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TOILET TANK FLUSH VALVE

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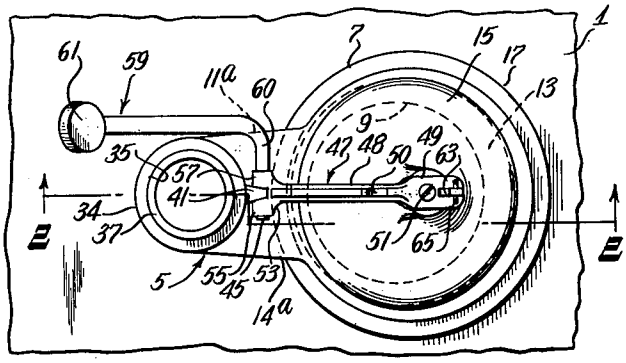


Fig. 1.

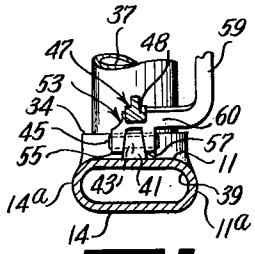


Fig. 3.

Fig. 2.

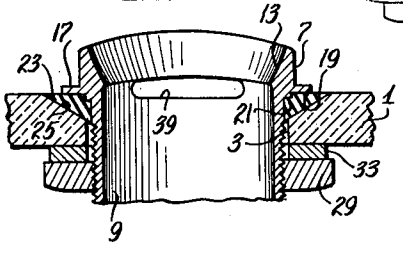


Fig. 4.

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TOILET TANK FLUSH VALVE

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This invention relates generally to valves and, more particularly, to an improved flush valve having a low, inclined seat and counterweighted ball valve adapted to be installed in a discharge opening in a water tank connected with a toilet bowl.

One of the disadvantages of conventional toilet tank flush valves is that the ball valve closes with several inches of water remaining in the bottom of the flush tank. As a consequence, the flush tank must be made higher and/or larger than would be the case if all, or nearly all, of the water were drained therefrom during the flushing operation. Even when the ball valve is manually held from its seat to permit as much drainage as possible, over an inch of water will remain in the tank because of the height of the valve seat above the bottom of the tank. This means that rust or any sediment that accumulates at the bottom of the tank cannot be flushed out. Moreover, in any instance where the water supply valve is shut off, the undrained water remaining in the tank presents a drainage hazard in an unheated building during freezing weather, unless special precautions are taken to siphon or mop out the captive water. Many flush tanks in summer homes have been ruined in such weather as a result of this common defect.

It is, therefore, the principal object of the present invention to provide an improved flush tank valve assembly that will permit the use of flush tanks that are smaller and of lower height than is required with conventional flush valve assemblies.

Another object is to provide a flush tank valve assembly including a novel body design which insures the draining of water to a level closer to the bottom of the tank then has heretofore been possible.

Still another object is to provide a flush tank valve wherein the ball seating action is controlled or delayed by a counterweighted lever to assure maximum drainage of water from the tank before the ball is permitted to engage its seat.

Still another object is to provide a flush tank valve assembly which insures a minimum of turbulence during a flushing cycle.

Yet another object is to provide a flush tank valve body having an ample overflow passage, and which body may be positioned in a flush tank that has protrusions, such as bolt heads, in the immediate vicinity of the tank discharge opening, without interfering with the bolt heads.

A further object is to provide a positive acting, properly seating flush tank valve which is both simple and economical to manufacture and assemble.

A still further object is to provide a flush tank valve which can be quickly and easily installed in a discharge opening in the bottom of a tank, and which will insure a leakproof connection therebetween.

Other objects and advantages will become apparent from the following description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a fragmentary plan view of the bottom of a toilet flush tank showing the flush valve of the present invention installed therein;

FIG. 2 is a vertical sectional view taken on line 2—2 of FIG. 1, showing the flush valve installed in a drain opening in the bottom of the flush tank;

FIG. 3 is a sectional view through the throat of the body of the flush valve, taken on line 3—3 of FIG. 2; and

FIG. 4 is a sectional view through the valve seat taken on the line 4—4 of FIG. 2.

