

REPLACED SHEETS		SG
☒	Description : paged 2,3,7 to paged	
☒	Claim(s) : paged 9 to paged 10	
☐	Drawing(s) : paged to paged	1
☐	Abstract : paged to paged	

MAINS PRESSURE FLUSHER VALVE

Field of the invention

5 The invention relates to a mains pressure valve for a mains pressure water system which, upon activation, will deliver a predetermined volume of water.

In this description, where the valve is described in respect of water, it will be understood that other fluid could be used with the valve as well.

Background

Conventionally, where it is necessary to discharge a predetermined
10 amount of water, a header tank is commonly used with a controlling float valve. Typically, this is required for toilets. The tank is sized to hold a set amount of water. After each discharge the tank needs to be refilled with an attendant delay between flushes. These tanks can be unsightly or otherwise need to be safeguarded against vandalism and it is common to
15 locate them in the partitioning walls or ceilings of the urinal. Further, particularly in large buildings, the combined weight of the many header tanks requires substantial addition to the size of the foundations and framework of the building. In view of the bulk of these tanks, installation costs are increased. Accordingly, there was a need for a
20 mains pressure flushing system which would avoid the need for these types of tanks.

Valves have been proposed to fulfil this need which, upon actuation, allow a predetermined volume of water to flow through the valve before
25 automatically closing or stopping the flow of water. However, such valves to date have usually been large, cumbersome and required specially adapted plumbing (such as larger diameter pipes, pressure regulators and extra valves) for their proper operation. They are also expensive in themselves and expensive to install. Such known valves may also be
30 unable to deliver a sufficient volume of water to flush as required. They permit little adjustment for the volume of water to be delivered and cannot readily provide the well-known "dual flush" capability.

Australian patent number 577932 describes a self close flush valve which is intended to operate at lower than mains pressure as one of several similar valves, each servicing a separate toilet, where the water supply for each is one large header tank. This valve allows the delivery of a fixed volume of water and its particular advantage is stated to be that the volume of water delivered can be easily varied. This valve is, however, not appropriate for connection directly to a mains pressure water system.

That valve has a principal valve which controls the flow of water from the inlet to the outlet by the pressure of water in an inner chamber. By releasing the pressure of water in the inner chamber through a valve contained within the principal valve, the principal valve opens (allowing water to flow from the inlet through to the outlet). While that water flows through to the outlet, some of that water is diverted into the inner chamber which increases the water pressure in the inner chamber and thus causes the principal valve to close again.

Accordingly investigations have been carried out in an attempt to provide an improved mains pressure valve to permit the delivery of a predetermined (although variable) volume of water from a mains pressure water system.

20 Description of the Invention

According to this invention, there is provided a mains pressure valve which comprises:

- (a) a main chamber having an inlet for fluid and an outlet for fluid;
- (b) a piston located in the main chamber which is movable into and out of sealing engagement with the outlet of the main chamber;
- (c) a port in an upper portion of the main chamber above the piston which permits fluid to flow therethrough; and
- (d) a valve associated with the port to regulate the flow of fluid through the port.

30 In a preferred embodiment of the invention, the valve further comprises an inlet chamber communicating with the inlet of the main chamber.





Additionally or alternatively, the valve further comprises a discharge chamber communicating with the outlet of the main chamber.

In another preferred embodiment of the invention, the valve further comprises a bypass passageway communicating between the port in the upper portion of the main chamber and the discharge chamber.

In a another preferred embodiment of the invention, the piston sealingly engages the walls of the main chamber and has an internal passageway which communicates between the upper portion of the main chamber and the inlet. A flow valve is located in the passageway to regulate the passage of fluid from the inlet to the upper portion of the main chamber.

In another preferred form of the invention, a stop tap is located in the inlet chamber and adapted to vary the amount of water flowing through the inlet chamber into the main chamber. Further, the stop tap can be closed completely to prevent any flow of water through the valve. This feature would be particularly relevant for maintenance for example. Typically the stop tap may be raised or lowered to obstruct the flow of water from the mains pressure system into the main chamber. By allowing less water into the main chamber, less water is able to flow through the valve to the outlet during the period the valve is open.

In another preferred form of the invention, the valve further comprises a non-return valve attached to, or located in, the outlet to restrict fluid which has been discharged from the outlet from flowing backwards through the outlet and out of the inlet into the mains pressure system.

In another preferred embodiment of the invention, the valve can be controlled by an actuation means which can be mechanical or electrical. The actuating means for the delivery of water may preferably be adapted so that there are two predetermined volumes of water which the valve may deliver (one being approximately double the other) to allow for the well known "dual flush" mode of operation. A "dual-flush" operation can be achieved by altering the period of activation of the mechanical means (such as holding the handle down for a short period before releasing it as opposed to a mere push and release) or, in the case of electrical means,

by building a delay into the electronic circuitry so that the passage of water through the passageway bypass is allowed to continue for a longer period of time.

