

April 14, 1959

R. F. SCHAETZLY

2,881,809

LIQUID-LEVEL-CONTROLLED FILLING DEVICE

Filed Dec. 18, 1957

2 Sheets-Sheet 1

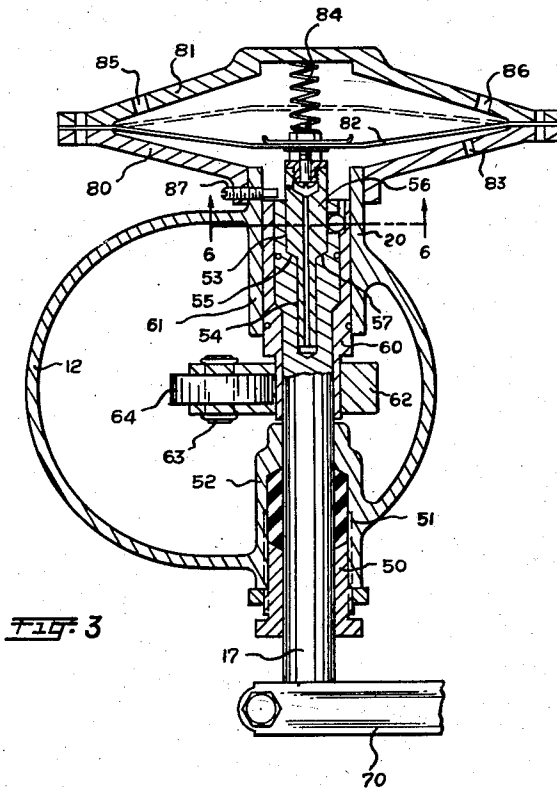


FIG. 3

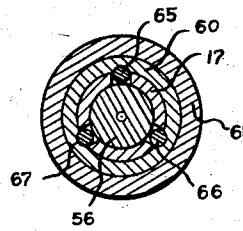


FIG. 6

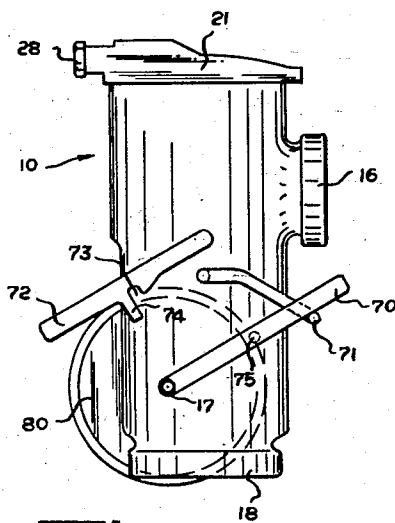


FIG. 1

INVENTOR
RAYMOND F. SCHAETZLY

BY

W. E. Sherwood

ATTORNEY

April 14, 1959

R. F. SCHAETZLY

2,881,809

LIQUID-LEVEL-CONTROLLED FILLING DEVICE

Filed Dec. 18, 1957

2 Sheets-Sheet 2

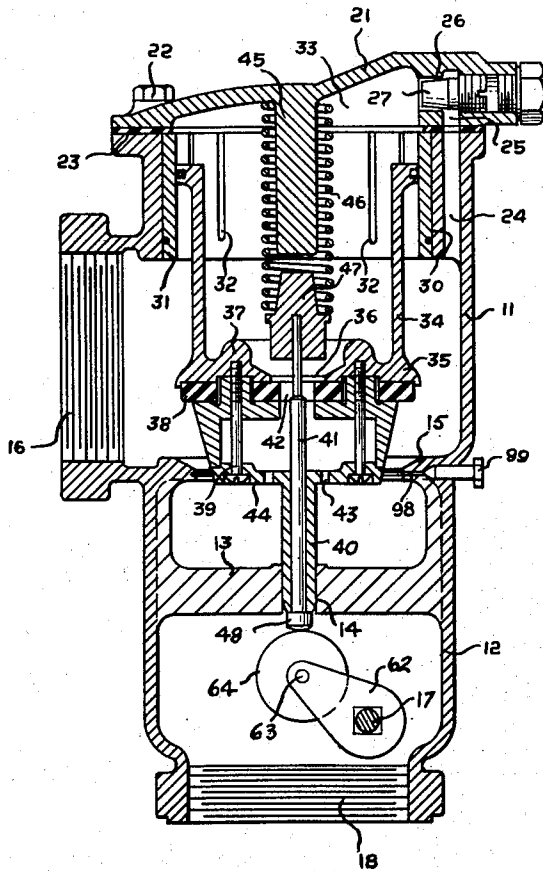


FIG. 4

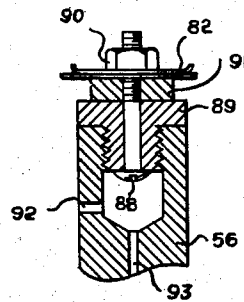
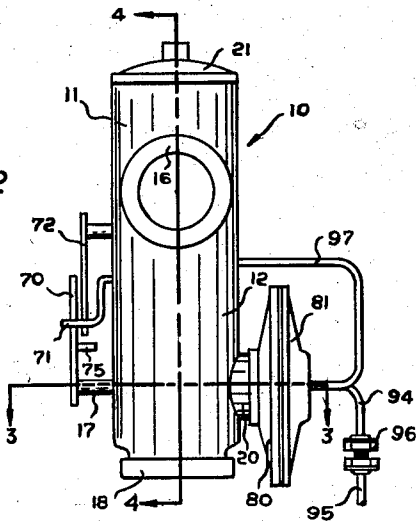


FIG. 5

FIG. 2



INVENTOR
RAYMOND F. SCHAETZLY

BY

W. E. Sherwood
ATTORNEY

1

2,881,809

LIQUID-LEVEL-CONTROLLED FILLING DEVICE

Raymond F. Schaetzly, Louisville, Ky., assignor to Oil Equipment Manufacturing Company, Inc., Louisville, Ky., a corporation of Kentucky

Application December 18, 1957, Serial No. 703,685

12 Claims. (Cl. 141—209)

This invention relates to an improved apparatus for filling a container with liquid, the apparatus being of the type in which the filling operation is automatically suspended upon attainment of a predetermined level of liquid in the container. More particularly, the invention relates to heavy duty apparatus of this type in which the initiation and suspension of relatively high rates of liquid flow can be accomplished without setting up objectionable pressure waves in the supply system. The invention is especially well adapted for use at bulk loading stations for gasoline, or other liquids, at which flow rates in the range of, for example, 100 to 1000 gallons per minute may be employed. However, as will become apparent to those skilled in the art as the description proceeds, the invention in its broader aspects may be employed in much smaller loading operations, as, for example, the filling of automobile gasoline tanks at a conventional service station.

An object of the invention is to provide an improved liquid flow control device having an automatic flow suspension capability and operable without establishing objectionable pressure waves in the system.

