United States Patent [19]

Esten

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[54] **BALLCOCK**

[76] Inventor: **Harold Esten,** 73 Messenger Ln., Willingboro, N.J. 08046

[22] Filed: **July 10, 1972**

[21] Appl. No.: **270,117**

Related U.S. Application Data

[63] Continuation of Ser. No. 25,060, April 2, 1970, abandoned.

[52] **U.S. Cl.** **137/414,** 137/49, 137/444

[51] **Int. Cl.** **F16k 31/18**

[58] **Field of Search** 137/414, 419, 424, 425, 137/430, 432, 434, 444; 73/322.5

[56] **References Cited**

UNITED STATES PATENTS

3,285,277	11/1966	Goldtrap	137/414
3,387,620	6/1968	Walters	137/414 X
2,007,048	7/1935	Goodwin	137/414
3,115,153	12/1963	Delamater	73/322.5 X
3,158,173	11/1964	Bachli et al.	137/414
3,254,665	6/1966	Bachli et al.	137/414

Primary Examiner—Alan Cohan
Assistant Examiner—David R. Matthews
Attorney, Agent, or Firm—Caesar, Rivise, Bernstein & Cohen

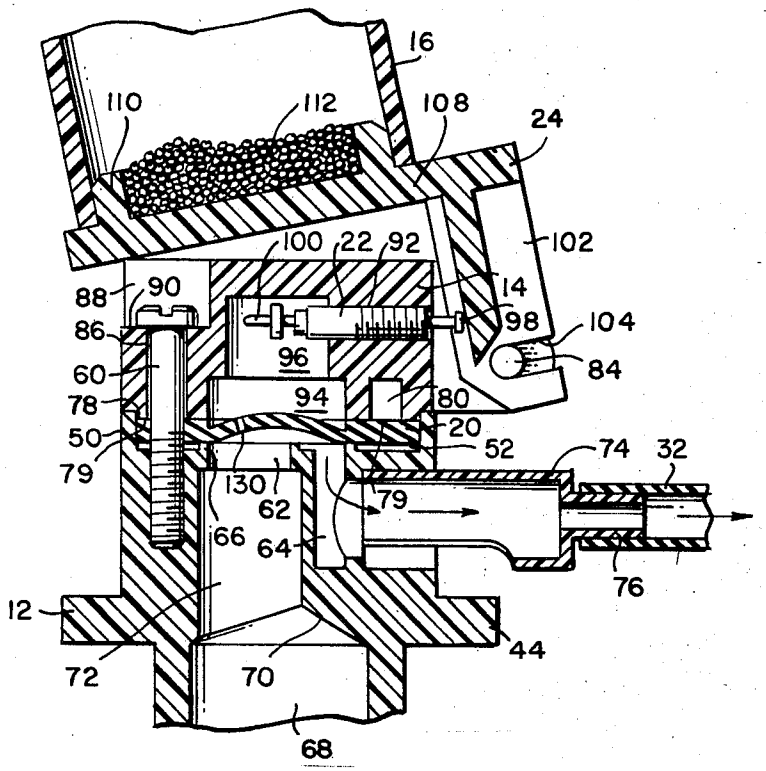
[57] **ABSTRACT**

A ballcock for use in a toilet tank comprising a base that is adapted to be connected to a water supply, a cap that is attached to the top of the base with the cap having an opening to receive a pilot valve and the cap also having means to receive a hinge piece, a diaphragm which is received and held in place between the base and the cap with the diaphragm having a central opening, a weight tube having a hinge piece and a float tube being telescopically slidable on the weight tube.

When the water level within the toilet tank drops, the float pivots downwardly to depress the pilot valve which have the effect of venting the space above the diaphragm to atmosphere. In this condition the water pressure in the supply line urges the diaphragm upwardly, and water now flows in a flow passage within the base to an outlet containing a fitting which divides the flow, permitting the major part (approximately 90 percent) to go directly into the tank with the remainder going via a flexible tubing to an overflow tube (which is a part of the toilet tank).

When the desired liquid level is reached within the tank, the float tube is again upright, so that the pilot valve returns to its normally closed position. Fluid pressure quickly builds above the diaphragm until it equals the liquid line pressure below the diaphragm, and at this time the diaphragm returns to its original closed position, and water no longer flows.

