids under relatively high pressure from a source such as an aerosol can wherein the valve has a finger pressure actuated member normally biased to closed position by a coil spring. The spring encircles the valve member and has a chordal portion formed in its bottommost turn to provide a yieldable detent or spring latch which must be cammed out of the way by a stop-trip shoulder of the valve member before the member can be depressed by finger pressure to its opened, liquid dispensing position. This insures that the valve opens, and also closes, with a snap action, thereby eliminating the dribble or droplets obtained with conventional dispensing valves when the same are gradually opened or closed.

An object of the present invention is to provide a dispensing valve for dispensing of various liquids under relatively high pressure, as commonly found in aerosol spray devices, which positively and instantly opens and closes independently of the manner in which it is manipulated, thereby eliminating all dribble commonly associated with dispensing valves now available.

Another object is to provide a dispensing valve for dispensing liquids under pressure from containers which is leak-proof through the provision of a reliable, simple single seal arrangement.

Another object is to provide a valve of the above character in which the fluid under pressure being dispensed via the valve does not enter any "dead spaces" in the valve structure but rather travels directly from the source to the dispensing outlet to thereby insure a clean operating valve which has a long operating life and constant high efficiency over prolonged periods of use with a wide range of fluid materials to be dispensed.

Still another object is to provide a valve of the above character which is easy to assemble, economical to manufacture and is constructed of a minimum of parts.

Other objects as well as features and advantages of the present invention will become apparent from the following detailed description taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a vertical sectional view along the longitudinal axis of the valve assembly of the present invention with the valve member shown in closed position.

FIG. 2 is a view similar to that of FIG. 1 but showing the valve member in open, liquid dispensing position.

FIG. 3 is a horizontal section taken on the line 3—3 of FIG. 1 but on an enlarged scale.

FIG. 4 is a vertical fragmentary section taken on line 4—4 of FIG. 3 on a still further enlarged scale illustrating the operation of the stop-trip shoulder of the valve member and cooperating latch portion of the retractor spring.

FIG. 5 is a fragmentary vertical sectional view illustrating a second embodiment of a valve assembly in accordance with the present invention with the valve member thereof shown in closed position.

FIG. 6 is a view of the valve assembly of FIG. 5 illustrating the valve member in open position.

FIG. 7 is a vertical sectional view taken on the line 7—7 of FIG. 6.

FIG. 8 is a fragmentary plan view of the valve seal element of the valve assembly of FIGS. 5–7 shown in closed position.

FIG. 9 is an elevational view partially in section of the valve element of FIG. 8, also shown in closed position.

Referring in more detail to the accompanying drawings, one embodiment of a valve assembly **10** (FIGS. 1–4) in accordance with the present invention is suitably mounted in sealed relation in an opening **12** in the top wall **14** of a container **16** containing liquid under pressure. By way of example, valve assembly **10** may be mounted in opening **12** by a cap **18** having a flat circular top wall **20** and a resilient cylindrical skirt **22** dependent therefrom adapted to be press fitted or otherwise sealably secured in opening **12**. The lower edge **24** of skirt **22** may be beveled to facilitate insertion in the housing wall. Cap **18** in turn supports a valve housing **26** which has a flange **28** at its upper end insertable within skirt **22**. Skirt **22** can flex due to its resilience to permit flange **28** to be forced past an internal circumferential rib **30** which, when flange **28** is fully inserted with its upper end abutting wall **20** of the cap snaps under and engages the beveled underface **32** of flange **28** to thereby securely retain housing **26** in cap **18**. Housing **26** has a barrel portion **33** with an axial bore **34** which opens at its upper end in the end face of housing **28** and terminates at its lower end at a radial face **36** flush with the lower end of barrel portion **33**. The lower end of housing **26** has an inlet stem **38** which is smaller in diameter than portion **33** and which is joined thereto by a conical portion **40**. A flexible dip tube **42** is frictionally attached to the inlet stem **38**, either by slipping the tube frictionally onto the exterior of the stem as shown, or in the case of a capillary dip tube, being inserted into a bore **44** of a stem **38** until the upper end of the tube abuts a partition **46** which separates bore **44** from a larger concentric bore **48** in portion **40**. Wall **46** has a central aperture **50** which is suitably dimensioned to control flow of liquid conducted from the reservoir in the container via the tube **42** and stem **38** to the inlet chamber defined by bore **48**.

