ABSTRACT OF THE DISCLOSURE

A flush valve control assembly for regulating the flushing operation by limiting the quantity of water flow out of a water closet that includes a float operated cam for retaining the valve stem of a ball valve in a flush position until the float lowers to a preset selected level and then releases the ball valve stem. Adjustment mechanism is provided to retain the cam in a valve stem release position when the valve stem is in a non-flushing position and to limit the movement of the cam and thereby the maximum lowering of the float.

BACKGROUND OF THE INVENTION

This invention relates to float operated mechanism to limit the quantity of water flow out from a water closet that operates independently of other water closet elements once the flushing operation commences. U.S. Pat. No. 2,817,849 to Hewitt discloses flush tank control mechanism that includes a float operated foot for holding a valve stem that has been moved to a flush position in a flush position until either the tank has been completely flushed and then partially refilled or until the lever arm is manually rotated in a direction opposite that for commencing a flushing operation. With this structure, one may manually control the operation thereof to use less than the tank capacity of water. However, to do so, requires observing the decrease of water level in the tank and a manual operation to discontinue the flushing. In order to cause the flushing operation to automatically cease prior to the water closet or flush tank becoming completely empty, this invention has been made.

SUMMARY OF THE INVENTION

For controlling the degree of emptying of a water closet, a flush valve control assembly having a float operated cam to bind against a valve stem when the valve stem has been raised to a flushing position and to release the valve stem when the water level has lowered a preselected amount. Advantageously adjustment mechanism is provided to limit the lowering movement of the float.

One of the objects of this invention is to provide new and improved flushing mechanism for flushing a water closet that cause the flushing operation to cease before the water tank empties to the level of inlet of the flush water outlet. A further object is to provide an improved and simplified flush valve control assembly which operates independently of other water closet elements once the flushing operation commences and the assembly is activated.

Another object is to provide a flush valve control assembly which requires a minimal modification of the elements already existing in the conventional water closet. A further object is to provide a flush valve control assembly which is inexpensive to manufacture and is free of parts which may be subject to rapid wear.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partial side view of a water closet, right hand portions being removed beyond the broken line and a portion of the front wall also being removed to expose the interior elements of the water flushing mechanism; FIG. 2 is an enlarged perspective view of the flush valve control assembly; FIG. 3 is an enlarged perspective view of the wedging cylinder alone, as well as portions of the float rod; FIG. 4 is an enlarged side view of the wedging block and its associated elements. Portions of the block are broken away to show the internal relation of the parts; FIG. 5 is a view similar to FIG. 4 but with the valve stem being moved vertically along its axis by the lift wire; FIG. 6 is a view similar to FIG. 4 but with the valve stem being released vertically whereby to close the flush water outlet; FIG. 7 is a fragmentary side view of the wedging block and associated elements as viewed from the opposite side as that shown in FIG. 3 for illustrating the structure to limit the downward movement of the float block; and FIG. 8 is a fragmentary exploded view to illustrate the structure for adjusting the level to which the water will fall in the water closet when flushed. In more detail, and referring generally to FIG. 1, a water closet 10, typical of that used in flushing type toilet stalls, is shown with a portion of the front wall 11 broken away to expose the interior of the closet and the water flushing mechanism referred to generally as 12. Included in the flushing mechanism 12 are the conventional elements such as the float 13, the trip lever and trip arm 14 and 15, respectively, and a lift wire 16. Fitted through the bottom wall 17 are a water inlet pipe 18 and a flush water outlet 19. Mounted in communication with the flush water outlet 19 is an overflow stand pipe 20 and also resting upon part of the flush water outlet 19 is a hollow valve ball 21 having a hole 21a adjacent the upper end thereof. The valve ball is imperfect beneath hole 21a, or if it had any opening below hole 21a, such an opening is sealed.