10 Claims, 8 Drawing Figures



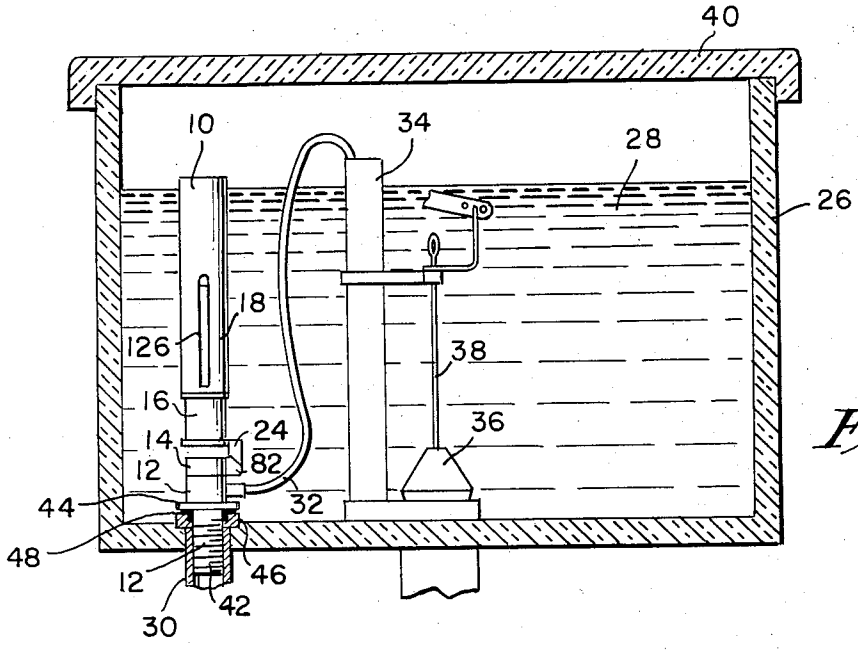


Fig. 1.

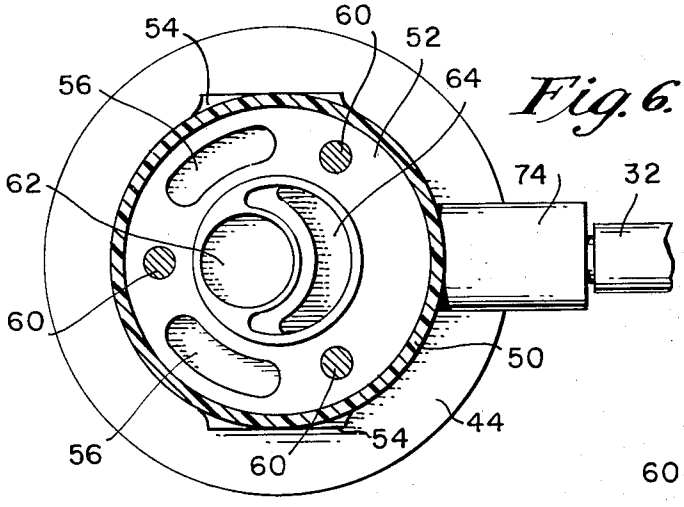


Fig. 6.

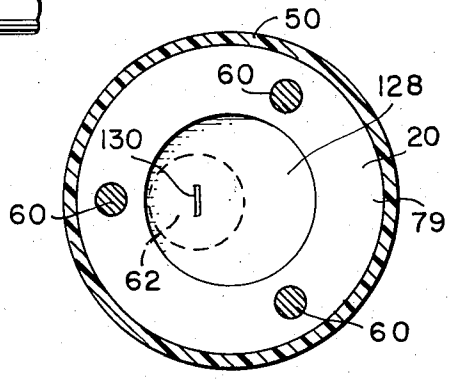


Fig. 7.