A washer-type seal **52** made of a suitable synthetic rubber material is held tightly against face **36** in a permanent leak-proof position by a seal retainer ring **54** secured against axial movement in housing **33** by having a press fit in bore **34**. A tubular valve member **56** is slidably mounted in housing **26** and extends coaxially through bore **34**. The lower end of member **56** has a cylindrical nose portion **58** closed by an end wall **59** which extends with a clearance fit through the central aperture of retainer **54**, with a frictional sliding fit through the central aperture of seal **52** and with a clearance fit into bore **48**. Valve member **56** is slidably guided for reciprocating axial motion by a collar portion **60** received with a loose sliding fit in bore **34**. Collar **60** abuts the underface of wall **20** of cap **18** to define the upper limit of travel of member **56**.

A coil compression spring **62** encircles member **56** and butts at its upper end against collar **60** and at its lower end against retainer **54** to normally bias member **56** to the raised position thereof shown in FIG. 1. In this position valve assembly **10** is closed due to seal **52** cutting off fluid communication between bore **48** and an inlet

port 64 which extends radially between the exterior cylindrical side surface of nose portion 58 and an interior axial bore 66 in valve member 56. Bore 66 extends from end wall 59 of nose portion 58 upwardly to the end of a shank 68 of member 56 which protrudes upwardly through wall 20 of cap 18. A conventional finger push button and spray nozzle 70 is mounted with a press fit on the upper end of shank 68. Button 70 has a chamber 72 registering with bore 66 and a restricted orifice 74 extending between chamber 72 and the exterior of the button adapted to produce a fine spray mist when pressurized liquid is delivered thereto via valve assembly 10 from the interior of container 16.

In accordance with a principal feature of the present invention, and as best seen in FIGS. 3 and 4, the bottommost turn 76 of spring 62 has a terminal chordal portion 78 which is bent to extend straight for a sector angle of about 90 degrees and into tangential contact with the side wall of nose portion 58 of valve member 56. When valve member 56 is in its uppermost, closed position as shown in FIG. 1 spring portion 78 lies beneath a stop-trip shoulder 80 located at the junction of nose portion 58 with a larger diameter cylindrical portion 82 of valve member 56. As best seen in FIGS. 3 and 4, the underface 84 of shoulder 80 extends radially of valve member 56, and the difference in diameter between cylindrical portions 58 and 82 is preferably slightly less than the radius of the circular wire stock of spring 62. If desired, shoulder 80 may have a chamfered edge, in which case the inner edge of the chamfer, at the junction with face 84, should be located to strike spring portion 78 slightly radially inwardly of the center high point of portion 78.

Valve member 56 is normally held by spring 62 in closed position wherein valve port 64 is tightly sealed by seal 52, thereby providing a reliable leak-proof valve assembly capable of retaining the charge of liquid under pressure in container 16 without leaking for extended periods, such as during shipment and storage. When it is desired to dispense liquid from the container, valve assembly 10 is manually operated in the same manner as conventional aerosol dispensing valves, e.g., the user grips container 16 in one hand and applies the index finger of this hand against the curved upper surface 86 of push putton 70, as shown in FIG. 2, thereby applying a downward axial force on valve member 56. This will move member 56 downwardly against the pressure of spring 62 until the outer edge of face 84 strikes the chordal portion 78 of spring 62. When the stop-trip shoulder 80 thus engages the spring portion 78 further downward movement of valve member 56 is halted unless and until a predetermined minimum pressure, in the order of about four pounds, or about the maximum force normally required to open a conventional aerosol valve, is manually applied to button 70 which is sufficient to overcome the resistance provided by portion 78.

Due to the outer edge of face 84 engaging portion 78 slightly radially inwardly of the central "high spot" thereof (i.e., the point on its surface facing shoulder 80 intersected by a diameter of portion 78 taken parallel to the direction of travel of member 56), the force acting on spring portion 78 is inclined slightly outwardly relative to the axis of valve member 56 so that a radially outwardly directed component of this force results from this engagement which tends to push portion 78 radially outwardly toward its "unlatched" position shown in broken lines in FIGS. 3 and 4. Such movement of portion 78 is resisted by its frictional engagement with the upper face of retainer 54 as well as by the force exerted by the coils of spring 62 which tend to bias portion 78 inwardly against nose portion 58. However, when the aforementioned predetermined minimum axial force is exerted on valve member 56, these forces will be overcome and portion 78 will be cammed out of the way by shoulder 80. As portion 78 starts to move outwardly, the angle of engagement between shoulder 80 and portion 78 changes at a progressively increasing rate for each increment of downward travel of member 56 due to the curvature of the circular wire stock from which spring 62 is made, thereby rapidly decreasing the axial force required to cam portion 78 radially outwardly. In normal operation, this releasing action occurs so fast that the operator cannot reduce the finger pressure applied to button 70 quickly enough to slow the downward motion of valve member 56 once detent portion 78 starts to move outwardly. Hence valve member 56 will be moved suddenly and rapidly downwardly to its fully opened position wherein shoulder 80 abuts a seat 88 formed at the end of a counterbore 89 in retainer 54, as shown in FIG. 2. In this position port 64 is disposed below the lower face of seal 52 in which position, due to the radial clearance between portion 58 and bore 48 and the axial clearance between the end wall 59 and wall 46, communication is established with control orifice 50 and stem passage 44.

