Feb. 14, 1956 J. FRASER 2,734,712

SELF-METERING FLUSH VALVE

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Fig. 1.

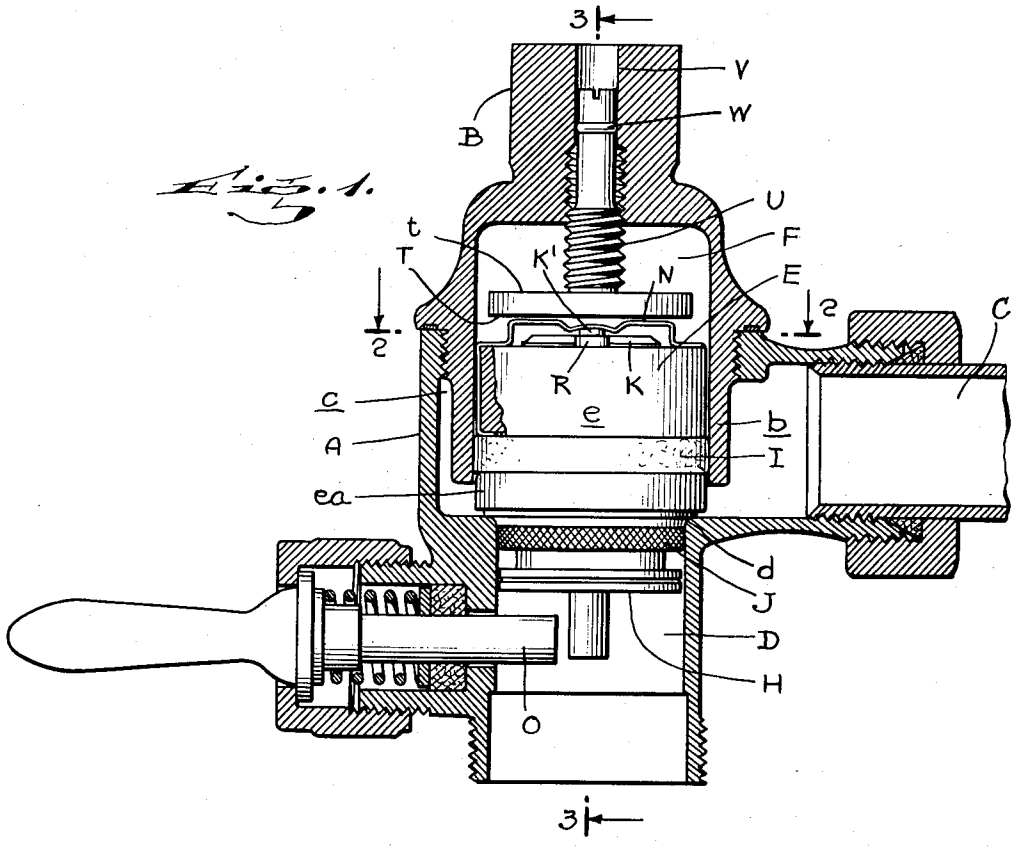

Fig. 2.

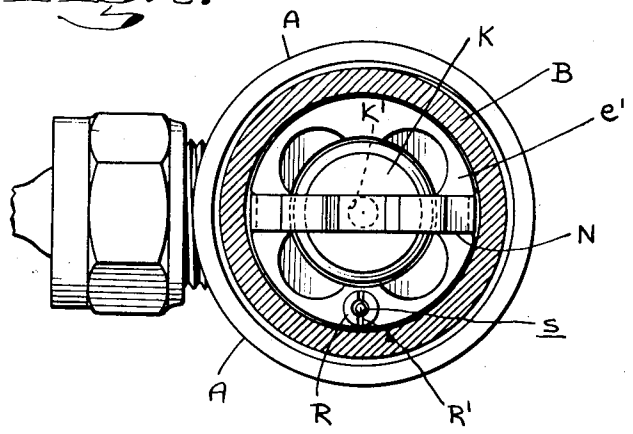

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Fig. 3.

