July 20, 1965 C. G. MACKIE 3,195,565

BALL COCK

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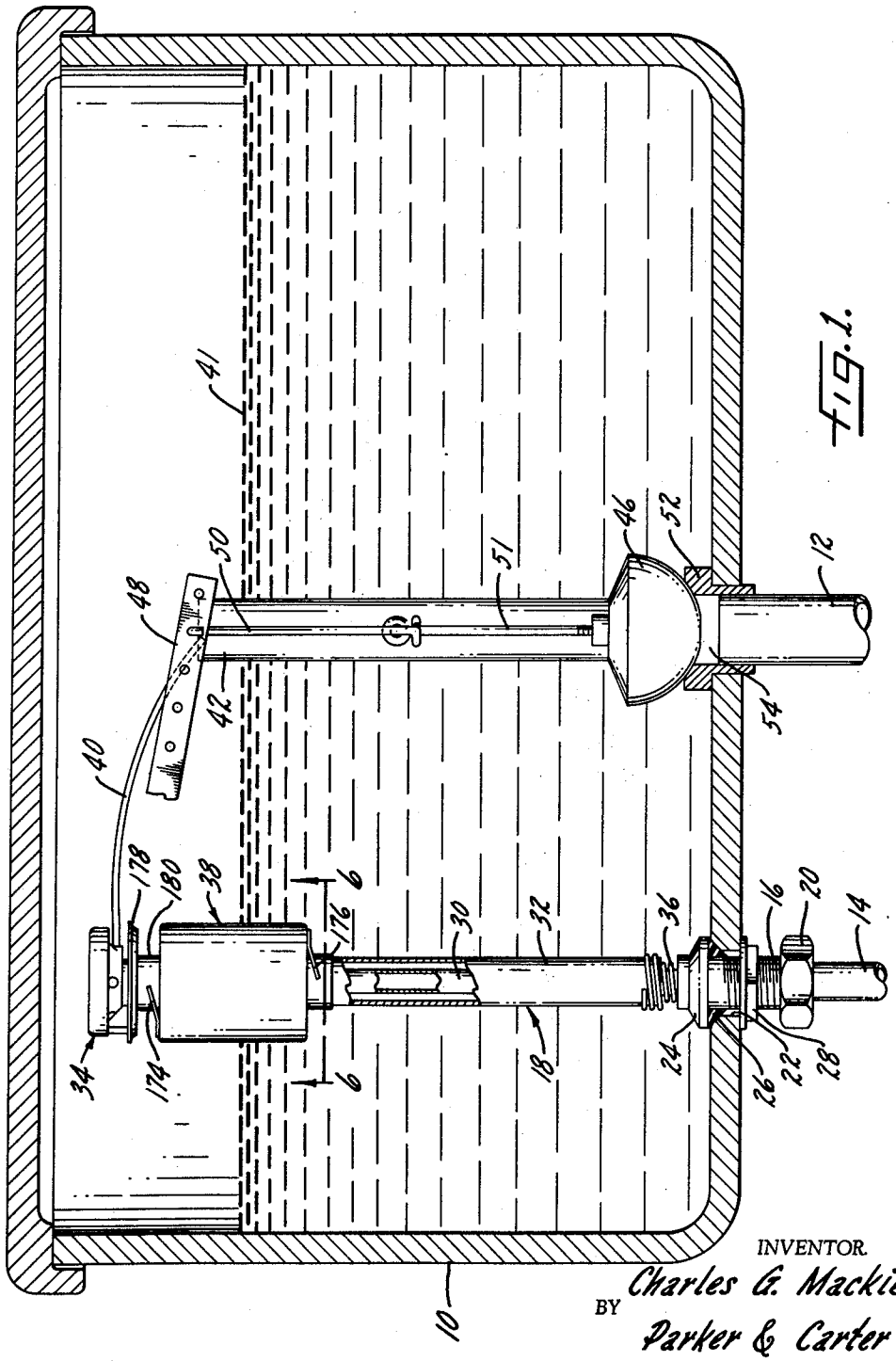


FIG. 1.

