This invention relates to flush valves for tanks supplying water closets and the like, and more particularly to flush valves having a time control for closing.

At the present time the flush valves for closet tanks are generally of a hollow ball made of rubber or some other resilient material which, when raised from its seat, floats on the water in the tank and allows the water to escape until the level of the water in the tank has reached such a level that the float is again drawn onto the valve seat. The action of this type of valve is extremely limited in that it will only partially empty the tank. Therefore, large tanks must be used which not only add to the expense of installation but also to the size of the installation.

This hollow ball type of valve is highly unsatisfactory with the new designs of tank and closet bowl in which the bottom of the tank is lower than the top of the bowl because, as heretofore stated, the tank can be only partially emptied and further, if the bowl should become clogged for any reason, the bowl will overflow with resultant damage to the floor and the ceiling of the adjoining rooms. This is due to the peculiar construction of the supply valve now used in flush tanks which opens as soon as the level of the water in the tank drops below a predetermined level. Therefore, since the outlet of the tank is below the top of the bowl, when the bowl becomes clogged, there is always a sufficient head of water in the tank to prevent the hollow ball from seating and closing the outlet of the tank, and the water being introduced through the inlet valve keeps the head of water in the tank sufficiently high to cause it to flow over the top of the bowl.

One object of this invention is to provide a flush valve which will remain open until the tank is completely emptied and will close in a predetermined length of time regardless of the head of water in the tank thereby preventing the overflow of a bowl when it becomes clogged.

A further object of this invention is to provide a flush valve which is of simple mechanical structure, which has few working parts, and will permit the size of the tank to be reduced.

A still further object is to provide a flush valve which is quiet and smooth in action and positive in its operation.

These and other objects which will be herein-after made apparent to those skilled in this particular art are accomplished by means of this invention, one embodiment of which is described in the following specification and illustrated in the accompanying drawings, wherein:

Figure 1 is a view in vertical section of a bowl and tank combination illustrating the action of our improved flush valve when the head of water in the tank becomes level with the head of water in the bowl;

Fig. 2 is an enlarged partial view in section showing our improved valve in its closed position and having portions thereof broken away for convenience of illustration;

Fig. 3 is a partial view in section showing our improved valve structure in its raised or open position;

Fig. 4 is a view in section showing the position of the valve just prior to closing;

Fig. 5 is a view in section taken on lines V—V of Figure 1;

Fig. 6 is a view in section having a portion thereof broken away to clearly bring out the construction of the valve, illustrating a modification of our improved valve structure;

Fig. 7 is a view in elevation illustrating another modification of our invention;

Fig. 8 is a view in elevation having a portion thereof broken away, illustrating another modification of our improved flush valve, and

Fig. 9 is a view in section illustrating another flush valve constructed in accordance with our invention.

In the several figures of the drawings, like numerals refer to like parts of the structure.

A flush valve for a storage tank constructed in accordance with this invention, comprises an inverted cylindrical member which is mounted in the tank over the outlet opening therein and has a float-sidably mounted therein which is spaced above and connected to a disc valve adapted to seat over and normally close the outlet opening of the tank.

The valve is operated by a lifting stem which is attached to the float and extends through a calibrated opening in the top of the inverted cylindrical member. When the float is raised, the valve is moved away from the outlet opening and is held in spaced relation thereafter by the head of water in the tank and by atmospheric pressure acting on the float.

In order to delay the closing of the valve so that the tank will be completely emptied, a water reservoir is provided on the top of the inverted cylindrical member which is in communication.
with the interior of the cylindrical member. When the water being exhausted from the tank falls below the level necessary to float the valve, there is a graviating tendency in the valve and float to move downwardly and close the outlet opening in the tank. This downward movement of the float and valve creates a suction within the cylindrical member, which retards the closing of the valve until the water in the reservoir has been drawn into the interior of the cylindrical member through the calibrated opening therein. As soon as the reservoir is emptied, air enters the inverted cylindrical member through the opening adjacent the lifting stem breaking the suction which allows the valve to drop rapidly to its seat.

It is apparent that in this manner and by varying the size of the opening leading from the reservoir to the interior of the inverted cylindrical member, the time during which the valve remains open may be readily controlled. In the drawings, 1 is a water closet bowl having a flush tank 2 connected thereto, the bottom of which is in a plane lower than the top of the bowl. The bottom of the tank 2 has an outlet opening 3 therein connected by passage 4 to the bowl 1.