Another object is to provide an improved liquid flow control device arranged for closing in a plurality of stages, the first closing stage being initiated automatically in response to the level of liquid in a container being filled.

A further object is to provide an improved liquid flow control device arranged for multi-stage opening and multi-stage closing, the first opening stage being selectively initiated by an operator and the first closing stage being automatically initiated in response to the level of liquid in a container being filled.

In carrying out my invention, I provide a housing having a first portion in which a hollow main valve is adapted to move and a communicating second portion in which a valve actuating means is disposed. An inlet conduit is connected to the first portion of the housing and an outlet conduit leading to the container to be filled is connected to the second portion of the housing. Included in the valve actuating means is a diaphragm controlled plunger whose positioning is responsive to the level of liquid in the container during the filling operation. Also included in the valve actuating means is a selectively operable member, such as a manually operated handle which is provided for opening the main valve by stages and for permitting that valve to close by stages, thus to avoid pressure waves, such as the well-known "water-hammer effect," in the piping system. Carried in the main valve is a pilot valve biased toward closing position and movable therefrom by the selectively operable member. Within the first portion of the housing, means are provided for supplying liquid into the interior of the hollow main valve, thus to urge the main valve toward closing position when the pilot valve is closed. The entire apparatus is characterized by its compact and rugged construction and by the absence of numerous, delicate, parts which might prove a liability under heavy-duty usage as at loading terminals for example.

