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TOILET FLUSH VALVE

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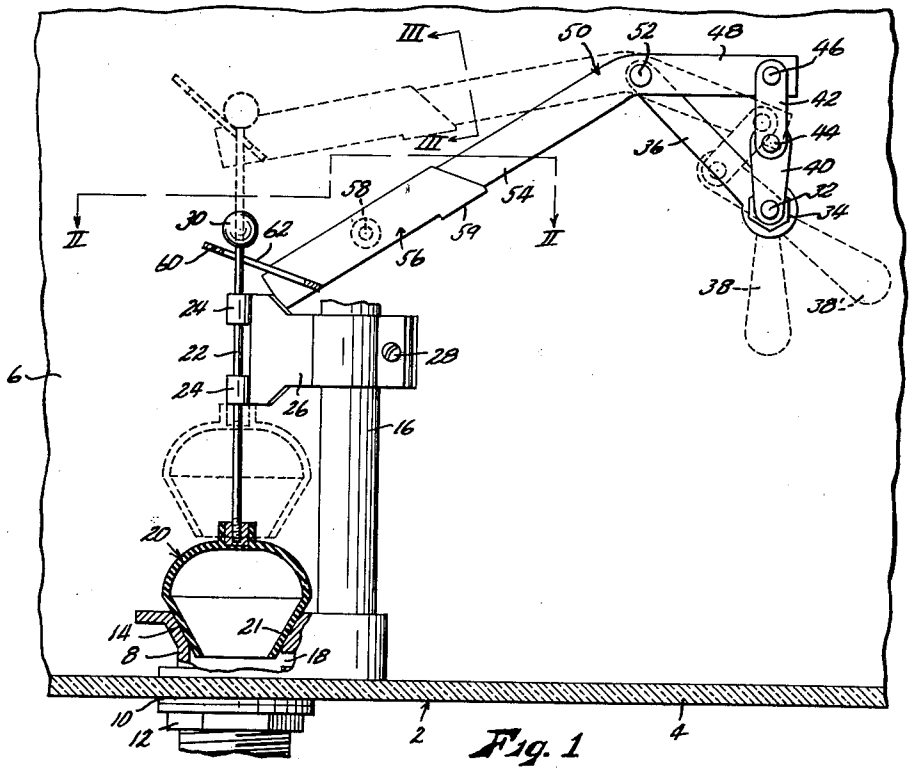


Fig. 1

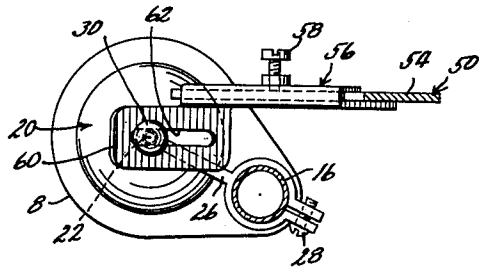


Fig. 2

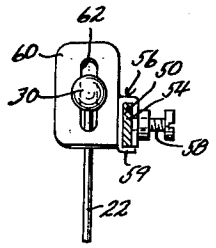


Fig. 3

INVENTOR.
Cecil H. Taylor
BY
John A. Hamilton
Attorney.

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TOILET FLUSH VALVE

Cecil H. Taylor, 1508 High Grove Road, Grandview, Mo.

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This invention relates to new and useful improvements in toilet flush valves, and has specific reference to the means for lifting the valve ball from its seat.

