Jan. 5, 1954 W. H. PATTEN 2,664,913

NONSIPHONING BALL COCK

Filed June 30, 1949 2 Sheets-Sheet 1

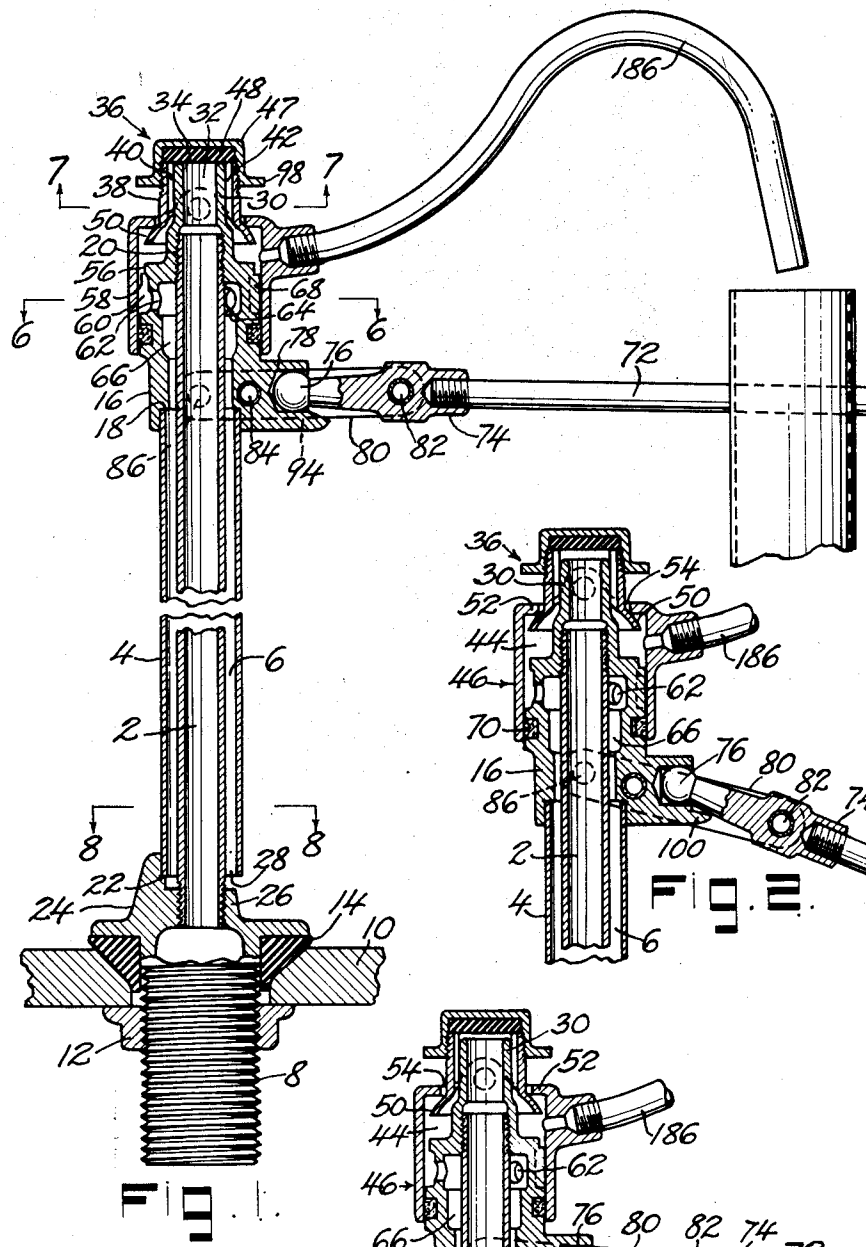


Fig. 1.

Fig. 2.

Fig. 3.

INVENTOR.
WILBERT H. PATTEN.
BY Albert Sperry
ATTORNEY

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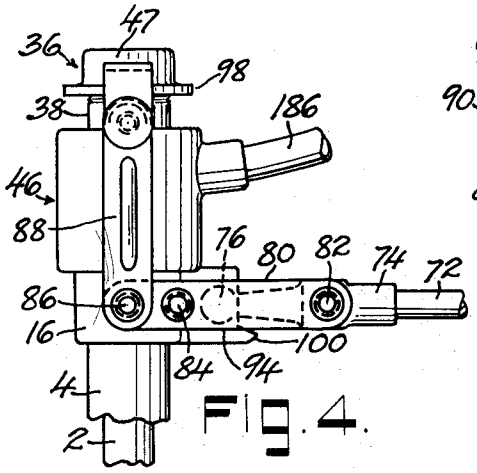


Fig. 4.