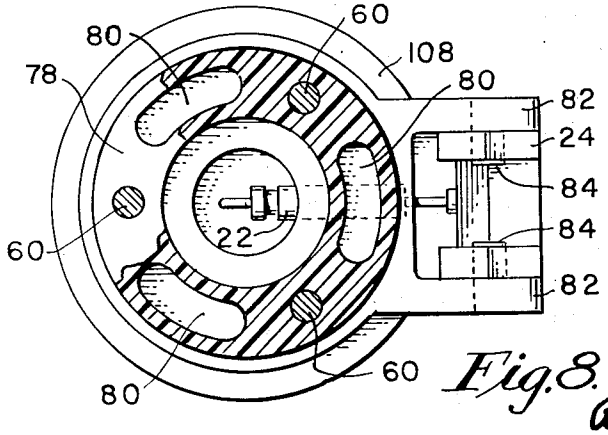


Fig. 8.

INVENTOR.
HAROLD ESTEN
BY
Caesar, Rivise, Bernstein & Cohen
ATTORNEYS.

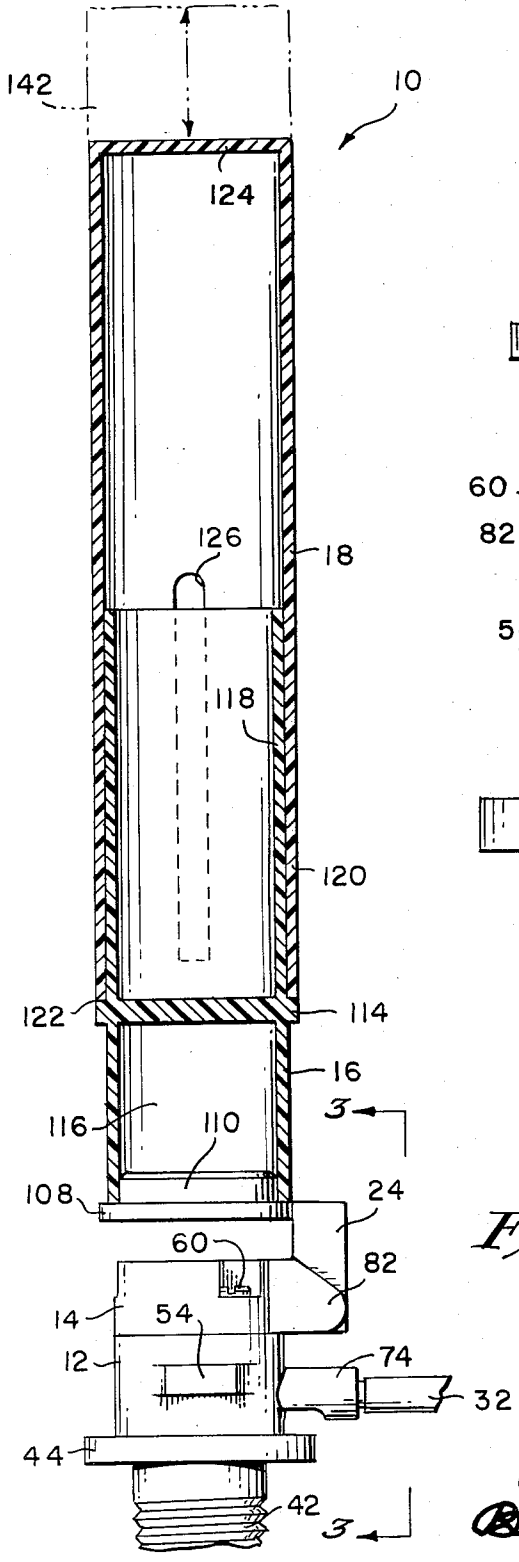


Fig. 2.