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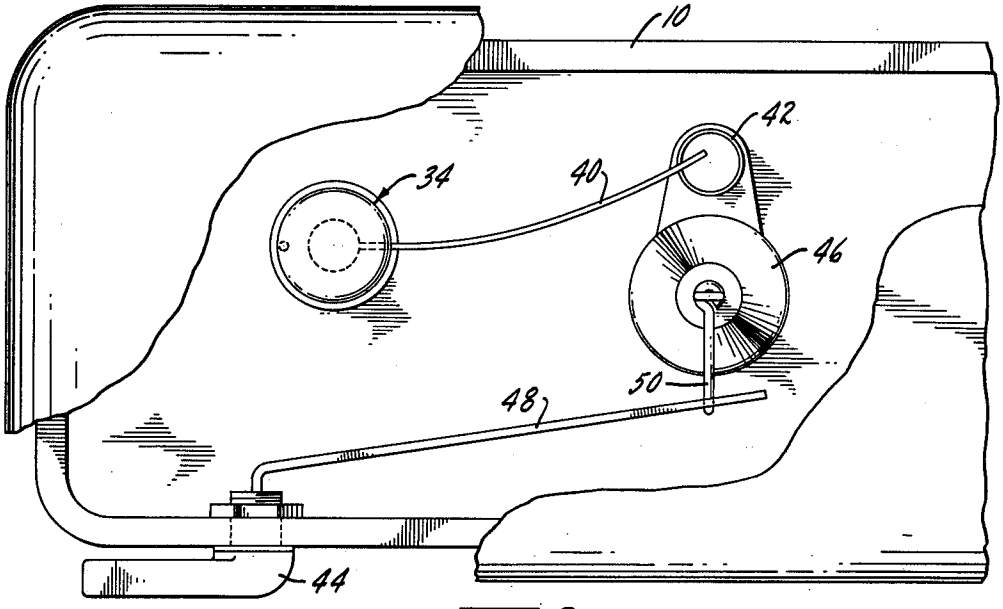


Fig. 2.

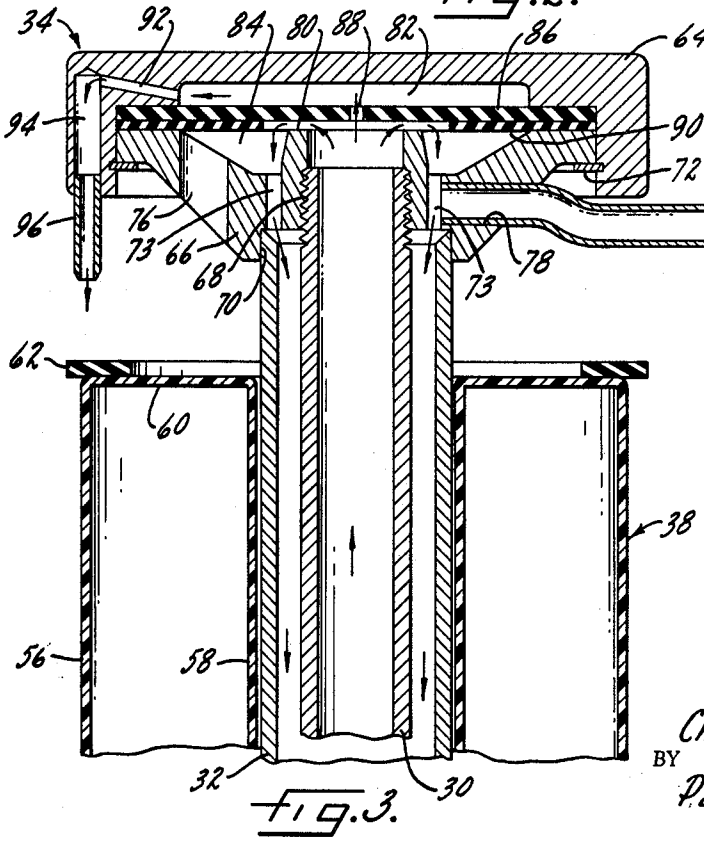


Fig. 3.

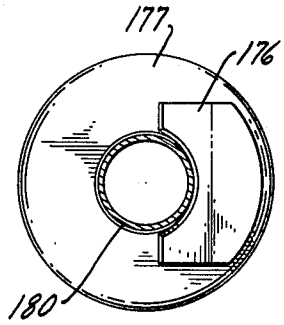


Fig. 7.