5 In another preferred form of the invention, the valve associated with the port to regulate the flow of fluid through the port may be opened or closed by either mechanical or electrical means. Typical mechanical means may be a handle, lever or push-button and the electrical means would normally incorporate a solenoid which may, for example, be activated by infra-red sensors or electrical buttons/switches.

10 In another preferred form of the invention, the distance of upward movement of the piston in the main chamber can be controlled by, for example, a spindle projecting into the upper portion of the main chamber. The spindle indirectly controls the volume of water discharged by controlling the time for which the valve is "open" (where the valve permits
15 the flow of water from the inlet to the outlet). The spindle can be lowered into the main chamber to decrease the distance through which the piston may rise which increases the volume of the upper portion of the main chamber. This volume determines the length of time for which the valve is open as water must fill the upper portion to force the piston
20 downward to close the inlet.

In another preferred form of the invention, the discharge chamber is provided with an air-vent. The air-vent allows air into the discharge chamber which enables water remaining in the discharge chamber to drain out. In use, this establishes an "air-break" between the toilet bowl and
25 the valve to assist in the prevention of bacteria moving from the toilet bowl to the mains pressure water system.

With the preferred embodiments of the invention, the volume of water delivered can be controlled over a range sufficiently broad for normal use which is a substantial advance on the valves currently available.

30 The body and components of the valve may be manufactured from any material which has sufficient strength, resilience and non-corrosive

properties to withstand the pressures involved (typically up to 2,000 Pa) although the valve will typically be made from an alloy such as brass.

Description of Drawings

5 The invention is now further illustrated with reference to the accompanying drawings in which:

Figure 1 is a cross-section of a valve according to one form of the invention;

Figure 2 is an exploded partial plan view of the valve of figure 1; and

10 Figure 3 is a cross-section of a valve according to another form of the invention.

In the drawings illustrating various embodiments of the invention, for convenience only like components are given the same numerical reference.

15 Figures 1 and 2 show a valve having a valve body 10 comprising principally an inlet chamber 11, a main chamber 12, a bypass passageway 13 (only shown in figure 2) and a discharge chamber 14.

20 Inlet chamber 11 contains a stop tap 15 which can be raised or lowered by turning bolt-head 16. Stop tap 15 may be lowered sufficiently to completely seal the remainder of the valve from the inlet chamber. However it is principally used to adjust the rate of flow of water entering the valve body 10.

25 The main chamber 12 contains a piston 17. The piston 12 has in its lower portion a rubberized surface 18 which engages with a corresponding seat formed in the valve body 10 to form a seal when the valve is in the closed position. This prevents water flowing from inlet chamber 11 to discharge chamber 14. Piston 12 has a depending projection 19 of slightly smaller diameter than the discharge chamber 14 to form a choke. Piston 12 also has a transverse passageway 19 and an axial passageway 20 which communicate with one another. A filter 20 is located in the axial passageway 20 where it meets with the transverse passageway 19. Two
30 small flow valves 21 and 22 are also

located in the axial passageway 20. Channel 23 of axial passageway connects valve 22 to the upper portion 40 of the main chamber 12 and is offset from the main axis of the valve so that it is not blocked by spindle 30 when the valve is open.

- 5 Water flows from the inlet chamber 11 into main chamber 12 and into transverse passageway 19. Thereafter, a portion of the water flows into the axial passageway through flow valves 21 and 22, and through channel 23 into the upper portion 40. The flow valves regulate the amount of water permitted to flow into upper portion 40.
- 10 Situated above main chamber 12 is a bonnet 25 which contains a spindle 30 which projects into the main chamber 12. Bonnet 25 is partially located in the main chamber 12. (In the other form of the invention illustrated in figure 3, an "O"-ring 32 is necessary to seal the main chamber 12). The amount of the spindle projecting into the upper
- 15 portion 40 may be adjusted by means of a bolt head 33. To prevent leakage of water from the bonnet 25, an "O"-ring 24 is located beneath bolt head 33. The spindle 30 projecting into the main chamber 12 controls the extent of upward movement of piston 17 and thus the volume of upper portion 40 when the valve is in the open position. That volume controls
- 20 the period between actuation of the valve and the cessation of water flow through the valve.

The bonnet 25 also has a port 35 leading from upper portion 40. A valve 42 is connected to the port 35 and also to a tube 41. Valve 42 is controlled by a solenoid unit 43 which is electrically actuated to open

- 25 valve 42 for a predetermined period of time or times and then close. Tube 41 is connected at its other end to a passageway 13. Passageway 13 is a passageway which communicates with discharge chamber 14. An "O"-ring 37 assists in maintaining the connection between the discharge pipe 44 and the discharge chamber 14.