When the operator wishes to discontinue spraying from the container, finger pressure is released from button 70, whereupon spring 62 forces member 56 upwardly to its raised closed position shown in FIG. 1. As portion 78 rides past the edge of shoulder 80 during this movement, the spring force tending to force portion 78 radially inwardly develops additional upward thrust on member 56 so that the valve tends to "snap" shut.

It is to be noted that port 64 is axially spaced from shoulder 80 such that during initial downward movement of member 56 from its closed toward its open position port 64 remains covered by a seal 52 until portion 78 has been cammed out of the way. This insures that port 64 will be uncovered when member 56 is moving at its maximum downward speed. The same relationship obtains, only in reverse, on the upstroke of member 56 so that port 64 is again covered by seal 52 during the final snap action movement of the valve member 56 to closed position.

From the foregoing description, it will now be apparent that the improved valve assembly 10 of the present invention, due to its snap action mode of operation in both opening and closing, eliminates the undesirable gradual build-up of liquid pressure at the spray orifice 74 as communication is opened up between the container and the orifice 74, thereby eliminating the dribble or droplets obtained with conventional dispensing valves when the same are gradually opened or closed. With valve assembly 10, the operator cannot help but produce a rapid opening movement once he has applied sufficient finger pressure on button 70 to overcome the restraining force of the spring latch or yieldable detent 78. In addition, due to its few parts and simple configuration valve assembly 10 is economical to manufacture and is completely leak-proof using only the single seal 52. Valve 10 also remains clean over long periods of intermittent operation due to the wiping action of seal 52 on portion 58, and also due to the fact that the fluid material being dispensed under pressure never enters the spring chamber in bore 34 but rather travels directly from the source via chamber 48 and port 64 to the outlet 74. This feature also insures automatic self-purging which maintains the working parts in a clean condition. Consequently valve assembly 10 has a long life and constant high efficiency, and is well adapted for use with a very wide range of materials.

Referring to FIGS. 5–9 inclusive, a modified form of the valve assembly 100 of the present invention is illustrated wherein elements corresponding to those described above with respect to valve assembly 10 are given like reference numerals. Valve assembly 100 operates in the same manner as valve assembly 10 but differs therefrom primarily in the modified seal 152 and modified nose portion 158.

Seal 152 is a cup-like member made of suitable material such as synthetic rubber and having a beveled lower edge 154 which bottoms against a complemental surface formed in conical portion 140 of the modified valve hous-

ing **126**. Seal **152** has a central blind bore **156** which opens at the upper face of the seal and terminates at its lower end at a radial upper face **160** of the bottom wall **168** of seal **152**.

The modified nose portion **158** has a cylindrical side wall dimensioned to have a close sliding fit in bore **156** to maintain a tight leak-proof seal around portion **158**. The lower end **162** of portion **158** is bullet-shaped and has a central, axially extending inlet port **164** which communicates with the axial passage **66** in member **156**. Member **156** is dimensioned so that its lower end **162** just touches face **160** in the closed position of valve member **156**, as shown in FIG. 5, in which position portion **78** of spring **62** is biased against the cylindrical surface of portion **158** beneath shoulder **80**.

Seal **152** is provided with a "razor-cut" slit **166** in wall **168** which extends diametrically thereacross, as best seen in FIGS. 8 and 9. Preferably the diametrically opposite end edges **170** and **172** (FIG. 9) of slit **166** are tapered to diverge outwardly and downwardly.

Liquid under pressure acts on the underside of seal **152** so that, with valve member **156** in its raised, closed position (FIG. 5), it tends to push the lips **170** and **172** together with a force proportionate to the pressure acting on the underface of the seal. As with the previous valve assembly **10**, when finger pressure is applied to the nozzle of valve assembly **100** to open the valve, the previously described automatic snap action takes place. However in the case of valve assembly **100**, as valve member **156** is plunged downwardly the rounded end **162** is forced against the bottom wall **168** of seal **152** to force the same down into a counterbore **174** provided in portion **140**, thereby spreading the lips **176** and **178**. Due to the sudden rapid downward movement of member **156** as well as the sudden release of pressure via slit **166**, the wall **168** suddenly gives way so that the slit opens very rapidly to supply liquid under pressure from the source via stem passages **44** and **50**, counterbore **174**, inlet **164** and bore **66** to the discharge orifice of the nozzle (not shown), thus effecting an almost instantaneous pressure rise at the orifice as in the previous embodiment. This in turn eliminates any dribble or droplets in the fine spray produced by the discharge nozzle. Closing movement of the valve member **156** likewise occurs with a snap action to cut off the spray almost instantaneously.