2

The novel portions which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its organization and mode of operation, may be best understood by reference to the following description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a side elevation view of the housing for the filling device;

Fig. 2 is an end elevation view of the housing for the filling device;

Fig. 3 is a partial sectional view taken on line 3—3 of Fig. 2 and to a larger scale;

Fig. 4 is a partial sectional view taken on line 4—4 of Fig. 2 and to a larger scale;

Fig. 5 is a detail view partly in section of a suitable swivel means for attaching the plunger to the diaphragm; and

Fig. 6 is a sectional view taken on line 6—6 of Fig. 3. Referring to the drawings, I have shown therein a housing member generally indicated at 10 and having a first housing portion 11 and a second housing portion 12 communicating therewith. Intermediate the two housing portions is a spider-like transverse reinforcing member 13 having a central aperture therein containing a guide surface 14. Adjacent the reinforcing member is a seat 15 for the main valve and extending from the first housing portion is a suitable inlet 16. This inlet may conveniently comprise a threaded boss into which an inlet pipe, not shown, leading to a source of liquid under pressure may be connected.

Extending transversely through the second housing portion 12 and offset to one side of the central plane thereof is a shaft 17, the purpose of which will later become apparent. Outwardly of the axis of this shaft is a suitable outlet 18 for the liquid passing through the housing. This outlet also may conveniently comprise a threaded boss into which an outlet pipe leading to the container to be filled, not shown, may be connected. As seen in Fig. 2, a short tubular extension 20 preferably coaxial with shaft 17 extends from the second housing portion 12 and serves as a rigid member upon which a diaphragm casing may be detachably mounted.

At the extreme end of the first housing portion 11 a cover member 21 is adapted to be securely mounted upon the housing as by means of bolts, one of which is shown at 22. A suitable seal 23 serves to prevent leakage from between the cover member and the housing of the liquid under pressure entering that housing from inlet 16. Adjacent one side, the first housing portion is provided with a thickened wall through which extends a bleed passage 24 communicating with a complementary bleed passage 25 in the cover member 21. In the bleed passage 25 a suitable valve seat 26 is provided and with which an adjustable bleed valve 27 is adapted to cooperate. This bleed valve 27 in turn may be adjusted externally of the housing, by conventional means, thus to determine the flow rate of liquid through passages 24 and 25 for the purpose of regulating the time in which a main valve seats during its final closing stage.

Concentrically formed with respect to the main valve seat 15 is a cylindrical inner wall 30 of the first housing portion extending outwardly into contact with seal 23. Rigidly mounted against this cylindrical inner wall and preferably sealed with respect thereto is a cylindrical sleeve 31 and lower end of which extends to a position adjacent the inlet end of bleed passage 24. Formed interiorly of sleeve 31 is a plurality of bypass passages 32, the outer ends of these passages communicating with open space 33 within the housing cover 21 and the inner ends thereof terminating at a short, but predetermined, distance above the lower end of the sleeve

31. This predetermined distance represents the cushioned distance through which the main valve moves during the final closing stage and is a significant feature of the invention, as will later be described. Reciprocally mounted within the stationary sleeve 31 and suitably sealed with respect thereto, is a hollow cylindrical main valve 34, the interior of which is in free communication at one end with the space 33 of the housing cover. At its other end, however, the main valve is provided with a head member 35 having a centrally located aperture 36 therethrough and a substantial boss 37 on the inner surface of the head member. On the outer surface of the head member a suitable seat is arranged for a disc-like sealing gasket 38, this gasket being securely mounted upon the valve head member by means of a plurality of screws 39, or the like, which in turn are attached to the backing plate section of the main valve stem 40.

Valve stem 40 is supported on guide surface 14 and contains a longitudinal passage in which a pilot valve stem 41 is adapted to reciprocate and this longitudinal passage also communicates with the aperture 36 in the main valve head member 35 through an intermediate aperture 42 in the sealing gasket 38. Drainage passages 43 lead from the aperture 42 in the gasket through the backing plate section 44 of the main valve stem and into the open space downstream of the main valve. The backing plate section 44 of the main valve stem also serves as an abutment against which the central portion of the sealing gasket is retained for cooperation with the pilot valve now to be described. It will be understood, of course, that the outer periphery of this same sealing gasket cooperates with the seat 15 for the main valve 34 during the seating and unseating of that main valve.