Referring to the drawings, the numeral 1 identifies a bottom wall of a conventional flush tank which is provided with the usual drain opening 3. The flush valve assembly of the present invention is generally identified by the numeral 5 and includes a cast brass body 7 having a depending cylindrical outlet 9 that extends through the tank opening 3. The body 7 also includes an inclined wall 11 provided with a seat 13 of spherical formation and of substantially the same radius and configuration as the lower end of a conventional hollow, rubber ball valve 15. The valve seat 13 is preferably inclined on an angle of approximately 12° with respect to the horizontal wall 1 of the flush tank. This angle has been found to reduce turbulence in flow through the valve seat 13 to a minimum.

The valve body 7 also includes an annular horizontal flange 17 that is concentric with the cylindrical outlet 9. The underside 19 of the flange 17 and the outer surface of the outlet 9 are machine finished to provide, in effect, at their juncture, a ring 21 that engages the inner, upper edge of a rubber sealing ring 23 surrounding the cylindrical portion 9. The drain opening 3 in the tank wall 1 is chamfered at its upper end as indicated at 25, and the sealing ring 23 is of complementary shape and generally triangular in radial cross-section. The ring-like formation 21 is approximately 1/32 of an inch thick and 1/32 of an inch wide and functions to provide a zone of increased compression in the sealing ring 23 to assure a tight seal between the valve body 7 and the tank bottom 1.

The outer surface of the outlet 9 has threads 27 adapted to cooperate with a clamping nut 29 for mounting the valve assembly 5 in the flush tank, and with a fitting 31 for connecting the valve 7 to a toilet bowl, not shown. A gasket 33 is disposed between the clamping nut 31 and the lower surface of the tank wall 1 to permit rotation of said clamping nut relative to said wall without damaging the same. Upon tightening of the clamping nut 31, the metal "ring" 21 penetrates the rubber ring 23 and cooperates with the flange 17 to compress the ring 23 to form a seal with the tank wall 1.

The body 7 also has an offset portion 34 containing a vertical threaded opening 35 in which a conventional overflow pipe 37 is mounted. A lower wall portion 14 is disposed in a plane parallel with the wall portion 11, and both are inclined on the same angle as the valve seat 13, namely, approximately 12°. The walls 11 and 14 cooperate to provide an overflow passage 39 in the valve body 7 that is generally oval shaped in transverse cross-section, as best shown in FIG. 3. The side edges 11*a* and 14*a* of the walls 11 and 14 diverge in a direction away from the opening 35 toward the outlet 9, as best shown in FIG. 1, so that the discharge end of the overflow passage 39 becomes wider and assumes a flat oval shape, as best shown in FIG. 4.

As will be seen from FIG. 1, the axis of the outlet 9 and the axis of the threaded opening 35 lie on the same vertical plane. A boss 41 is cast integral with the wall 11 and the portion of the body defining the opening 35 and extends from the opening 35 in a direction toward the valve seat 13. The boss 41 has a transverse horizontal opening 43, FIG. 3, for receiving a pin 45. The opening 43 is made a few thousandths of an inch larger in diameter than the outside diameter of the pin 45, for a purpose which will be explained later.

An operating lever 47 for the ball valve 15 has a rightwardly extending arm 48 with an enlarged, flat, angularly offset end portion 49 through which a screw 51 extends for securing the ball valve 15 to the lever 47. The lever 47 conforms somewhat with the contour of the ball valve 15 and includes a clevis portion 53, FIG. 3, intermediate

the ends thereof comprising depending legs 55 and 57, each of which has an opening to tightly receive therein a portion of the pin 45.

A leftwardly extending arm 59 of the lever 47 includes an offset portion 60, FIG. 1, that exends laterally or rearwardly from the clevis 53. The arm 59 extends in a direction opposite to that of the arm 48, or away from the ball valve 15, and is arranged so that it can move in a vertical plane located rearwardly of the overflow pipe 37. The lever arms 48 and 59 diverge from the clevis 53, are non-parallel with the seat 13, and are disposed on an angle of about 112° to each other, as indicated in FIG. 2. A counterweight 61 is formed by an enlargment at the free end of the arm 59 for counterbalancing the arm 48 and the ball valve 15, for controlling their return movement to delay engagement of the ball valve 15 with the seat 13, as will be explained more fully hereinafter.

The arm 48, FIG. 2, of the lever 47 carries a lug 63 located beyond the screw 51, containing an opening 64 to receive the lower end of a chain 65 for connecting said chain to said lever. The upper end of the chain 65 is attached to a conventional arm 67 that is pivotally mounted upon the front wall of the flush tank and provided with an operating handle, not shown, in the customary manner. The arm 48 carries an integral, triangular stop 50 adapted to engage the overflow pipe 37 to limit counterclockwise movement of the lever 47, so that the counterweight 61 is held clear of the bottom of the tank.

