Nov. 14, 1961 J. J. FILLIUNG ET AL 3,008,682

FLUSH VALVES

Filed July 10, 1959

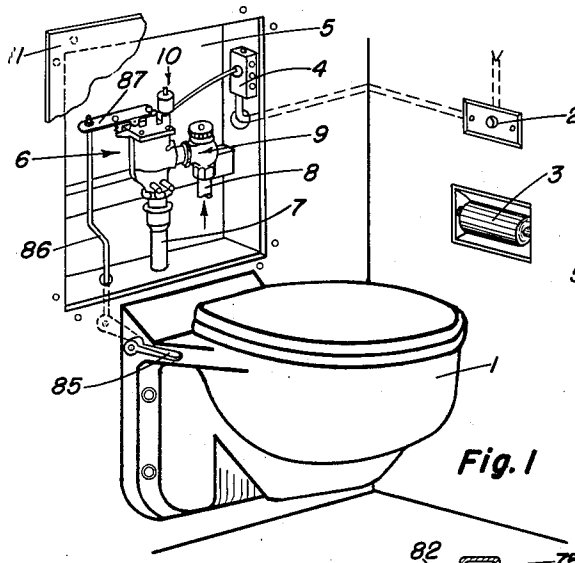


Fig. 1

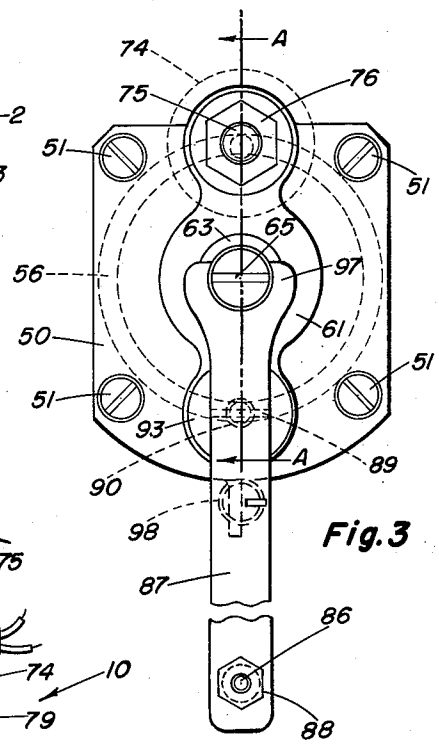


Fig. 3

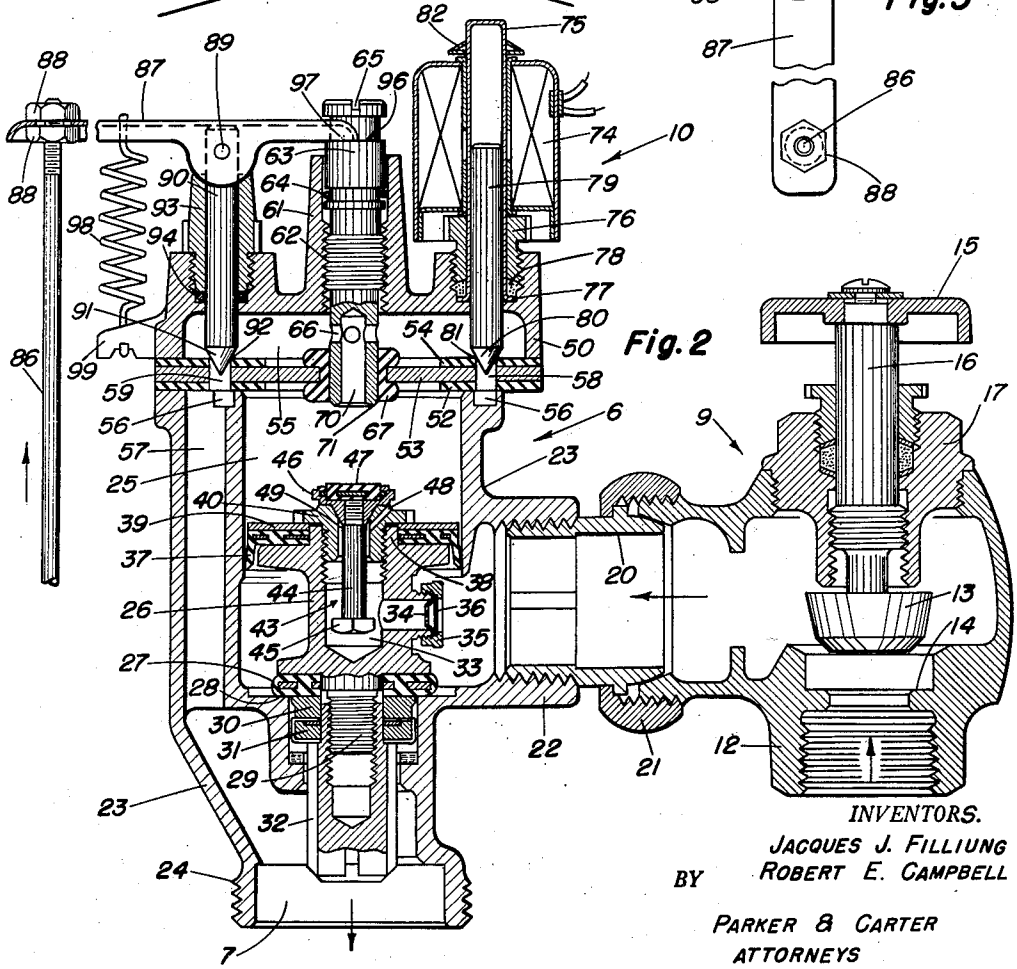


Fig. 2

INVENTORS.
JACQUES J. FILLIUNG
ROBERT E. CAMPBELL

BY PARKER & CARTER
ATTORNEYS

United States Patent Office 3,008,682 Patented Nov. 14, 1961

3,008,682

FLUSH VALVES

Jacques J. Filliung, Chicago, and Robert E. Campbell, Arlington Heights, Ill., assignors to Sloan Valve Company, Chicago, Ill., a corporation of Illinois

Filed July 10, 1959, Ser. No. 826,252
7 Claims. (Cl. 251—19)

This invention relates in general to flush valves for water closets and other plumbing fixtures, and the general object is to design a new and improved flush valve and operating mechanism therefor suitable for use in the average small residence where only relatively low rates of flow are obtainable from the water supply piping.

A further object is to provide a new and novel arrangement for causing the operation of a flush valve by remote control.

Another object of the invention is to design a new and improved flush valve in which novel electrically operated means are employed to activate the flush valve and in which manual operating means are arranged for optional operation independent of the electrically operated means, together with means for adjusting the amount of water flushed by the flush valve; all in a single unitary structure.

A further object is to design an improved flush valve closet combination suitable for a small home in which the flush valve is concealed in the wall of a toilet room, thereby conserving space; in which a wall-hung water closet bowl is provided, permitting easy cleaning of the floor; and in which a remote electrical switch or a manual lever is provided actuated by the user for operating the flush valve to flush the closet bowl.

Another object is to design a new and improved flush valve for the purpose stated, in which electrical actuating means and manual operating means, together with a volume adjusting means, are all supported as a compact unitary structure upon the cover or end closure of a flush valve, thereby conserving space, simplifying manufacture and facilitating assembly. A further advantage in arranging the above elements as a unit upon the supporting cover is that it enables a common pressure chamber and a common relief valve passage to be utilized for the two independent operating means.

With the above and other objects in view, the invention consists in certain novel features of construction, operation, arrangement of parts and elements, all of which will be hereinafter more fully described, claimed, and illustrated in the accompanying drawing disclosing a preferred embodiment.