As best seen in Fig. 4, the housing cover 21 contains an inwardly directed projection 45 around which a compression spring 46 is mounted. At one end of the valve stem 41 a pilot valve 47 is mounted concentrically with projection 45 and with spring 46 which bears at one end against the stationary cover member 21 and at its other end against the movable pilot valve 47. At its other end the pilot valve stem terminates in a lifting member 48 adapted for engagement with a valve actuating means now to be described. As an important feature of the invention, pilot valve stem 41 is longer than main valve stem 40 and the lifting member 48 is of a size sufficient to engage and lift the main valve stem 40 whenever it is suitably actuated.

Referring now to Fig. 3, shaft 17 forming part of the valve actuating means may be mounted for limited rocking movement within a gland 50 serving to hold suitable sealing material 51 within the apertured boss 52 through which the shaft extends in the second housing section downstream from the above-described main valve. At its distal end, the shaft 17 is provided with an inwardly extending enlarged cylindrical recess 53 joined to a reduced cylindrical recess 54 by means of a conically shaped surface 55. Mounted for reciprocable movement in the shaft recess is a closely fitting plunger 56 having a conically shaped cam surface 57 intermediate its enlarged and reduced diameters.

Surrounding the periphery of the distal end of shaft 17 is a bushing 60 supported for rocking movement in a suitable boss 61 extending inwardly from the side of the second housing portion 12 and arranged coaxially with the boss 52. Adjacent its inner end the bushing 60 has rigidly attached thereto a crank arm 62 forming a clevis at its free end and through which a pin 63 extends. Rotatably mounted upon pin 63 is a roller 64 adapted for engagement with the valve lifting member 48. As will thus be apparent, torque applied to the bushing 60 when engaged with shaft 17 in the manner now to be described acts upon the valve lifting member through the same fulcrum at all times, thus providing a close control over the opening of the main valve against the pressure of the incoming liquid.

Referring now to Fig. 6, the shaft 17 is provided with one or more radially extending holes, here shown as three such holes located at 120° spacings, and containing latching ball members here shown at 65, 66 and 67. On the inner surface of bushing 60, a corresponding number of small concave depressions are formed for reception of those balls during engagement of the bushing and shaft and for acting as cams when the bushing is rocked with respect to that shaft. The size of the several parts is so chosen that after assembly the balls cannot escape from the radial holes in the shaft but are free to move radially therein, depending upon the position occupied by the plunger 56. Thus, when the plunger is at its innermost position, the balls are held in engagement with the depressions in the bushing; when the conical surface 57 of the plunger contacts the balls they may move radially inwardly or outwardly depending upon the direction of movement of that camming surface; and when the plunger is in its outermost position the balls are withdrawn from engagement with the depressions in the bushing. It will be understood that suitable sealing means, such as O-rings, will be interposed between the bushing 60 and the boss 61 and between the shaft 17 and the bushing 60, thus to prevent leakage of liquid toward the diaphragm.

Various means may be employed for selectively actuating the shaft 17 and, as shown in Fig. 1, a simple manually operable handle 70 may be used. This handle preferably moves through an angle less than the angle between each of the several latching balls 65, 66 and 67. A suitable stop 71 may be rigidly mounted on the exterior of the housing 10 and against which the handle may rest when the apparatus is inoperative and during which condition the main and pilot valves are closed. Upon moving handle 70 to conduct a filling operation, the operator may hold the handle or may engage it with a suitable releasable holding means. For example, a simple latch member 72 pivoted to the housing 10 and having a notch 73 adjacent a stop 74 may be used. On the handle a short pin 75 may be affixed for releasable engagement in the notch 73.