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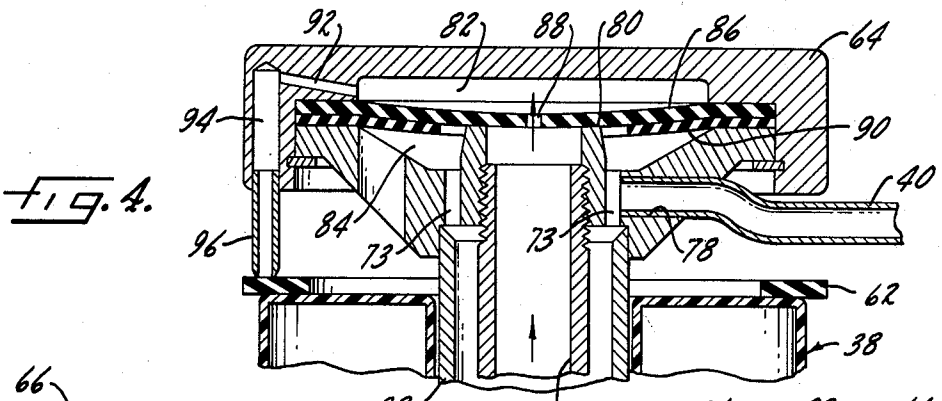


Fig. 4.

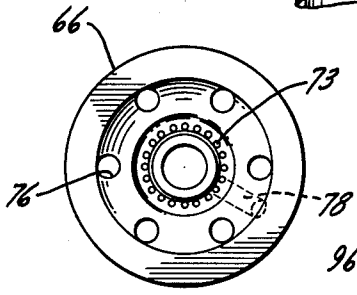


Fig. 6.

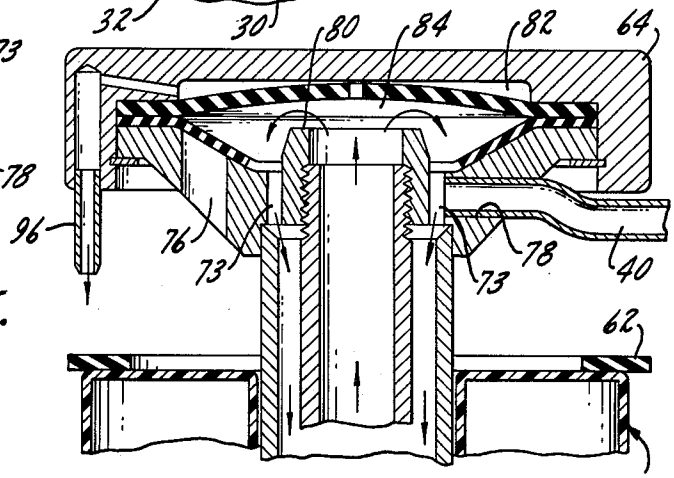


Fig. 5.

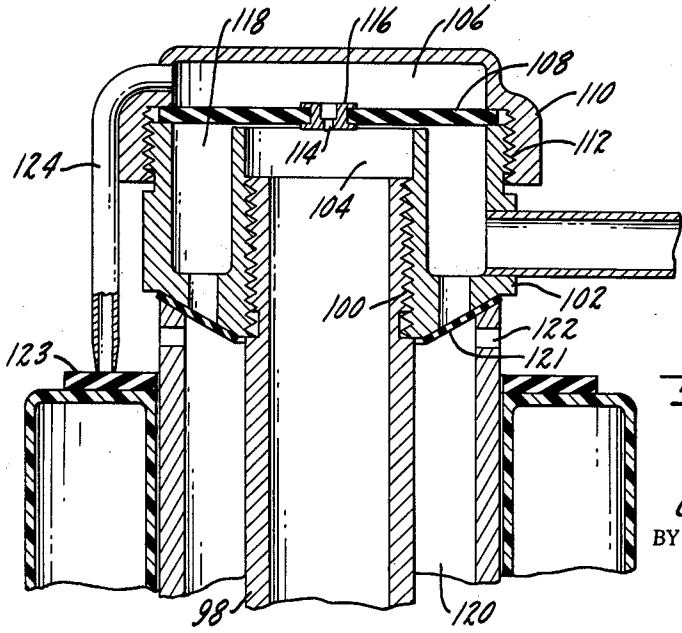


Fig. 8.

