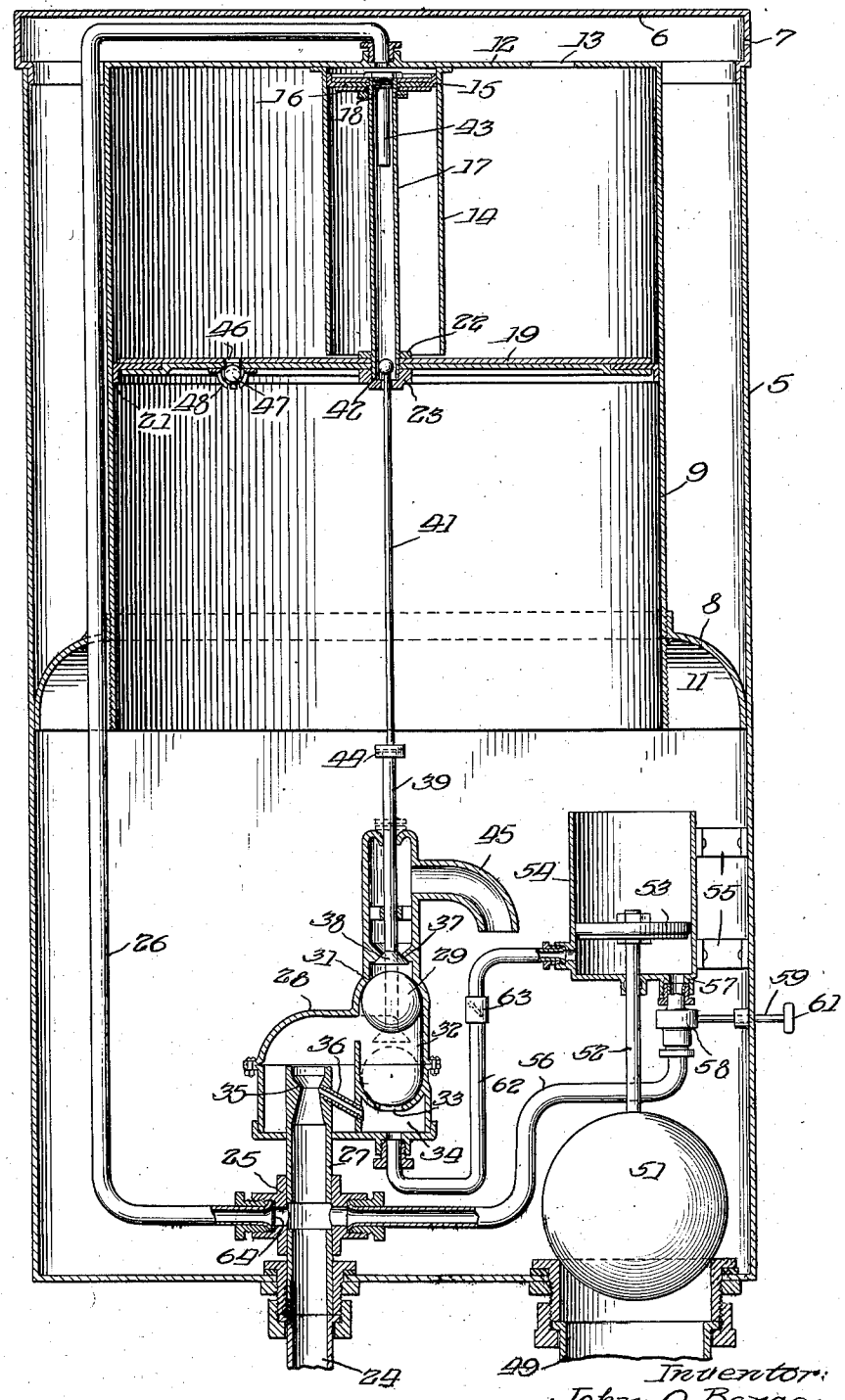
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FLUSHING APPARATUS

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FLUSHING APPARATUS

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This invention pertains in general to flushing apparatus designed for flushing of closet bowls and the like and has more particular reference to the apparatus by which the storage and delivery of the flush water is controlled.