With the foregoing in mind, reference now is made to Figs. 2 and 3 showing a means for automatically controlling the operation of the apparatus in dependence upon the level of liquid obtained in a container. The particular container to be filled and the particular piping system for supplying liquid under pressure may be of any conventional nature and accordingly are not shown. In accordance with my invention, I employ a diaphragm housing including a first cup-shaped portion 80 and a second complementary cup-shaped portion 81 between which a flexible diaphragm 82 is securely mounted at its perimeter. A vent 83 in the diaphragm housing serves to permit the diaphragm to be biased normally by a light compression spring 84 into plunger-latching position. On the side of the housing opposite the vent two separate apertures 85 and 86 are provided. The diaphragm 82 may consist of any suitable flexible material which is substantially impervious to the chemical effect of the liquid being handled. The diaphragm housing may be keyed or otherwise secured to the projection 20 from the second housing portion 12 and may be detachably held in place by a set screw 87 which preferably is long enough to engage the outer ends of both the bushing 60 and the shaft 17.

As best shown in Fig. 5, the diaphragm 82 is attached to the outer end of plunger 56 by means of a swivel connection so that rocking movement of that plunger, or torque tending to rock the same, is not transmitted to the diaphragm. One suitable means for this purpose may comprise a bolt having a head 88 thereon engaging a plug 89 inserted into the end of the plunger. The bolt may be affixed to the diaphragm by threaded nuts 90 and 91, the bolt having a sufficiently loose fit in plug 89 to permit rotary movement of the plunger with respect to the diaphragm but to assure a firm mounting of the dia-

5

phragm and plunger for longitudinal movement of the plunger. In order to increase the sensitivity of the control, I may also employ suitable vent passages 92 and 93 in the plunger so that the plunger may move freely in a longitudinal direction in the shaft 17 despite the close fit therewith, although for general usage such a close fit is not always necessary.

As seen in Fig. 2, I provide a conventional sensing conduit 94 leading into the container to be filled and connected at one end to aperture 85 in the diaphragm. At its other end this sensing conduit is adapted to reach into the container to the sensing level for liquid therein and to be covered by such liquid when it reaches that sensing level. The sensing conduit may be in one piece which is attached entirely to the apparatus as described herein, or may be merely a short conduit adapted to be connected to another conduit portion 95 by means of a suitable detachable connecting means 96, that latter portion representing a portion of the container itself, or being a separate element for use with different containers. Moreover, the sensing conduit may be housed within the pipe leading from housing 10 or be formed as a passage in the wall of such pipe, should this be desired for purposes of protecting the conduit, all such modifications being well known in the art.

As further noted from Figs. 2 and 4, I provide a diaphragm-actuating vacuum conduit 97 connected at one end to the aperture 86 in the diaphragm housing and at its other end to a suitable location at which vacuum may be established by movement of liquid through the filling device. For convenience, I provide a small transverse opening 98 in valve seat 15 across which liquid flows at relatively high velocity when main valve 34 is open, although other locations within housing 10 or even within the pipe leading from such housing into the container, may be employed without departing from the invention. The opening 98 may terminate in a suitable fitting 99 to which one end of conduit 97 may readily be attached. Moreover, as known in the art, the vacuum conduit may, if desired, for purposes of protection, be enclosed within the housing 10 and lead to the diaphragm housing interiorly of the housing 10. Also, if desired, various known forms of guard means may be placed around exposed portions of conduits 94, 95 and 97 to afford protection during use.

The several advantages of my invention will now be noted from a consideration of a normal operating cycle for the apparatus. With the inlet 16 of the housing attached to a source of liquid under pressure and with both the main and pilot valves closed, the interior of the main valve is filled with liquid under pressure. At this start of operation the plunger 56 and diaphragm 82 are in the position shown in Fig. 3, and the sensing conduit 95 is in position within the container to be filled. The operator then moves handle 70 to the left as shown in Fig. 1, thus rocking shaft 17. By reason of the position of plunger 56 behind the latching balls, rotation of shaft 17 simultaneously rotates bushing 60 and moves roller 64 into engagement with valve lifting member 48. As this member moves, it first lifts pilot valve 47 from its seat on gasket 38 against the biasing spring 46, permitting liquid to drain from within the main valve. Since the drainage capacity through aperture 36 is greater than the bleed capacity through bleed passage 24, the volume of liquid within the main valve is promptly diminished, thus providing room for that valve to move. As the movement of shaft 17 continues, the lifting member 48 engages the end of main valve stem 40 and gradually raises the main valve 34 from its seat 15, thus preventing a sudden surge in the pressure line. After the main valve has lifted a sufficient distance to avoid the setting up of a pressure wave, for example, a distance of about $\frac{3}{8}$ inch, the outer edge of that valve uncovers the by-pass passages 32 which then become effective to serve as supplemental drains for the liquid still within the main

6

valve. As this occurs, the shaft 17 is then rapidly turned to its fully open position at which it may either be held by the operator, or be detachably latched, as by the means shown in Fig. 1.