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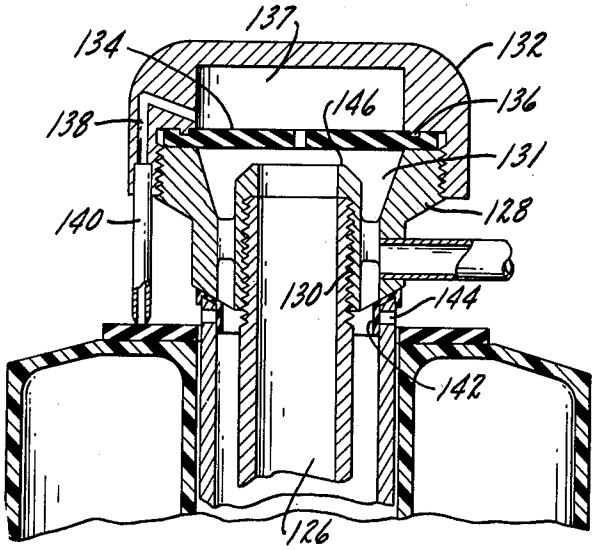


Fig. 9.

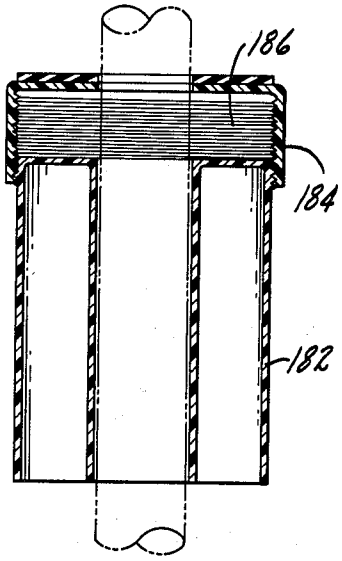


Fig. 11.

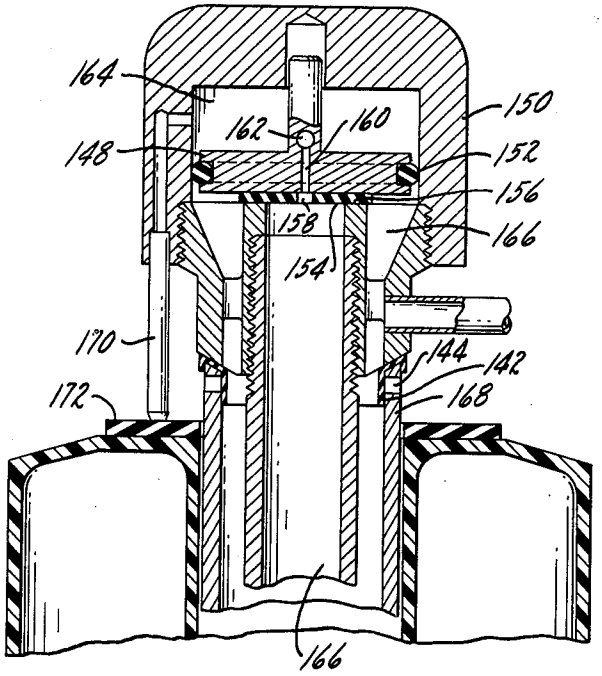


Fig. 10.

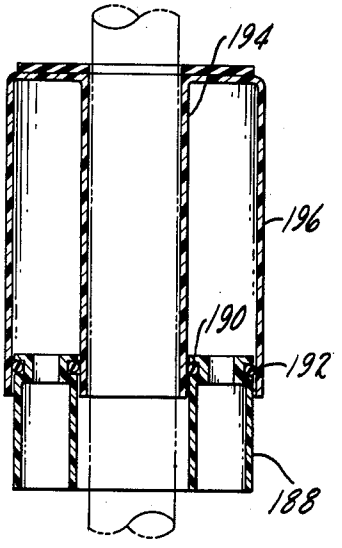


Fig. 12.

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3,195,565

BALL COCK

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Filed July 1, 1963, Ser. No. 291,848
6 Claims. (Cl. 137—414)

This invention relates to a method and structure for filling liquid receptacles, and specifically to a ball cock for use with a water closet flush tank.