In toilet flush tanks, perhaps the most common flush valve consists of a valve body secured in the floor of the tank, being interconnected at its lower end to the toilet bowl and terminating at its upper end in a valve seat opening upwardly into the tank, a hollow valve ball engaged in said seat and being open at the bottom, a valve stem extending upwardly from said ball and being guided for vertical movement, and manually operable means for lifting said stem. Said lifting means usually comprises a lever pivoted on a horizontal axis for vertical movement, and connecting means joining the free end of the lever to the stem. When the ball is lifted, air entrapped therein causes it to rise vertically, and it falls into the seat again only when the water level has fallen approximately to the level of the seat. However, the lift lever is lowered to its original position much sooner, that is, as soon as it is released by the operator. Since the lift lever and valve stem must thus move independently of each other, and also because the pivotal motion of the lift lever causes some horizontal transitional movement thereof concurrently with its vertical movement, the connecting means joining the lever to the stem has heretofore been some intermediate member connected respectively to the lever and stem but movable relative to each. Such connecting members in common use constitute a flexible chain, or a link pivoted to the lever and having loose and limited sliding engagement with the stem. Such connecting members are slack after the ball is lifted and the lever is lowered, and are free to be moved about somewhat by water currents in the tank, with the result that the elevated stem may become fouled with the connecting means, so that the ball cannot engage the seat to close the valve properly. This is an extremely common type of malfunction in valves of this type, and the elimination thereof is an important object of the present invention. This object is accomplished by the provision of a connecting means comprising a pair of slidably cooperating members which, while movable relative to each other to permit the desired operation, are rigidly connected respectively to the lift lever and the stem. Thus there is no part having free uncontrolled movement which could bind or restrict movement of the stem.

A further object is the provision of means providing a mechanical advantage or force increasing action intermediate the lever and the stem, so that less manual force is required to operate the lever. This provides easier, smoother operation.

A still further object is the provision of means for forcing the stem laterally or horizontally with respect to its guides, each time the valve is operated. This action tends to break, or prevent the formation of, hard water mineral salt deposits in the guides, which might otherwise impede movement of the stem, or destroy proper alignment of the valve ball with the seat.

Other objects are simplicity and economy of construction, efficiency and dependability of operation, and adaptability for application to pre-existing flush valve assemblies with a minimum of alteration, and without tools.

With these objects in view, as well as other objects which will appear in the course of the specification, reference will be had to the drawing, wherein:

FIG. 1 is a general sectional view through a toilet flush tank with a flush valve embodying the present invention, showing the valve closed in solid lines and open in dotted lines, and

FIGS. 2 and 3 are fragmentary sectional views taken respectively on line II—II and III—III of FIG. 1.

Like reference numerals apply to similar parts throughout the several views, and the numeral 2 applies generally to a toilet flush tank, the floor thereof being shown at 4 and the front wall thereof at 6. The flush valve includes a tubular valve body 8 inserted through floor 4 and sealed therein by means including a gasket 10 and a nut 12 threaded thereon. It will be understood that said valve body is interconnected at its lower end to a toilet bowl, not shown. Said valve body terminates at its upper end in an upwardly opening frusto-conical valve seat 14. An overflow pipe 16 is affixed in the valve body and extends upwardly therefrom to a point above the normal water level of the tank, although its upper portion is broken away in the drawing to avoid obscuring other parts. It communicates with the valve body below seat 14 by means of passage 18. The overflow pipe has the functions of draining off excess water which may be delivered to the tank, and of delivering refill water to the toilet bowl after it is flushed, but these functions are not pertinent to the present invention. As far as the present invention is concerned, it serves merely as a support for the valve stem guide, as will presently appear.

Normally engaging in seat 14 is a valve ball 20 which is hollow and formed of soft, resilient rubber or the like, being sealed except at its lower end, and having a frusto-conical lower portion 21 which engages snugly in seat 14. A slender, rod-like stem 22 is threaded in the top of the valve ball, and extends upwardly therefrom, being supported for vertical sliding movement in a pair of tubular guides 24 formed integrally with a bracket 26 fixedly mounted on overflow pipe 16 by a clamp screw 28. Said stem extends above said guides when the ball is seated, and a knob 30 of any suitable hard, smooth material is affixed to the upper end thereof.

A short, horizontal shaft 32 extends through front wall 6 of the tank, being journalled in a suitable bracket 34 affixed in said wall. A support arm 36 is affixed to the brackets within the tank, and extends diagonally upward therefrom. Affixed to shaft 32 outside the tank is a manual operating handle 38, and affixed to said shaft within the tank is a radially extending crank 40. A link 42 is pivoted at 44 to the free end of said crank, and at 46 is pivoted to one end portion 48 of a lift lever 50. Said lift lever is pivoted intermediate its ends to the upper end of arm 36, as at 52. The opposite end portion 54 of the lift lever extends adjacent stem 22. Thus it will be seen that whenever shaft 32 is turned in either direction by means of handle 38, say by moving handle 38 to the position indicated by the numeral 38', crank 40 and link 42 function to elevate lever portion 54 adjacent stem 22, pivoting it in a vertical plane.