The flush tank is attached to a toilet bowl, not shown, by bolts 69, which pass through the bottom wall 1 of the tank. It will be noted from FIG. 2 that the valve body 7 is designed so that the offset portion 34, including the wall 14 defining the lower portion of the overflow passage 39, provides clearance for the head of the bolt 69, even when the bolt is in alignment therewith and in close proximity to the tank outlet 3.

In the present valve construction, it is important that the projected distance between the axis of the pivot pin 45 and the axis of the valve seat 13 be the same as the projected distance between the axis of said pivot pin 45 and the axis of the ball valve 15. In other words, the distance between a line passing through the axis of the pivot pin 45 and a parallel line passing through the axis of the valve seat 13, as represented by the dimension A, is equal to the distance between the first-mentioned line and a line parallel thereto and passing through the axis of the ball valve 15, as represented by the dimension B. In one operative example of the invention, the dimensions A and B each equal 1¾ inches. Therefore, the ball valve 15 will always seat properly. However, in order to provide for some tolerance in manufacturing and assembly, the opening 43 in the boss 41 is made a few thousandths of an inch larger than the diameter of the pivot pin 45, in order to provide some "floating" action for the lever and ball assembly to compensate for any slight difference in the dimensions A and B that may occur in actual practice and, thus, insure accurate seating of the ball valve 15 on the seat 13.

It will be understood that water is supplied to the flush tank through the usual ball cock, not shown. It will also be understood that, when the operating handle (not shown) on the flush tank is actuated to operate the arm 67, the chain 65 will rock the lever 47 counterclockwise and the ball valve 15 will be moved from its position shown in full lines in FIG. 2 to the position shown in dot-and-dash lines. The lifting of the ball valve 15 from its seat 13 will initiate a flushing operation and permit the water in the tank to rapidly discharge through the outlet 9. The counterweight 61 and lever arm 59 supplemented by the buoyant effect of the water in the tank acting on the ball valve 15 will, at this time, hold the valve open.

The design of the inclined seat 13 is such that the discharge flow occurs through the valve 7 without creating undesirable turbulence. In view of the fact that the lowest portion of the seat 13 is disposed slightly less than ¼ inch above the upper surface of the bottom wall 1 of the tank, nearly all of the water in the tank will be discharged under maximum head before the ball valve 15 returns to its seat. In this connection, the counterweight 61 on the lever arm 59 functions for an interval to overcome the suction closing effect on the ball valve 15 induced by the water rushing through the valve seat 13, thereby permitting the water in the tank to fall to a very low level before the ball valve 15 starts its movement to ultimately engage the seat 13.

The functional and operational advantages of the present flush tank valve will be better understood in light of the fact that, when the ball valve 15 is in the position shown in dot-and-dash lines in FIG. 2, the counterweighted lever arm 59 acts to retain the ball valve in this position against the suction force created by the water rushing through the body of the valve. In one operative form of the invention, the counterweight 61 effectively restrains closing of the ball valve 15 until the water level in the flush tank is reduced to that indicated by the legend "Level C," in FIG. 2 of the drawings. At this level, the air in the hollow ball 15 still provides a certain amount of buoyancy which, together with the counterweight, resists the vacuum forces tending to pull the ball downwardly toward the seat 13. The level C corresponds to a water depth of about 1¾ inches. As the water level continues to drop, the air will spill out of the opening in the lower part of the ball 15, producing a large bubble, after which the ball becomes less buoyant, and the combined weight of the ball and the lever arm 48, and the suction effect of the discharging water, overcome the resistance offered by the lever arm 59 and the counterweight 61, so that the ball 15 actually seats when the level of the water in the tank corresponds to the level indicated by the legend "Level D" in FIG. 2 of the drawings. This level corresponds to a depth which may vary from about 1⅛ inches to 1⅜ inches, thus leaving a minimum volume of unused water in the tank. Of course, if the ball valve 15 is manually held raised from its seat during the entire flushing operation, the water level will drop to the lowest point of the inclined seat 13. However, in normal use, the ball valve 15 is manually lifted from its seat to start a flushing operation and the handle is released, allowing the valve to seat itself automatically.