The remaining elements of the flushing mechanism 12 constitute a flush valve control assembly referred to generally as 22 which is clearly shown in more detail in FIG. 2. The assembly 22 has a clamping ring 23 which is adapted to be slipped over the top of the stand pipe 20 and then vertically adjusted to approximately the final desired height. The ring is provided with a bolt 23a for tightly securing the ring to the pipe. Fixedly secured to the outer periphery of the ring 23 and projecting at right angles thereto is a mounting shaft 24. A wedging block 25, having an axial bore 26 (see FIG. 4) is slidable journaled upon the shaft 24. The set screw 27 provides positive securement of the block 25 upon the mounting shaft 24 at any one of the many possible axial positions. The outer end 28 of the wedging block is provided with a vertically disposed transverse passageway 29 (see FIG. 5) of a square cross sectional area. Positioned at right angles to the passageway 29 is a second transverse opening or bore 30 of a circular cross section. Bore 30 is in partial communication with opening 29 as may readily be seen in FIGS. 4-6. Positioned within the passageway 29 is an elongated guide pin or valve stem 31 that has its lower end 55 threadedly attached to the upper end of the ball valve 21 (see FIGS. 1 and 2). The stem 31 shown is of a rectangular cross section so as to mate with the cross section of the passageway 29. The lower portion 32 of the valve stem is substantially square and small enough so that it will be freely movable within passageway 29 thereby preventing any binding of the stem with the passageway walls. The upper end 33 of the stem is of a rectangular cross...
section such that stem sides 34 are parallel and stem sides 35 converge as they approach the upper end. Although the valve stem preferably is of the shape described above, it could be a rounded tapered rod (elongated frusto conical shape), or could be of a stepped construction having an upper end portion that has a rectangular cross section that had a smaller horizontal dimension in one direction than the corresponding dimension of the lower end portion which also is of rectangular cross section.

The ends 33 of the stem 31 also has secured thereto a ball 36 or some such similar element for the hook 37, of lift wire 16, to force upon thereby imparting a lifting force to the valve stem to vertically and axially move it upwardly upon depression downwardly of the trip lever 14. The trip arm 15 acts upon the lift wire 16 by engaging the crown 38 located on the upper end of the lift wire (see FIG. 1).

Jouneled horizontally through the bore 30 is a wedging cylinder or cam 39 which is more clearly shown in FIG. 3. The cylinder 39 is provided with an angulated cutout side portion 40 which is defined by a pair of parallel confronting side walls 41 and face surface 42 (see FIG. 4) which is recessed relative to circumferential surface 45 of the cylinder. Face surface 42 joins the outer cylindrical surface 45 in a gripping edge 46, the function of which will be described in detail subsequently. Side wall 41 are so positioned as to slideably mate with the parallel sides 34 of the valve stem 31 thereby providing an additional guide means for the valve stem during raising and lowering thereof in addition to the guiding provided by the passageway 29.

One end portion 52, 53 of the wedging cylinder 39 extends outwardly of the wedging block. To the end portion of the cylinder is secured a control float rod 48, the outer end of which is bent into a C-shaped hook 49 that is in turn secured to a control float 50. The other or inner annular end 51 of the rod 48 has an inner surface to form a matching fit with the splined portion 52 of the wedging cylinder. A nut 54 is threaded on the thread portion 53 of the wedging cylinder to retain rod end 51 in a selected adjusted position on splined portion 52. The relative angular positions of portions 51, 52 determines the height of upward movement of the float 50. The control float is preferably comprised of an expanded cellular polystyrene which has a high buoyancy characteristic. Any similar element having like buoyancy characteristics may also be used, however.

The end portion of the wedging cylinder opposite the splined portion 52 has a tongue 58 that extends axially. A pivot member 59 mounts an elongated adjusting plate 60 on the wedge block 25 for pivotal movement about an axis parallel to the axis of angular movement of the wedging cylinder relative to the block, the pivot member being secured to the mid-portion of plate 60. Plate 60 has a tapered edge 61 that is abuttable against tongue 58 to limit the pivotal movement of wedging cylinder as will be subsequently described. The opposite edge 62 is curved to permit adjusting the angular position of plate 60 and at the same time retaining the plate in the adjusted angular position by threading in the screw 64 to clamp the plate against the wedging block, screw 64 being threaded into the wedging block 25. In the installation of the flush valve control assembly, the clamping ring is vertically positioned upon the stand pipe to the desired height as mentioned previously. This height may vary according to different water flushing mechanisms. The tapered valve stem 31 is then slipped through the lift wire hook 37 and passageway 29 of the wedge block 25 and then the threaded portion 55 of trip rod 31 is secured to the valve ball 21. The valve ball 21 is squeezed to force the air out through hole 21a. As the ball resumes its shape through natural resiliency, it fills with water. Prior to the insertion of the valve stem through the passageway it is necessary that the wedging cylinder be inserted in bore 30 and then rotated so that the face surface 42 is positioned as shown in FIG. 6 whereby to prevent blocking the passageway and insertion of the trip rod therethrough.

With the parts thus assembled, the wedging block 25 may be horizontally adjusted upon mounting shaft 24 until the valve ball 21 is precisely centered over the flush water outlet. Then, set screw 27 is tightened.