The modified valve assembly **100** thus provides the advantages of the previous valve assembly **10** and in addition offers a more economical valve member **156** since the need for molding a cross feed hole **64** is eliminated. The central, axial inlet port **164** also provides a straight-through feed passage between bore **44** and bore **66** so that there is less pressure drop through the valve, thereby further contributing to an instantaneous pressure rise upon opening of the valve.

What is claimed is:

1. A valve assembly comprising a valve housing having a first passageway therein adapted to be connected to a source of liquid under pressure, a valve member mounted in said housing for controlling flow in said first passageway and movable in said housing between open and closed flow controlling positions, said valve member having a second passageway therein adapted to be connected to a spray nozzle or the like, said valve member having an inlet port connecting said passageways in the open position of said valve member, seal means in said housing closing said inlet port when said valve member is in said closed position, and detent means engageable with said valve member to yieldably resist movement thereof from said closed toward said open positions, said detent means yielding to release said valve member for movement to said open position upon application of a predetermined force thereto tending to move the valve member toward said open position to thereby cause a snap acting opening motion of said valve member to place said inlet port in communication with said first passageway.

2. The valve assembly as set forth in claim **1** wherein said detent means comprises a helical coil spring encircling said valve member and acting between said housing and valve member to force said valve member toward closed position, said spring having a convolution thereof formed with a chordal portion adapted to slidably contact the side of said valve member, said valve member having a shoulder engageable with said chordal portion during travel of said valve member between closed and open positions thereof, said shoulder and said chordal portion having surfaces adapted to develop upon interengagement thereof a radially outwardly directed force on said chordal portion in response to axial opening force exerted on said valve member to thereby cam said chordal portion out of engagement with said shoulder to thereby effect sudden release of said valve member so that it is rapidly propelled to open position.

3. The valve assembly as set forth in claim **2** wherein said seal means is disposed between an end convolution of said spring and said housing such that said spring clamps said seal means against said houisng, said chordal portion of said spring comprising the terminal end of said end convolution of said spring.

4. The valve assembly as set forth in claim **2** wherein said spring is made from circular spring wire stock and said shoulder has a generally radial face having an outer edge engageable with said chordal portion inwardly of a diametrical line drawn through said spring wire in a direction parallel to travel of said valve member.

5. The valve assembly as set forth in claim **2** wherein said valve housing has a cylindrical bore open at one end and terminating at its opposite end at a radial wall of said housing, said housing having a counterbore therein opening at said radial wall and being smaller in diameter than said bore, said seal means comprising a resilient washer positioned against said radial wall and a seal retainer ring disposed against the side of said seal member remote from said radial wall, said endmost convolution of said spring bearing against the face of said retainer ring remote from said washer, said retainer ring having an axial bore through which said first portion of said valve member extends axially, said retainer ring further having a counterbore concentric with said axial bore of larger diameter than said axial bore with a shoulder between said bore and counterbore engageable by said valve member shoulder to determine the limit of travel of said valve member toward its open position.

6. The valve assembly as set forth in claim **2** wherein said valve member has first and second cylindrical portions, said second portion being larger in diameter than said first portion and the junction of said portions defining said shoulder therebetween, said first portion slidably engaging said seal means and containing said inlet port.

7. The valve assembly as set forth in claim **6** wherein said first portion of said valve member is closed at one end and said inlet passage comprises a radial port in the side wall of said first portion communicating with said second passageway in said valve member, said seal means comprising a resilient annular member having a central bore through which said first portion slidably passes with a seal fit, said seal member being disposed between said first passageway and said spring such that the liquid in said first passageway is sealed from the spring by said seal member and by said valve member in the open and closed positions of said valve member.

8. The valve assembly as set forth in claim **6** wherein said seal means comprises a cup-like resilient member having a blind bore extending coaxially thereof sealably slidably receiving said first portion of said valve member and closed at one end by a transverse wall of said seal member extending across the end of said first portion, said inlet port comprising an axial passage in the end of said first portion coaxial therewith, said seal member having a diametrical slit in said transverse wall thereof aligned

with said inlet port, said first portion of said valve member being engageable with said transverse wall of said seal member during movement between its closed and open positions to flex said transverse wall of said seal member to thereby open said slit and thereby open communication between said first passageway and said inlet port of said valve member.

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