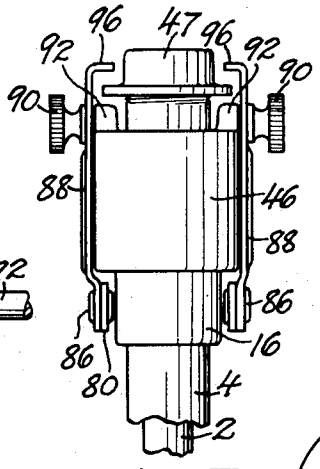


Fig. 5.

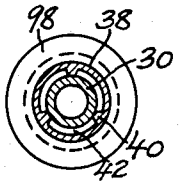


Fig. 7.

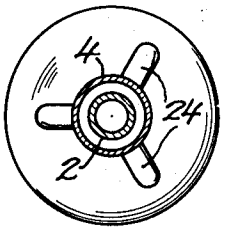


Fig. 8.

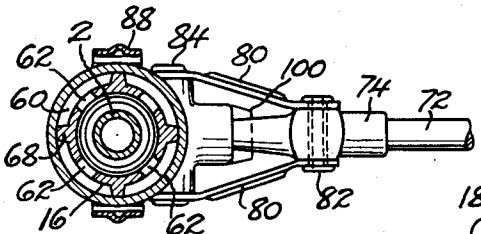


Fig. 6.

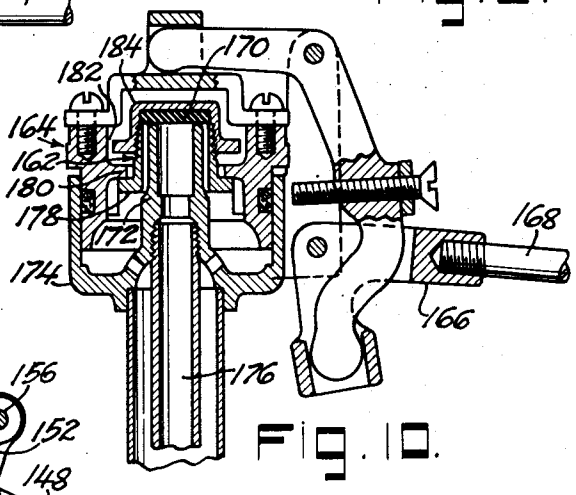


Fig. 10.

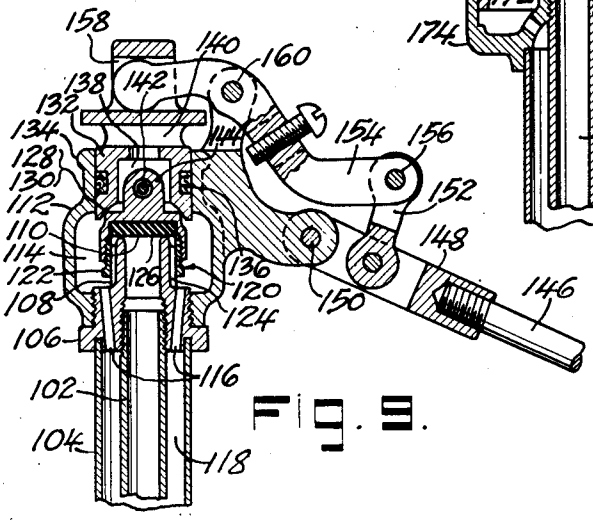


Fig. 9.

INVENTOR.
WILBERT H. PATTEN.
BY
Albert Sperry
ATTORNEY

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2,664,913

NONSIPHONING BALL COCK

Wilbert H. Patten, Trenton, N. J.

Application June 30, 1949, Serial No. 102,225

10 Claims. (Cl. 137—218)

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This invention relates to non-siphoning ball cocks and is directed particularly to constructions of the type frequently used in the flush tank of a toilet.

