Sept. 21, 1954 C. O. CARLSON 2,689,706

PILOT CONTROLLED FLUSH VALVE

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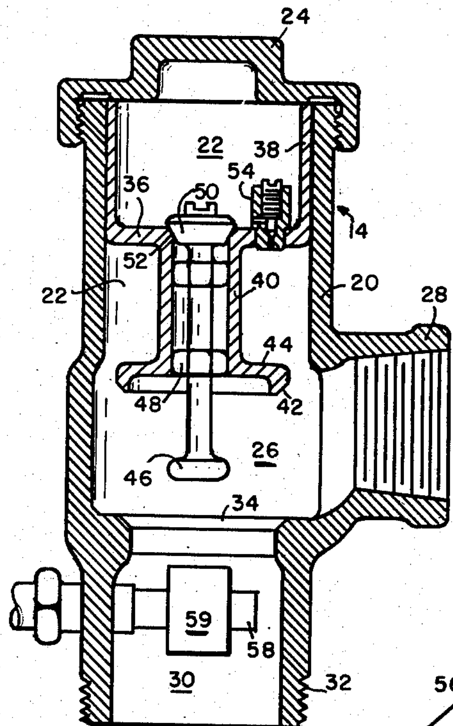

FIG. 3

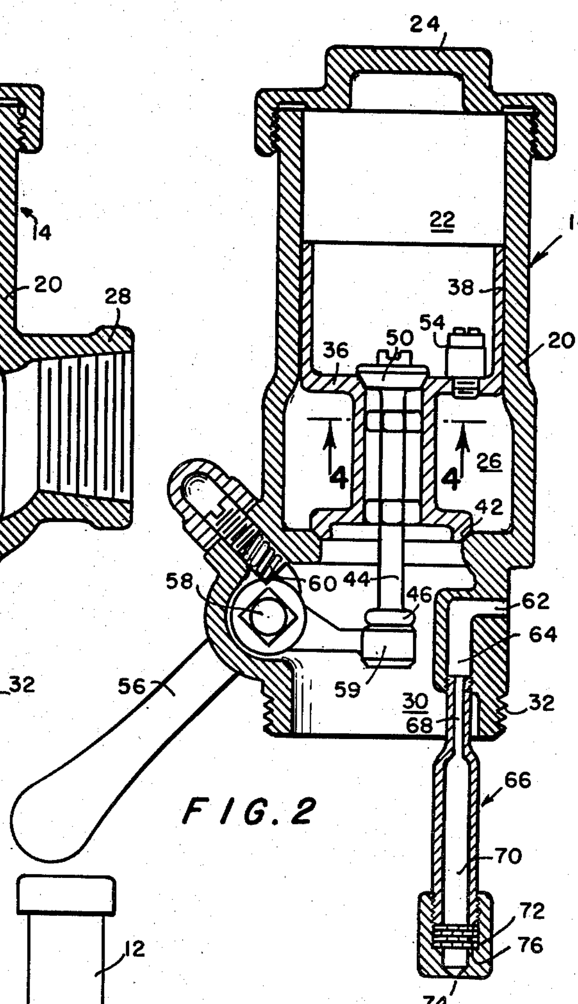

FIG. 2

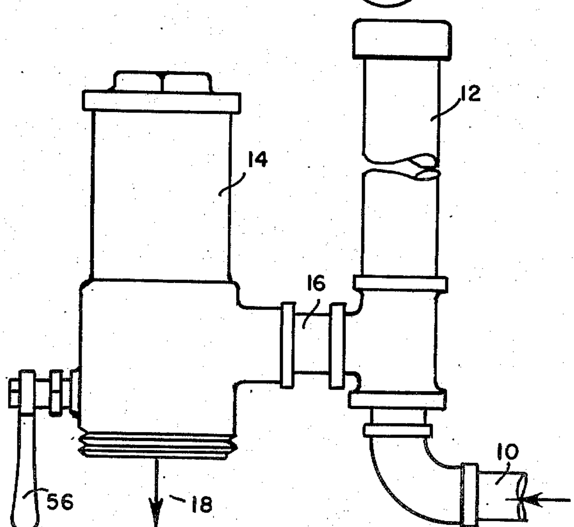

FIG. 1

FIG. 4

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PILOT CONTROLLED FLUSH VALVE

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1 Claim. (Cl. 251—38)

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This invention relates to a valve for a system for flushing toilets of the type which deliver flushing water from pressure accumulators.

