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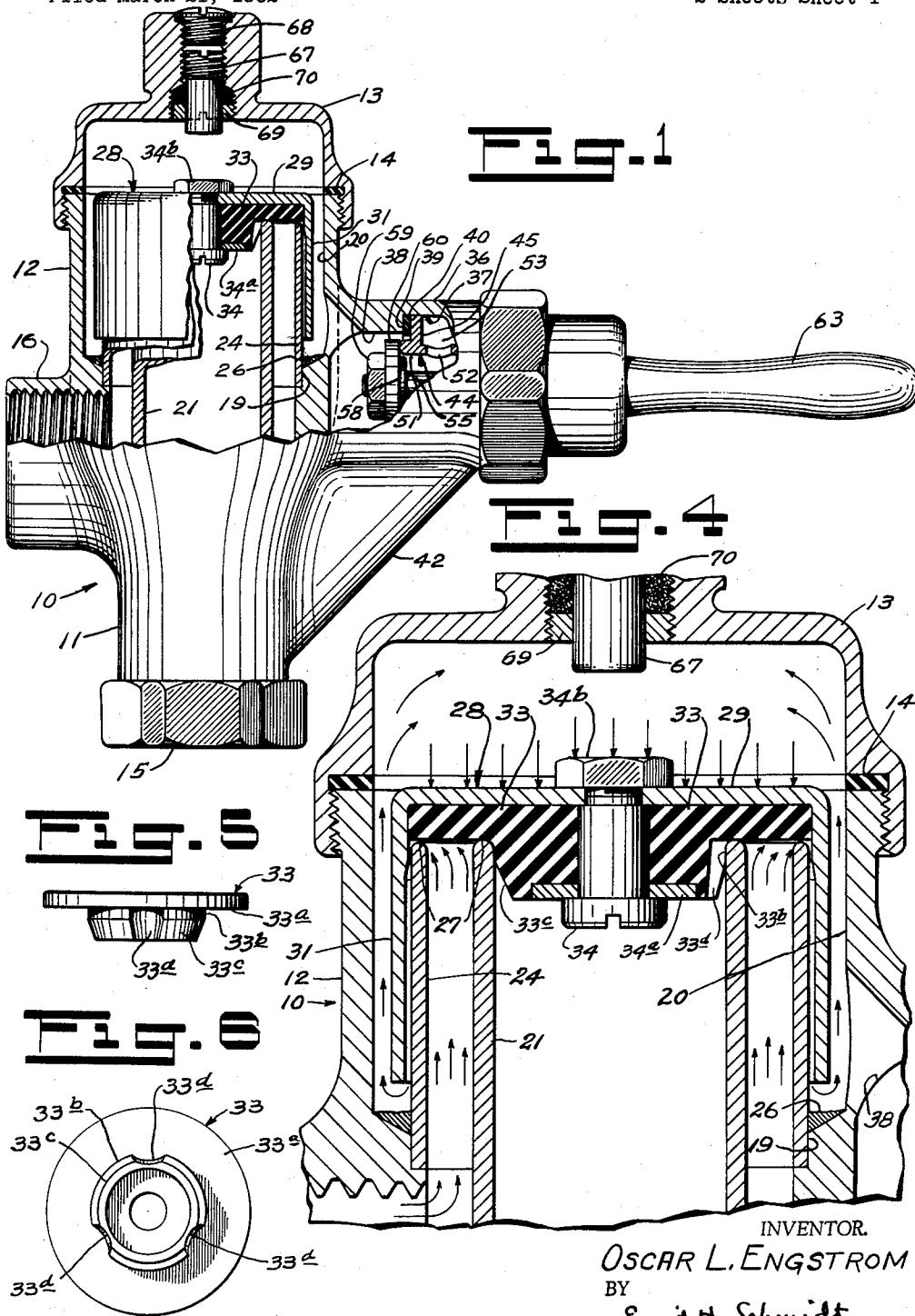
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FLUSH VALVES