Mounted in the opening 3 is a ring member 5 having a flange portion 6 which is secured to the bottom of the tank 2 in any suitable manner such as with bolts 7. The ring member 5 forms the outlet orifice of the tank and the flow of water therefrom into the passage 3 is controlled by a valve 8 having a washer or seat 9 secured thereto of some soft material, such as rubber or leather, which is adapted to seat on the ring member 5.

The valve 8 is connected to the end of a stem 10 depending from a float 11 which is so spaced above the valve that its position of buoyancy is in a plane removed from the valve 8. The float 11 is slidably and loosely mounted in a cylindrical member 12, the lower end of which is open and in communication with the contents of the tank while the upper end is provided with a depressed cover 13 forming a reservoir 14 on the top thereof, the purpose of which will be hereinafter explained.

The cylindrical member 12 is mounted on a series of lugs 15 projecting upwardly from the flange portion 6 of the ring member 5. These lugs 15 also act as guides for the valve 8 and insure its seating on the valve seat 5 after it has been raised to empty the tank.

The valve 8 is operated by a lifting stem 16 connected to the float 11 and extending upwardly through an enlarged opening 17 in a guide bushing 18 in a guide bushing 16 mounted in an opening formed in the cover 13 of the cylindrical member 12. The lifting stem is raised through the usual link and arm mechanism 19 connected to an operating handle 20 on the outside of the tank.

When it is desired to flush the bowl 1, the handle 20 is turned which, through the arm and link mechanism 19, raises the lifting stem 16 and moves the float 11 and valve 8 upwardly in the cylindrical member 12. This operation can readily be accomplished due to the fact that the float is loosely in the surrounding cylindrical member and the water therein above the float is readily displaced. The upward movement of valve 8 uncovers the valve seat 5 and permits the water to flow from the tank into the bowl.

As soon as the float 11 and valve 8 are moved to their raised positions, there is an equalization of pressure on each side of the valve 8 and as a result, the valve 8 is held in its open position due to the buoyancy of the valve. As soon as the water in the tank 2 has fallen below the neutral point of flotation of the float 11, indicated by the line A—A (Figs. 2, 3, and 4), the float and valve will naturally tend to lower and would do so if it were not for the column of water retained in the cylindrical member. As soon as the float descends beneath the float 11 by atmospheric pressure, it is apparent that the float and valve would be sustained in their raised position indefinitely if the effect of the atmospheric pressure sustaining the column of water in the cylindrical member were not neutralized. To overcome the effect of atmospheric pressure, and to permit the valve to seat on the ring member 5, the cylindrical member 12 is so constructed that a small body of water is retained on the cover 13.

When the water recedes below the point of buoyancy of the float (A—A), the gravitational effect of the valve 8 and float 11 tends to create a suction in the cylindrical member 12 which is manifested at the opening 17 and draws the water at a very slow rate from the reservoir 14.

The opening 17 in the guide bushing 18 is of such size that the water is drawn therethrough very slowly so that the valve is sustained in substantially its extreme wide open position until the tank has been completely emptied. As soon as the water in the reservoir 14 is exhausted, air enters through the opening 17 and due to its less frictional resistance, allows the valve 8 to drop rapidly to its seat 5. By controlling the size of the opening 17 in the guide bushing 18 and by forming other openings in the cylindrical member 12 to permit the water therein to flow back into the tank, it is apparent that a very definite time control of the open position of the valve can be secured.

It is readily apparent from the foregoing description that our improved flushing valve is readily adaptable for use with tank and bowl combinations in which the bottom of the tank is lower than the top of the bowl. It is obvious that in such a combination when the bowl becomes clogged for any reason, the water in the tank will flow into the bowl until the level of the water therein reaches the same level as the water in the bowl at which point it becomes clogged. However, since the supply valve is opened as soon as the water in the tank starts to recede, it is evident that if the valve is not closed, the head of water in the tank will be raised sufficiently to cause the water in the bowl to overflow.

With our improved flush valve the overflowing of the bowl is impossible because the valve will close in a predetermined length of time after the water has receded below the line indicated as A—A which represents the flotation depth of the float and is above the top of the bowl. Thus, the valve will close within its time limit cycle and prevent the further delivery of water to the bowl.

In Figs. 6, 7, 8, and 9, we have illustrated a series of modifications of my improved valve structure which may be employed to hold the valve in its raised position. Since the operation of these floats is the same as heretofore described, no further comment is deemed necessary.
it is to be understood that the float may be slid-ably mounted in a member of any desired shape and that the reservoir may be formed separate-ly and secured on the encircling member in any suitable manner. Also, other means besides the guiding bushing may be employed for guiding the valve and float and that any suitable form of communication between the reservoir and the interior of the encircling member will suffice to permit the water to be drawn into the encircling member and regulate the time during which the valve is held open.