- 30 In the other form of the invention illustrated in figure 3 the valve is actuated by mechanical means. A handle 29 is provided on bonnet 25. Upon depressing handle 29, water is able to flow from upper portion 40 of main chamber 12 through port 35 into the annular cavity around



spindle 30 and then flow into passageway 13. The passageway 13 is opposite the inlet chamber 11 in contrast to figures 1 and 2.

With either embodiments when the valve is in the closed position, inlet chamber 11 and main chamber 12 are filled with water. In this state, the total force exerted on the top of the piston 17 by the water contained in the upper portion 40 of the main chamber 12 is greater than the force exerted by the water in the lower portion 39 of the main chamber 12 because the piston 17 has greater surface area exposed to the upper portion 40. In this state, the valve is closed because seal 18 prevents water flowing from inlet chamber 11 to discharge chamber 14.

Upon actuation (by either mechanical or electrical means), water is permitted to flow from upper portion 40 through to port 35 and passageway 13 and into discharge chamber 14. Consequently, the force of the water on the top of piston 17 in the upper portion 40 of the main chamber becomes less than the force exerted by the water in the lower portion 39. This causes piston 17 to rise and permits water to flow from inlet chamber 11 through discharge chamber 14 and through the non-return valve 36. Water discharged from passageway 13 into discharge chamber 14 is drawn (by a venturi effect by the water flowing from the inlet chamber 11 to discharge chamber 14) down discharge chamber 14. In this state, water from inlet chamber 11 will still flow into channel 19, through filter 20, through flow valves 21 and 22 and then through channel 23 into upper portion 40.

Upon release of the actuating means (which in normal use would be very shortly after actuation), water is no longer able to pass through from upper portion 40 to passageway 13. Thus, water flowing through piston 17 into upper portion 40 will force piston 17 back down to its initial position in the "closed" state. As seal 18 nears its seat in main body 10, the flow of water from inlet chamber 11 to discharge chamber 14 will slowly decrease and finally stop upon seal 18 again forming a seal with main body 10 preventing the flow of water from inlet chamber 11 to discharge chamber 14. Air-vent 38 from discharge pipe 44 will enable any remaining water in discharge pipe 44 to drain away. This creates an air-break between the valve and the downstream end of discharge pipe 44.

The means for actuating the valve may be selected to provide alternate flushing options. For example appropriate electronic controls for the solenoid 42 may permit selection of different volumes of water to be discharged. Such electronic controls are well known.

- 5 In summary, a compact valve which is straightforward to use and relatively simple to install is provided which can be connected to a mains pressure water system to deliver a predetermined volume of water. The actuating means for the delivery of the water may be electrical or mechanical.

Claims

The claims defining the invention are as follows:

1. A mains pressure valve which comprises:
 - (a) a main chamber having an inlet for fluid and an outlet for fluid;
 - (b) a piston located in the main chamber which is movable into and out of sealing engagement with the outlet of the main chamber;
 - (c) a port in an upper portion of the main chamber above the piston which permits fluid to flow therethrough; and
 - (d) a valve associated with the port to regulate the flow of fluid through the port.
2. A valve according to claim 1 further comprising an inlet chamber communicating with the inlet of the main chamber.
3. A valve according to either claims 1 or 2 further comprising a discharge chamber communicating with the outlet of the main chamber.
4. A valve according to claim 3 further comprising a bypass passageway communicating between the port in the upper portion of the main chamber and the discharge chamber.
5. A valve according to any one of claims 1 to 4 in which the piston sealingly engages the walls of the main chamber and includes an internal passageway which communicates between the upper portion of the main chamber and the inlet.
6. A valve according to claim 5 in which the piston includes a flow valve located in the internal passageway of the piston to regulate the passage of fluid from the inlet of the main chamber to the upper portion of the main chamber.





7. A valve according to any one of claims 2 to 6 further comprising a stop tap located in the inlet chamber and movable to vary the amount of water flowing through the inlet chamber.
- 5 8. A valve according to any one of claims 3 to 7 further comprising a non-return valve attached to, or located in, the outlet to restrict fluid which has been discharged from the outlet from flowing backwards through the valve from the outlet to the inlet.
- 10 9. A valve according to any one of claims 1 to 8 further comprising adjustment means to control the distance of upward movement of the piston in the main chamber.
10. A valve according to claim 9 wherein the adjustment means comprises a movable spindle projecting into the upper portion of the main chamber.
- 15 11. A valve according to any one of claims 3 to 10 wherein the discharge chamber includes an air-vent.
12. A valve according to any one of claims 1 to 11 further comprising mechanical and/or electrical actuation means to control fluid flow in and through the valve.