Mounted on the free end portion of lever arm 54 is a bracket 56 formed of sheet metal and being of inverted channel shape to fit loosely over the lever arm so that it may be moved slidably along said arm. Said bracket may be fixed on said arm by means of a set screw 58 threaded in one of its side walls. Adjacent its inner end, one of the side walls of the bracket is formed to present an ear 59 which extends horizontally beneath the lever arm. At the outer end of the bracket, one of the side walls thereof is bent outwardly to form a planar lift plate 60. Said lift plate extends horizontally outwardly from lever arm 54, at right angles to the plane of movement of said lever arm. In a direction parallel to the plane of movement of said lever arm, the lift plate is inclined from the horizontal so as to remain inclined in

the same direction from horizontal at all positions of lever arm **54**. A slot **62** is formed in said lift plate, said solt being elongated in a direction parallel to the vertical pivotal plane of lever arm **54**. Stem **22** extends upwardly through said slot, engaging only loosely therein, and knob **30** is disposed above the lift plate and is too large to pass through the slot.

When valve ball **20** is fully seated and lever arm **54** is in its normal lowered position as shown in solid lines in FIG. 1, lift plate **60** is disposed below and out of contact with knob **30**. This clearance provides that the lift plate cannot interfere with the seating of the valve ball, which may sink more or less deeply into the seat on successive operations of the valve, or as the ball becomes worn or deformed. When lever arm **54** is elevated by the operation of handle **38**, as previously described, say to the position indicated in dotted lines in FIG. 1, lift plate **60** engages knob **30** and lift stem **22** to elevate ball **20** above seat **14**. Once elevated, ball **20** is rendered buoyant by air entrapped therein, and it remains elevated until the fall of the water level caused by the flow of water through the valve body again allows the ball to seat by gravity. At the same time, lever arm **54** is lowered immediately by gravity as soon as handle **38** is released. However, as the lever arm falls, slot **62** passes freely along stem **22** without affecting the movement thereof.

Thus a flush valve having several advantages has been produced. Firstly, it will be seen that the cooperating members (lift plate **60** and knob **30**) forming the connecting means between lever arm **54** and stem **22**, while movable relative to each other, are respectively fixed to the lever arm and the stem, which in turn have substantially fixed and controlled paths of movement. Thus the connecting means includes no member, such as the loose sliding link or the chain presently in common use, which can be moved about freely by random water currents in the tank, and which therefore could contact the stem and bind it or interfere with its free downward movement to engage the ball in the seat. The ball-stem assembly is necessarily of very light weight so as to be buoyant, and it is therefore very easily affected by even very slight friction or resistance to its movement. By eliminating the possibility of this occurrence, I have eliminated a very common and irritating malfunction of flush valves of this type.

A second advantage results from the inclination of lift plate **60** from the horizontal, and from the fact that the lift plate is shifted horizontally as it is lifted, due to the pivotal mounting of lever arm **54**. Thus, as the lift plate is elevated, knob **30** moves slidably therealong, downwardly with respect to the incline, so that the knob and stem are actually elevated to a lesser extent than plate **60**. Said lift plate thus acts as a sliding wedge or inclined plane, multiplying the lifting force of lever arm **54** as applied to the valve stem. This produces an easier, smoother operation of the valve, requiring less manual force on handle **38**. This phase of the operation renders it desirable that the inclination of lift plate **60** be as steep as is consistent with efficient lifting action, in order that the mechanical advantage may be as great as possible. However, too great an inclination will result in excessive lateral or horizontal pressure on the stem, which might cause binding thereof in guides **24**. Obviously, the inclination of plate **60** must be opposite to that of lever arm **54**, in order that the sliding movement of the knob **30** during the lifting action will be toward the lower edge of the plate. It is desirable also that pivot **52** be disposed at or above the maximum elevation of knob **30**, as shown. If lever arm **54** were required to pivot above a horizontal position, the horizontal movement of plate **50** would be reversed, and knob **30** would be required to move upwardly along the incline of the plate, with a resulting mechanical disadvantage.