It is one of the principal objects to provide a valve for a system whereof satisfactory operation can be expected with low hydraulic supply pressures and fluid conduits of smaller diameters than prior systems have been capable of employing. This objective is realized in part by the use of a new valve system herein particularly described. I have found that in systems heretofore used, large supply pipes have been necessary to conduct the flushing liquid to the accumulator and to the flushing valve, and that by the use of the valve of my invention these supply pipes can be much reduced in diameter.

It is another object to provide a flushing valve wherewith the amount of flushing fluid released at each operation may be varied through relatively wide limits; for example, from a quart to five gallons of liquid.

It is an additional object to provide a relatively silent flushing valve.

It is a further object to provide in a flushing valve for a system having provision for storing a charge of flushing fluid adjacent the point of use in a storage tank and for permitting the development of a gaseous pressure head over the liquid charge during a period between flushings, for operation at relatively low values of hydraulic pressure at the source. Thus it is possible with applicant's invention to utilize a source of low water pressure to operate this type of valve and extends the benefits of the valve to residential water systems where low pressure prevails. I have found that flushing valves in systems of this type heretofore used are so constructed that relatively high values of pressure are required at the valve in order to effect satisfactory flushing operation. The attainment of this objective hinges in part on the removal of obstructions to fluid flow from the storage tank to the fixture being flushed while flushing occurs, and in part on the construction of the flushing valve in a manner so that it operates without such obstructions as have heretofore been found essential to the operation of such systems.

With the foregoing objects and advantages in view, reference is made to the following specifications and accompanying drawing for a full description of a preferred embodiment of the invention. In the drawing:

Fig. 1 is a diagrammatic illustration of a flushing system;

Fig. 2 is a vertical section through a flushing valve;

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Fig. 3 is a section perpendicular to the plane of Fig. 3; and

Fig. 4 is a section at plane 4—4 of Fig. 2.

Referring first to Fig. 1, the flushing system includes a supply line 10 which is often individual to the fixture to be flushed; a local storage tank 12; a flushing tank valve assembly 14, and short pipes 16 and 18 of large cross sectional area leading from tank 12 through valve 14 and thence to the fixture, which may be a conventional toilet.

The tank 12 is an air sealed metal vessel, usually cylindrical and of relatively small diameter and considerable vertical height, the long dimension being disposed vertically. The inlet and outlet for pipes 10 and 16 are placed at the bottom of vessel 12. With valve 14 closed, fluid is forced into tank 12 and compresses air therein above the fluid level. When valve 14 is opened, the compressed air in tank 12 drives the liquid out through the large short pipes 18 and 16 to the fixture. In systems of this general character as heretofore known, it has been necessary to employ a pipe 10 of relatively large diameter in order to insure the proper operation of the usual valves employed at 14, even though the tank itself tends to reduce the diameter of the pipe needed. According to this invention, the cross section of pipe 10 is much reduced over those used at this point in the past. Furthermore, in systems of this general character as heretofore known, the pressure applied to drive fluid through pipe 10 has been required to be relatively high in order to insure the proper operation of the valve 14. According to this invention, the pressure existing in the supply pipe 10 may be relatively low as compared to other systems.

Although the flushing system is, as a whole, improved by using lower pressures which result in system economies and reduced pipe sizes, these modifications are permitted through the employment of the valve 14 specifically illustrated in Figs. 2, 3, and 4.

The valve 14 includes the body 20 which may be described to include a cylinder portion 22, the head of which is closed by a sealing cap 24 threaded thereon; a valve chamber 26 subjoining the cylinder portion 22 to which chamber there is provided an inlet fitting 28 for the connection therewith of pipe 16; and a portion 30 subjoining the valve chamber wherein there is disposed valve tripping elements to be described, and through which portion 30 the flushing liquid is discharged to pipe 18, suitable connection being provided with pipe 18 as by threads 32.