While we have described one embodiment of our invention, it is apparent that certain changes, modifications, omissions and substitutions may be made therein without departing from the spirit of our invention or the scope of the appended claims.

What we claim as new and desire to secure by Letters Patent is:

1. A fixture of the character described comprising a closet bowl having a flush rim at the top thereof, a water storage tank supported on said bowl and having its bottom located in a plane below the flush rim, and a water outlet therein, connected to said flush rim, a valve in said tank adapted to normally seat over and close said outlet, a float connected to said valve, means for raising said valve and float, and means cooperating with said float for holding the valve in its raised position for a predetermined length of time after the water in the tank has dropped below the point of flotation of said float, said float being spaced above the valve and having its point of flotation located in a plane above the top of the bowl whereby the valve closes in a predetermined length of time after the water has dropped below the plane of buoyancy of the float and prevents the bowl from overflowing.

2. In combination with a water closet bowl having a flush rim at the top thereof, of a storage tank integral with said bowl and having its bottom located in a plane below the flush rim and having a water outlet therein connected to the flush rim, a valve adapted to seat over and close said outlet, a float secured to said valve and having its plane of flotation located in a plane substantially above the top of the bowl, a housing surrounding said float and having a water reservoir on the top thereof, and means extending through an aperture in said reservoir for lifting said valve and float, the water in said reservoir forming a seal to hold said float and valve in its raised position after the water in the tank drops below the flotation point of the valve, the aperture in said reservoir being of such size that the water seal is broken to permit the valve and float to drop before the water in the bowl reaches the upper edge thereof.

3. A fixture comprising a water closet bowl having a flush rim, a storage tank integral with said bowl and having the bottom thereof located in a plane substantially below the flush rim and having a water outlet therein connected to the flush rim, a valve in said tank adapted to seat over and close said outlet, means for raising said valve and float, means for holding said valve in its raised position, said means being adapted to release said valve within a predetermined interval of time after the water in the tank has dropped to a level slightly above the top of the bowl.

4. A mixture comprising a water closet bowl having a flush rim adjacent the top thereof, a water storage tank integral with said bowl and having its bottom located in a plane substantially below the flush rim, a passage in the bottom of said tank leading to the flush rim, a valve in said tank adapted to seat over and close said passage, a float carried by said valve, means for raising said valve and float and means cooperating with the float for holding the valve in its raised position for a predetermined length of time after the water in the tank has dropped below the floatation point of the float.

5. A fixture comprising a water closet bowl having a flush rim adjacent the top thereof, a water storage tank integral with said bowl and having its bottom located in a plane below the flush rim, a passage leading from the bottom of the storage tank to the flush rim, and means for controlling the passage of water from said tank to the flush rim including a valve, a float connected to said valve, means for raising said float and valve, an inverted chamber surrounding said float and having a reservoir thereon to provide a water seal on the top thereof, and means for breaking said water seal to permit said valve to close within a predetermined length of time after the water in the tank has dropped below the floatation point of said float.

6. In combination with a water closet having a flush rim, of a water storage tank supported by said bowl and having its bottom disposed in a plane below the top of the bowl with the outlet thereof connected to the flush rim, a valve adapted to seat over said outlet, a float connected to said valve and spaced thereof, means for raising said valve and float, means for sustaining a column of water beneath said float to hold said valve in its raised position, and means for releasing said column after the water in the tank has dropped below a predetermined level to permit said valve to reset over said outlet.

7. In combination with a water closet having a flush rim, of a water storage tank supported on said closet and having its bottom disposed in a plane below the top of the closet with the outlet thereof connected to the flush rim, a valve adapted to seat over said outlet, means for raising said valve, means cooperating with said valve for utilizing atmospheric pressure to hold said valve in its raised position, and means for neutralizing the atmospheric pressure to release said valve and permit it to reset over the outlet.

8. A fixture comprising a water closet bowl having a flush rim adjacent the top thereof, a water storage tank integral with said bowl and having a passage in the bottom of the tank leading to the flush rim, a valve in said tank adapted to seat over and close said passage, a float carried by said valve, means for raising said valve and float, means for utilizing atmospheric pressure to sustain a column of water beneath said float and hold said valve in its raised position, and means for neutralizing said atmospheric pressure to release said column of water and permit the valve to seat over said passage.

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