The use of direct connected flush valves for water closets in small residences has not been entirely practical heretofore because only small sized piping is installed to bring in water from the street main, and the rate of flow available from this small piping system is only about twelve gallons a minute, while the conventional water closet requires around twenty-five gallons per minute for a successful flushing operation. As a consequence, the well known direct connected flush valves have been largely limited to multiple apartment buildings and other larger installations where larger piping is installed. However, a flush valve suitable for small homes that has been commercially available is disclosed in Patent No. 2,295,871, issued September 15, 1942, to William E. Sloan and John I. Bellamy and to which reference may be had for further details of construction and operation insofar as it relates to the present invention. A water closet bowl also commercially available for use in small homes with a flush valve as pointed out above is disclosed in Patent No. 2,344,649, issued March 24, 1944, to William E. Sloan. This water closet is capable of being satisfactorily and reliably flushed when supplied with a low rate of flow of around twelve gallons a minute, and therefore

may be connected up with the flush valve of the present invention for reliable operation.

Referring now generally to the drawings, they show sufficient views of a flush valve toilet room installation to enable the invention to be readily understood.

FIG. 1 shows a diagrammatic view of a typical small home installation of a closet bowl and associated flushing equipment showing the invention;

FIG. 2 is a cross-sectional view taken along the line A—A of FIG. 3 of the improved flush valve, including the throttle valve, and the combined electrical and manual operating means; while

FIG. 3 is a top view of the improved flush valve.

Referring now to FIG. 1 of the drawings, reference character 1 shows generally a water closet bowl of the type disclosed in the aforesaid Patent No. 2,344,649, except that it may be suitably supported upon the wall rather than by a pedestal mounting on the floor. This type of wall mounting is desirable in small homes because it conserves space in the toilet room and the floor may be more easily cleaned. In accordance with the invention, the closet bowl 1 may be flushed by simply pressing the push button of an electrical switch indicated at 2 and located preferably adjacent the toilet paper roll 3 where it is conveniently accessible and requires very little effort to actuate it as when small children use the toilet. The push button 2 is connected by suitable electric conduit to a source of electrical current and to conduit box 4 located in an access space 5 formed in the wall of the toilet room directly behind the closet bowl 1, as shown. The flush valve indicated generally at 6 is suitably supported in the access space 5, as shown, and has its outlet flush connection 7 connected to the water closet 1 while the water supply inlet connection 8 is connected to the throttle valve 9 and this in turn to the flush valve inlet. An electrical connection is made between the conduit box 4 and the electric operating means indicated at 10 on the flush valve. The access space 5 is preferably closed off by a thin access panel 11 flush with the wall surface so that all of the mechanism is concealed in the wall except the push button 2, thereby conserving space in the toilet room, preventing tampering with the mechanism, and producing quieter operation.

In FIG. 2 of the drawings there is indicated generally at 9 the shut-off and throttle valve, the purpose of which is to throttle the flow of water through the flush valve to the proper amount to suit the closet bowl. This valve 9 includes a body having a threaded inlet water supply connection 12 and a valve member 13 adjustable with respect to its valve seat 14 by the wheel handle 15 attached to threaded valve stem 16 in bonnet 17. This throttle valve 9 is preferably designed to be capable of quietly throttling the rate of water flow and hold it to approximately twelve gallons per minute when the inlet water pressures are relatively high, without introducing line and water noises as a result of such throttling. Such a quiet valve is illustrated in Patent No. 2,334,686, issued November 16, 1943, to which reference may be made for further details.

The throttle valve 9 is connected by tailpiece 20 and coupling nut 21 to the flush valve 6 through its threaded inlet 22 formed in the side of the flush valve body 23. At its lower end, flush valve 23 has a threaded outlet 24 for attachment of a suitable discharge pipe leading from the outlet 7 into the closet bowl 1 as seen in FIG. 1. Inside the flush valve casing 23 there is formed a pressure chamber 25 within which a piston 26 is slidably disposed carrying a main valve seat 27. Seat 27 has seating engagement with the seating surface 28 surrounding the outlet end of the flush valve casing to close off the flow of water through the flush valve. The main seat 27 is maintained centralized with piston 26 by the

depending threaded stem 29. Assembled together with the seat 27 is the pre-entrant throttle plug 30, the silencing plug 31, and the winged guide member 32 threaded upon the lower end of stem 29, all for the purpose of gradually closing off the flow of water and producing quiet action.