Many plumbing codes require the ball cock used in the flush tank of a toilet to be provided with means for eliminating any possibility of back siphoning of water from the flush tank or toilet into the water system when the pressure in the system is reduced or cut off entirely. The siphon breaking means heretofore used for this purpose have generally been designed to be applied as attachments to systems containing existing ball cocks or have otherwise operated independently of the ball cock itself. As a result such constructions have been bulky, complicated and expensive to produce and have not always been capable of use in the limited space available in small flush tanks of modern design. Those siphon breaking devices which have heretofore operated with the ball cock have ordinarily included flexible members which are uncertain in their action and tend to deteriorate on long continued use.

In accordance with the present invention a new type of ball cock is provided in which siphon breaking means are embodied directly in the ball cock so that the construction is small, inexpensive and simple in construction. This is preferably accomplished by providing the ball cock with a dual valve member which is movable by a float to control the admission of water to the flush tank from the system and is movable by gravity to admit air to the system when the pressure falls so low as to induce back siphoning.

One of the objects of the present invention is to provide a novel type of non-siphoning ball cock which is relatively small, simple and economical to produce.

Another object of the present invention is to provide a ball cock with siphon breaking means embodied directly in the ball cock.

A further object of the invention is to provide a ball cock with dual valve means actuated by a float to control the flow of water from the system and actuated by gravity to admit air to the system when the pressure in the system falls so low as to induce back siphoning.

These and other objects and features of the present invention will appear from the following description thereof in which reference is made to the figures of the accompanying drawings.

In the drawings:

Fig. 1 is a vertical sectional view through a preferred form of ball cock embodying the present invention;

Fig. 2 is a view similar to Fig. 1 showing the valve portion with the parts in the position they assume when the tank is being filled;

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Fig. 3 is a view similar to Fig. 2 with the parts in the position they assume when the water pressure is low and back siphoning tends to occur;

Fig. 4 is a side elevation of the construction shown in Fig. 1;

Fig. 5 is a rear elevation of the construction shown in Fig. 1;

Figs. 6, 7 and 8 are horizontal sectional views taken on the lines 6—6, 7—7, and 8—8 respectively of Fig. 1;

Fig. 9 is a vertical sectional view of an alternative form of ball cock construction embodying the present invention; and

Fig. 10 is a vertical sectional view of a further alternative form of ball cock construction embodying the present invention.

That form of the invention shown in Figs. 1 to 8 of the drawings is designed to be mounted in the flush tank of a toilet and is provided with a supply pipe 2 which is surrounded by an outlet pipe 4 spaced from the supply pipe to form a discharge passage 6. The supply pipe and outlet pipe are mounted on a fitting 8 secured to the bottom of a tank 10 by means of a nut 12 and washer 14.

The ball cock is mounted on the upper ends of the supply and outlet pipes and as shown includes a head 16 having a downwardly facing shoulder 18 bearing against the upper end of the outlet pipe 4. The upper portion of the head is in threaded engagement with the supply pipe 2 as shown at 20 so that when the head is screwed down on the supply pipe the shoulder 18 is forced against the upper end of the outlet pipe 4 and serves to hold the outlet pipe in engagement with the shoulder 22 on the fitting 8. The shoulder 22 is surrounded by ribs 24 which hold the lower end of the outlet pipe in place and elevated from the collar 26 of the fitting so as to provide an outlet opening 28 adjacent the bottom of the tank and communicating with the discharge passage 6.

The upper end of the head 16 is formed with a cylindrical extension 30 having a central opening 32 which communicates with the supply pipe 2 and presents an upwardly facing valve seat 34. A dual valve member 36 is formed with a cylindrical stem 38 surrounding the extension 30 on the upper end of the head 16 and provided with inwardly projecting guide ribs 40. These ribs prevent tilting of the valve member during vertical movement thereof and cooperate with extension 30 to form water passages 42 leading from the opening 32 in head 16 to the chamber 44 between the head and a surrounding valve carrier or housing 46.