Float arm 45 is rotated relative the wedging cylinder portion 52 so that the float will be at position A of FIG. 1 (together with any necessary angular adjustment of plate 60 that may be necessary) when the tongue abuts against edge 61 and the end portion 51 is moved angularly to abut against splined portion 52 and nut 54 threaded to permit portion 51 moving angularly relative portion 52. Thus the tongue and plate 60 limit the upward movement of float 50 (rotation of float 50 in the direction of arrow 66). At this time surface 42 slopes upwardly toward the valve stem but edge 46 is spaced from the valve stem. Edge 61 is tapered to permit the wedging cylinder rotating in the direction opposite arrow 66.

In the use and operation of the flush valve control assembly, water is forcibly admitted to the water closet to the height shown at 56 (see FIG. 1). In this condition, the control float 50 tends to float upwardly to the water level at 56 but is instead restricted to the position A because of tongue 58 bearing against plate 60 and preventing further upward movement. In this position edge 46 is rotated to a maximum counterclockwise position (see FIG. 4). When a flushing operation is desired, the trip lever is manually pushed downwardly whereby to raise trip arm 15 and lift wire 16. As this operation takes place, the valve stem is likewise raised vertically (as shown in FIG. 5) until the width of the tapered valve stem between sides 35 is sufficient that a wedging or binding relation exists between the valve stem, passageway 29 and edge 46. When sufficiently wedged, the trip lever may be released and the edge 46 will maintain the valve stem secure and thus, the valve ball 21 above the flush water outlet 19. Water within the water closet will then be removed. When the water level reaches the lower level of 57, the float will slightly rotate clockwise (opposite arrow 66). This slight amount of rotation will release edge 46 from its wedging relation with the tapered valve stem 31 as shown in FIG. 5, and thus permit the water filled valve ball 21, to descend downwardly whereby to allow water to escape. Consequently, the minimum amount of water remaining in the water closet after a flushing operation will be that depicted by level 57. Thus, it is readily recognized that the maximum head of water has been utilized (which in and of itself provides adequate flushing) and the remainder of the water saved. As the water begins to replenish in the water closet, float 50 will again float to position A, being restricted again by tongue 58 and stop 60, and edge 46 will again be repositioned for wedging the tapered trip rod when a flushing operation is begun.

To be mentioned is that in the event one holds the trip lever 14 too long, i.e. until no water was left in the tank, without the tongue and plate limiting the movement in the direction opposite arrow 66, the float 50 would drop to a level that the edge of surface 42 opposite edge 46 would come up against stem 31 and thus allow water to escape. This plate prevents this as well as adjusts the cam to have surface 42 adjacent but not binding against stem 31 when the tank is full, and still allow the cam to lock the valve stem up for flushing action.

If it is desirous to use a greater or lesser amount of water for the flushing operation, the control float rod 48 may be bent, or the nut 54 loosened and portion 51 rotated relative portion 52 and the angular position of plate 59 adjusted so that the position A of float 50 is either lower or higher. The operation of the assembly will still remain the same.

It is pointed out at this time that by providing the tapered trip rod with a very gradual taper, a considerable
degree of wedging may be realized during the tripping action. Thus, the valve ball will be held up in spite of the weight of the nonbuoyant valve ball 21.

Through the above-detailed description of the invention, it will be readily recognized that the flush valve control assembly is very simple in operation, is easy to install upon existing water flushing mechanisms, and is of considerable value when considering the water savings occasioned through its use over a period of time.

It will, of course, be understood that various changes may be made in the form, details, arrangements and proportions of the parts without departing from the scope of my invention as set forth in the appended claims.

What is claimed:

1. A flush valve control assembly for a flushing mechanism utilized in water closets and the like, said flushing mechanism having a stand pipe and a lift wire, said flush valve control assembly comprising a non-buoyant valve ball, an elongated valve stem having an upper end adapted to be engaged by said lift wire and a lower end secure to said valve ball to move with said valve ball, first means secured to said stand pipe for guiding the valve stem as it moves between a flushing position and a non-flushing position, said first means including a mounting member secured to said stand pipe and having a surface abutable against said valve stem, and said means for engaging said valve stem upon initial tripping of said flush mechanism and subsequently respond to the water level in said water closet to release said valve stem from engagement, said valve stem having an upper intermediate portion and a lower intermediate portion that in transverse cross section is of a larger area than the upper intermediate portion, said upper intermediate portion being closely adjacent said mounting member surface in the valve stem non-flushing position, said lower intermediate section being closely adjacent said mounting member surface in the valve stem flushing position, said upper intermediate portion having a generally vertically extending surface and a second generally vertically extending tapered surface that is progressively further transversely spaced from the first surface in a direction toward the lower intermediate portion, the second means including a float and third means attached to the float and mounted by said mounting member for limiting the upward movement of the valve stem while permitting the valve stem to be moved from the non-flushing position to the flushing position and thereafter retain the valve stem in a flushing position with the tapered surface transversely adjacent the first means surface until the float has moved to a preselected lower elevation with water flows, the valve stem being engaged with the valve stem portion and the mounting member surface portion both in the valve stem flushing position and non-flushing position.