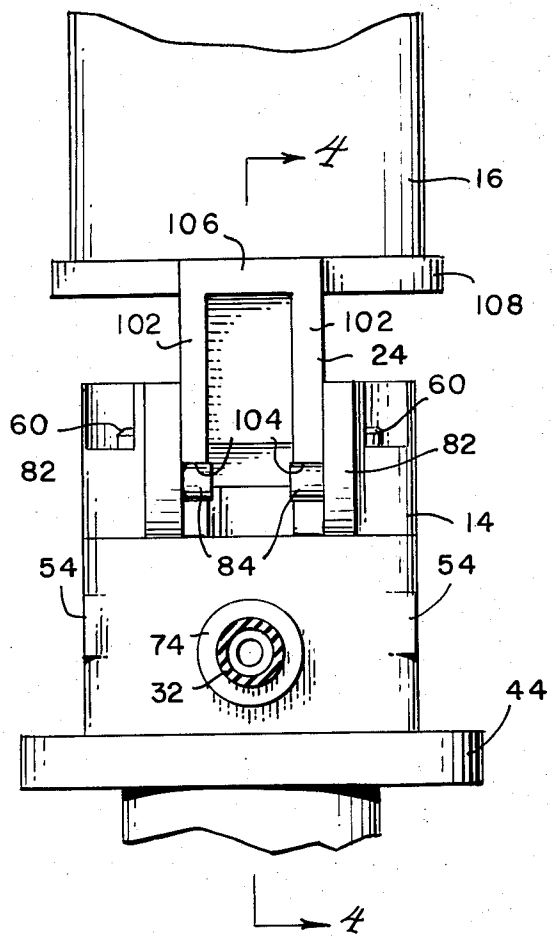


Fig. 3.

INVENTOR.
HAROLD ESTEN
BY
Caesar, Rivise, Bernstein & Cohen
ATTORNEYS.

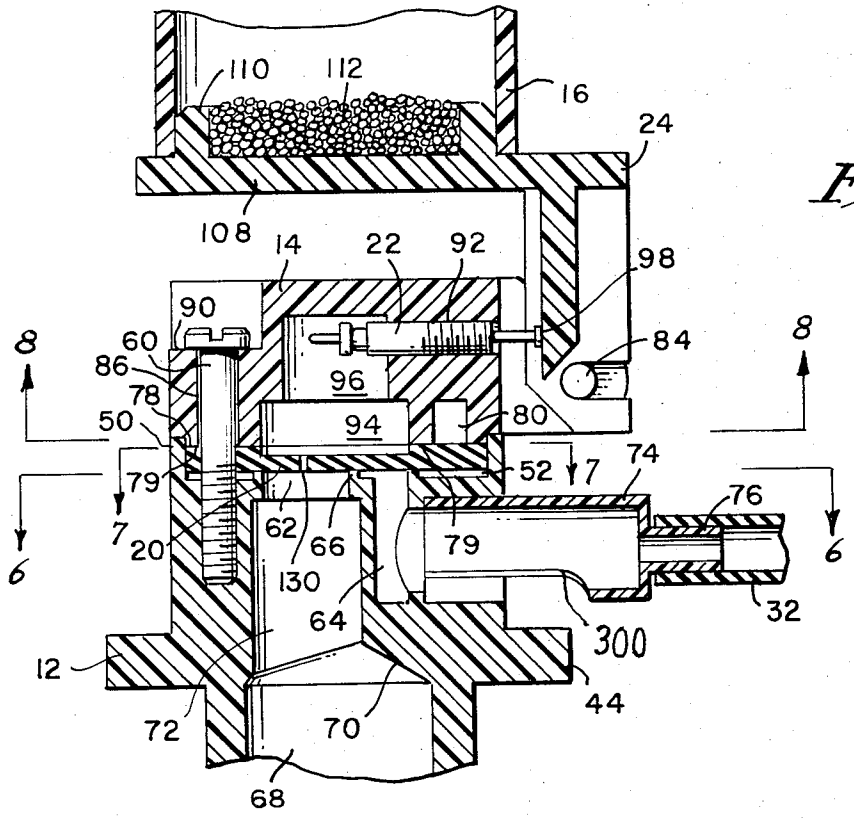


Fig. 4.