The piston 26 above the main seat 27 has a hollow interior passage 33, one portion of which leads to the by-pass or metering orifice 34 in the side of the piston and through which water from the supply line is allowed to slowly refill the upper pressure chamber 25 after the flush valve has been opened. The disc having the by-pass 34 therein is clamped in place by the nut 35 which also clamps the fine screen 36 in front of the by-pass on the side of the piston 26. At its upper end piston 26 is provided with a molded rubber cup or packing 37 which defines the pressure or control chamber 25 of the flush valve. The packing 37 is centrally located with respect to the piston body 26 by the upstanding lip 38 around the top end of the central opening through the piston. A top plate 39 serves to stiffen the cup rubber 37 and both are held in assembled position on the top of the piston 26 by the gland 40 threaded into the central piston opening 33.

Located within the piston opening 33 is a limit valve member 43 having a stem 44 with a lower head portion 45 and an upper valve head 46 having a rubber valve seating disc 47 secured thereon. To permit water flow from the passage 33 to the pressure chamber 25 a passage 48 is formed in gland 40 and in this connection it will also be noted that the stem 44 is somewhat smaller in diameter than the opening 49 in gland 40 through which the stem 44 extends. The limit valve 43 is adapted to be carried upwardly along with the piston 26 and released from its seating engagement on the valve seat 47 when the piston 26 descends and the limit valve head 45 is engaged by the underside of gland 40. For further details of the specific structure and operation of the parts so far described, reference may be had to the previously mentioned Patent No. 2,295,871.

Referring now specifically to the upper end closure or cover 50 of the flush valve body 23, the mechanism and parts including the present invention indicated generally at 10, are supported by this cover 50 as a unitary structure readily assembled and detachable from the flush valve body 23 by the screws 51 (see FIG. 3).

Arranged between the top of the casing 23 and the cover 50 is a rubber sealing gasket 52 and on top of this gasket is a stiff metal cover plate 53 having a combination sealing and seat forming rubber gasket 54 lying directly on top thereof. Both sealing gaskets 52 and 54 and plate 53 are tightly clamped on top of the valve body by the cover 50 and screws 51 so that no leakage outward can occur. Cover 50 has a secondary pressure chamber 55 formed therein directly over gasket 54 while the top edge of casing 23 has an annular relief passage or groove 56 formed in it directly below gasket 52. Relief passage 56 leads into the vertical relief passage 57 formed in the side of casing 23 and extending downwardly to the outlet 7 below the main valve seat 28. The sealing gaskets 52 and 54 and cover plate 53 have two sets of valve controlled openings 58 and 59 therein connecting the annular relief passage 56 with the secondary pressure chamber 55 in the cover.

Upstanding from the center part of cover 50 is the cylindrical portion 61 internally threaded at 62 and into which the flush valve volume regulating member 63 is screwed. An O ring 64 provides effective sealing between the regulating member 63 and cylinder 61 as the member 63 is adjusted up or down to provide the desired regulation. At its upper end the regulating member 63 has a screw driver slot 65 to facilitate the adjustment of the member 63. Near its lower end and in pressure chamber 55 the member 63 is provided with a series of transverse passages 66 leading into pressure chamber 55 and below these passages a rubber sealing ring 67 around the member 63 provides effective sealing between the passages 66 and the main pressure chamber 25 as the adjusting member 63 is moved up or down. The lower end of adjusting member 63 also has a central opening 70 therein to permit passage of water inwardly to the passages 66 and a limit valve seat 71 surrounds the lower end of opening 70 and is adapted to be engaged by limit valve member 47.