2. The apparatus of claim 1 further characterized in that the third means includes a cam rotatably mounted by the mounting member between a first position for binding against the valve stem laterally opposite said first means surface when the valve stem is in a flushing position and a second position out of binding engagement with the valve stem in a flushing position, and fourth elongated means for attaching the float to the cam to rotate the cam between said cam positions when the elevation of the float varies.

3. The apparatus of claim 2 further characterized in that the third means includes stop means on the mounting member for limiting the angular movement of the cam and thereby through the fourth means limit the maximum and minimum elevations of the float relative the stand pipe regardless of the level of the water in the tank, the stop means and cam having cooperated to limit the angular movement of the cam to positions where the cam is spaced from the valve stem when the float is at its maximum elevation and the valve stem is in its non-flushing position, to bindingly engage the valve stem when the valve stem is in its flushing position and the float is at its maximum elevation and to release the binding engagement with the valve stem when the valve stem is in its flushing position and the float is in its minimum elevation and block binding engagement with the valve stem when the float is at its minimum elevation.

4. The apparatus of claim 2 further characterized in that the third means includes stop means on the mounting member for limiting the angular movement of the cam and thereby through the fourth means limit the maximum and minimum elevations of the float relative the stand pipe regardless of the level of the water in the tank, the stop means being mounted by the mounting member portion to be spaced from said valve stem surfaces and on the opposite side of said valve stem from said mounting member surface when the valve stem is in the non-flushing position and the float is at said maximum elevation.

5. The apparatus of claim 4 further characterized in that the stop means is mounted on the mounting member to limit the angular movement of the cam in its position to a float minimum elevation condition so that the cam is transversely spaced from the valve stem when the valve stem is in the flushing position.

6. A flush valve control assembly for a flushing mechanism utilized in water closets and the like, said flushing mechanism having a stand pipe and a lift wire, said flush valve control assembly comprising a non-buoyant valve ball, an elongated valve stem having an upper end adapted to be engaged by said lift wire and a lower end secure to said valve ball, first means secured to said stand pipe for guiding the valve stem as it moves between a flushing position and a non-flushing position, said first means including a mounting member secured to said stand pipe and having a surface abutable against said valve stem, and said means for engaging said valve stem upon initial tripping of said flush mechanism and subsequently respond to the water level in said water closet to release said valve stem from engagement, said valve stem having an upper intermediate portion and a lower intermediate portion that in transverse cross section is of a larger area than the upper intermediate portion, said upper intermediate portion being closely adjacent said mounting member surface in the valve stem non-flushing position, said lower intermediate section being closely adjacent said mounting member surface in the valve stem flushing position, said upper intermediate portion having a generally vertically extending surface and a second generally vertically extending tapered surface that is progressively further transversely spaced from the first surface in a direction toward the lower intermediate portion, the second means including a float and third means attached to the float and mounted by said mounting member for limiting the upward movement of the valve stem while permitting the valve stem to be moved from the non-flushing position to the flushing position and thereafter retain the valve stem in a flushing position with the tapered surface transversely adjacent the first means surface until the float has moved to a preselected lower elevation with water flows, the valve stem being engaged with the valve stem portion and the mounting member surface portion both in the valve stem flushing position and non-flushing position.

7. The apparatus of claim 6 further characterized in that the wedge cylinder and stop member have cooperating means for limiting rotation of the wedge cylinder in said one direction to a position that said cylinder portion is out of binding engagement with the valve stem when the valve stem is in its non-flushing position.

8. The apparatus of claim 7 further characterized in that the mounting member surface portion and the cylinder portion are located to transversely abut against opposite sides of the means to limit the angular movement of the cam to positions where the cam is spaced from the valve stem when the float is at its maximum elevation and the valve stem is in its non-flushing position, to bindingly engage the valve stem when the valve stem is in its flushing position and the float is at its maximum elevation and to release the binding engagement with the valve stem when the valve stem is in its flushing position and the float is in its minimum elevation and block binding engagement with the valve stem when the float is at its minimum elevation.
10. The apparatus of claim 6 further characterized in that said mounting member includes a vertical passageway having said apertured surface portion, that said cylinder portion is located to have the passageway open thereto, and that said valve stem has an upper portion and a lower portion that are movable adjacent said cylinder portion, said upper portion in horizontal cross section having a horizontal dimension in a horizontal direction that said bore opens to said passageway that is less than the corresponding horizontal dimension of the lower portion.