Filed March 21, 1962

2 Sheets-Sheet 1



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Fig. 2

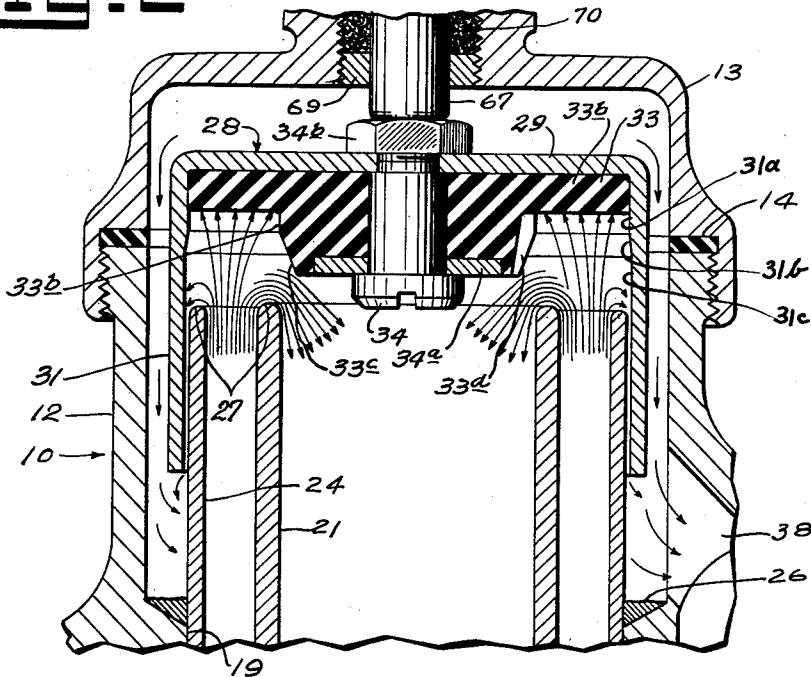
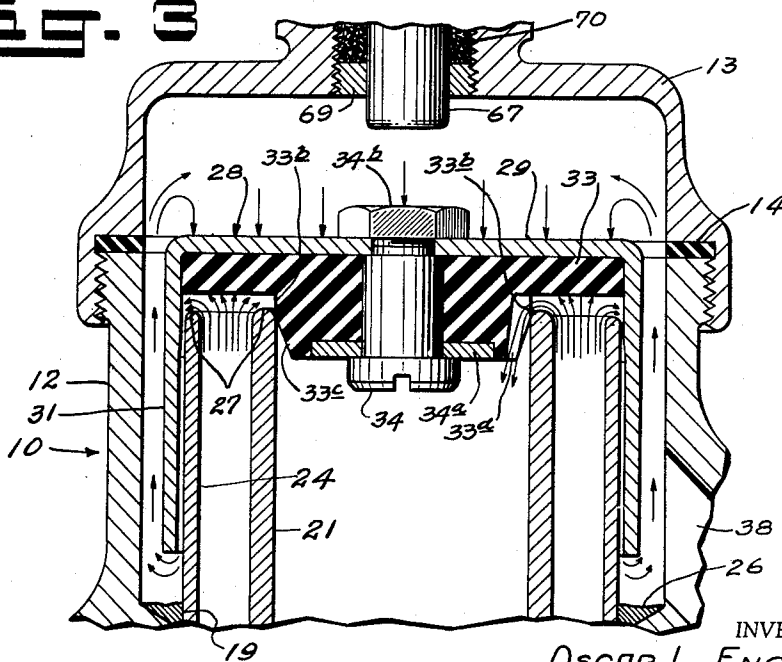


Fig. 3



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FLUSH VALVES

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My invention relates to flush valves or flushometers and is directed particularly to improvements in flushometers or flush valves for wash basins, water closets, showers, urinals and other plumbing installations.

This invention is a continuation-in-part of my application Serial No. 19,380, filed April 1, 1960, now abandoned.

It is the principal object of my invention to provide a flush valve of the above nature which includes improved means for preventing "water hammer" upon shut-off, which is anti-syphonic in action, which has a large and unrestricted outlet waterway, and in which the path of water discharge is controlled by valve mechanism devoid of springs, diaphragms, sliding pistons or cup diaphragms.

Another object is to provide a flush valve of the character described which is extremely simple in construction, which has few parts of comparatively low tolerance limits and therefore which is simple and inexpensive to manufacture, and which is long-wearing and positive-acting in use.

Other objects, features and advantages of the invention will be apparent from the following description when read with reference to the accompanying drawings illustrating a preferred form in which the invention may be embodied in practice. In the drawings, wherein like reference numerals denote corresponding parts throughout the several views:

FIG. 1 is an elevational view, partly in cross-section, of a water closet flush valve embodying the invention.

FIG. 2 is an enlarged, partial, vertical cross-sectional view of the valve illustrating the position of the valve head member in its uppermost position after the pressure relief control valve has been opened.