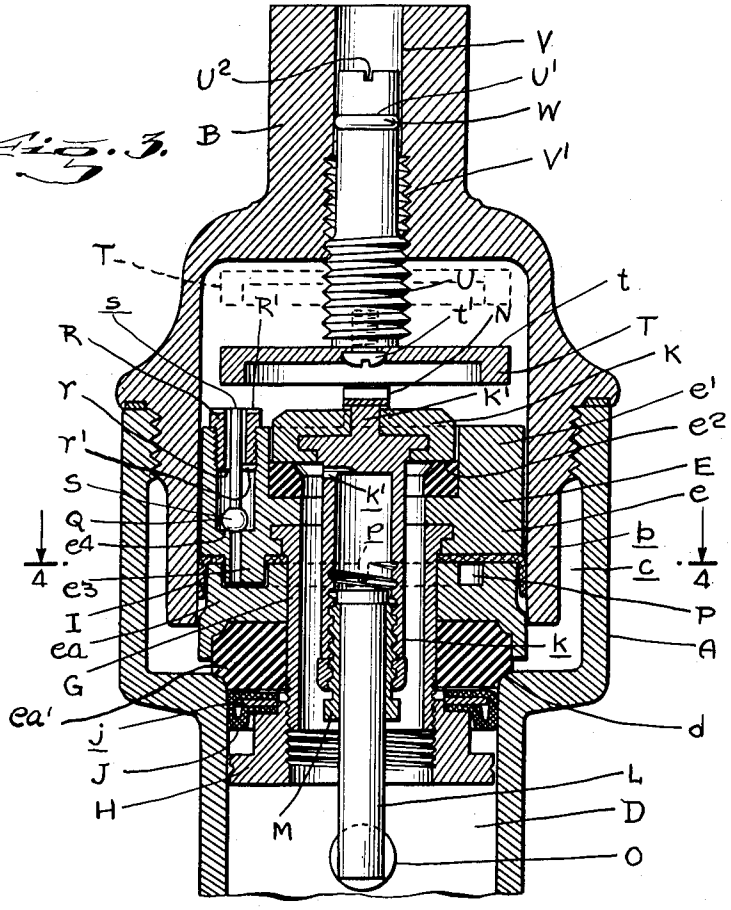
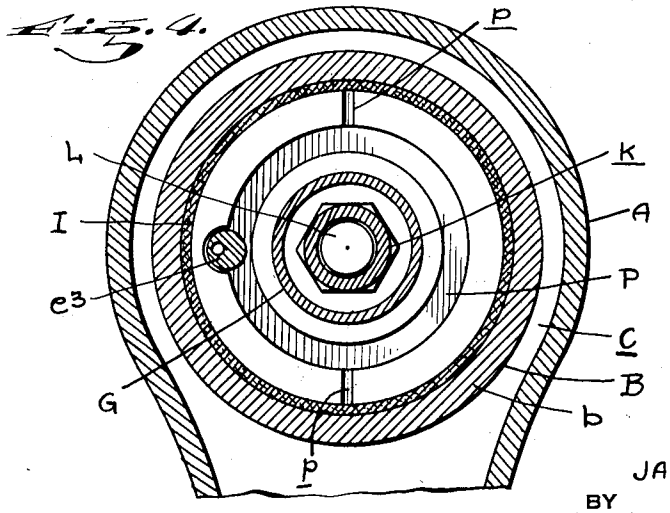


Fig. 4.



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SELF-METERING FLUSH VALVE

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Application December 4, 1952, Serial No. 324,059

3 Claims. (Cl. 251—35)

The general object of the present invention is to provide an improved self-metering flush valve of the known type including a timing chamber which is automatically varied in volume during each flushing operation.

A primary object of the invention is to provide a flush valve of the above mentioned type with novel means of simple and effective character for adjusting the relative maximum and minimum values of the timing chamber and thereby regulating the amount of water discharged during each flushing operation.

A more specific object of the invention is to provide a flush valve of well known type comprising a cylindrical casing enclosing a cylindrical space and a cylindrical main plunger valve movable longitudinally of and free to rotate about the axis of said valve chamber, and having a timing chamber between the upper end wall of the casing and the plunger valve with an adjusting element including an annulus within and coaxial with said chamber and supported by an adjusting spindle coaxial with the chamber and extending through the top wall of the casing. Said annulus forms an abutment adjustable axially of the timing chamber for arresting the upward opening movement of the main plunger valve at a distance from the top of the timing chamber depending on the adjustment position of said annulus. The latter also operates in conjunction with the main plunger valve to regulate the flow of water into the timing chamber through a restricted refill duct in the main valve, as the latter moves into its open position.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages, and specific objects attained with its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described a preferred embodiment of the invention.

Of the drawings:

Fig. 1 is a sectional elevation of a flush valve;

Fig. 2 is a plan section taken on the line 2—2 of Fig. 1;

Fig. 3 is a partial sectional elevation on an enlarged scale taken on the line 3—3 of Fig. 1; and

Fig. 4 is a plan section through the main plunger taken on the line 4—4 of Fig. 3.