At the bottom of valve chamber 26 and below inlet 28 there is provided a valve seat 34 centered preferably on the axis of cylinder 22 and of a diameter somewhat smaller than the diameter of cylinder 22. A piston 36, which is preferably cup shaped to provide an upwardly disposed piston skirt 38 having an axial length approximately one-half the cylinder length, is fitted for snug sliding in cylinder 22 and carries integral therewith a main tubular valve stem 40 to the lower end of which there is rigidly attached a main flushing valve 42 for engagement against valve seat 34. The construction and arrangement are such that valve 42 is moved to a retracted position where it offers little or no obstruction to the passage of flushing fluid through chamber 26.

A pilot valve comprising a stem 44 having a trip lever engaged end 46, cruciform guide lugs 48 slidably received in tube 40 and providing a fluid passage between the stem and the tube, and valve 50, normally seats by its own weight on valve seat 52 formed at the junction of the inside tube 40 with the piston cup bottom formed by piston head 36.

The piston head 36 is provided with an adjustable valved passage device 54 by which liquid is allowed to pass from the valve chamber 26 to the cylinder part above the piston at an adjustable rate. The cap 24 is removed for the purpose of effecting this adjustment. Normally, however, the cap 24 forms an air seal with the cylinder. A tripping lever 56 connected to a shaft 58 journalled in the valve body 20 drives arm 59 disposed in outlet passage 30 to engage the foot of the pilot valve stem 44. A suitable adjustable spring structure 60 serves to bias the lever 59 to the position of Fig. 2, out of contact relation with the pilot valve stem.

Fig. 2 illustrates the position of the parts of the valve prior to flushing. Full static pressure from source 10 is transmitted through the bypass 54 into the cylinder 22 above piston 36, holding valve 50 against its seat and therefore forming a downward force by piston 36 which is proportional to the static pressure and the cross sectional area of cylinder 22. This force is transmitted through tubular stem 40 to valve 42 and effects closure of valve 42 on seat 34. Under these conditions the charge of flushing liquid in chamber 12 has accumulated to the height permitted by the air trapped in tank 12.

Upon moving lever 56 counterclockwise in Fig. 2, the stem 44 is moved upwardly causing valve 50 to unseat and remove the downward seating thrust on valve 42 caused by piston 36 by allowing the escape of some liquid from above the piston 36. The action is enhanced by the impact with which lever 56 may be activated, whereby valve 50 is impelled well above its seat 34. The pressure tank 12 is now active on the top of valve 42 and the exposed bottom of head 36. Since head 36 is larger than the valve 42 the resultant thrust is upward and valve 42 is impelled up to the Fig. 3 position. The passage by bleeder 54 is so minute that it has no substantial effect in retarding this movement.

The movement to Fig. 3 position is almost instantaneous, being facilitated by the large pilot valve passage through stem 40, which allows the liquid above piston 36 to be driven out at high velocity as the piston 36 moves up under the impact of pressure from tank 12. The pressure in chamber 26 under the stem 44 tends to hold valve 50 well above its seat until the pressure in chamber 26 drops due to discharge of the liquid from the tank. The energy of the air stored in tank 12 accelerates the fluid which also engages under valve 42 and temporarily assists to hold it in Fig. 3 position. At the Fig. 2 position, as the pressure in chamber 26 falls away, valve 50 is moved by gravity and the pull of fluid on foot 46 into closed position. Thus the valve 50 closes while the piston 36 is still near the upper position of Fig. 3, and causes the sealing of the chamber 22 except for bleeder 54. In this way the chamber 22 becomes somewhat vacuous due to the downward pull of gravity and fluid flow pull on the moving parts. It is this vacuous condition which prevents the valve parts from being greatly accelerated to the Fig. 2 position, and which allows the valve to close gradually and without noise productive impact. The rate of lowering is governed by adjusting the opening in bleeder 54, which also results in governing the amount of fluid that escapes from tank 12 before the valves reclose. As soon as the valve 42 reaches its seat the pressure above it builds up both in chamber 26 and chamber 22 so as to give maximum thrust on the valve.