The valve member 36 has a lost motion connection with the valve carrier or housing and is

movable therewith into position to engage the valve seat 34 but is movable by gravity into position to admit air to the chamber 44. For this purpose the valve member is provided at its upper end with threads for receiving a cap 47 which carries an inner, downwardly facing washer 48 engageable with the valve seat 34 to control the flow of water from the supply pipe 2. The lower portion of the valve member 36 below the cylindrical stem 38 is formed with an outwardly projecting annular skirt 50 which projects beneath the inturned annular flange 52 at the upper end of the housing 46. The upper surface of the skirt 50 is preferably spherical in shape or is otherwise formed to cooperate with the edge or downwardly facing surface of the flange 52 to form an air inlet valve controlling the flow of air into the chamber 44 through air inlet opening 54 between the stem 38 and the flange 52.

The head 16 is provided with an outwardly projecting flange 56 below the chamber 44 and spaced from the inner walls of the housing 46 to form a passage 58 extending to an annular recess 60 having openings 62 therein which communicate with the inner chamber 64 of the head. The latter chamber communicates with passage 66 which leads to the upper end of the outlet passage 6 between the supply pipe 2 and the outlet pipe 4.

The housing or valve carrier 46 surrounds the head 16 and slidably engages ribs 68 which project outward from the head between the openings 62. Packing means 70 are located between the housing 46 and the head 16 below the annular recess 60 to prevent the flow of water from the sleeve and cause it to flow through openings 62 to the outlet passage 6.

As shown in Figs. 1, 4, 5 and 7 the housing 46 is movable vertically with respect to the head 16 by means of a float (not shown) connected to the float rod 72. The inner end of the rod 72 is threaded into the outer end of an arm 74 which is provided at its inner end with a rounded head 76 seated within the recess 78 in the lower portion of the head 16. Lever arms 80 are pivotally connected at their outer ends to the arm 74 as shown at 82 and are movable about the pivot 84 on head 16 as fulcrums. The inner ends of the lever arms 80 are connected at 86 to links 88 which extend vertically on opposite sides of the housing 46. The upper portions of the links 88 are connected to the housing 46 by means of thumb screws 90 which extend through openings in the links 88 and into upwardly projecting bosses 92 on the housing 46. The housing is thus movable vertically with respect to head 16 and in response to movement of the float and float rod 72. The compound lever arrangement afforded by arm 74 and lever arms 80 serves to provide the desired movement of the elements and the necessary force for closing the valve while using relatively short links and levers. It is therefore possible to mount all of the moving parts above the water level indicated by line 94. They are then readily available for inspection and repair and are not subject to the corrosion and deterioration of submerged parts. Moreover, the links 88 impart linear movement to the housing 46 whereby tilting or cocking of the housing is prevented. At the same time the spherical upper surface of the skirt 50 of the valve member cooperates with the edge of flange 52 to provide a line contact and afford effective sealing of the air inlet opening 54 even though the valve member should be displaced as the washer 48 is seated or for any other reason.

The upper extremities of the links 88 are turned inwardly as shown at 96 so as to project over the outwardly extending annular flange 98 on the cap 47 of the dual valve member 36. The flange 98 is also positioned to be engaged by the bosses 92 when the housing 46 is raised to lift the dual valve member and positively prevent sticking of the washer 48 to the valve seat 34 when the float rod 72 is lowered as the tank empties.

With this construction when the level of the water in tank 10 is lowered, as by flushing the toilet, the float descends and the float rod 72 is caused to tilt downward to the position shown in Fig. 2 whereby the outer end of arm 74 is moved downward about its inner end 76. The lever arms 80 are thereby rocked about their fulcrums 84 so that the inner ends of the lever arms are raised to raise the links 88 and the housing 46 as shown. As the housing 46 moves upward the inturned flange 52 engaging the skirt 50 of the dual valve member 36 is also raised and the valve member is then released by its lost motion connection with the housing so that it is free to move upward in response to the pressure of water in the supply pipe exerted against the washer 48 and the inner surface of the valve member 36. The pressure of the water on the inner surface of the dual valve member serves to hold the skirt 50 of the valve member against flange 52 of the housing as the housing rises and therefore air inlet opening 54 remains closed as long as the pressure of the water in the system and issuing from the supply pipe 2 is adequate to prevent back siphoning. Upward movement of the housing also serves to move the bosses 92 into engagement with the flange 98 on cap 47 so as to positively raise the valve member 36 and overcome any tendency of the valve to stick after long inaction.