In the drawings I have illustrated, by way of example, the use of the present invention in a flush valve of the general type and form disclosed in the Binnall Reissue Patent 20,246, dated January 19, 1937. The flush valve shown comprises a casing structure including a body portion A and a detachable cap portion B. The latter has a cylindrical wall *b* closed at its upper end and extending down into, and in threaded engagement with a cylindrical portion of the casing body A. Water is supplied to the valve through a lateral inlet passage C which communicates with an annular space *c* surrounding the lower portion of the wall *b* and between it and the surrounding portion of the casing body A. The annular space *c* is in communication below the lower end of the wall *b* with a depending outflow passage D surrounded at its upper end by a

valve seat *d*. Flow from the passage C into and through the space *c* and thence into the upper end of the depending discharge passage D, is controlled by a main cylindrical plunger valve E. The latter includes a major upper body portion *e* which in operation is at all times within the chamber space surrounded by the wall *b*, and also includes a lower skirt portion *ea*. More or less of the portion *ea* is below the lower end of the wall *b* in all operative conditions of the valve E. In the closed position of the valve E, its lower end engages the valve seat *d* at the upper end of the discharge passage D. The space between the upper end of the valve E and the top wall of the casing cap portion B constitutes a timing chamber F. The diameter of said chamber space and of the portion of the main valve therein is substantially greater than the diameters of the valve seat *d* and passage D. When the valve E is moved upward to open communication between the inlet C and outlet D, the vertical extent and volume of the timing chamber F is diminished.

As shown, the main valve plunger portions *e* and *ea* are advantageously formed of a molded synthetic resin, as described in Reissue Patent 20,246. A tubular metallic body G, coaxial with but smaller in diameter than the annular valve body *e*, has its upper end imbedded in the latter, and is surrounded by the skirt member *ea*, the inner wall of which is in snug engagement with the outer wall of the tubular body G. The lower end of the member G is externally threaded and is surrounded by an internally threaded annular assembly nut H. Interposed between the members *e* and *ea* is the horizontal annular upper portion of a non-metallic cup washer I, and interposed between the member *ea* and the nut H is a reversible rubber seat member *ea'* and a subjacent member J. In the closed position of the main valve, the member *ea'* directly engages the valve seat *d* and the member J extends into the discharge passage D. As shown, the member J comprises a core *j* which may be an annular body of brass with a covering body of wire gauze. The member J is operative as a silencing device in a manner described in said Reissue Patent 20,246.

The valve body portion *e* is formed at its upper end with a recess surrounded by a rim portion *e'*, and is formed with a valve seat e^2 at the bottom of the recess against which the head K of a timer control valve is normally seated. Said control valve includes a depending tubular metallic portion *k* coaxial with the head K, and having a diameter substantially smaller than the internal diameter of the tubular member G. A rod or stem L is telescopically connected to the tubular portion *k*. As shown, the telescopic connection comprises an externally threaded tubular part M extending into and in threaded engagement with the metallic portion *k*. The rod or stem L extends through and is slidable in the member M, and has an out turned flange at its upper end which normally engages the inner end of the member M and is supported by the latter. A stop nut threaded on the part M and engaging the lower end of the part *k*, forms a means for varying the length of the portion of the member M extending into the tubular part *k* and thereby regulates the normal level of the lower end of the rod L. A lateral port *k'* is formed in the upper end portion of the tubular part *k*.

The timer control valve K is formed at its upper end with a central uprising projection K' normally engaged by a yoke shaped spring member N. The latter is in the form of a metal strip bent to form vertical leg portions received in vertical grooves formed in the valve portion *e* at diametrically opposed sides of the latter and inturned ends received in grooves at the underside of the valve portion *e*. Horizontal portions of the spring N adjacent the leg portions of the spring, bear against the upper end of the rim *e'*. Portions of the spring N adjacent and at opposite sides of the projection K' are upwardly bowed,

and flex as required to permit the timer control valve K to tilt when lateral pressure is applied to the stem L by the conventional flush valve operating element O.

When the manually actuated valve operating element O is moved horizontally inward into the discharge passage portion D of the valve casing, it engages the lower end of the stem L and thereby tilts the valve head K and permits the rapid escape of water previously accumulated in the timing chamber F. This results in a practically instantaneous upward movement of the plunger valve E, due to the pressure of the water in the annular space *c* which acts upwardly against the lower portion of the valve E more remote from the axis of the valve than is the valve seat *d*. As soon as the pressure in the timing chamber F is thus reduced, water under pressure begins to flow into that chamber from the inlet space *c* through a restricted refill duct. The latter comprises a horizontal portion P in the upper portion of the valve skirt *ea*, and an uprising portion Q in the main upper plunger valve portion *e*. The duct portion P is in the form of an annular groove in the top surface of the lower main valve part *ea* immediately beneath the annular horizontal portion of the cup washer I. The duct portion P is in communication with the inlet water space *c* through a pair of aligned radial passages *p* in the outer wall of said annular groove.