Accordingly, a primary object of this invention is to provide a ball cock which provides full water flow up to the very last moment of filling, thereby achieving filling of the tank in the shortest possible time.

Another object is a ball cock assembly which does not require special linkages, hinges or arms or moving parts other than a simple float.

Another object is a ball cock assembly and method which permits the flush tank to be filled silently.

Another object is a ball cock assembly which quickly shuts water off when a predetermined level is attained so that objectionable noises do not occur, and it avoids "wire drawing" and reduced seat destruction.

Another object is a ball cock assembly having a replacement cartridge unit in which are contained liquid chambers and passageways, whereby such cartridge unit may be quickly and simply removed and replaced. This unit also provides anti-syphon or vacuum breaker action.

These objects are attained, along with other objects which will become apparent from reading the specification and claims, by the invention which will be described in detail and which is shown in the accompanying drawings.

In the specification and claims, the word "receptacle" occurs occasionally. This word, when used, refers to the flush tank itself within which the ball cock assembly is mounted.

FIGURE 1 is an elevational side view partly in section and partly diagrammatic of the ball cock valve in a flush tank;

FIGURE 2 is a top plan view of the view of FIGURE 1;

FIGURE 3 is an elevational view in section showing the valve member in the ball cock valve;

FIGURE 4 is a side elevational view in section showing the valve in the closed position;

FIGURE 5 is a side elevational view in section showing the valve in the open position and with liquid flowing;

FIGURE 6 is a plan view taken generally at line 6—6 of FIGURE 4;

FIGURE 7 is a view along line 6—6 of FIGURE 1;

FIGURE 8 is a side elevational view in section of another embodiment;

FIGURE 9 is a side elevational view in section of still another embodiment;

FIGURE 10 is a side elevational view in section of still another embodiment;

FIGURE 11 is a side elevational view in section of an adjustable float; and

FIGURE 12 is a side elevational view in section of another adjustable float.

The use of the same numerals in the various views will refer to the same structures, elements and concepts.

Referring to FIGURES 1 and 2, there is seen a receptacle or flush tank 10 from which outlet 12 extends. An inlet 14 is connected to a ball cock shown generally as 18 by a coupling nut or the like 20 engaging threaded end 16. The ball cock is shown connected to the base of the receptacle by means such as flange 24 positioning a tapered elastomeric gasket 26 in aperture 22, and using

a nut 28 on the other side of the aperture to make a secure lock.

The ball cock includes a counterflow conduit assembly which has an inner upflow conduit or tube 30 and an outer concentric downflow conduit or tube 32. The outer tube is urged against the assembly shown generally as 34 by coil spring or the like 36. A float shown generally as 38 is positioned on the outer tube to freely ride up and down in accordance with the level of the liquid 41 in the receptacle. A refill tube 40 is shown extending from the cap assembly to an overflow tube or pipe 42. A flush handle 44 is adapted to actuate flush ball 46 through a lift lever 48 and connecting links such as 50, 51. The flush ball will be lifted from seat 52 to open port 54 and thereby flush liquid through the port 54 and outlet pipe 12 projecting from the receptacle.

Turning to FIGURE 3, the float 38 as seen as a hollow structure having a continuous outer wall 56 spaced from a continuous inner wall 58 which is closely positioned to the outer conduit 32 which guides the float in its up and down movement. The inner and outer walls may be open at the bottom to permit entry of the liquid but are connected at the upper ends by means such as a solid wall 60 to provide an air chamber and rigidity. An annular drain tube seal 62 is fixed to the top of the float.

The cap assembly is shown here as having an outer cap 64 and a base 66. The base is secured to the top of the liquid upflow tube by means such as engaging threads 68. The base may be offset at 70 to receive the end of the outer or downflow tube which is urged against the base by the coil spring 36. The base is held within the outer cap by means such as a snap ring 72. The base has downflow passages such as 73, 73 communicating with the downflow outlet of the outer tube, as indicated by the arrows. The base may also have passageways 76 communicating with the receptacle. A passageway 78 communicates with and receives the refill tube 40. The base may have a raised portion or valve seat 80 which may be an extension of the upstream tube.