Flushing apparatus of two general types are at present in common use. One type comprises a flush tank which serves as a storage reservoir from which flush water is delivered under gravity only to the bowl. Because of the low gravity head of the water in the tank a substantial quantity of water is required for each flushing operation which necessitates the use of a tank of quite large capacity.

The other type comprises a hydraulically operated timing flush valve through which the water for flushing purposes is delivered directly from the water mains under substantial pressure. These valves are quite complicated in structure and somewhat delicate in operation and are therefore likely to get out of order. Furthermore the delivery of a sufficient volume of water in a relatively short time for a satisfactory flush requires that the supply pipe to the flush valve be at least one inch in diameter. This large size pipe is not only expensive to install but in buildings already equipped with flush tanks supplied by small piping, these tanks cannot be replaced with pressure flush valves without repiping with larger pipes.

My present invention aims to overcome the objectionable features of both of the above mentioned types of flushing apparatus by providing an apparatus which like the flush valve can be used with small water supply lines and will give an initial delivery of flushing water under a pressure but will be simple and inexpensive and not likely to get out of order. Because of this pressure delivery the apparatus of my invention will produce a satisfactory bowl flushing with much less water than is required for a flush by a gravity flush tank, thereby enabling the use of a storage tank of considerably less dimensions than those of a gravity tank.

Another object of my invention is to provide a flushing apparatus having a leak-proof water supply valve which will positively shut off the water supply when closed and which will be free from the objectionable noises of water hammer and the hissing noises of a closing valve which are incident to the use of the present float controlled shut-off valves.

Another purpose of my invention is to provide for positively opening and positively closing the flush valve which controls the discharge of flushing water from the tank. This opening and closing mechanism is designed to open the valve against the pressure within the tank, to insure the maintenance of the valve in open position until the flushing operation is completed and to insure the closing of the valve upon the completion of the flushing operation.

Other objects and many of the inherent advantages of my invention should be appreciated as the same become better understood by reference to the following description when considered in connection with the accompanying drawing.

Referring to the drawing, the single figure is a vertical sectional view, somewhat diagrammatic in character, of a flushing apparatus embodying my invention.

Referring to the drawing more in detail, reference character 5 indicates the flush tank of the required dimensions, smaller than those of the ordinary gravity flush tank, the tank being preferably of metal construction enameled for purposes of sightliness and durability. The upper end of the tank is closed by a tight fitting cover 6 provided with one or more vent openings 7.

An annular support 8 secured to the inner walls of the tank surrounds and carries an upright cylinder 9 the lower open end of which projects beneath the contact line between the cylinder and its support to provide an air pressure chamber 11, the purpose of which will be later explained. The upper end 12 of the cylinder is preferably substantially closed except for one or more vent openings 13, as shown.

A second smaller cylinder 14 depends from the top 12, the lower end of this cylinder being open, as shown. A piston 15 equipped with a cup washer 16 is adapted to reciprocate within the cylinder 14, this piston being secured upon the upper end of a tubular member 17, the open upper end of which is closed by a screw plug 18. The lower end of this tube projects through a large piston 19 equipped with a cup washer 21 to insure a working fit with the interior of the cylinder 9, the piston being secured to the tube 17 by nuts 22 and 23, respectively.

A water supply pipe 24 of the standard small size and connected with the water supply main in the usual manner enters the tank preferably through the bottom, as illustrated, the pipe being provided inside the tank with a cross connection 25 one branch of which is connected with a pipe 26 leading into the upper end of cylinder 14 for the delivery of water under pressure to the upper face of the piston 15.

The upper branch of cross connection 25 com-

municates through a pipe 27 with the interior of a valve casing 28 containing a shut-off valve operating upon the principle of that disclosed in my prior Patent No. 1,873,260 granted August 23, 1932. The casing houses a shut-off valve in the form of a ball 29 of less specific gravity than water so that it is adapted to rise when unrestrained and contact the seat 31 and effectually shut off the flow of water through the casing. The casing is formed to provide beneath the seat 31 a ball receiving chamber 32 in which the ball is disposed in the position indicated in dotted lines when the valve is open. The bottom curved wall of this chamber is provided with an opening 33 which establishes communication between chamber 32 and the lower chamber 34. The water supply pipe into the valve casing is provided near its delivery end with a Venturi tube 35, and a tube 36 connecting the chamber 34 with the throat of said venturi transmits to the chamber 34 the suction produced by the venturi when water under pressure is being delivered therethrough. This suction tends to produce a down-flow of water through the opening 33 and retains the ball 29 against the bottom wall of the chamber 32 so as to close the opening 33 when water is being delivered through the casing.