The duct portion Q extends upward through the upper portion *e* of the main valve E, and also through a depending tubular extension e^3 of the valve portion *e*. Said tubular extension e^3 extends into the duct portion P but terminates above the bottom wall of the latter. The portion e^3 extends into a notch in the side wall of the duct portion P and thus holds the upper main valve portion *e* and the lower valve portion *ea* in fixed relative angular positions.

The structural features of the apparatus hereinbefore described, do not differ significantly from the structural features of the apparatus disclosed in Reissue Patent 20,246. However, the apparatus disclosed in said reissue patent includes no equivalent for the means now to be described for varying the restriction to flow through the duct Q during the up movement of the valve E, and for varying the magnitude of the up movement of the valve E.

A tubular member or bushing R is inserted in the upper end of the duct Q. As shown, the bushing R is formed of metal and has its lower portion extending into and in threaded engagement with the wall of the duct Q, and the upper end of the bushing extends upward for a short distance above the rim *e'* of the valve portion *e*. Flow through the duct portion Q is variably restricted by a metal ball S vertically movable in the duct portion Q and attached to the lower end of a metallic stem *s* which extends through and is loosely received in the bore of the element R. Said bore is enlarged at its lower end to form a valve seat *r* engaged by the ball S on the upflow of water through the duct portion Q in the initial portion of each flushing operation. The seat *r* is formed with a notch or groove *r'* to permit leakage between the seat and the ball S when the latter engages said seat.

With the ball S in engagement with the seat *r*, a substantial portion of the stem *s* extends upward above the top of the bushing R. Advantageously, and as shown, the upper end of the stem *s* is flush with the upper end of the bushing R when the ball S is in its lowermost position. In that position the ball is supported by a lower portion e^4 of the wall of the duct Q. The upper end of the bushing R is formed with aligned radial grooves R' to permit leakage of water out of the duct Q when the upper end of the bushing is engaged by the underside of a horizontal annulus T. The annulus T is coaxial with and above the valve E, and its diameter is such that it forms an annular abutment directly above the pin *s* regardless of the angular position of the bushing R about the axis of the valve E.

The horizontal annulus T is advantageously made vertically adjustable by means accessible for adjustment outside of the valve casing, without opening the casing or otherwise interfering with the operation of the flush valve. As shown, the annulus T is in the form of a depending flange portion of a rigid disc *t* having its central portion connected by a screw *t'* to the lower end of an adjusting spindle U. The latter extends through an axial passage V in the top wall of the casing B. The passage V comprises a cylindrical upper portion in which the upper portion of the spindle U is received, and a lower portion V' of larger diameter and internally threaded to receive an enlarged, externally threaded, lower portion of said spindle. As shown, the upper portion of the spindle U is formed with a circumferential groove U' receiving a washer W of rubber or analogous material which packs the joint between the spindle U and the wall of the passage V, to prevent leakage out of the valve casing through said joint. Advantageously and as shown, the outer end of the spindle U is formed with a kerf U^2 to receive the end of a screw driver through which the spindle U may be rotated to move the annulus T toward and away from the upper end of the valve casing.

In the contemplated operation of the apparatus illustrated, the main valve member E is moved into and out of engagement with the valve seat *d* by hydrostatic means, as is the main valve shown in the Reissue Patent 20,246. Thus the valve member E is normally held in its closed position by the water in the timing chamber F which is under a pressure lower than the supply pressure. When the timing chamber control valve K is open, the timing chamber pressure is reduced and the valve E is immediately moved upward by the unbalanced supply water pressure acting against the under side of the portion *ea* of the main valve which extends radially outward beyond the valve seat *d*. As soon as the valve E moves upward far enough to raise the lower end of the stem L above the operating element O and thus permit the stem L to return to its vertical position, the timing chamber valve K closes and the pressure in the timing chamber F starts to build up as a result of the flow of water into said chamber from the duct section Q.

The combination with the apparatus disclosed in common in Reissue Patent 20,246 and herein, of an abutment T cooperating with the stem *s* of the flow restricting element S, permits of a novel and desirable automatic increase in the flow capacity of the charging duct section Q when the main valve element E is moving into and out of its wide open position. Furthermore, the vertically adjustable abutment T and the main valve element E directly cooperate in a simple and effective manner to adjust and regulate the minimum volume of the timing chamber F, and the amount of water discharged in each normal flushing operation. In Fig. 3 the member T is shown in full lines in approximately its lowermost position, and is shown in dotted lines in its uppermost position.

