

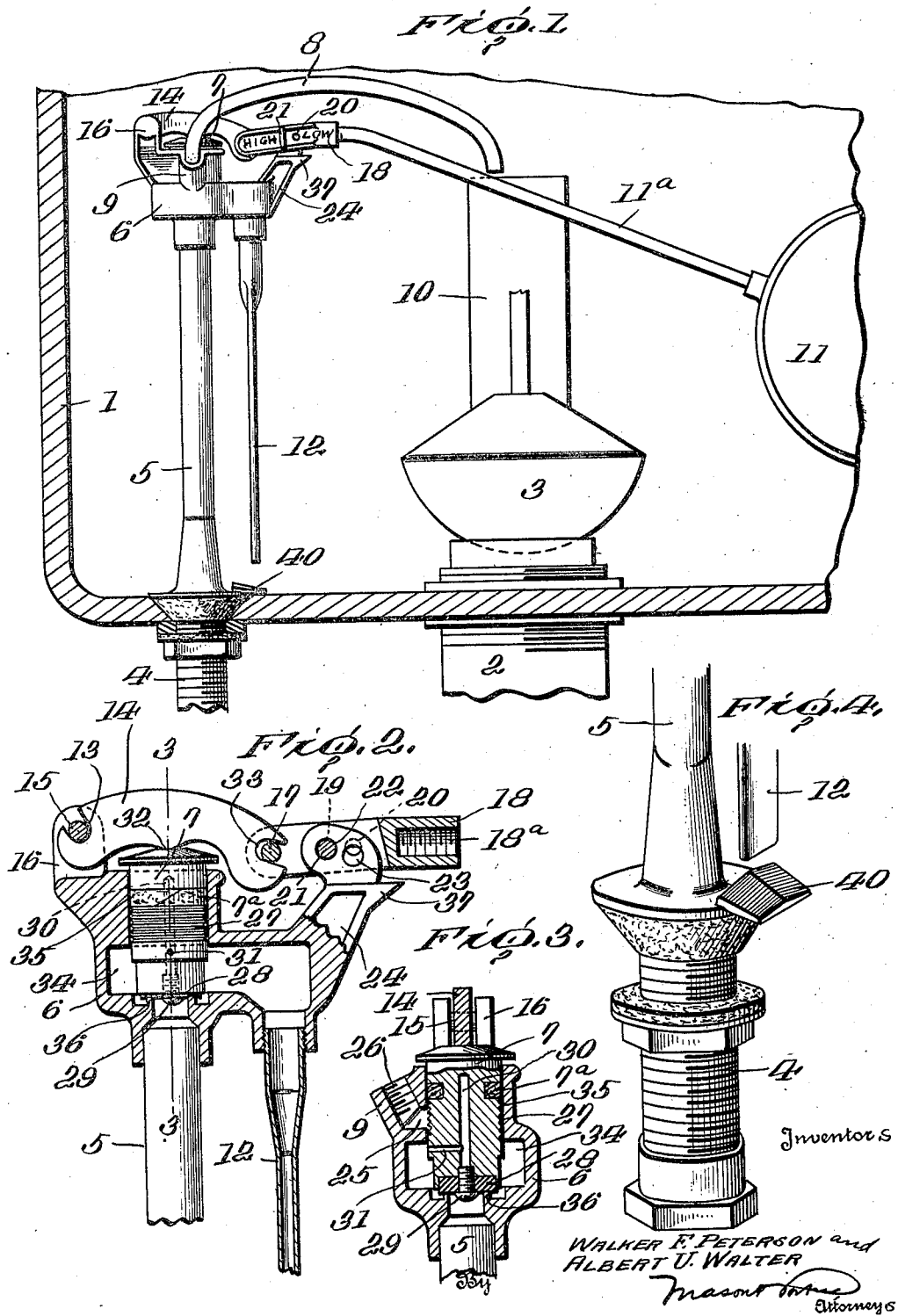
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DISCHARGE VALVE

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DISCHARGE VALVE

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This invention relates to discharge valves, and is especially desirable in ball cocks which are used as float-control discharge valves for establishing liquid levels in tanks.

When, for example, a discharge valve is located between a source of supply and a tank to be filled therefrom, and a flow-retarding device is placed downstreamward of the valve (for quieting the flow therethrough) certain other conditions of noise and operation, particularly with varying pressures may be encountered and must be provided for before quiet and most satisfactory operation can be obtained.

One feature of the invention is the provision of a means to prevent chatter of the valve at final closing.

With this and other features as objects in view, as will appear in the course of the following specification and claims, an illustrative form of employing the invention is set out on the accompanying drawing, in which:

Figure 1 is a conventionalized view of a flush tank for a toilet, with a valve of the present nature employed therein.