When the valve member 36 is raised water flows from the supply pipe 2 downwardly through the water passages 42 about the cylindrical extension of the head 16 to the chamber 44. From the latter chamber the water flows through passage 58 to openings 62 and into the inner chamber 64 of head 16 whence it flows through passage 66 to the upper end of outlet passage 6 between the supply pipe 2 and outlet pipe 4. From the outlet pipe 4 the water issues into the tank 10 through outlet opening 28 adjacent the bottom of the tank.

In this way the discharge of water into the tank takes place quietly and serves to refill the tank as soon as the tank outlet valve is closed. The parts are further designed and proportioned to insure consistent and quiet operation of the ball cock and for this purpose the cross sectional area of the water passages 42 about the cylindrical extension 30 of the head, the passage 58 at the bottom of chamber 44, and the openings 62 leading to the inner chamber 64 of head 16 are each made substantially equal to the cross sectional area of the opening 32 of the supply pipe 2. The pressure in chamber 44 when the valve member 36 rises is therefore maintained substantially equal to the pressure of the water in the system itself so that the valve member is immediately and directly responsive to the water pressure. On the other hand the cross sectional area of the passage 66 leading from the inner chamber 64 of the head to the outlet passage 6 and the cross section of the latter pas-

sage and outlet 28 are larger than the cross section of the supply pipe and openings 62 so that there is a continuous drop in pressure allowing free flow of water from the ball cock to the tank without noise or back pressure.

As the tank refills due to normal operation of the ball cock in supplying water to the tank, the float serves to move the rod 72 upward whereby lever arms 80 are tilted to draw the housing 46 downward. The flange 52 on the housing bears against the skirt 50 of the dual valve member to draw member 36 downward until the washer 48 is pressed against the valve seat 34 on the tubular extension 30 of the head 16. The supply of water to the tank is thus cut off and the elements are returned to the position shown in Fig. 1, with a minimum of movement of the float and float rod 72. A stop member may be formed on the head 16 as shown at 100 to limit downwardly tilting of the lever 74 while upward movement is limited by closing of the valve member after 10 or 15 degrees of movement. Rapid and effective closing of the valve is assured even when the water pressure is high due to the power exerted by lever 74 through the lever arms 84. Moreover, the movement of the housing 46 and valve member 36 is rectilinear since links 90 are pivotally connected to the housing 46 and the guide ribs 68 on head 16 and ribs 40 on the interior of the valve member maintain the elements in alignment and overcome any tendency for the elements to tilt. The spherical upper surface of skirt 50 further assures an air tight seal between the valve member and flange 52 of the housing even though cocking of the valve member should occur.

In the event the water pressure in the system should fall dangerously low or should be cut off altogether while the toilet is flushed and the tank ball is lowered, the lost motion connection between the housing or valve carrier permits the dual valve member to move by gravity from the position shown in Fig. 2 to the position shown in Fig. 3 wherein the skirt 50 is spaced from the inturned flange 52 and the air inlet opening 54 is opened to admit air to the system. At such times air flows through opening 54 to chamber 44 and thence upward about the cylindrical extension 30 of the housing to the supply pipe 2 whereby siphoning of water from the tank is prevented. It will further be noted that the air entering chamber 44 through inlet 54 is directed by the skirt 50 toward the passage 58 between flange 56 and the inner walls of the housing 16. In this way back surging of water from the tank to chamber 44 and into the system through supply pipe 2 is prevented even under the most adverse conditions. Thereafter when the pressure in the system rises the valve member 36 is again raised by pressure applied to the inner and lower surface thereof so that the skirt 50 closes the air inlet opening 54 and the valve will operate in its usual and intended manner as described above.

In that form of the present invention illustrated in Fig. 9 the supply pipe is shown at 102 and is surrounded by the outlet pipe 104. A head 106 is threaded onto the supply pipe and formed with a cylindrical extension 108 presenting an upwardly facing valve seat 110. A casing 112 is threaded onto the head 106 and formed with a chamber 114 surrounding the tubular extension 108 of the head. Passages 116 extend from chamber 114 to the outlet passage 118 between the supply pipe 102 and outlet pipe 104.