While in accordance with the provisions of the statutes, I have illustrated and described the best form of embodiment of my invention now known to me, it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit of my invention as set forth in the appended claims and that in some cases certain features of my invention may be used to advantage without a corresponding use of other features.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a liquid-metering flush valve, including a casing having an inlet port, an outlet port and a valve seat intermediate said ports, and a timing chamber coaxial with and at the inlet side of said seat and open at its end adjacent said seat, a main valve element having a cylindrical portion co-axial with said seat and chamber and extending into the latter through its open end and rotatable in said chamber and formed with a restricted charging duct having one end open to said inlet port and having

its second end opening into said chamber at a distance from the common axis of said valve element and chamber, a control valve governing a discharge port in said chamber, said discharge port being of greater capacity than the charging capacity of said duct and, when opened, effecting a reduction of fluid pressure in said chamber, hydrostatic means associated with said timing chamber and subject to pressures therein, said hydrostatic means opening said main valve when the chamber pressure falls below the pressure in the inlet port and closing said main valve as the chamber pressure becomes equalized with the pressure in the inlet port; the improvement comprising an annulus within and coaxial with said timing chamber and forming an abutment for engagement by the rim portion of the upper end of said main valve element including the second end of said duct when said main valve opens, a tubular member inserted in the upper end of said duct that has a valve seat at its lower end and a ball within said duct that is movable therein between an upper position in which the ball engages the last mentioned seat and a lower position, a stem attached to said ball extending into the bore of said tubular member and having its upper end projecting from the upper end of said tubular member when said ball engages the last mentioned seat but not when said ball occupies said lower position, and means extending through the top wall of said casing for adjusting said annulus toward and away from said top wall, whereby said annulus is adapted to regulate the minimum volume of said timing chamber.

2. In a liquid-metering flush valve, including a casing having an inlet port, an outlet port and a valve seat intermediate said ports, and a timing chamber coaxial with and at the inlet side of said seat and open at its end adjacent said seat, a main valve element having a cylindrical portion co-axial with said seat and chamber and extending into the latter through its open end and rotatable in said chamber and formed with a restricted charging duct having one end open to said inlet port and having its second end opening into said chamber at a distance from the common axis of said valve element and chamber, a control valve governing a discharge port in said chamber, said discharge port being of greater capacity than the charging capacity of said duct and, when opened, effecting a reduction of fluid pressure in said chamber, hydrostatic means associated with said timing chamber and subject to pressures therein, said hydrostatic means opening said main valve when the chamber pressure falls below the pressure in the inlet port and closing said main valve as the chamber pressure becomes equalized with the pressure in the inlet port; the improvement comprising a flow restricting device in said duct and biased for movement from a lower position into an upper position by the upflow of water through said duct and producing a greater flow restricting effect when in its upper position than when in a lower position, said device including a

stem projecting out of the upper end of said duct when said device is moved upward in said duct by said bias force, and an abutment in said timing chamber which is engaged by said stem and prevents further up movement of said stem without preventing further up movement of said main valve.

3. In a liquid-metering flush valve, including a casing having an inlet port, an outlet port and a valve seat intermediate said ports, and a timing chamber coaxial with and at the inlet side of said seat and open at its end adjacent said seat, a main valve element having a cylindrical portion co-axial with said seat and chamber and extending into the latter through its open end and rotatable in said chamber and formed with a restricted charging duct having one end open to said inlet port and having its second end opening into said chamber at a distance from the common axis of said valve element and chamber, a control valve governing a discharge port in said chamber, said discharge port being of greater capacity than the charging capacity of said duct and, when opened, effecting a reduction of fluid pressure in said chamber, hydrostatic means associated with said timing chamber and subject to pressures therein, said hydrostatic means opening said main valve when the chamber pressure falls below the pressure in the inlet port and closing said main valve as the chamber pressure becomes equalized with the pressure in the inlet port; the improvement in which the discharge end of said charging duct extends upward through the upper portion of said main valve and in which a tubular member is inserted in the upper end of said duct and has a valve seat at its lower end and in which a ball within said duct is movable therein between an upper position in which the ball engages the last mentioned seat and a lower position, a stem attached to said ball extending into the bore of said tubular member and having its upper end projecting from the upper end of said tubular member when said ball engages the last mentioned seat but not when said ball occupies said lower position, and an abutment being mounted in said timing chamber in position to arrest the up movement of said stem and thereafter to arrest the up movement of said main valve.

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