FIG. 3 is a view similar to FIG. 2 illustrating an intermediate position of the valve head member in its downward movement after closure of the pressure relief valve.

FIG. 4 illustrates the position of the valve head member in its downward movement just before the flow of water is completely shut off.

FIG. 5 is an elevational view of the main washer, shown separately, and

FIG. 6 is a bottom view thereof.

Referring now in detail to the drawings, my improved flush valve, designated generally by the numeral 10, is comprised of a lower housing member 11 of cast metal having at its upper end an externally-threaded circular wall portion 12 to which an upper dome or housing member 13 is removably secured. A circular rubber gasket 14 serves to hermetically seal the junction between the lower and upper housing member 11 and 13. The lower housing member 11 is formed at its lower end with an outlet opening 15 and an internally-threaded side inlet opening 16. The outlet opening 15 extends upwardly into and communicates with a cylindrical outlet pipe or conduit 21. A cylindrical inlet pipe or conduit 24 of greater diameter than the outlet conduit 21 is coaxially secured at its lower end within a bore 19 in the lower housing member 11, said cylindrical inlet conduit being soldered thereat as indicated by the reference numeral 26. The bore 19 communicates at its upper end with a coaxial cylindrical bore 20 of increased diameter. The upper end of the inlet conduit 24 extends slightly short of the upper end of the outlet conduit 21, and said upper ends together form the main valve seat structure, as is hereinbelow more fully described. Preferably, the edges of the upper ends of the cylindrical outlet and inlet con-

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duits 21 and 24 are rounded, as indicated at 27 (FIG. 2). It will be apparent that the water inlet opening 16 is in direct communication with the annular space between the cylindrical water outlet and inlet conduits 21 and 24, respectively.

A main valve cap member 28 is disposed in coaxial relation with the upper ends of the outlet and inlet conduits 21 and 24, respectively, said valve cap member comprising a circular disc portion 29 integrally formed with a downwardly-extending cylindrical sleeve member 31. The cylindrical sleeve member 31 coaxially surrounds the inlet conduit 24 in spaced relation. The sleeve member 31 is so formed as to provide an inner surface having at its upper end a short section 31a of a diameter of about .002 inch greater than the external surface of the inlet conduit 24 merging into a relatively long section 31c of increased diameter about .004 inches greater than said inlet conduit through a short beveled portion 31b. A circular neoprene washer 33 is sealed against the underside of the circular disc portion 29 of the valve cup member 28 and secured thereat by a flat-headed machine screw 34 extending through a metallic washer 34a and a central opening in said circular neoprene washer and held in place by a nut 34b. It is to be noted that the water inlet opening 16 is in communication with the interior of the upper housing member 13 through the valve seat when open by virtue of the spacing between the main valve cap member 28 and said upper housing member (see FIG. 2). The washer 33 has a flat peripheral portion 33a, integrally formed with a short central cylindrical portion 33b, of slightly lesser diameter than the internal diameter of the outlet conduit 21. The cylindrical portion 33b extends into a somewhat longer integrally-formed tapered portion 33c in the form of a truncated cone. The periphery of the cylindrical portion 33b and the tapered portion 33c is provided with a plurality, three in the embodiment illustrated, of equidistantly spaced slots or flutes 33d, for the purpose hereinafter appearing.

The lower housing member 11 is formed with a side-wardly-extending cylindrical housing portion 36 having a lateral bore 37 which at its inner end communicates with a concentric bore 38 of decreased diameter which opens into the vertical bore 20 in said lower housing member. The transition zone between the bores 37 and 38 provides an annular shoulder 39 against which an annular gasket 40 is seated and affixed. The lower housing member 11 is also formed with a boss 42 extending at an angle between the lower part of the cylindrical housing portion 36 thereof and the upper portion of the outlet opening 15 thereof. The boss 42 contains a pressure release passageway (not illustrated) communicating between the inner end of the bore 37 in the cylindrical housing portion 36 and the outlet opening 15.

Fitted within the bore 37 of the housing portion 36 is a relief valve body member 44 having at its inner end an annular portion 45 firmly seated in sealing engagement against the gasket 40. The inner end of the relief valve body member 44 is formed with an axial bore 51 the side wall of which is provided with a plurality of radial openings 52 communicating with a centrally located peripheral recess 53. The peripheral recess 53 communicates with the upper end of the pressure release passageway in the boss 42.