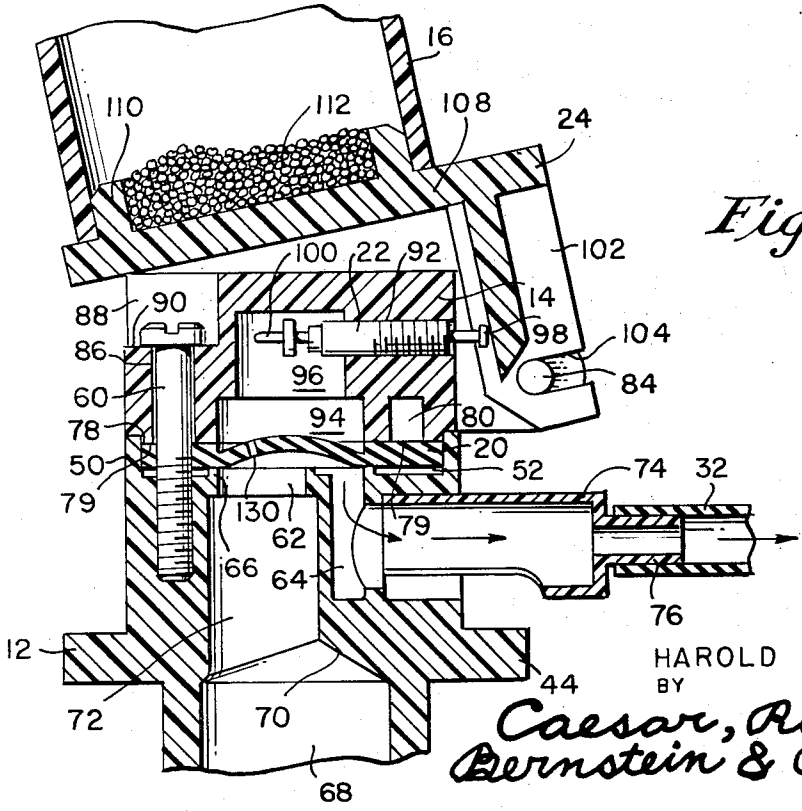


Fig. 5.

INVENTOR.
HAROLD ESTEN
BY
Caesar, Rivise, Bernstein & Cohen
ATTORNEYS.

BALLCOCK

This is a continuation of U.S. Pat. application Ser. No. 25,060, filed Apr. 2, 1970, now abandoned.

This invention relates to a ballcock, and more particularly to a ballcock of a new and improved construction. Most ballcocks now in use generally include a float that is positioned at a point somewhat remote from the off-on mechanism, with the float being secured to the remainder of the ballcock by means of a rod. When the liquid level in the toilet tank drops, the level of the float also drops. This causes a downward pivoting of the rod that has the effect of opening a water valve that is a part of the ballcock mechanism.

Over the years the float rod linkage concept has proven to be unreliable. This has been a consequence of corrosion and/or wear which interfered with the free action of the mechanism, generally resulting in the inlet valve not being completely shut off. Accordingly, this results in annoying trickling noises.

It has been recognized in the art as shown in U.S. Pat. No. 3,429,333 and in U.S. Pat. No. 3,319,913 that the float can be positioned generally above the shut-off means, rather than being secured to a rod that is located in an inclined, remote position with respect to the shut-off means. However, such recently developed devices have proved to be somewhat complicated in construction, and therefore have been offered to the public at a relatively high cost.

It is therefore an object of the present invention to provide a novel ballcock that is simply manufactured through the use of a small number of molded parts and other relatively inexpensive components.

Still another object of the present invention is to provide a ballcock which achieves essentially an either "on" or "off" operation that essentially eliminates the throttling that was inherent in ballcocks commonly in use.

Yet another object of the present invention is to provide a ballcock that can be easily assembled, and this contributes further to the economy of the present invention.

Still another object of the present invention is to provide a ballcock that can be simply adjusted when it is desired to achieve a particular water level that is necessary for the proper operation of a toliet tank.

The foregoing as well as other objects of the invention are achieved by providing a ballcock that is composed largely of a number of molded parts. The first molded part is a base that is adapted to be connected to a water supply. The second molded part is a cap that is attached to the top of the base with the cap having an opening to receive a pilot valve, and the cap also having means to receive a hinge piece.

A diaphragm is received and held in place between the base and the cap, with the diaphragm having a central opening.

The third molded part is a weight tube that has a separate hinge piece, and there is a fourth molded part which is a float tube that is slidable on the weight tube.

When the water level in the toilet tank drops, the float pivots downwardly to depress the pilot valve which has the effect of venting the space above the diaphragm to the tank. The line pressure of the water acts against the lower surface of the diaphragm, and since it is greater than the tank pressure, it immediately urges

the diaphragm upwardly to provide an opening through which the water flows to an outlet in the base.