The means for electrically causing the operation of the flush valve 6 consists of a suitable solenoid 74 having a hollow supporting brass sleeve 75 which is clamped on top of the cover 50 by a clamping nut 76 engaging lower flange 77 on the sleeve 75. A suitable leak-proof packing 78 is arranged between the nut 76 and sleeve 75 as shown to prevent the egress of water. Reciprocal within the sleeve 75 is a plunger 79 made of magnetic material having a conical lower end 80 serving as a valve member closed normally on a valve seat 81 formed around relief opening 58 in the rubber gasket 54. The magnetic plunger 79 is actuated upwardly to open valve seat 81 by energization of the coil winding of solenoid 74 and closes by gravity. A spring clip 82 may be slipped over the end of sleeve 75 to hold the solenoid coil 74 thereon and to enable the solenoid to be easily removed by merely sliding it off the top of sleeve 75.

The means for manually causing the operation of the flush valve 6 comprises a lever 85 (see FIG. 1) pivoted to the side of the water closet 1 and having a rear extension piece passing into the toilet room wall, where it is pivotally connected to an extension rod 86 in turn connected to a lever 87 arranged on top of the flush valve cover 50. The extension rod 86 is threaded on its upper end to provide for an adjustment of the coupling nuts 88 to the lever 87 on the rod 86. Lever 87 is pivoted at 89 to a plunger 90 having a conical valve 91 formed on its lower end and normally closed on a valve seat 92 formed around the relief opening 59 in gasket 54. Plunger 90 is reciprocal in a bushing 93 threaded into a boss formed upstanding in cover 50. An O-ring seal 94 prevents leakage outward from the cover and plunger 90. A shoulder 96 on adjusting member 63 provides a fulcrum point at 97 for the forked end of lever 87 so that as rod 86 is pushed upwardly by water closet lever 85, lever 87 pulls plunger 90 upwardly with pivot 89 and opens its valve seat 92. A restoring spring 98 having one end attached to an arm of lever 87 has the other end connected to a projection 99 formed on cover 50. The spring 98 is made strong enough to restore the rod 86, lever 87, and plunger 90 when the lever 85 on the closet bowl is released, assisted by gravity. Opening valve seat 92 releases the pressure in chambers 55 and 25 into the relief passages 59, 56 and 57, as will be pointed out.

The use and operation of the invention will now be explained. The flush valve 6 is normally in its illustrated closed position, being held so by the supply line pressure, transmitted to the pressure chamber 25 from the inlet of the flush valve, through by-pass opening 34, central passage 33 in the piston 26, and passageway 48. The pressure in the chamber 25 holds the piston seating member 27 down tight on seat 28 in spite of the upward pressure in the supply chamber below the piston, because the pressure area on top of the piston is much greater than the pressure area below. Now when electric push button 2 is depressed, electric current is caused to pass into the coil windings of solenoid 74 energizing the same and projecting armature plunger 79 upwardly. As a result, the relief valve 80 is opened from relief valve seat 81 and the pressure in chambers 25 and 55 is lowered by the outflow of water through passages 70 and 66 in adjusting member 63, chamber 55, open relief valve seat 81, opening 58, and thence out through annular passageway 56 and vertical passage 57 down the side of the flush valve to the outlet 7.

As a result of the lowering of the pressure in chamber

25, piston 26 rises upward because of the water pressure which is exerted below the piston from the line supply. Main valve member 27 opens from seat 28 slowly to permit quiet opening and render the quiet screen guide 31 to be effective and refill head 30 to be withdrawn from the throat of the flush valve outlet. The discharge area through the flush valve is controlled by the space around the wings of the guide stem 32 and the throttle valve 9 is set in some partially throttled position which will reduce the rate of flow to the desired value of about twelve gallons per minute. When the piston 26 reaches the top of its stroke, shortly after push button 2 is depressed, the limit valve head 46 closes its valve member 47 upon the seat 71 on the end of regulating member 63. When this occurs, the cover chamber 55 is completely isolated from the pressure chamber 25 and further escape of water is prevented, independent of whether or not the push button 2 is held actuated or released. The limit valve 47 is held up by pressure against its seat and prevents prolonged flushing when the push button is held depressed as will be pointed out.