Slidably arranged in a central bore in the relief valve body member 44 is an actuating rod 55. The inner end of the actuating rod 55 is threaded and has secured thereon, between a metal washer 58 and a nut 59, a resilient washer 60 normally seated against the inner end of the relief valve body member 44.

In operation, momentary sideward pushing of the handle lever 63, through cam mechanism not illustrated, will

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result in inward movement of the actuating rod, thus unseating its washer 60 and allowing water under pressure within the upper housing member 13 to be instantly released through the axial bore 51, the openings 52 and the peripheral recess 53 in the relief valve body member 44, and the pressure release passageway in the boss 42. Thus, instantaneous release of pressure and opening of a large discharge passageway to the outlet opening 15 will cause the valve cap member 28 to rise practically instantaneously to its full extent within the housing member 13 under the force of inlet water under pressure emerging from the annular space between the outlet and inlet conduits 21 and 24, respectively (see flow pressure arrows, FIG. 2), thereby initiating flushing action through the large unrestricted water discharge passageway afforded by the outlet conduit 21. During the flushing cycle a portion of the water will pass through the space between the outer surface of the inlet conduit 24 and the inner surface of the sleeve portion 31 of the valve cap member 28, and around said main valve cap member to enter the space above and gradually again increase the water pressure above said cap member (see FIG. 3), finally forcing it down again against the valve seat formed by the upper end of the outlet conduit 21 where it will become firmly seated by the time inlet pipe pressure is reached above said cap member to terminate the flushing cycle.

The washer 33 is of neoprene rubber and of sufficient thickness to give it the resiliency required for a cushioning effect and to render complete sealing of water flow at the top rounded edges of the two conduits 21 and 24, as illustrated in FIG. 1.

Referring to FIG. 2, it will be seen that after the pressure release valve has opened, the water that has been under pressure on the top surface of the valve cap member 28 has been released and the water supply pressure, shown by the arrows, pushing upward under the neoprene washer, has forced the valve cap member upward. This action allows full water action downward through the inner conduit 21, as indicated by the numerous arrows. At the same time some of the main line inlet water, as indicated by arrows, passes between the clearance of the valve cap member 28 and the outer conduit 24. With the closing of the pressure release valve as shown in FIG. 1, the water seeping through this clearance starts building up a pressure upon the top surface of the valve cap member 28 as indicated in FIG. 3. This is indicated by the reversal of the pressure arrows to the outside of the valve cap member 28 and the building up of a downwardly forcing water pressure upon the top surface of the said cap member, as indicated by the arrows. When the valve cap member reaches the position seen in FIG. 3, the amount of water flowing into the inner flush tube or conduit 21 will be restricted due to the truncated cone portion 33c of the neoprene washer having entered the top of the inner conduit 21. At this point, with approximately .002 inch clearance between the outer diameter of the cylindrical portion 33b of the washer 33 and the inner diameter of the inner conduit 21, the downward motion of the valve cap member 28 will be greatly retarded while flushing action is just being completed. It is also to be noted that, as illustrated in FIG. 3, when the truncated cone portion 33c of the neoprene washer 33 has been fully received within the inner conduit 21, the beveled portion 31b of the cylindrical sleeve number 31 will have passed the upper end of the outer conduit 24 so that the clearance between said sleeve member and said outer conduit will have just been reduced by about 50%, thereby allowing only about half the rate of water escape to apply pressure down upon the valve cap member 28, which further contributes to slowing down its downward motion to prevent water knock. The flutes 33d of the washer 33 allow enough water to pass during shut-off action to refill a bowl. The flutes 33d, being tapered outward at the bottom at an angle of approxi-

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mately seven degrees further decrease the volume of flow gradually as the valve cap member descends into the position whereat the top edge of the inner conduit 21 contacts the flat peripheral portion 33a of the washer 33, when the flow of water to said inner conduit is completely cut off. This discontinues the flushing action; but the water pressure on top of the valve cap member 28 has not built up sufficiently to seat it on the outer conduit 24, which is a little shorter than the inner conduit 21. As water continues to pass through the clearance between the outside surface of the skirt member 31 of the valve cap member 28, as shown in FIG. 4, the pressure on top of said cap member continues to build up, forcing the cap downward until the neoprene washer 33 seals itself against the upper edge of the outer conduit 24 (see FIG. 1). With the parts in this position, the water pressure on top of the valve cap member 28 is such as to cause the top of the inner conduit 24 to be embedded in the neoprene washer 33 creating a positive seal at this point.

The slow cutting off of the flushing action of the water eliminates all noises of the flush valve except that of the flow of water necessary to perform its required function.