Figure 2 is an enlarged view of the upper end of the supply pipe, with parts thereof in section.

Figure 3 is a section substantially on line 3—3 of Fig. 2.

Figure 4 is a perspective view of the lower end of the supply pipe, showing a silencing device thereon.

In the drawing, a conventional flush tank 1 of the type used for toilets is illustrated as having a pipe connection 2, commonly called a "tail piece," by which it is connected to the closet bowl. The upper end of this flushing pipe is normally closed by the flush valve 3 which may be operated for flushing by the usual trip lever (not shown). The flush tank is to be filled with water to a predetermined level, this water being introduced from a water supply connection 4 through the so-called supply pipe 5 which extends upwardly in the flush tank and has at its upper end, a ball cock body 6 rigidly secured by sweating thereto. In the body 6 is vertically movable the valve closure member 7.

Further, water is delivered through a so-called refill tube 8, secured in a threaded boss 9 of the ball cock body 6 and extending over for discharge into the overflow tube 10. Hence, the water from the refill tube 8 is passed by the overflow tube 10 to the bowl.

The valve closure member 7 is actuated by the float 11, which is connected by a float stem

11a and the linkages described hereinafter, for forcing the valve closure member 7 downwardly and into closed position when the water level in the tank has risen to the predetermined level.

The water which passes the valve closure member 7 in an open position of the latter, moves partly through the refill tube 8 while the bulk thereof is discharged through the so-called drop tube or discharge tube 12 into the tank. The discharge tube 12 is illustrated as being a flattened tube of the type described and claimed in our Patent 2,089,223, granted August 10, 1937, and functions as a flow retarding device. However, any other type of flow retarding device may be incorporated in the device downstreamward of the seat.

In the form illustrated in the drawing, the ball cock body 6 is formed integrally with a bifurcated bracket 16 which forms a yoke having a pivot pin 15 extending between the bifurcations. An actuated lever 14 is provided at one end with a slot 13 which slidably engages the pivot pin 15 in establishing a substantially fixed fulcrum for movement of the actuated lever 14. The actuated lever 14 extends above the valve closure member 7, and is formed with a downwardly projecting rounded portion 32 which engages the upper surface of the valve closure member. The other end of the actuated lever 14 has a slot 33 for receiving the pin 17 of the actuating lever end structure 18.

The actuating lever comprises the end structure 18 which usually has internal threads 18a for receiving the threaded end of the float stem 11a, or is otherwise secured thereto.

In this illustrated form, also, the ball cock body 6 has a further bracket 24 which is shown as diametrically opposite the bifurcated bracket 16, and as having an angularly directed upper end which is received between bifurcations of the end structure 18 of the actuating lever, and is fitted thereto so that the actuating lever is free to move, but is limited in its rocking about a vertical axis. The upper broadened end of the bracket 24 is provided with a plurality of apertures 22, 23; while the bifurcations in the end structure 18 have a similar number of apertures 19, 20, these apertures being spaced at different distances from the pin 17. A pivot pin 21 may be passed through selected apertures, that is, through apertures 19, 22 or 20, 23. It is preferred to form the pivot pin with threads on one end, and to thread the openings 19, 20 in one of the bifurcations, as a means of securing the parts in the desired relative positions.

The bracket 24 has a projection 37 which operates as a stop for limiting the movement of the end structure 18.

It will be noted that the apertures 22, 23 are not arranged with their axes in a horizontal plane, but with the outer aperture 23 below the aperture 22, so to speak: this arrangement is effective in association with the stop 37, to prevent disengagement of the levers in the maximum positions of operation thereof, while assuring limited sizes of the parts and freedom of operation of the pin 17 in the slot 33 so that the levers operate smoothly even in the extreme positions of movement.

The actuated lever 14 is in effect self-centering. The direction of the walls of the slot 13 is upward, and the angle A between the direction of the slot 13 and the axis of the pivots 15, 17 is illustrated as being about 135°, and may be at any angle substantially greater than 45°, and substantially less than 180°. Since the water pressure operating upon the valve closure member 7 causes a tendency toward upward movement thereof, this force is transmitted to the actuated lever 14, and the aforesaid positioning of the slot 13 causes the lever to assume and maintain a position relative to its pivot 15, by which a substantially constant fulcrum distance is preserved for the projection 32 and the slot 33.