The base and outer cap form a chamber therebetween which is divided into an upper or pressure chamber 82 and a lower flow chamber 84 by a diaphragm 86 which is held securely along its periphery between the base and the outer cap. The diaphragm has a passageway or aperture of reduced diameter 88 which communicates with the upper and lower chambers. A vacuum breaker or anti-syphon diaphragm 90 may also be positioned between the base and the outer cap. Such a breaker diaphragm may be in the shape of an annular band which may be moved by the flowing liquid to close passageways such as 76 which communicate with the interior of the flush tank.

The outer cap is seen to have a lateral drain passageway 92 and a connecting vertical drain passageway 94 joined to a drain tube 96. The drain passageways and drain tube communicate the upper chamber with the interior of the liquid receptacle.

Upwardly flowing liquid will move through the inner tube and empty into the lower chamber 84 of the cap assembly. From there it will pass through the downflow passageways 73, 73 in the base and into the outer tube where it will empty into the receptacle. This route is indicated by the arrows in FIGURES 2, 4 and 5. The pressure of the upwardly flowing liquid will fully unseat the diaphragm. If a vacuum breaker is present, the flowing liquid will also move the vacuum breaker into the FIGURE 5 position so that it seals off the passageways 76 communicating with the interior of the receptacle.

A small portion of the upwardly flowing liquid will pass through the aperture 88 into the upper or pressure closing chamber. This liquid will be bled or allowed to

escape from the upper chamber through the drain passageways **92, 94** and drain tube **96** so long as the drain tube remains open. When the drain tube is closed by the drain tube seal or platform **62** on the float, the liquid will accumulate in the upper chamber and the resulting pressure will build up until it is greater than the pressure of the upstream liquid. This will cause the diaphragm to move onto the raised portion or valve seat of the base and the flow of liquid will be stopped. This condition is depicted in FIGURE 4.

FIGURE 8 shows another embodiment in which an inner upflow conduit **98** is connected by threads **100** to a base **102**. A lower flow chamber **104** in the base is separated from an upper closing chamber **106** by diaphragm **108** held between the base and outer cap **110** by threads or the like **112**. The diaphragm has an aperture of reduced diameter **114** which is shown formed by a rigid inert or grommet **116**.

Upflowing liquid empties from the lower chamber **104** to communicating passageways **118** which lead to downflow conduit **120**. Vacuum breakers such as **121** are fixed between the base and the wall of the downflow conduit and are adapted to be moved against aperture **122** in response to flowing liquid to close off communication with the interior of the receptacle. Other forms of vacuum breakers may be used if desired. A drain tube **124**, communicating with the upper chamber, is seen closed by the drain tube seal **123**.

Another embodiment is shown in FIGURE 9 wherein the inner upflow conduit **126** is shown again directly connected to the base **128** by means such as engaging threads **130**. The chamber **131** between the base and the outer cap **132** is separated by a diaphragm **134** which is securely fixed along its periphery by a continuous ridge in the outer cap engaging a continuous groove in the diaphragm as at **136**. The upper chamber **137** is connected with the exterior by drain passageway **138** and drain tube **140**. The vacuum breaker **142** is shown closing the apertures **144**. FIGURE 9 is intended to illustrate the ball cock just upon closing of the drain tube before pressure buildup in the pressure closing member **137** moves the diaphragm onto the seat **146** of the base.

FIGURE 10 shows still another embodiment wherein a piston element **148** is in fluid tight engagement with outer cap **150** by a continuous O-ring **152**. An elastomeric sealing member such as a gasket **154** is fixed to the bottom of the piston element so that it makes a fluid tight seal when seated on valve seat **156**. An aperture **158** in the seal leads to connecting passageways **160, 162** which communicate with upper pressure closing chamber **164**. When the liquid is flowing upwardly in conduit **166**, the piston element or seal is raised from the valve seat and the liquid moves through passageways **166** into downflow conduit **168**. FIGURE 10 illustrates the piston seal seated on the valve seat from a pressure buildup of liquid in chamber **164** after drain tube **170** is sealed by contact with platform or tube seal **172**. In this position the valve is closed and no flow occurs.