Above the seat 31 the casing is provided with an annular shoulder or seat 37 against which a head 38 on the lower end of a rod 39 projecting upwardly from the vertical extension of the casing is adapted to seat so as to materially reduce and substantially shut off the delivery of water from the casing. This head 38, however, is not relied upon to seal the valve and insure against water flow as this function is performed by the ball 29. A reduced extension 41 of the rod 39 extends upwardly into the tube 17 connecting the pistons 15 and 19 and within the tube this extension is provided with a head 42 of larger diameter than the hole through the nut 23 through which the extension 41 projects. A lost motion connection is thereby established between the rod 39 and the pistons by which the rod is actuated as the pistons approach the limit of their travel in both directions.

In the position shown on the drawing the head 38 having been lifted from the position shown in dotted lines by engagement of the head 42 with the nut 23 as the pistons approach the upper limit of their travel is urged against its seat 37 by the water pressure beneath. Upon travel of the pistons in the reverse direction the rod will remain in the position shown until it is engaged by an extension 43 of the plug 18, whereupon continued downward movement of the pistons will depress the rod into the dotted line position illustrated, the downward movement of the rod being limited by engagement of a collar on shoulder 44 on the rod with the upper end of the valve casing extension. Depression of the rod forces the ball 29 downwardly away from its seat into the chamber 32, permitting a flow of water through the casing from which it is delivered through the spout 45 into the tank. This flow creates a suction in the chamber 34, as previously described, tending to hold the ball 29 in the lower end of the chamber. When the rod 39 is raised by upward movement of the pistons to a point where it will be moved against its seat to substantially shut off the flow of water, the suction upon the chamber 34 is discontinued, the water in the chamber becomes substantially quiescent and the ball 29 floats upwardly to engage its seat 31 against which it is forced and held by the water pressure, thereby completely shutting off the flow and sealing the valve against leakage.

The pistons are actuated to open and close the supply valve in the following manner. Assuming the parts to be in the position shown and that the flush valve to be later described has been opened to permit the discharge of flush water from the tank, as the water is discharged the pressure in the tank will be reduced until the pressure upon the lower face of the larger piston 19 is over-balanced by the line water pressure upon the upper face of piston 15, whereupon the two pistons will be forced downwardly as a unit by this water pressure. When during this movement the lower end of extension 43 engages the head 42 on the upper end of the rod extension 41 the rod 39 will be forced downwardly, moving the head 38 away from its seat and forcing the ball 29 away from its seat into the chamber 32, thereby permitting a flow of water into the tank. The downward movement of the pistons is limited by engagement of the collar 44 with the valve casing, after which the water is discharged from the tank under gravity, the out-flowing water being replaced in the chamber by air which enters through openings 7, 13, and a port 46 in the piston 19 which is controlled by a float check valve 47. This valve, which is a ball valve adapted to float in water similarly to the ball valve 29, is caged within a series of depending converging prongs 48 and opens downwardly to permit entrance of air into the tank below the piston 19 as the flush water is discharged therefrom.

When the flush valve is closed in a manner to be later described, the water level in the tank rises, displacing the air which escapes through ports 46, 13, and 7 to atmosphere. As the water level rises above the lower end of cylinder 9 air is trapped in the annular chamber 11 which serves as an air pressure reservoir as the pressure in the tank increases. When the water level reaches the lower face of piston 19 the valve 47 floats upwardly against its seat and shuts off further escape of air and escape of water through the piston. When the pressure on the lower face of the larger piston 19 reaches a point which overbalances the water line pressure upon the upper face of piston 15, the pistons will be bodily moved upwardly into the position shown in full lines on the drawing. As the pistons approach the upper limit of their travel the rod 39 is lifted in the manner previously described to cause engagement of the head 38 with the seat 37 and thereby permit seating of the ball valve 29 to completely shut off further flow of water into the tank. The parts remain in this position until the next flushing operation and the water thus stored in the tank will be under a pressure dependent upon relative areas of the pistons 15 and 19. Assuming that the relative areas are as one to five and that the line water pressure is forty-five pounds per square inch, it will be manifest that the water will be stored in the tank at slightly above nine pounds pressure and that the initial discharge from the tank for flushing purposes will be under this pressure which is maintained for an appreciable period during the discharge by the air under pressure in the pressure chamber 11.