When the desired liquid level has been reached within the tank, the float tube is again upright so that the pilot valve returns to its normal closed position. Fluid pressure quickly builds above the diaphragm until it equals the liquid line pressure below the diaphragm so that the diaphragm returns to its original closed position, and water no longer flows.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is a cross sectional view of a toilet tank showing the ballcock of the present invention seated in place, and also showing certain other conventional elements including a trap refill hose, an overflow tube and the inlet line for the water supply;

FIG. 2 is a sectional view taken vertically through the ballcock of the present invention;

FIG. 3 is an enlarged sectional view taken along the lines 3—3 of FIG. 2;

FIG. 4 is a sectional view taken along the lines 4—4 of FIG. 3, showing the ballcock wherein the foat tube is upright, and no water flows since the diaphragm is seated in its closed position;

FIG. 5 is a view similar to FIG. 4, but wherein the float tube has pivoted downwardly to depress the pilot valve, and thereby allow the diaphragm to move upwardly of its seat, and thereby allow water flow through an outlet in the base;

FIG. 6 is a sectional view taken along the lines 6—6 of FIG. 4;

FIG. 7 is a sectional view taken along the lines 7—7 of FIG. 4; and

FIG. 8 is a sectional view taken along the lines 8—8 of FIG. 4.

Referring now in greater detail to the various figures of the drawing wherein like reference characters refer to like parts, there is shown at **10** in FIG. 2 a ballcock which basically comprises a base **12**, a cap **14**, a weight tube **16** and a float tube **18**.

With reference to FIG. 4 it will be seen that the ballcock **10** further includes a diaphragm **20** and a pilot valve **22**.

Also, as shown in FIG. 2, the hinge piece **24** connects the cap **14** to the weight tube **16**.

The positioning of the ballcock **10** within toilet tank **26** containing water **28** may be seen from an inspection of FIG. 1. The ballcock **10** is threadedly received in a compression fitting water inlet pipe **30**, and the usual trap refill tube **32** is provided which connects the water supply to the overflow pipe **34**. Other standard elements shown in FIG. 1 include toilet tank ball **36** and associated rod **38**, with the toilet tank closed with the usual cover **40**.

The details of the base **12** may be seen from an inspection of FIGS. 2, 4, 5 and 6 wherein base **12** is shown to have a lower threaded area **42** so that it can be simply received in complementary internal threads formed in the inlet pipe **30**. Moving upwardly along the base **12** there is a circular flange **44** which aids in the seating of the base **12** upon a complementary flange **46** of the inlet pipe **30** with the usual gasket **48** being employed for sealing purposes.

The base 12 terminates in an upper ledge 50 that defines a somewhat recessed area 52 (FIGS. 4 and 5) which receives a diaphragm 20 as will be discussed hereinafter. The recessed area 52 may be viewed in elevation by referring to FIG. 6.

Also visible in FIG. 6 are wrench flats 54 to aid in the tightening of the base 12 within the inlet pipe 30. Openings 56 are provided for the purpose of lightening the mass of the base 12, and three circular openings 58 are provided in order to receive bolts 60 as are visible in FIGS. 4 and 5.

Also appearing in FIG. 6 is the water inlet chamber 62 and the water discharge chamber 64. As can be seen in FIG. 4, so long as the diaphragm 20 is seated upon upper rim 66 defining chamber 62, the line water cannot travel from the inlet chamber 62 to the discharge chamber 64. As further shown in FIG. 4, the lower area of the base 12 includes inlet section 68 which narrows by way of inclined wall 70 to upper chamber 72 that communicates with the inlet chamber 62.

With further reference to FIG. 4 it will be seen that the outlet chamber 64 communicates with separately molded discharge tube 74 that is unitary with a nipple 76 to which refill tube 32 is secured.

The details of the cap 14 appear in FIGS. 2 to 5 and FIG. 8. The cap 14 is basically cylindrical in shape and includes a lower surface 78 that bears against raised peripheral area 79 of the diaphragm 20 which is in turn positioned against upper rim 66 of chamber 62.

With further reference to FIG. 8 it will be seen that the cap 14 includes spaced openings 80 for lightening purposes, as well as a pair of arms 82 from which project inwardly facing hinge pegs 84 for attachment of the hinge piece 24 as will be discussed hereinafter.

With reference to FIG. 5, it will be seen that the cap 14 includes openings 86 coinciding with the openings 58 in the base 12 to allow the passage of bolts 60. As shown in FIGS. 4 and 5, the cap 14 also includes near its top recesses 88 that terminate in the shoulder 90 to permit the seating of the head of bolt 60. In this way the cap 14 is secured to the base 12, and the interposed diaphragm 20 is securely held in place between the cap 14 and the base 12.