In ball cocks where a device is incorporated down-streamward of the seat for the retarding of the flow, it is necessary to provide the bypass connection for the refill below such retarding device, or take it off the main chamber of the ball cock, where there is a substantial pressure. As many retarding devices are incorporated in the discharge tube, it is difficult to make the connection for the refill water down-streamward of the retarding device. In such cases, the connection for the refill is ordinarily taken off the main chamber and throttling means for controlling the flow of refill are provided. Such throttling means generally causes a great deal of noise. In the present invention the control of the flow of refill is provided in a simple, inexpensive and quiet manner.

As shown in Fig. 3, the side boss 9 of the valve closure body 6 has a threaded cavity 26 for receiving the refill tube 8, this cavity being joined by the port 25, with the passage formed in the valve body 6 for receiving the valve closure member 7. This passage extends from the seat 36, which is engaged by the usual rubber washer 28 of the valve closure member 7 and in shutting off the flow from the supply pipe 5. Immediately adjacent the seat, the ball cock body has a chamber passage 34 which leads laterally and has a downward threaded opening for receiving the upper end of the drop tube 12. From the upper surface of the chamber 34, the passage 35 is of uniform diameter and loosely corresponds to the valve closure member 7.

Above the port 25, the valve closure member is provided with a groove for receiving the sealing ring 7a. Below this sealing ring 7a, the valve closure member 7 is provided with grooving 27 to form collector rings for carrying the refill water to the port 25. These grooves are preferably formed as a plurality of endless peripheral grooves, or as helical grooves as formed by cutting a thread on the valve closure member 7 at the proper points thereof. By construction, the valve closure member 7 has a certain amount of play for mechanical necessities, and this construction of the grooves assures a proper supply

of water to the refill tube, regardless of the eccentric position actually occupied by the valve closure member 7.

The quantity of this flow is dependent on the cross sectional area of the grooves opposite the port 25 or, in case a single small groove is used, upon the cross sectional area of said groove.

In particular, it is preferred to form these grooves by a V-threading tool which provides the successive peripheral grooves or thread grooves at a spacing of, say, one thirty-second of an inch, with the individual grooves being cut to a depth of ten thousandths of an individual width of eleven thousandths at the outer surface of the valve closure member 7. Thus, flat portions or lands having a width of about twenty thousandths of an inch are provided between the adjacent grooves, which maintain a good bearing surface between the closure member 7 and the passage 35.

In the preferred form, the seat washer 28 is retained in the lower cavity of the valve closure member 7 by a screw 29. The threaded hole for receiving this screw is, however, continued upwardly to provide an air chamber 30 which is located at the axis of the valve closure member 7, and extends to within a short distance of the upper surface thereof. This air chamber may be formed by drilling a hole of approximately 0.120 inch diameter. Communication between this air chamber and the chamber 34 is secured by a cross hole 31 located just above the upper end of the screw 29. This hole 31 may be about one sixteenth of an inch in diameter, so that turbulence in the chamber 34 will not displace the air from the chamber 30.

Disassembly is easily accomplished by unscrewing the pivot pin 21, and tilting the end structure 18 so that the pin 17 may be slid out of the slot in the actuated lever 14. This actuated lever 14 is then rocked in a counter-clockwise direction (Fig. 2) and similarly separated from the pin 15. The assembly of the closure member 7 may now be withdrawn. It is now possible to inspect and replace the seat washer 28, if necessary. The parts can now be reassembled by reverse operations.

The distance between the pins 15 and 17, when the axes of pivots 15, 17 and 21 are in a plane, is sufficiently greater than the distance between the slots 13 and 33 to permit free movement; and the lengths of the slots are made great enough to prevent disengagement from the pins at the extreme positions of normal movements of the parts.

When the illustrated ball cock, for example, is in operation, the flushing is accomplished by raising the flush valve 3 in the usual way, so that the contents of the flush tank are discharged. The float 11 sinks and therewith causes a counterclockwise rocking of the actuated lever 14, so that the valve closure member 7 can rise under the water pressure, and water flows past the valve seat 26. The major part of this water moves through the discharge chamber 34 and the drop tube 12, and enters the flush tank. A minor part of the water escapes upwardly along the wall of the closure member 7 and enters the collector grooves 27, and thus passes to the port 25 and through the refill tube 8, being discharged into the closet bowl during the period of operation of the ballcock. When the flush tank has completed its discharge, the discharge valve 3 becomes seated again, and thereafter the water entering the tank begins to restore the liquid con-

tents of the same to the predetermined water level. After the valve 3 closes, syphoning action from the bowl may remove so much water that a further quantity must be introduced, and this is accomplished by the action of the refill tube 8, until the ballcock is closed again.