The discharge from the tank for flushing purposes is delivered through a discharge pipe 49 of materially larger capacity than the water supply line. The flushing discharge is controlled by a valve 51 preferably spherical in form carried by

a rod 52 which is connected at its upper end to a piston 53 adapted to reciprocate in a cylinder 54 having a closed lower end and an upper end communicating with the water chamber of the tank. This cylinder may be supported in any suitable manner such, for instance, as by brackets 55. A pipe 56 connected at one end with one of the lateral branches of the cross connection 25 and at its other end to the cylinder 54 as indicated at 57 is equipped with a manually opening self-closing valve 58. A rod 59 projecting from the valve through the side wall of the tank and provided with an operating knob affords provision by which the valve may be opened when the rod is pressed inwardly. The opening of this valve admits water beneath the piston 53 which moves the piston upwardly, thereby positively lifting the valve 51 from its seat against the pressure of the water within the tank. The valve 58 of any suitable self-closing type will thereupon close to shut off further water flow to the cylinder 54. The lowering of the water level in the tank by the discharge through the discharge pipe 49 as previously explained will after an interval result in the opening of the supply valve, to permit a flow of water into the tank. The water flowing in under pressure through the venturi 35 induces a suction upon the chamber 34 as previously described, which through a pipe 62 gradually withdraws the water from beneath the piston 53 causing the piston to be lowered to close the flush valve 51. Water will thereupon continue to flow into the tank until the predetermined pressure has been established therein, as previously described, whereupon the supply valve will be automatically closed. During the quiescent storage period counterflow through the pipe 62 to the cylinder 54 which would result in opening the flush valve is precluded by a check valve 63 interposed in the pipe 62.

To protect the piston 15 and cylinder 14 from wear occasioned by dirt and silt carried by the inflowing water, the line 26 is provided with a fine mesh screen 64. The flow of water through the screen alternately in opposite directions as the piston 15 rises and falls automatically cleans the screen and prevents the accumulation of dirt and sludge thereon.

It will be manifest from the foregoing that my apparatus enables the storage of flush water under pressure and that this result may be accomplished with the use of an ordinary small water supply line, thereby obviating the necessity of a large supply line such as is required by a pressure flush valve. The discharge or flush valve is positively operated in both directions so that full opening and complete closing after a predetermined interval are insured. Leakage into the tank is precluded by the ball type supply valve utilized and noiseless delivery of water into the tank is insured.

While a preferred embodiment of my invention has been illustrated and described, it should be understood that my invention is not limited to the details illustrated but is capable of embodiment in a wide variety of forms comprehended within the scope of the following claims.

I claim:

1. A flushing apparatus comprising a tank having an automatic seal enabling the storage under pressure of flush water therein, means for supplying water under pressure to said tank, a valve controlling said water supply, means movable in one direction by tank pressure and in the opposite direction by water line pressure for closing said valve upon the creation of a predetermined pressure in said tank and for opening the same when the water in said tank is depleted to a predetermined level, a flush valve, and means for operating said valve.

2. A flushing apparatus comprising a tank, a water supply valve adapted to be closed by line pressure, means responsive to the relative pressures of the water supply to the tank and the pressure within the tank for positively opening said supply valve, a flush valve, and means for operating said flush valve.

3. A flushing apparatus comprising a tank, a valve closable by line pressure for controlling the supply of water under pressure thereto, means responsive to the differences between the pressure within said tank and the water supply pressure for positively opening said supply valve, a flush valve, and means for positively opening and closing said flush valve.