It will be understood that all water is drained from the ball valve 15 when seated, so that it becomes filled with air. This air becomes entrapped in the ball by the water in the tank when the ball valve 15 is suddenly raised from its seat for the next flushing operation. In this way, air is always present in the ball valve 15 when it is in the dot-and-dash position shown in FIG. 2 and is available to effect the restraining or retarding, closing function described above.

Moreover, with the present flush valve, the inclined seat 13 permits the water to rush through the seat opening with a minimum of turbulence, as beforestated, thereby assuring quiet operation and negligible interference with the closing action of the ball valve 15.

In flush tank installations having a conventional ball flush valve, if the valve is opened and released so that it is allowed to automatically seat during the flushing operation, the ball valve will close when the water level in the tank is still about 2½ to 3½ inches from the bottom of the tank, thereby preventing maximum utilization of the available water for flushing purposes. In contrast, and as has been pointed out above, the present ball valve 15 will automatically close at the level D of 1⅛ to 1⅜ inches, thereby making more water available for flushing purposes for a tank of a given size than would be available with a conventional flush valve. It is apparent, therefore, that the present flush valve is not only more efficient than conventional flush valves, but also makes it possible to provide the same volume of flushing water, with a tank of substantially less height, for example 1⅛ to 1⅜ inches

less, than a conventional tank. This means that a substantial saving in space and tank material can be effected with the present valve.

The present structure also has the advantage that, when the supply of water to the flush tank is cut off, as in winterizing a summer house, the ball valve **15** can be manually held from its seat, whereupon substantially all of the water in the tank will be drained out, leaving insufficient water in the tank to cause damage in the event that the temperature should drop below freezing.

It will be understood that various changes may be made in the proportions and in the arrangement of the components of the present flush valve, and that said components may be made of any suitable corrosion-resistant materials, without departing from the principles of the invention or the scope of the annexed claims.

I claim:

1. A toilet tank flush valve, comprising: a hollow body having an outlet in a lower portion thereof for the discharge of flushing water therethrough, an inlet for tank overflow water in an upper portion thereof, and an overflow passage establishing communication between said inlet and outlet, said body having a ball valve seat in said upper portion disposed above and vertically aligned with said outlet, said seat being inclined relative to a horizontal line disposed at right angles to the axis of said outlet; a boss on said body located between said inlet and said valve seat; a lever; means pivotally mounting said lever upon said boss, said lever having arms extending in opposite directions from said pivot means and each terminating in a free end; a ball valve mounted upon the free end of one of said arms; a counterweight mounted upon the free end of the other of said arms, said other arm including a laterally extending portion connecting the same with said one arm and arranged so that said other arm is disposed to one side of said inlet opening; and means on said one arm connectible with actuating means for lifting said valve element from its seat.

2. A toilet tank flush valve as defined in claim 1, in which the inclination of the valve seat is on an angle of approximately 12° to the plane of the horizontal line.

3. A toilet tank flush valve as defined in claim 1, wherein the arms of the lever extend upwardly and away from the pivotal mounting means therefor.

4. A toilet tank flush valve as defined in claim 3, wherein the arms of the lever are disposed upon an angle of about 112° relative to each other.

5. A toilet tank flush valve as defined in claim 1, in which the one arm of the lever has a free end that terminates in an angularly offset enlargement, and wherein the valve element is connected with said offset enlargement.

6. A toilet tank flush valve, comprising: a hollow body having an outlet in a lower portion thereof for the discharge of flushing water therethrough, an inlet for tank overflow water in an upper portion thereof, and an overflow passage establishing communication between said inlet and said outlet, said body having a spherical seat in said upper portion disposed above and vertically aligned with said outlet; a boss on said body located between said inlet and said valve seat; a lever; means pivotally mounting said lever upon said boss, said lever having arms extending in opposite directions from said pivot means; a hollow ball valve mounted upon the free end of one of said arms and being engageable with said spherical seat; a counterweight mounted upon the free end of the other of said arms, said other arm including a laterally extending portion arranged so that the lever arms are longitudinally offset and said other arm is disposed to one side of said inlet opening; and means on said one arm connectible with actuating means for lifting said valve element from its seat.

7. A toilet tank flush valve as defined in claim 6, in which one of the arms of the lever includes a clevis connecting the same with the pivot means, and wherein the laterally extending portion of the other arm of the lever projects from one side of said clevis.

8. A toilet flush tank valve as defined in claim 7, in which the clevis is connected to the boss by a pivot means including a pin and wherein the boss has an opening through which said pin extends of a diameter a few thousandths of an inch larger than the diameter of said pin, whereby the lever is floatingly mounted upon said boss.