As the water level rises, the float 11 is raised with it, and operates through the lever system to produce a downward movement of the valve closure member 7. Upward movement of the float 11, as the water rises in the tank, is resisted by the pressure in the chamber 34 (due to retarding device downstreamward) acting on the valve member 7. Therefore, with the proper leverage adjustment, a substantial but not excessive portion of the float 11 is submerged before any movement occurs and remains so submerged until the valve member 7 starts to reduce the flow through the seat and consequently the pressure in the chamber 34. When this occurs, the pressure against the valve member 7 is reduced and there is sufficient buoyancy in the float 11 to rise almost instantly and a sufficient distance to effect final closure of the valve member on the seat without a further rise of the level of the water in the tank.

If the leverage is sufficiently great to effect closure at the higher pressures, it is so great that sufficient submergence of the float 11 in the initial stages and later utilization of this extra submergence in a quick final closure, is not obtained at lower pressures. As pressures of 20 to 125 pounds per sq. in. are ordinarily encountered and as the adjustment in leverage by changing the length of the float arm 11a is limited because of the size of the tank and the other fixtures therein, it is necessary to provide leverage adjustment in the linkage of the ball cock in order to obtain this quick or snap shut-off over this wide range of pressures. Such quick or snap shut-off is desirable not only in eliminating the noise, but also the wire drawing at and corrosion of the seat which occurs during the final closing period of the valve and which, in the ordinary valve, is of long duration. It will be noted that the quick or snap shut-off can not be obtained in a ball cock unless a flow-retarding device, downstreamward of the seat, is incorporated therein.

It will further be noted that, by moving the pivot pin 21 from the innermost apertures 19, 22 to the outer apertures 20, 23, the leverage of the float 11 upon the actuated lever 14 is materially reduced. We have found that when this reduction is about 33%, satisfactory operation can be obtained over the above range of pressures.

Chatter quite frequently occurs in ball cocks and other valves as the stem approaches its seat to close the valve. One cause of chatter is due to the momentum of the high velocities of the water in the hush tube tending to pull the valve off its seat as the valve closes. We have found that by incorporation of an air chamber in or connected to any point of the main chamber 34 of the ballcock, that this chatter is eliminated. This air chamber can be quite small and its position in or the location of its connection to the main chamber 34 is immaterial. Because of the high turbulence in the chamber 34, it is difficult to prevent the air from being washed out of the air chamber. This tendency can be materially reduced by making the connection between the air chamber and the main chamber 34 relatively small. The location of this air chamber in the

stem as illustrated in Figure 2 is simple, inexpensive and very effective.

As shown in Fig. 4, it is preferred to incorporate a further silencing device as a part of the valve assembly, to overcome noises created during the refilling period. In our prior Patents 2,037,737; 2,089,223 and 2,089,224, we have described devices for controlling the flow of liquids with substantial quietness. We have found, however, that noises may arise at other points of the system altho these noises are to be distinguished from those produced in retarding or throttling liquids under the conditions stated in said patents. For example, when a jet of water at high velocity encounters a surface, noise is produced. The velocity referred to is not that at the point of discharge from the nozzle, but at the point of impact with the surface. Although the velocity of the discharged stream decreases rapidly, as the jet mixes with water already present in the chamber, yet space and constructional considerations often require that the drop tube 12 shall open downwardly, and that its lower end shall be but a small distance from the floor of the tank.

According to the present invention, noise at this point is substantially reduced and usually eliminated by providing an impact surface of a definite character for receiving the jet. The character of this surface is of primary importance in determining the critical velocity of the jet at which the noise occurs.

It is preferred to provide this impact surface at a slight angle to the direction of the jet, and to provide it with a roughening which causes an action in the nature of diffusion, so that the jet is broken up into innumerable fine streams which dissipate into the main body of water without noise. The surface of castings as ordinarily produced is not sufficiently rough or sharp in texture, so that the noise can be eliminated thereby: and this is particularly true after the casting has been rumbled or sand blasted in the usual way. As pointed out in our prior patents, various factors influence the critical velocity, above which noise occurs: and reference is made thereto for a discussion of these factors.

It has been found, however, that if the impact surface is "roughened," in that it has elevations and depressions throughout its effective area of the nature of the surface of ordinary sand paper of the types known commercially as #3/0 to #3, or similar to those resulting from cutting full or partial depth grooves with the adjacent grooves spaced 16 to 80 to the inch, or similar to the surface of a single or double cut file with a coarseness from bastard to dead smooth, or a knurled surface of like spacing, quietness is attained with all normal supply pressures of water while employing the structure illustrated in the drawing: and it is obvious this quietness can likewise be attained with similar arrangements.

It has been found that the minimum depth of the depressions between the elevations should not be less than 0.005 inch.