Upon the seating of the limit valve 47, the slow inflow of water to the pressure chamber 25 through by-pass opening 34 results in the slow refilling of the pressure chamber 25 and consequent slow descent of the piston 26 to eventually return the seating member 27 into seating engagement around the main valve seat 28 and shut off the water flow. The limit valve 47, however, remains seated for a time even after the push button 2 is released so the downward movement of the piston is not affected. The closing of the main valve seat 27 is accomplished in a quiet manner and the refill provisions take place as is described more completely in the aforementioned Patent No. 2,295,871.

When the push button is released, the electric current is disconnected from solenoid 74 deenergizing the same and resulting in plunger 79 dropping down to close its seat 81 and closing off the pressure chamber 55 completely, preventing further escape of water therefrom. After the relief valve 81 is closed and the piston descends, the limit valve 47 is pulled away from its seat 71 just before the main valve 27 finally seats. This is accomplished by the head 45 being forcibly pulled downward due to its engagement with the bottom of gland 40, whereupon the limit valve member 43 drops down to the position shown in FIG. 2. On the other hand, if the push button 2 is held depressed (and relief valve 81 held open), when the head 45 is pulled downward, the descent of the piston is arrested. This arrested movement occurs when seating member 47 is only very slightly separated from the seat 71. When this condition obtains, the resulting escape of water from the pressure chambers 25 and 55 through open relief valve 81 lowers the pressure in chamber 25 just sufficiently that the piston 26 remains stationary. The flush valve is thus held in its almost closed position with water flowing therethrough at a small trickle until the push button is released.

The quantity of water delivered by the flush valve may be readily regulated by turning the regulating member 63. Turning the end 65 in a direction to raise it, raises the limit valve seat 71 on the lower end for the limit valve 43. With this adjustment made, the piston 26 of the flush valve rises further before the limit valve 47 comes up to its seat 71 to terminate the outflow of water from the upper chamber 20. As a result, the piston 26 has a longer distance to travel in its downward movement and a corresponding larger quantity of water is delivered. When the quantity of water is higher than desired to meet the requirements of the water closet bowl, the regulating member 63 is turned downward, resulting in a shorter downward travel of the piston and less quantity of water being delivered to the closet bowl.

The foregoing flushing operation of the flush valve which has been described as having taken place when the electric push button 2 was depressed, will occur exactly the same when the manual operated lever 85 on the closet 1 is depressed by the user of the toilet. In this event, however, the plunger 90 is lifted upwardly by the linkage 86 and lever 87 to open its valve seat 91 and cause the pressure in chamber 25 to be lowered, resulting in the operation of the piston 26.

It will be noted that the annular relief passage 56 in the top of the valve body (see FIG. 3) serves as a common passage for both relief valves 80 and 91 leading to the vertical relief passage 57. The secondary pressure chamber 55 formed in the cover 50 directly on top of the valve body, is also common to both relief valves 80 and 91. This arrangement simplifies manufacture and enables the parts to be more compactly arranged. By utilizing the cover 50 of the flush valve 10 as a common support for the solenoid 74, the adjusting member 63, and the manual operating lever 87, a more convenient, compact and easily assembled unitary structure has been devised, facilitating the electrical connection to the solenoid 74 and the mechanical linkage to the lever 87.

With the provision of both the remote control operation of the closet bowl 1 by the electrical push button 2, and the manual operation by lever 85, either one may be optionally selected if both are connected up. In the event that it is desired that only the manual lever is to be used in the installation, the solenoid 74 is left off or simply slid off the sleeve 75 and removed along with the electrical cord and plug inserted in conduit box 4, without affecting the relief valve member or plunger 79. Relief valve member 80 remains seated by gravity, and because the pressure in chamber 55 is on the member tending to hold it seated on seat 81.