The horizontal pressure exerted on the stem as it is lifted, resulting from the horizontal component of the force exerted on knob **30** by plate **60**, is also advantageous so long as it is not so excessive as to cause binding in guides **24**. This lateral pressure forces the stem to one side in the guides as it is lifted, while the stem is allowed to assume a normal position in the guides as it is lowered. This lateral movement of the stem, which is within the operating clearance in said guides, tends to break up, or prevent the formation of, mineral sediments or scale in said guides and on the stem. In hard water localities, such deposits often become so substantial as to prevent free movement of the stem, and to prevent proper seating of ball **20**.

My invention also has the advantage of being easily adaptable to many pre-existing flush valves simply by eliminating the old connecting means between lever **54** and the stem, together with the old stem, and adding bracket **56** and stem **22**, which may be packaged as a kit and sold for this purpose. The rest of the structure is generally standard. The stems may be interchanged simply by unscrewing the old one from the ball and inserting stem **22**. Bracket **56** is adapted to be mounted on any standard lift lever **50**. The proper direction and attitude of lever arm **54** may be obtained by bending the existing lever. Lift plate **60** of the bracket may be placed at the proper distance from pivot **52** by loosening set screw **58** and moving the bracket along the arm. Ear **59** renders the bracket essentially tubular in form, and specifically it prevents any tendency of the rearward or inner end of the bracket to pivot upwardly from lever **54** in response to the downward pressure of knob **30** on plate **60**.

While I have shown and described a specific embodiment of my invention, it will be readily apparent that many minor changes of structure and operation could be made without departing from the spirit of the invention as defined by the scope of the appended claims.

What I claim as new and desire to protect by Letters Patent is:

1. A toilet flush valve comprising a valve body having an upwardly opening valve seat, a buoyant valve ball normally engaging in said seat and being elevatable to open said valve, a valve stem affixed to said valve ball and rising vertically therefrom, a guide member supported rigidly relative to said valve body and guiding said valve stem for limited vertical movement, a lift member supported for vertical movement adjacent said stem, means for elevating said lift member, a horizontally extending lift plate affixed to said lift member and having an aperture formed therethrough, said stem extending upwardly from said guide member through said aperture and engaging loosely therein, and an enlargement affixed to the upper end of said stem of sufficient size that it cannot pass through said aperture, whereby as said lift member is elevated, said lift plate will engage said enlargement and lift said stem and valve ball, said lift plate being inclined from horizontal at all positions of said lift member, and wherein said means for elevating said lift member is so arranged that it moves said lift plate horizontally as it is elevated, in a direction toward the higher edge of said lift plate, said enlargement having sliding engagement with the upper surface of said plate and said aperture being elongated in the direction of horizontal movement of the plate whereby said movement will not cause interference between said plate and said stem, as a result of which said lift plate acts as a sliding wedge multiplying the lifting force applied thereby to said stem.

2. A toilet flush valve comprising a valve body having an upwardly opening valve seat, a buoyant valve ball normally engaging in said seat and being elevatable to open said valve, a valve stem affixed to said valve ball and rising vertically therefrom, a guide member supported rigidly relative to said valve body and guiding said valve stem for limited vertical movement, a lift member supported for vertical movement adjacent said stem, means for elevating said lift member, a horizontally extending

lift plate affixed to said lift member and having an aperture formed therethrough, said stem extending upwardly from said guide member through said aperture and engaging loosely therein, and an enlargement affixed to the upper end of said stem of sufficient size that it cannot pass through said aperture, whereby as said lift member is elevated, said lift plate will engage said enlargement and lift said stem and valve ball, said lift member comprising a lever pivoted for movement in a vertical plane on an axis disposed in fixed relation to said valve body, said lever being inclined downwardly from its pivotal axis toward said stem and being movable between upper and lower limits both disposed below horizontal, whereby said lift plate is moved horizontally as it is lifted, and wherein

said lift plate is at all positions of said lever inclined downwardly toward said pivotal axis in a direction parallel to the plane of movement of said lever, said aperture being elongated in a direction parallel to the plane of movement of said lever, whereby the horizontal movement of said lift plate as it is elevated will not cause interference between said lift plate and said stem.

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