As a specific example of the construction employed, the pipe 10 may be as small as one quarter inch in diameter but it has been chosen as one-half inch. In most instances of prior devices of this general nature, the pipe diameter is of the order of one and one-half inches, and the pressure accumulator is not employed. The pipes 16 and 18 are one inch pipes. The accumulator 12 is constructed of standard two inch pipe and is about four feet long for the maximum desired amount of flushing water, and may be mounted in a wall out of sight. The height of the accumulator 12 is independent of the water supply pressure, but the accumulator may be wholly omitted if both high pressure and the large supply pipe are used. The water supply pressure may range as low as one and one-half pounds per square inch when the accumulator and my valve assembly 14 are used. The supply pipe 10 enters from below the level of inlet 28, as shown. The valve seat 34 is of the order of one inch in diameter and the internal diameter of tube 40 is about three-eighths of an inch, its passage being large for the expulsion with great rapidity of the water from the head chamber 22 over the piston. This rapid activity insures that the valve 44 takes the elevated position of Fig. 3 instantly upon unseating the pilot valve 50, the motion of which reseats the pilot valve as shown. With these approximate physical constants, the flushing system will operate on pressure ranges as indicated and will flush successfully as little as a quarter of a gallon of water, the amount of water flushed being dependent on the setting of the bleeder valve 54. Part of the flushing liquid comes from the accumulator and part from the supply pipe, the ratio depending upon the relative sizes of these and the time allowed for flushing by the bleeder valve. It is believed that the efficient flushing action is largely due to the freeing of the valve chamber and passage 30 of obstructions while the flushing takes place to a degree sufficient to the result, this being attained in part by the removal of the flushing valve to a point above the inlet to the valve chamber, and in part to the relatively small resistance to flow offered by the tappet 46 and the pilot release lever 59 as compared to other devices of this general nature, and in further part to the delayed fall of the valve into the valve chamber toward its seat.

My flushing system provides, in addition, for a vacuum break at the discharge side of valve 14. The main function of this device is to prevent syphoning of the fluid in the fixture back into the water system and resultant pollution of drinking water. Such action might occur frequently where several flush valves are located along the same supply line 10 because when one valve opens the draft may open adjacent valves 14.

To prevent such syphon action I provide the body 20 adjacent chamber 30 with a vent passage 62 joining with an interior passage 64 disposed with its axis vertical and opening toward the pipe 18. A tube 66 having a small diameter portion 68 has threaded to the bottom end thereof a cap 72 provided with an orifice 74. A series of wire screens 76 of fine mesh are stacked in the path of flow from orifice 74 to chamber 70 and serve to both restrict flow and to strain off solids. This device fits within the adjacent connected pipe end. Tube 66 provides enlarged reservoir portion 70.

The action of this syphon preventer is that should valve 42 open due to vacuum in line 10, air is sucked through inlet 62 freely into space 30 and past valve 42, thus preventing flow from the fixture below space 30. When the valve 42 is operated in flushing the associated fixture, the orifice 74 and screens restrict the liquid flow to a minute amount which is deposited in reservoir 70 and from which it later drains through the orifice and to the fixture. The passage 68 serves to restrict discharge from 62 by damping the flow of air displaced by water entering reservoir 70.

I claim:

A flush valve comprising a cylindrical body having a substantially uniform bore from end to end, one end being closed with a cap and the other end forming an outlet, said bore having a valve seat near its outlet end of slightly smaller diameter than said bore, an inlet for said bore of substantially the same diameter as said bore and posi-

tioned adjacent to the seat on the cap side thereof, a cup-shaped piston slidably mounted in the cap end of said bore and having a restricted orifice through its bottom connecting the inside of said piston with the bore adjacent the inlet, said piston also having a depending tubular stem of smaller outside diameter than either said piston or said seat and of a length substantially equal to the diameter of said inlet, a valve disc on the free end of said stem of slightly smaller diameter than said piston but larger than said tubular stem and coacting with said seat, the length of said bore beyond said inlet and the length of said piston being so dimensioned that the valve disc is moved out of the line of flow of fluid from the inlet when the valve disc is fully opened, a pilot valve coacting with the piston end of said tubular stem to control flow of fluid from within said cup-shaped piston to said outlet and having a pin extending through said stem and seat when the valve disc is seated, an enlarged head on the free end of said pin and an operator supported by said body adjacent the outlet for engaging said head to open said pilot valve.

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