The cap 14 also includes a lateral opening 92 which communicates with a central opening 94 through central chamber 96 which in turn communicates with opening 92. It will be seen that the pilot valve 22 is positioned in the opening 92 with external actuating pin 98 of pilot valve 22 projecting externally of the cap 14. The pilot valve 22 may be threadedly held within the opening 92.

The internal end of the pilot valve 22 terminates in a nose 100 that extends into the chamber 96. It will be seen from an inspection of FIGS. 4 and 5 that the actuating pin 98 of the pilot valve is depressed by pivoting action of hinge piece 24 as will be discussed hereinafter.

The hinge piece 24 is shown in FIG. 3 as comprising a pair of arms 102 having notches 104 formed therein which embrace the pegs 84 of the cap 14. The arms 102 terminate in a rib 106 that is integrally molded with a circular base 108 to which is attached weight tube 16 using epoxy or other adhesives. It will be seen from FIGS. 4 and 5 that a rim 110 is also integrally molded with the base 108. The lower edge of the weight tube 16 telescopes about the rim 110 as shown in FIGS. 4 and 5, and aids in the retention of sand 112 or other weighty material that is contained within the weight tube 16.

The details of the weight tube 16 can be seen with reference to FIG. 2 wherein the weight tube includes an integrally molded disk 114 which together with the sides of the weight tube 16 and the base 108 of the hinge piece 24 defines the sealed chamber 116 for permanent enclosure of sand 112 or other weighty material. the weight tube 16 also includes upper cylindrical walls 118 which are open at the top.

As further shown in FIG. 2, the float tube 18 includes outer walls 120 that telescope about the walls 118 of the weight tube 16. The disk 114 presents a shoulder 122 upon which is seated the lower edge of the wall 120 of the float tube 18. There is also an upper wall 124 of the float tube 18, and an elongated slot 126 is provided in the float tube 18 to assure that water will fill the weight tube 16, and hence less sand is required in the weight tube.

The diaphragm 20 is best shown in FIG. 7 as it includes a raised outer area 79 and a somewhat thinner central area 128 which contains a small opening 130 for venting purposes as will now be described.

FIG. 4 shows the closed position of the ballcock when the water 28 is at a predetermined high level as shown in FIG. 1. In such a condition, the float tube 18 is buoyed up by the water into the vertical position as shown in FIG. 1. When the water level in the tank 26 drops, the float tube 18 starts to tilt as allowed by the hinge piece 24 in the manner as shown in FIG. 5. The pilot valve 22 may be a conventional tire valve which is placed in the cap 14 solely to vent chamber 96 and opening 94 above the diaphragm 20 to tank pressure. When this happens, the reduced pressure now existing above diaphragm 20 in opening 94 is immediately overcome by the greater pressure of the inlet water line that is being exerted against the undersurface of the diaphragm 20 in inlet chamber 62. Thus, the central section 128 of the diaphragm 20 is immediately bulged upwardly as shown in FIG. 5, and water flow takes place from inlet chamber 62 into outlet chamber 64 through discharge tube 74 then dividing with somewhat less than 10% of the flow through the nipple 76 into the refill hose 32, and the balance through the lateral opening 300 of the tube 74. In this way the water level in the tank 26 starts to rise.

Since the float tube 18 is telescoped upon the weight tube 16, the height of the float tube 18 can be raised or lowered as indicated by the dashed line 142 in FIG. 2. In this way, the desired level of the water 28 can be adjusted since the water will continue to flow into the tank 26 so long as actuating pin 98 of the pilot valve 22 is sufficiently depressed to vent to the tank the uppermost surface of the diaphragm 20. In other words, actuating pin 98 is spring loaded and therefore normally urged outwardly to the position of FIG. 4.

Hence, when the float tube 18 is sufficiently buoyed by the rising level of water 28, the float tube 18 will return to its initial vertical position, and thereby allow the actuating pin 98 to return under spring pressure to its normal outward position of FIG. 4. When this occurs, the uppermost surface of the diaphragm 20 is no longer vented to the tank.