4. A flushing apparatus comprising a tank, a water supply valve therefor, a piston within said tank having one face exposed to tank pressure and the opposite face exposed to atmospheric pressure, a second piston connected with said first piston and having one face exposed to the water supply pressure and the other face exposed to atmosphere, and means controlled by the position of said pistons within the tank for operating said supply valve.

5. A flushing apparatus comprising a tank, a water supply valve therefor, a cylinder within said tank communicating at its lower end with the water chamber of the tank and at its upper end with atmosphere, an air pressure chamber within the tank, a second cylinder communicating at one end with a source of water supply under pressure and at its other end with atmosphere, a piston reciprocable in each of said cylinders, a connection between said pistons, a connection between said pistons and said supply valve, a flush valve, and means for operating said flush valve.

6. A flushing apparatus comprising a tank, a water supply valve therefor, a cylinder communicating at one end with a water chamber in the tank and at the other end with the atmosphere, a piston reciprocable in said cylinder, a check valve carried by said piston, a second cylinder communicating at one end with atmosphere and at its other end with a source of water supply under pressure, a piston in said cylinder, an operative connection between said pistons, means controlled by movement of said pistons for actuating said supply valve, and means providing an air pressure chamber within said tank.

7. A flushing apparatus comprising a tank, a water supply valve, means for automatically controlling said valve, a flush valve and hydraulically actuated means for positively opening and closing said flush valve.

8. A flushing apparatus comprising a tank, means for supplying water under pressure thereto, pressure actuated means for controlling the supply of water, a flush valve, a hydraulic piston for positively opening and closing said flush valve, means for admitting water under pressure from the water supply to said piston to actuate the same in one direction, and means for withdrawing said water so admitted to actuate said piston in the opposite direction.

9. A flushing apparatus comprising a tank, means for supplying water thereto, means for automatically shutting off the water supply upon

a creation of a predetermined pressure in said tank, a flush valve, a cylinder open at one end to the pressure in said tank, a piston in said cylinder connected with said flush valve to positively open and close the same, means for admitting water beneath said piston to open the valve, and means for causing the withdrawal of said water so admitted to close said valve.

10. A flushing apparatus comprising a tank, a water supply valve therefor including a casing provided with a seat, a ball valve for closing said seat, means for forcing said ball away from its seat, hydraulic means for retaining said valve away from its seat during a flow of water through the casing, a flush valve, a piston for positively opening and closing the same, means for admitting water to actuate said piston in one direction, and means connected with said casing through which a flow of water through the casing induces the withdrawal of water from beneath said piston to close said flush valve.

11. A flushing apparatus comprising a tank, a water supply valve therefor, a multiple piston having its smaller face exposed to the water line pressure and its larger face exposed to the tank pressure connected to said supply valve to operate the same, and a screen interposed in the supply line to the smaller piston, said screen being cleaned by the alternate flow of water in opposite directions to said supply line.

12. A flushing apparatus comprising a tank, a water supply valve, a flush valve, manually controlled means for causing the opening of said flush valve, means operable by water line pressure for maintaining a predetermined pressure on the flush water being discharged during a portion of the discharge and for opening said supply valve, and means actuated by the flow of water to the tank for closing said flush valve.

13. A flushing apparatus comprising a tank a water supply valve, a flush valve, manually controlled means for causing the opening of said flush valve, means operable by water line pressure for maintaining a predetermined pressure on the flush water being discharged during a portion of the discharge and for opening said valve and also operable by the tank pressure to close said valve, and means for actuating said flush valve.

14. A flushing apparatus comprising a tank, a water supply valve, a flush valve, manually controlled means for causing the opening of said flush valve, means operable upon the opening of the flush valve for maintaining pressure on the discharge water during a portion of the discharge and for opening the supply valve after a predetermined discharge, means operable by the supply water for closing the flush valve, and means for closing the supply valve when a predetermined water level in the tank has been attained.

15. A flushing apparatus comprising a tank, a water supply valve, a flush valve, manually controlled means for causing the opening of the flush valve, means operable upon the opening of the flush valve for maintaining pressure upon the discharge water until a predetermined low water level in the tank has been reached and for then opening the supply valve, means rendered operable upon the opening of the supply valve for closing said flush valve, and means for closing the supply valve when a predetermined high water level in the tank has been reached.

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