The dual valve member shown in Fig. 9 is shown

at 120 and includes a stem 122 which extends downward about the tubular extension 108 on the head 106, being guided in its movement by the ribs 124 which project outward from the tubular extension and define passages extending from the upper end of the supply pipe to chamber 114. The valve member is provided with an inner downwardly facing washer 126 for engaging the valve seat 110 and with an upwardly facing right angle shoulder 128 which is engageable with the downwardly facing spherical surface 130 of a valve carrier piston member 132 to form an air inlet valve.

The piston member is slidable within the tubular guide portion 134 of the casing 112 and is provided with a packing 136 for preventing leakage of water upward past the piston member from chamber 114. The central portion of the piston member is formed with an air passage 138 surrounded at its lower end by the valve surface 130 and opening at its upper end into the cross slot 140 which communicates with the air above the water line maintained in the tank. A pin 142 extends across the passage 138 and through the ring portion 144 formed on the top of the valve member. The opening in ring portion 144 is of substantially larger diameter than pin 142 so that a lost motion connection is provided whereby the valve member is movable relative to the piston member to open and close the air valve defined by spherical surface 128 on the valve member and surface 130 on the piston member.

The piston member and valve member may be raised and lowered by any suitable means for controlling the flow of water into the tank where the ball cock is used. As shown the float actuated rod 146 is connected to the arm 148 pivoted at 150 on the casing 112. A link 152 connects arm 148 to the longer end of lever arm 154 as shown at 156 whereas the shorter end of arm 154 extends into a slot 158 on the upper extremity of the piston member 132. The lever arm 154 is pivotally mounted at 160 on the casing 112 as a fulcrum so that when the float rod moves downward the piston member is raised and when the float rod moves upward the piston member is moved downward.

With this construction emptying of the tank causes the float rod to tilt downward raising the piston member so as to lift the valve member 120. The initial upward movement of the piston member does not positively lift the valve member because of the lost motion afforded by the loose connection between pin 142 and the ring portion 144 of the valve member. However, the valve member is released to rise under the action of water pressure exerted on washer 126 and the inner surfaces of the stem 122 of the valve member. The valve member therefore follows the piston member as it rises and the air inlet valve is held closed by the pressure of water within the chamber 114.

If the water pressure should fall while the piston member and valve member are raised the valve member will at once fall by gravity to the extent permitted by the pin and ring portion and sufficiently to admit air to chamber 114 through the passage 138 and the air inlet valve formed by shoulder 128 and spherical surface 130. In this way back siphoning is prevented by the admission of air to the system whenever the pressure falls low enough to allow the valve member to fall as the valve opens.

The construction shown in Fig. 10 is essentially the same in principle as those forms of the

invention illustrated in Figs. 1 and 9. In Fig. 10 the dual valve member 162 is mounted within a valve carrier or piston member 164 actuated by the bell crank lever 166 and float rod 168. The form of the dual valve member is generally similar to that of Fig. 1 and it is provided with a lost motion connection with the piston member so that it will be actuated by the piston member during normal operation of the device to move washer 170 into and out of engagement with the valve seat at the upper end of the tubular extension 172 of the head 174 on supply pipe 176. When the pressure in the system falls or is cut off the lost motion connection allows the valve member to move with respect to the piston member under the action of gravity to open the air inlet opening between skirt 178 of the valve member and flange 180 of the piston member. Air can then enter the system through passage 182 about the cap 184 so as to flow through the air inlet opening about the stem of the valve member.

The skirt 178 of the valve member 162 is shown in Fig. 10 as having a flat upper surface for engaging the flat, downwardly facing surface of flange 180 in acting as an air inlet valve. However, it will be apparent that the particular form of the valve forming surfaces of the dual valve member and parts cooperating therewith may be varied considerably as exemplified by the typical constructions which have been shown in Figs. 1, 9 and 10. It will also be evident that the various forms of the invention embody other parts which may be interchanged or varied in that the operating levers for raising and lowering the housing or piston members may be substituted one for another.