In case only the remote electrical operation is desired, the lever 85 and associated link rod 86 are not installed or can be easily removed. A decided advantage in providing both the electrical as well as the manual control of the flush valve, is that failure of one control will still enable the closet bowl to be flushed. Many times the electrical supply current to a home is disrupted rendering the solenoid 74 inoperative, whereas wear and tear over a period of years of manual operation may cause the linkage 86 and levers 85 and 87 to wear out or fail. In either event, the other flush valve operating means could then be employed to maintain the flushing action effective.

What is claimed is:

1. In a flush valve, a casing having a main chamber therein with an inlet and an outlet, a main valve member in said main chamber for controlling water flow from said inlet to said outlet, a cover for said casing, a cover plate arranged between said cover and the top end of said casing, the portion of said main chamber between said main valve member and said cover plate comprising a main pressure chamber for holding said main valve member closed upon said outlet, said cover having a secondary pressure chamber formed therein above said cover plate, a manually operated relief valve and an automatically operated relief valve, both being arranged in said secondary pressure chamber, said cover plate having a vertical relief passage therein for each relief valve and being closed thereby, means forming a common relief passage extending from both of said relief valve passages, the operation of either of said relief valves releasing the pressure in said main and secondary pressure chambers into said common relief passage to permit the operation of said main valve member, and an adjusting member extending from outside said cover through said secondary pressure chamber and said cover plate, and into said main pressure chamber, said adjusting member adjusting the extent of movement of said main valve member, said adjusting member having openings therein affording passage from said main to said secondary pressure chambers.

2. In a flush valve, a casing having a main chamber therein with an inlet and an outlet, a main valve member in said main chamber for controlling water flow

from said inlet to said outlet, a cover for said casing, a cover plate arranged between said cover and the top end of said casing, the portion of said main chamber between said main valve member and said cover plate comprising a main pressure chamber for holding said main valve member closed upon said outlet, said cover having a secondary pressure chamber formed therein above said cover plate, a manually operated relief valve and an automatically operated relief valve, both being arranged in said secondary pressure chamber, said cover plate having a vertical relief passage therein for each relief valve and being closed thereby, a common relief passage extending from both of said relief valve passages, the operation of either of said relief valves releasing the pressure in said main and secondary pressure chambers into said common relief passage to permit the operation of said main valve member, and an adjusting member extending from outside said cover through said secondary pressure chamber and said cover plate into said main pressure chamber between said relief valves, said adjusting member adjusting the extent of movement of said main valve member, said adjusting member having end and side openings therein affording passage from said main to said secondary pressure chambers, the end opening in said adjusting member being closed by said main valve member when operated whereby pressure in said main pressure chamber may again be built up.

3. In a flush valve body having a main valve member therein for controlling water flow therethrough and having a main pressure chamber therein, a cover for said flush valve body having a secondary pressure chamber therein, a relief valve member on said cover and extending through the same into said secondary pressure chamber, an adjusting member in said cover having a water passage therein extending between said main and said secondary pressure chambers, said valve body having a relief passage therein controlled by said relief valve whereby the pressures in said main and secondary pressure chambers are reduced when said relief valve opens said relief passage to cause said main valve member to be operated, said adjusting member on said cover having its lower end extending through said cover and into said main and secondary pressure chambers, said adjusting member regulating the extent of operation of said main valve member by engagement of said main valve member with the lower end of said adjusting member, a lever pivotally attached to the top end of said relief valve member, one end of said lever engaging the top end of said adjusting member as a fulcrum point, a manually operated means connected to the other end of said lever for actuating said lever to open said relief valve member, a second relief valve member on said cover extending through the same into said secondary pressure chamber and also controlling said relief valve passage, and automatic means for operating said second relief valve, said relief valve members being arranged diametrically opposite one another on said cover and with said adjusting member between them, said relief valve members and said adjusting member being supported on said cover and removable therewith as a unit from said valve body.