The sealing surface or platform on the float is preferably adjustably positioned so that the upflow of liquid into the receptacle is stopped in response to different predetermined levels of liquid in the receptacle. This may be done by using contact tabs or fringes such as **174** and **176** fixed to a top wall and a bottom wall such as **177** of a float to frictionally hold a concentric tube **180** which freely slides on outer tube **32**. A platform **178** is fixed to the top of tube **180** and its position is set by raising or lowering tube **180**.

Another adjustable float is shown in FIGURE 11, wherein a lower float portion **182** may be adjustably engaged to upper portion **184** by threads **186**. The downflow conduit is indicated in phantom outline.

FIGURE 12 shows still another float. Here a lower float portion **188** has an inner O-ring **190** and an outer O-ring **192** which form a sliding seal with the inner wall **194** of an upper float portion **196**.

The use and operation of my invention are as follows:

Referring to the embodiment in FIGURES 1, 3, 4 and 5 for example, in which the tank **10** has just been emptied by tripping handle **44** and the water level is lowered. The float **38** has descended a greater or lesser amount. Then the following action will occur.

Water will flow from inlet **14** upwardly in inner tube **30**. The diaphragm **86** will divert the bulk of the inflowing water downwardly into passages **73, 73** and then into the annular passage formed between tubes **30** and **32**. The downflowing water will then pass into the tank from the lower end of outer tube **32** which is so arranged as to be disposed below the water level in tank **10** at all times, thereby assuring silent filling.

The water diverted by diaphragm **86** will seat the vacuum breaker **90** against the inclined upper surface of base **66**, as in FIGURE 5, thereby preventing passage of water through passages **76**.

That portion of the water which is not diverted downwardly by diaphragm **86** will pass through the center aperture **88** and into upper pressure chamber **82**. There will be no pressure buildup in pressure chamber **82** tending to seat the diaphragm on the upper end of the inlet tube **30** however so long as drain tube **96**, which is connected into pressure chamber **82** by passages **92, 94** is open.

Float **38** slides along tube **32** and moves up and down with the water level in the tank **10**. When the float is in the FIGURE 4 position, that is when water reaches the level of FIGURE 1 and the drain tube **96** is closed, a pressure buildup occurs in pressure chamber **82** and deflects the diaphragm downwardly, which eventually closes off water flow altogether. The flow shut-off comes about as follows.

The lower side of the diaphragm may be viewed as the seating surface and the upper side may be viewed as the pressure surface. Since the incoming liquid is moving through an aperture of reduced diameter, the downwardly acting seating pressure on the pressure surface side will be less than the upwardly acting unseating pressure on the seating surface side. The diaphragm will therefore move away from the valve seat **80** and permit a steady and rapid flow of liquid through the lower chamber **84**, downwardly in the outer conduit, and into the receptacle below the liquid level. The rapid and continuous flow will continue as long as the portion of the liquid transferred to the upper pressure closing chamber is bled from the chamber or allowed to escape as by drain passageways **92, 94** and drain tube **96**.

When the float has been raised by the raising of the water level, the drain tube is sealed by the impingement of the seal **62** on the float against the tube and the pressure differential will change. The accumulation of liquid in the upper chamber **86**, acting over the entire surface area of the diaphragm, will develop a pressure which exceeds the pressure of the upflowing liquid which acts only against a portion of the lower surface area of the diaphragm. This differential will cause the diaphragm to be seated on the valve seat and stop the flow.

The diaphragm will remain on the valve seat and the flow of liquid will be stopped so long as seal ring **62** or slide valve **178** closes off the drain tube **96**. The water closet flush tank in this static condition is illustrated in FIGURE 1. When it is desired to empty the flush tank, outlet port **54** is opened by actuating handle **44** and lift lever **48** which unseats flush ball **46** by means of connecting links **50, 51**. The water will flow out of the receptacle and the float **38** will drop with the decending level of water. Once the float moves away from the drain tube **96**, the pressure in upper pressure chamber **82** will fall off, the seating surface of the diaphragm will move away from the valve seat and water flow will commence through the tubes **30** and **32**. The float will rise with the liquid

until drain tube 96 is closed, pressure buildup in chamber 82 occurs and the valve is closed.