In each of the forms of the invention a refill tube 186 communicates with the chamber beneath the valve member as shown most clearly in Fig. 1 and in each case there is also provided a stop means for limiting downward movement of the float rod and float. Conventional elements of this character may be used or added to the constructions shown and each of the elements of the assembly may be altered in form, construction and arrangement to adapt the invention to specific uses and applications or to preferred manufacturing methods. In view thereof it should be understood that those forms of the invention shown in the drawings and described above are intended to be illustrative only and are not intended to limit the scope of the invention

I claim:

1. A ball cock comprising a member formed for attachment to a liquid supply pipe and having a valve seat thereon, a housing forming a chamber communicating with said valve seat and provided with a passage for the discharge of liquid from said supply pipe, means providing an air inlet opening communicating with said chamber, a dual valve member loosely carried by and vertically movable with respect to said housing and having two oppositely facing surfaces held in fixed relative positions one of which is movable into and out of engagement with said valve seat to control the admission of liquid to said chamber from said supply pipe and the other of which is movable in response to the pressure of liquid in said chamber to close said air inlet opening and movable by gravity to open said opening, said housing being movable with respect to said member and float actuated means for moving said housing.

2. A ball cock comprising a head formed for attachment to a liquid supply pipe and having a valve seat thereon, a housing movable with respect to said head and having a chamber therein communicating with said valve seat and provided with a passage for the discharge of liquid from said supply pipe, means providing an air inlet opening communicating with said chamber, a dual valve member loosely carried by and movable with respect to said housing to open and close said air inlet opening, said valve member having a portion thereon engageable by the housing for positively moving the valve member into engagement with said valve seat on downward movement of the housing, the valve member being movable upward with the housing and out of engagement with the valve seat in response to the pressure of liquid in said chamber.

3. A ball cock comprising a head formed for attachment to a liquid supply pipe and having a valve seat thereon, a housing surrounding said head and having a chamber therein communicating with said valve seat and provided with a passage for the discharge of liquid from said supply pipe, said housing being movable with respect to said head and formed with an air inlet opening in the upper portion thereof communicating with said chamber, and a valve member located within said housing and vertically movable with respect thereto and in response to the pressure of liquid in said chamber to a position in which it closes said air inlet opening, said valve member being movable by gravity and with respect to said head to open said air inlet opening, and float actuated means for raising said housing to a position in which said valve member may move by gravity to a position in which said air inlet opening is open.

4. A non-siphoning ball cock comprising a head formed for attachment to a liquid supply pipe and having a valve seat thereon, a member slidable with respect to said head and cooperating therewith to form a chamber communicating with said valve seat and provided with a passage for the discharge of liquid from said supply pipe, means providing an air inlet opening communicating with said chamber, a dual valve member carried by said slidable member and movable with respect thereto to a normal position in response to normal pressure of water in said chamber and to an air inlet opening position in response to sub-atmospheric pressures in said chamber, said valve member when in said normal position being movable with said slidable member into and out of engagement with said valve seat and float actuated means for actuating said slidable member.

5. A non-siphoning ball cock comprising a head formed for attachment to a liquid supply pipe and having a valve seat thereon, a housing surrounding said head and having a chamber therein communicating with said valve seat and provided with a passage for the discharge of liquid from said supply pipe, said housing being movable with respect to said head and formed with an air inlet communicating with said chamber, float control means connected to said housing for raising and lowering the housing with respect to said head, a valve member located within said housing and movable to raised and lowered positions with respect thereto, said valve member when in raised position serving to close said air inlet opening, and when in lowered position serving to open said air inlet opening, said valve member being responsive to the pressure of liquid in said chamber and movable under

normal liquid pressure to said raised position and movable under sub-atmospheric pressure by gravity to said lowered position, said valve member further being movable with said housing into and out of position to engage said valve seat in response to movement of said float actuated means.

6. A non-siphoning ball cock for a flush tank comprising a head formed for attachment to a supply pipe and designed to be located above the level of water in the tank, said head having a valve seat thereon, a valve carrier having an air inlet opening therein communicating with said valve seat, float actuated means for moving said carrier with respect to said head, and a dual member movable into and out of engagement with said valve seat and into and out of position to close said air inlet opening, said dual valve member having a lost motion connection with said valve carrier permitting relative movement of the carrier and valve member, said valve member being positively movable with said carrier into position to engage said valve seat and being movable by gravity and with respect to the carrier into position to open said air inlet opening.