The duration of the flushing cycle, which is determined to a great extent by the spacing between the outside of the inlet conduit 24 and the inside of the sleeve 31 of the valve cap member 28, can be adjusted by controlling the upward travel extent of said valve cap member by means of an adjustment screw 67 threaded in a central opening in a cylindrical boss formed in the top of housing member 13. A cap screw 68 threads into the opening to normally cover the adjustment screw 67. Leakage of the water under pressure within the housing member 13 is prevented by packing 70 held in place by a retainer 69.

While I have described and illustrated preferred embodiments of my invention, it is to be understood that this disclosure is for the purpose of illustration only, and that various omissions, or changes in arrangement of parts, as well as the substitutions of equivalent elements for those herein shown and described, can be made without departing from the spirit and scope of the invention as defined in the following claims.

What I claim is:

1. In a flush valve, the combination comprising, a housing structure having a water inlet opening and a water outlet opening, a first conduit within said housing structure and communicating at one end with said outlet opening, a second conduit within said housing structure having a greater cross-sectional size than said first conduit and surrounding said first conduit, a communicating passageway between said water inlet opening and the space between said first and second conduits, the other end of said first conduit providing a valve seat, a valve cap member freely movable within said housing structure, said valve cap member comprising a resilient washer arranged to seat against said valve seat from time to time upon movement of said valve cap member, said washer comprising a substantially flat annular peripheral portion, a central cylindrical portion and an outer frusto-conical portion coaxial with said first conduit, said central cylindrical portion having a diameter slightly less than the insides diameter of said first conduit, and being arranged to fit within said first conduit when said washer is seated against said valve seat, said valve cap member having a peripheral sleeve portion arranged in closely spaced surrounding relation with respect to the outer wall of said second conduit, a chamber within said housing structure at the other side of said valve cap member, said space between the peripheral sleeve portion of said cap member and said outer wall of said second conduit providing a passageway communicating between said first and second conduits and said chamber for by-passing to said chamber water under pressure from said inlet opening, and means to temporarily release the pressure of water in said chamber to allow movement of said valve cap member away from said valve seat for flushing action through said first conduit, the in-

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terior wall of said peripheral sleeve portion of said valve cap member being formed at its inner end with a reduced diameter portion substantially co-extensive with the length of said central cylindrical portion of said washer, whereby said bypassing space is automatically substantially reduced in area just prior to the seating of said washer against said valve seat.

2. In a flush valve mechanism, the combination comprising a housing structure having a water inlet opening and a water outlet opening, a first cylindrical conduit arranged upright within said housing structure and communicating at its lower end with said outlet opening, a second cylindrical conduit of greater diameter than said first conduit and coaxially arranged in surrounding relation with respect thereto within said housing structure, water passage means communicating between said water inlet opening and the annular space between said first and second conduits, the upper end of said first cylindrical conduit providing a valve seat, a valve cap member freely movable within said housing structure above said valve seat, said valve cap member comprising a resilient washer arranged to seat against said valve seat from time to time upon movement of said valve cap member, said washer comprising a substantially flat annular peripheral portion a central cylindrical portion and an outer frusto-conical portion coaxial with said first conduit, said central cylindrical portion having a diameter slightly larger than the inside diameter of said first conduit, and being arranged to fit within said first conduit when said washer is seated against said valve seat, said valve cap member having a peripheral sleeve portion arranged in closely spaced surrounding relation with respect to the outer wall of said second conduit, a chamber within said housing structure

at the other side of said valve cap member, said space between the peripheral sleeve portion of said cap member and said outer wall of said second conduit providing a passageway communicating between said first and second conduits and said chamber for by-passing to said chamber water under pressure from said inlet opening, and means to temporarily release the pressure of water in said chamber to allow movement of said valve cap member away from said valve seat for flushing action through said first conduit, the interior wall of said peripheral sleeve portion of said valve cap member being formed at its inner end with a reduced diameter portion substantially co-extensive with the length of said central cylindrical portion of said washer, whereby said bypassing space is automatically substantially reduced in area just prior to the seating of said washer against said valve seat.

3. The invention as defined in claim 2 wherein the upper end of said second conduit extends slightly short of said first conduit, said flat annular peripheral portion of said washer being operative to seal off said one end of said second conduit when said resilient washer is fully seated against said valve seat.

4. The invention as defined in claim 1 wherein said central and frusto-conical portions of said washer are provided with a plurality of peripherally spaced flutes.

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