In the illustrated form, the surface shown is provided by a member 40 formed integrally with the casting which provides the water supply pipe 3, and having an upper surface which inclines at a slight angle in each direction from the center of length of this piece 40, and having a plurality of grooves of the aforesaid character formed therein and extending from this center line. The piece also is inclined so that this center line is disposed at an angle of about 80° to the

axis of the drop tube 12. In this illustrated form, the roughening is shown as a series of parallel ribs and grooves spaced 20 ribs to the inch, with the grooves having a depth about 0.020 inch.

It is obvious that the invention is not limited solely to the illustrative form shown, but that it may be employed in many ways within the scope of the appended claims.

We claim:

1. A ball cock assembly having a valve body 10 providing a valve seat, a discharge chamber for receiving water which passes said valve seat, a bore above said chamber communicating with the chamber, and a lateral port from said bore; a refill tube communicating with said lateral 15 port; a valve closure member movable in said bore for closing and opening passage through said seat, said closure member loosely fitting the bore between said chamber and said port so that pressure in said chamber is effective to 20 cause water to move toward said port in the restricted passageway between the bore and closure member and is restricted in its said movement by the presence of the closure member in said bore, said closure member having axially 25 spaced grooves therein presented opposite said port in the opened position of the ball cock for providing collector rings for bringing water to said port, sealing means on the closure member 30 between said port and the open end of the bore, and float-controllable means for moving said closure member.

2. A ball cock assembly having a valve body 35 providing a valve seat, a discharge chamber above said valve seat for receiving water which passes the same and having a discharge connection, a bore communicating with and extending upwardly from the chamber independently of the discharge connection, and a lateral port 40 from said bore; a refill tube communicating with said lateral port; a valve closure member movable in said bore for closing and opening a passage through said seat, said closure member loosely fitting the bore between said chamber and port and having axially spaced grooves 45 therein presented opposite said port in the opened position of the ball cock for providing collector rings for bringing water to said port, said closure member including means closely fitting the 50 bore above said port for preventing leakage along said bore, and float-controllable means for moving said closure member.

3. A ball cock assembly having a valve body 55 providing a valve seat, a discharge chamber for receiving water which passes said seat, a conduit for delivering water from said chamber and including flow-retarding means having the effect of creating back pressure in said discharge chamber while the valve seat is open, a bore 60 communicating with the chamber, and a lateral port from said bore; a refill tube communicating with said port; a valve closure member movable in said bore for closing and opening passage through said seat, said closure member loosely fitting the bore between said chamber and said 65 port so that pressure in said chamber is ef-

fective to cause water to move along said bore toward said port, said closure member having axially spaced grooves therein presented opposite said port in the opened position of the ball 5 cock for providing collector rings for bringing water to said port; and float-controllable means for moving said closure member.

4. A ball cock assembly having a valve body 10 providing a valve seat, a discharge chamber for receiving water which passes said valve seat, and a bore communicating with the discharge chamber; a conduit for delivering water from said chamber and including flow-retarding 15 means having the effect of creating back pressure in said discharge chamber while the valve seat is open, a valve closure member movable in said bore for closing and opening water passage at said seat, said closure member having an air 20 chamber located wholly therein, and a passage from said air chamber which is continuously open to said discharge chamber for cushioning changes in the water pressure in said discharge chamber; and means for moving said valve closure 25 member.

5. A ball cock assembly having a valve body 30 providing a valve seat, a discharge chamber for receiving water which passes said valve seat, and a bore communicating with the discharge chamber, a valve closure member movable in said bore 35 for closing and opening water passage at said seat, said valve closure member including a sealing washer at its end for presentation against the valve seat for closing the same, said closure member having a substantially axial bore 40 providing a closed air chamber located wholly within the closure member and a passage from said second named bore which is continuously open into said discharge chamber for cushion- 45 ing changes in the water pressure in said discharge chamber, the lower end of the second named bore being threaded, a screw for securing said washer and engaged in the threaded end of the second named bore for closing the 50 lower end of the air chamber; and means for moving said valve closure member.

6. A valve assembly for controlling the flow 55 of water, comprising a valve body providing a valve seat, a reciprocable valve closure member coacting with said seat, a discharge chamber for receiving water which passes said closure member, means for closing the closure member 60 against the seat, a flow-retarding device for restricting the flow of water from said discharge chamber and in which at the full rate of flow the water moves with a momentum effective to 65 produce chatter of the member upon the seat during the closing thereof by said means, and means providing an air chamber separate from the discharge chamber and connected therewith by a restricted orifice near the bottom of the air chamber and thereby constructed and arranged to be effective for eliminating chatter of said valve closure member upon said seat during the operation of said closing means.

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