7. A non-siphoning ball cock for a flush tank comprising a head formed for attachment to a supply pipe and designed to be located above the level of water in the tank, said head having a valve seat thereon, a valve carrier surrounding said head and cooperating therewith to form a chamber having a discharge opening and communicating with said valve seat, said valve carrier having an air inlet opening therein, float actuated means for moving said carrier with respect to said head, and a dual valve member movable into and out of engagement with said valve seat and into and out of position to close said air inlet opening, said dual valve member having a lost motion connection with said carrier permitting relative movement of the carrier and valve member, said valve member being positively movable with said carrier into position to engage said valve seat and being movable by gravity and with respect to said carrier into position to open said air inlet opening.

8. A non-siphoning ball cock for a flush tank comprising a head formed for attachment to a supply pipe and designed to be located above the level of water in the tank, said head having a valve seat thereon, a valve carrier in the form of a housing slidably movable in opposite directions and with respect to said head, said carrier cooperating with the head to form a chamber having a discharge opening and communicating with said valve seat and having an air inlet therein communicating with said chamber, float actuated means for moving said carrier with respect to said head, and a dual valve member movable into and out of engagement with said valve seat and into and out of position to close said air inlet opening, said dual valve member having a lost motion connection with said carrier permitting relative movement of the carrier and valve member, said valve member being positively movable in one direction with said carrier into position to engage said valve seat and being movable by gravity in the opposite direction and with respect to said carrier into position to open said air inlet opening.

9. A non-siphoning ball cock comprising a head having a valve seat thereon and formed for attachment to a supply pipe above the level of water in the tank, a dual valve member having one portion thereof movable into and out of engagement with said valve seat, a valve carrier surrounding said valve member and cooperating with said head to define a chamber communicating with said valve seat and provided with a discharge outlet, and float actuated means connected to said valve carrier for moving said carrier in opposite directions with respect to said head, said carrier having an air inlet opening therein communicating with said chamber and positioned to be closed by another portion of said valve member, there being a lost motion connection between the valve member and the valve carrier serving to urge the valve member toward said valve seat on movement of the carrier in one direction and to permit movement of the valve member by gravity and with respect to said carrier into position to admit air to said chamber through said air inlet opening on movement of the valve carrier in the opposite direction.

10. A non-siphoning ball cock for a flush tank comprising a head having a valve seat thereon and formed for attachment to a supply pipe above the level of water in the tank, a valve member movable into and out of engagement with said valve seat and having a cylindrical portion surrounding said head and guided for longitudinal movement with respect thereto, a housing forming a chamber surrounding said head and communicating with said valve seat, said chamber having a discharge opening therein and being formed with an air inlet opening, said housing being movable with respect to said head by float actuated means, said housing being guided for longitudinal movement with respect to said head and valve member, said valve member having a part engageable with said housing to positively move the valve member toward said valve seat on movement of the housing in one direction and having another part engageable by the housing to positively move the valve member away from the valve seat on movement of the housing in the opposite direction, said parts being so spaced as to provide a lost motion connection between said housing and valve member, said valve member being movable with respect to said housing to open and close the air inlet opening in the housing.

WILBERT H. PATTEN.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
645,662	Emery	Mar. 20, 1900
1,503,433	Shaffer	July 29, 1924
2,046,792	Schmiedeknecht	July 7, 1936
2,086,637	Price	July 13, 1937
2,153,904	Wilson	Apr. 11, 1939
2,181,900	Langdon	Dec. 5, 1939
2,247,525	Sherwood	July 1, 1941
2,259,984	Anderson	Oct. 21, 1941
2,270,910	Svirsky	Jan. 27, 1942
2,290,145	Owens	July 14, 1942
2,294,785	Langdon	Sept. 1, 1942
2,299,706	Svirsky	Oct. 20, 1942
2,324,084	Horner	July 13, 1943
2,367,951	Lewis	Jan. 23, 1945
2,569,017	Owens	Sept. 25, 1951
2,607,364	Smith	Aug. 19, 1952

FOREIGN PATENTS

Number	Country	Date
211,511	Germany	of 1909