With the main valve fully open, a constantly acting pressure is exerted by spring 46 tending to rock the bushing 60 back toward the closing position. Thus, at any time during the filling operation and prior to automatic closing operation by the diaphragm, the filling will be interrupted merely by releasing handle 70 and permitting the bushing to rock backwards.

As liquid flows across passage 98 a venturi-effect is produced lowering the pressure in diaphragm housing 81, but until the liquid in the container covers the exposed end of the sensing conduit 95, this lowering of pressure is compensated by air pressure on the same side of the diaphragm housing as supplied through that sensing conduit. When, however, the liquid in the container reaches the exposed open end of the sensing conduit and closes off the compensating air pressure, the following occurs:

Immediately after the sensing conduit is closed at the sensing level within the container, continued flow through the housing 10 provides a sufficient vacuum to move diaphragm 82 outwardly against biasing spring 84. This diaphragm movement shifts plunger 56 attached thereto to bring the conical surface 57 of that plunger beneath the latching balls. Immediately the torque upon the bushing 60 forces the balls inwardly, thus unlatching the bushing from the shaft 17. Normally, the operation of the diaphragm does not set up a sufficient torque to disengage the handle from the holding means 72 at this same time, but even though the handle is not so disengaged, the bushing rocks backward independently of that shaft. As the bushing rocks backward, roller 64 moves downwardly permitting the compression spring 46 to extend the pilot valve stem 41 and to close the pilot valve 47. As this occurs, the liquid under pressure within the first housing section 11 flows into the main valve through by-pass passages 32 and causes the main valve to move downwardly toward closing position. This first stage of closing is relatively rapid and quickly reduces the volume of liquid passing into the container. However, as soon as main valve 34 moves to a point where communication through by-pass passages is interrupted, for example within about $\frac{3}{8}$ inch of fully closed position, its final stage of closing requires the supply of the necessary liquid into its interior through bleed passages 24 and 25. As this final volume of liquid bleeds into the valve, it gradually settles upon seat 15, thus avoiding any pressure waves in the piping system.

As the volume of liquid flowing across the passage 98 in the valve seat diminishes, the diaphragm spring 84 tends to move the plunger 56 inwardly. If at this time the handle 70 is resting upon stop 71, inward movement of the conical surface 57 of the plunger carries the latching balls outwardly into engagement with the depressions in bushing 60 and the apparatus is ready for another filling operation as soon as it is placed in cooperation with another container to be filled. However, as is usually the case, if the handle had been locked in its normally open position when the diaphragm spring 84 thus became effective, the plunger will not move until that handle is restored to its starting position with respect to the bushing.

It will be understood that the apparatus is suitably calibrated so that the sensing level at which conduit 95 becomes effective takes into account the volume of liquid passing through the housing 10 during the final closing stage of the main valve.

In accordance with the patent statutes, I have described what at present is considered to be the preferred embodiment of my invention, but it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the true spirit and scope of the invention. I therefore aim to cover

in the appended claims, all such equivalent variations and modifications.

What is claimed is:

1. In a filling apparatus for liquids, a housing having an inlet for liquid under pressure at a first portion thereof and an outlet for liquid at a second portion thereof adapted for discharge into a container to be filled, a main valve seat intermediate said housing portions, a hollow main valve mounted in said first housing portion and having a valve stem extending into said second housing portion, means for bleeding liquid under pressure constantly into the interior of said main valve, a pilot valve for draining liquid from said main valve and having a valve stem coaxial with said main valve stem, said pilot valve stem being movable with respect to said main valve stem and having means engaging said main valve stem during fully opened position of said pilot valve, means normally biasing said pilot valve to closed position upon said main valve, valve actuating means for the main valve and the pilot valve comprising a rocking shaft mounted in said second portion of said housing and movable between a first extreme position in which said pilot and main valves are fully open and a second extreme position in which said valves are fully closed, valve stem engaging means mounted upon said shaft, means for selectively actuating said shaft during initiation of a filling operation to move said valve stem engaging means into contact with said valve stems, and means responsive to the level of liquid attained in said container for disengaging said valve stem actuating means from contact with said valve stems whereby said biasing means may close said pilot valve and permit liquid to accumulate within said main valve during a rapid initial stage of closing thereof and to permit liquid to accumulate further in said main valve through said bleeding means during a slower final closing stage of said main valve as it approaches said main valve seat.
2. Apparatus as defined in claim 1 wherein said first housing portion includes a sleeve mounted therein and along which said hollow main valve is adapted to reciprocate, said sleeve including by-pass passages one end of which terminates at a predetermined distance from the end of said sleeve, said by-pass passages communicating the interior of said hollow valve with said inlet for liquid when uncovered by said main valve.
3. Apparatus as defined in claim 1 wherein said means for bleeding liquid into said main valve comprises a means adjustable from the exterior of said housing for regulating the time of closing of said main valve during its final closing stage.
4. Apparatus as defined in claim 1 wherein said pilot valve stem is longer than said main valve stem and is mounted interiorly thereof.
5. Apparatus as defined in claim 1 wherein said valve stem engaging means comprises a roller mounted on a crank arm providing a constant leverage during valve-opening movement of said shaft.
6. Apparatus as defined in claim 1 including a valve gasket carried by said main valve and adapted to seat at its periphery upon said main valve seat and to provide a surface near a central portion of said same gasket upon which said pilot valve seats.

7. In an automatic liquid filling apparatus, a housing containing a valve means and a valve seat and adapted to discharge into a container to be filled, a rocking shaft mounted in said housing, a bushing mounted in said housing in releasable rocking engagement with said shaft, means normally urging said valve means toward closing position, valve means actuating means carried by said bushing and adapted to move said valve means to open position when in contact with said valve means and to permit said valve means to close when out of contact therewith, a plunger reciprocably mounted in said shaft, latching means carried by said shaft and operable by said plunger, said latching means being operable to engage said shaft and bushing when said plunger occupies a first position and to disengage said bushing from said shaft when said plunger occupies a second position, means for selectively rocking said shaft while said plunger occupies said first position thereby to bring said valve actuating means into contact with said valve means and to open said valve means, said bushing being adapted to rock independently of said shaft into valve closing position when disengaged from said shaft, a diaphragm housing mounted adjacent said valve housing and containing a pressure responsive diaphragm therein, means connecting said diaphragm with said plunger thereby to establish the setting of said plunger at said first and second positions in response to pressure exerted upon said diaphragm, means for applying a vacuum upon a first side of said diaphragm responsive to flow of liquid through said valve housing, and a liquid level sensing means connecting said container and said diaphragm housing on said first side of said diaphragm and operable to render said vacuum ineffective to move said diaphragm prior to attainment of a predetermined liquid level in said container and to render said vacuum effective to move said plunger upon attainment of said liquid level.
8. Apparatus as defined in claim 7 wherein said latching means comprises a ball member mounted in a radial recess in said shaft.
9. Apparatus as defined in claim 7 wherein said means for selectively rocking said shaft comprises a handle attached to said shaft at an end opposite the mounting of said plunger in said shaft.
10. Apparatus as defined in claim 7 wherein said means for applying a vacuum includes an aperture in said main valve seat across which said liquid flows during the filling operation.
11. Apparatus as defined in claim 8 wherein said bushing contains an interior concave recess adapted to receive a portion of said ball while said plunger occupies said first position and to cam said ball radially inwardly of said shaft as said plunger moves to said second position.
12. Apparatus as defined in claim 7 wherein said valve actuating means includes a crank arm rigidly affixed to said bushing and a roller rotatably mounted adjacent the end of said crank arm.

References Cited in the file of this patent

UNITED STATES PATENTS

2,527,760 Piquerez ----- Oct. 31, 1950