9. A toilet flush tank valve as defined in claim 6, wherein the body has a horizontal, annular mounting flange extending outwardly therefrom and has a depending cylindrical portion defining said outlet opening, and wherein a small annular ring-like formation is provided at the juncture of said flange and cylindrical portion.

10. A toilet tank flush valve as defined in claim 6, in which the hollow ball valve is formed with an opening in the bottom thereof; and wherein the total weight of the other of the arms together with the weight of the counterweight on one side of the pivot means is slightly heavier, when the valve is in raised position, than the weight of said one arm together with the weight of said ball valve while buoyed up in water covering said opening on the other side of said pivot means, whereby said ball valve, when actuated, is maintained in raised position against the suction action of water flowing downwardly through the outlet and is automatically returned to a seated position on its seat by the weight of water entering the opening in said ball valve to replace air escaping therefrom upon a lowering of the level of the water in said tank to below said opening in said ball valve.

11. A toilet tank flush valve assembly, comprising: a hollow body having a depending cylindrical portion containing an outlet for the discharge of flushing water therethrough, said body having a threaded overflow inlet; an overflow pipe mounted in said threaded inlet, said body also having an overflow passage establishing communication between said overflow inlet and said outlet, said body further having a ball valve seat portion above and vertically aligned with said outlet, said body still further having a horizontal, annular mounting flange extending outwardly therefrom immediately adjacent said seat, said seat being inclined on a small angle relative to said horizontal mounting flange and having the low side of said inclined seat disposed only a slight distance above said mounting flange; a boss on said body located between said inlet and said valve seat; a lever; means pivotally mounting said lever upon said boss, said lever having arms extending in opposite directions from said pivot means; a ball valve element mounted upon the end of one of said arms and being engageable with said seat; a counterweight mounted upon the end of the other of said arms, said other arm including a laterally extending portion arranged so that the lever arms are longitudinally offset and said other arm is disposed to one side of said overflow pipe; and means on said one arm connectible with actuating means for lifting said valve element from its seat.

12. A toilet tank flush valve assembly, comprising: a hollow body having an outlet opening for the discharge of flushing water therethrough, an overflow inlet, and an overflow passage establishing communication between said overflow inlet and said outlet, said body further having a seat portion above and vertically aligned with said outlet, said seat being inclined on a small angle relative to a horizontal line disposed at right angles to the axis of said outlet opening; a boss on said body located between said inlet and said valve seat; a lever; means including a pin pivotally mounting said lever upon said boss, said lever having arms extending in opposite directions from said pivot means and in non-parallel relation with the plane of said seat; a ball valve mounted upon the end of one of said arms and being engageable with said seat; and a counterweight mounted upon the end of the other of said arms, the distance between a line passing through the axis of said pin to a line parallel therewith and passing

through the axis of said seat being equal to the distance between said first-mentioned line and a line parallel therewith and passing through the axis of said ball valve.

13. A toilet tank flush valve, comprising: a hollow body having a depending cylindrical portion formed with an outlet passage, said body having a spherically shaped, ball valve seat above said outlet inclined on an angle of about 12° from the horizontal; an annular flange formed on said body extending horizontally outwardly therefrom immediately below the lowermost portion of said inclined seat; a ring formed on said body at the juncture of said flange with said body adapted to penetrate and compress a seal disposed between said flange and the discharge opening in a flush tank; an overflow passage formed in said body extending at an angle of substantially 12° from a point adjacent the highest portion of said inclined seat and terminating in a vertical passage adapted to receive the lower end of a flush tank overflow pipe; a boss having a horizontal opening therethrough formed on the surface of said body above said overflow passage; a lever having angular arms pivoted on said boss, said lever including a counterbalance weight fixed on the end of one of said arms, an upstanding lug having a horizontal opening extending therethrough formed on the upper surface of the end of the other of said arms adapted to be

attached to a manually actuated valve operator; a clevis portion formed intermediate the ends of said lever having aligned, horizontal openings through the legs thereof, the openings in the legs of said clevis being smaller than the opening in said boss; a ball valve attached to said other arm, the protected distance from the center of said opening in said clevis to the center of said ball valve being the same as the projected distance from the center of said opening in said clevis to the center of said valve seat; and a pin of substantially the same diameter as the openings in said clevis extending through the openings in said clevis and through the opening in said boss, mounting said lever for floating pivotal movement in a vertical plane.

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