It can be demonstrated by Bernoulli's theorem that fluid pressure will quickly build up above the opening 94 when the pilot valve 22 is closed so that the forces being exerted downwardly on the upper surface of dia-

phragm **20** becomes greater than the upward forces exerted on the under surface of the diaphragm **20** by the line water pressure. This occurs quite smoothly and so the diaphragm **20** smoothly is reseated upon the upper arm **66** of chamber **62** to return to the initial position of FIG. **4.** All water flow now stops, and the level of water **28** in the tank **26** is maintained.

It will be appreciated that when the space above the diaphragm is no longer vented to the tank, that the greater liquid pressure below the diaphragm will force liquid through the opening in the diaphragm into the space above the diaphragm. Since, as can be observed from FIG. **4** or FIG. **5**, the space above the diaphragm acts upon a greater area of the diaphragm as compared with the smaller portion of the under surface of the diaphragm affected by the liquid line pressure, the downward force quickly becomes greater than the upward force. Thus, the diaphragm is forced to its normal closed position, and liquid flow stops.

It will be seen from the foregoing description that the present invention basically relies upon six molded parts (preferably of nylon — although other plastics may be used), a diaphragm and a pilot valve. These parts are simply produced or acquired, and the assembly of these parts occurs rather quickly with the help of relatively unskilled labor.

The ballcock of the present invention has a life prediction greater than 10^6 operational cycles. This is a consequence of extremely lightly stressed parts, and materials which are insensitive to corrosion. Accordingly, for all practical purposes, the life of the ballcock may be considered to be infinite.

In view of the foregoing it will be appreciated that the present invention constitutes a simple and relatively inexpensive solution to a long existing problem.

Without further elaboration, the foregoing will so fully illustrate my invention that others may, by applying current or future knowledge, readily adapt the same for use under various conditions of service.

What is claimed as the invention is:

1. A ballcock operating in an axial path comprising a base including a diaphragm and a pivoting cap, said base, diaphragm and cap all normally axially aligned with respect to each other, said base also having a water inlet chamber and a water discharge chamber with said diaphragm interposed between said chambers to normally isolate the chambers from each other, said base including a space above the diaphragm, said diaphragm having a relatively small opening, nonaxial means to vent the space above said diaphragm, including actuating means, a float tube coupled to said cap and normally axially aligned with said base and diaphragm and adapted to pivot along with the cap to cause movement of said actuating means when it is desired to allow liquid flow through said inlet chamber to said discharge chamber, said actuating means causing the space above said diaphragm to be vented in response to the pivoting of said cap, wherein the liquid pressure below said diaphragm unseats at least a portion of said diaphragm to allow liquid to flow from said inlet chamber to said discharge chamber, and whereby, when a predetermined liquid level is reached, said float tube and cap pivot back to their normal axially aligned orientation whereupon said actuating means are released to cease the venting of the space above said diaphragm so that fluid pressure quickly builds up therein to be sufficiently effective to counteract the water pressure below said diaphragm and thereby cause said diaphragm to again isolate the chambers from one another to prevent further liquid flow.

2. The ballcock of claim **1** wherein said venting means is a tire valve.

3. The ballcock of claim **2** wherein said discharge chamber is connected to a discharge tube to which a refill hose is attached.

4. The ballcock of claim **2** wherein said base is threaded so that it can be attached to a water inlet pipe.

5. The ballcock of claim **2** wherein said cap is attached to the top of said base with said diaphragm being disposed under said cap, said diaphragm having a thinner central section, including said opening, with said central section being adapted to be bulged away from said base to allow liquid flow.

6. The ballcock of claim **5** wherein said cap includes a hinge piece upon which a weight tube is positioned, and wherein said float tube is positioned on said weight tube.

7. The ballcock of claim **6** wherein said float tube is telescopically slidable on said weight tube.

8. The ballcock of claim **7** wherein said hinge piece includes a web that is pivoted by said float tube and said weight tube, with said web contacting the actuating means asssociated with said pilot valve during the pivoting of said float tube to open said pilot valve.

9. The ballcock of claim **7** wherein said float tube includes a slot permitting water to enter a portion of said weight tube.

10. The ballcock of claim **9** wherein said weight tube includes a compartment for reception of sand.

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