The device incorporates a delayed action feature which raises the water level sufficiently to give the float more buoyancy or force and thus to close off the drain tube tightly. This is accomplished by the high deflection of the diaphragm 86 upwardly, as shown in FIGURE 5, and time is thus allowed for the pressure to buildup in chamber 82, thus deflecting the diaphragm downwardly to the seat to accomplish sealing. The sealing position is below a straight level line of the diaphragm.

The time required to accomplish this movement of the diaphragm gives sufficient delay in shutting off the water to give the float added buoyancy and thus to seal the drain tube off tightly.

One obvious change which can be made in the structure is an interchange of the diaphragm 134 and the piston 148. The structures of FIGURES 9 and 10, except for the details of the caps 132 and 150, is identical to accomplish a change from one to the other. All that is required is the removal for example of the cap 132 and the diaphragm 134 and the substitution for them of the cap 150 and the piston 148.

In view of the obvious variations which are possible from the foregoing exemplary description, it is intended that the scope of this invention be measured not solely by the description but rather by the following claims as interpreted in the light of the prior art, having due regard to the doctrine of equivalents.

I claim:

1. A ball cock including a liquid tube assembly having an upflow conduit and a downflow conduit, means to admit liquid into the tube assembly, a float movably associated with the tube assembly, a sealing surface carried by the float, a valve structure mounted on one end of the tube assembly, a pressure chamber and a flow chamber in the structure, an elastomeric diaphragm separating one chamber from the other chamber, a passageway of reduced diameter in the diaphragm connecting one chamber with the other chamber, communicating passageways between the flow chamber and the downflow conduit, a valve seat for the diaphragm associated with the upflow conduit, some of the liquid from the upflow conduit adapted to pass through the diaphragm passageway and into the pressure chamber, means to drain such liquid away from the pressure chamber, and the sealing surface of the float adapted to close the drain means when liquid outside the tube assembly reaches a predetermined liquid level whereby liquid within the pressure chamber accumulates and moves the diaphragm onto the valve seat thereby stopping upflow liquid in the tube assembly.

2. A ball cock including a liquid tube assembly having an upflow conduit and a downflow conduit, means to admit liquid into the tube assembly, a float movably associated with the tube assembly, a sealing surface carried by the float, a valve structure mounted on one end of the tube assembly, a pressure chamber and a flow chamber in the structure, a rigid wall separating one chamber from the other chamber, said wall movable in fluid tight engagement within the structure in response to the pressure of flowing liquid, a passageway of reduced diameter in the wall connecting one chamber with the other chamber, communicating passageways between the flow chamber and the downflow conduit, a valve seat for the wall associated with the upflow conduit some of the liquid from the upflow conduit being adapted to pass through the wall passageway into the pressure chamber, means to drain such liquid away from the pressure chamber and the sealing surface of the float adapted to close the drain means when liquid outside the tube assembly reaches a predetermined liquid level, whereby liquid within the pressure chamber accumulates and moves the wall onto the valve seat thereby stopping upflow liquid in the tube assembly.

3. A ball cock including a liquid tube assembly having an upflow conduit, a coaxial downflow conduit around said upflow conduit, means to admit liquid into the tube assembly, an annular float coaxial with and telescoping said conduits for sliding movement along the length thereof, a sealing means carried by the float, a valve structure mounted on one end of the tube assembly, a pressure chamber and a flow chamber in the structure, an elastomeric diaphragm separating one chamber from the other chamber, a passageway of reduced diameter in the diaphragm connecting one chamber with the other chamber, communicating passageways between the flow chamber and the downflow conduit, a valve seat for the diaphragm associated with the upflow conduit, some of the liquid from the upflow conduit adapted to pass through the diaphragm passageway and into the pressure chamber, means to drain such liquid away from the pressure chamber, and the sealing means of the float adapted to close the drain means when liquid outside the tube assembly reaches a predetermined liquid level whereby liquid within the pressure chamber accumulates and moves the diaphragm onto the valve seat thereby stopping upflow liquid in the tube assembly.

4. A ball cock as in claim 3 further characterized in that the float sealing means is located on the upper portion of the float.

5. A ball cock as in claim 3 further characterized in that said float sealing means are positioned outside of the pressure chamber drain when in closing contact therewith.

6. A ball cock as in claim 3 further characterized in that said elastomeric diaphragm is biased to be normally flexed away from said valve seat.

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