4. In a flush valve body having a main valve member therein for controlling water flow therethrough and having a main pressure chamber therein, a cover for said flush valve body having a secondary pressure chamber therein, a cover plate arranged between said cover and the top end of said valve body, a separate sealing gasket arranged on both sides of said cover plate, means defining a water passage connecting said main pressure chamber with said secondary pressure chamber, said valve body having an annular relief passage formed in the top end thereof below the lower gasket, means forming two vertical relief passages extending through said gaskets and said cover plate connecting said annular relief passage with said secondary pressure chamber, and a pair of relief valve members each having a valve seat arranged in said upper gasket around one of said vertical relief passages, said relief valve members controlling the operation of said main valve member independent of one another, the opening of said relief valve seats causing the pressure in said main and secondary pressure chambers to be exhausted into said annular relief passage whereby said main valve member is operated.

5. In a flush valve body having a main valve member therein for controlling water flow therethrough and having a main pressure chamber therein, a cover for said flush valve body having a secondary pressure chamber therein, a cover plate arranged between said cover and the top end of said valve body, a separate sealing gasket arranged on both sides of said cover plate, means defining a water passage between said main pressure chamber and said secondary pressure chamber, said valve body having an annular relief passage formed in the top end thereof below the lower gasket, means forming two vertical relief passages extending through said gaskets and said cover plate connecting said annular relief passage with said secondary pressure chamber, and a pair of relief valve members each having a valve seat arranged in said upper gasket around one of said vertical relief passages, said relief valve members controlling the operation of said main valve independent of one another, the opening of said relief valve seats causing the pressure in said main and secondary pressure chambers to be exhausted into said annular relief passage whereby said main valve member is operated, and an adjusting member extending through said cover, said gaskets, said cover plate and into both of said pressure chambers, said adjusting member being arranged on said cover between said relief valves and controlling the extent of movement of said main valve member, and a sealing member around said adjusting member in said cover plate where it projects through said cover plate.

6. In a hollow flush valve body having a cylindrical shaped main valve therein for controlling fluid flow through said body, a cover on said body, a cover plate arranged between said cover and said valve body, there being a main pressure chamber formed between said main valve and said cover plate and a secondary pressure chamber formed between said cover and said cover plate, an adjusting member extending axially through said cover, said secondary pressure chamber, said cover plate and into said main pressure chamber, said adjusting member having fluid passages therein establishing communication between said main pressure chamber and said secondary chamber, said adjusting member being arranged coaxial with said main valve member and adjustably limiting the stroke thereof, said valve body having a horizontal annular relief passage formed therein between the top end thereof and the bottom of said cover plate, said cover plate having a pair of vertical relief valve openings formed therein extending between said secondary pressure chamber and said annular relief passage, said vertical relief valve openings being arranged in said cover plate opposite one another and said adjusting member being located between them, a manually operated relief valve controlling one of said vertical relief valve openings, and an automatically operated relief valve controlling the other relief valve opening.

7. In a flush valve having a hollow body with an inlet and an outlet therein together with a main valve member operable in said body for controlling fluid flow from said inlet to said outlet, a cover plate arranged across the top of said valve body and defining a main pressure chamber above said main valve member, a top cover arranged over said cover plate and defining a secondary pressure chamber above said cover plate, an adjusting member for limiting the stroke of said main valve member, said adjusting member extending through said top cover, said secondary pressure chamber, said cover plate, and into said main pressure chamber, said adjusting mem-

ber having fluid passages therein establishing communication between said main and secondary pressure chambers, said valve body having a common relief passage formed therein contingent to said cover plate, said cover plate having a plurality of relief valve passages therein connecting said secondary pressure chamber with said common relief passage, and separate relief valve means in each of said relief valve passages for controlling the passage of fluid therethrough from said secondary pressure chamber into said common relief passage whereby said main valve member is operated.

References Cited in the file of this patent

UNITED STATES PATENTS

857,896	Parks	June 25, 1907
1,560,770	Everstam	Nov. 10, 1925
2,295,871	Sloan	Sept. 15, 1942
2,664,916	Conley	Jan. 5, 1954