ABSTRACT**MAINS PRESSURE FLUSHER VALVE**

A mains pressure valve which comprises a main chamber (12) having an inlet chamber (11) for fluid and an outlet for fluid; a non-return valve (36) located downstream of the outlet and adapted to provide resistance to fluid flowing therethrough; a piston (17) located in the main chamber (12) which is movable into and out of sealing engagement with the outlet of the main chamber and which defines above it an upper portion (40) of the main chamber (12) and having an internal passageway (20) which communicates between upper portion of the main chamber (40) and the inlet (11); a port (35) in the upper portion (40) which permits fluid to flow therethrough; and actuation control (42) associated with the port to regulate the flow of fluid through the port. Upon actuation fluid in the upper portion (40) drains through port (35) allowing piston (17) to rise and mains pressure fluid passes from inlet chamber (11) through main chamber (12) and out discharge chamber (14). Non-return valve (36) provides some resistance to the passage of fluid to reduce the vacuum force created by the passage of fluid at mains pressure. Fluid bleeds via flow valve (21) and (22) into upper port (40) and as port (35) is closed piston (17) closes the valve after a predetermined period.

Fig 1

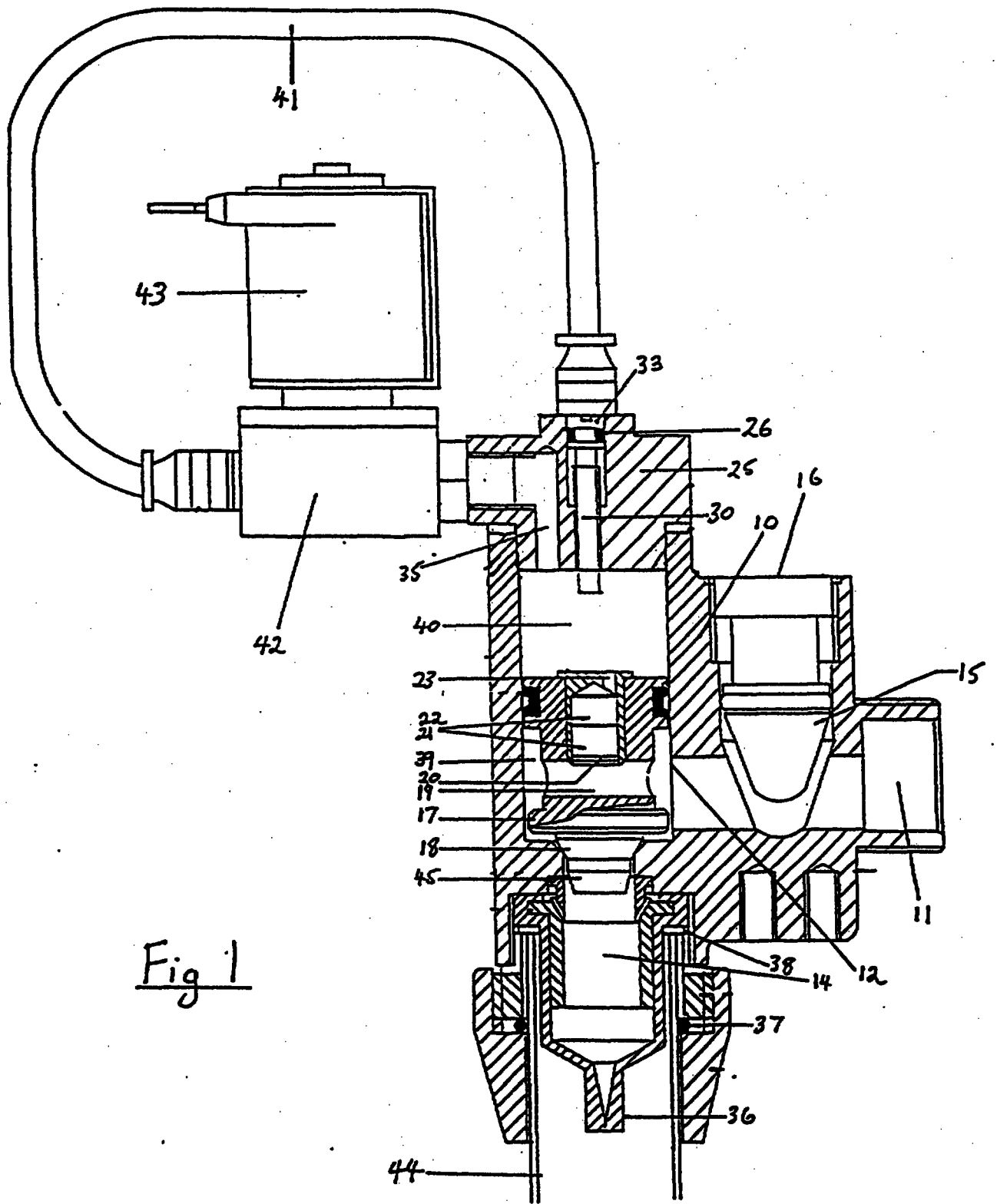
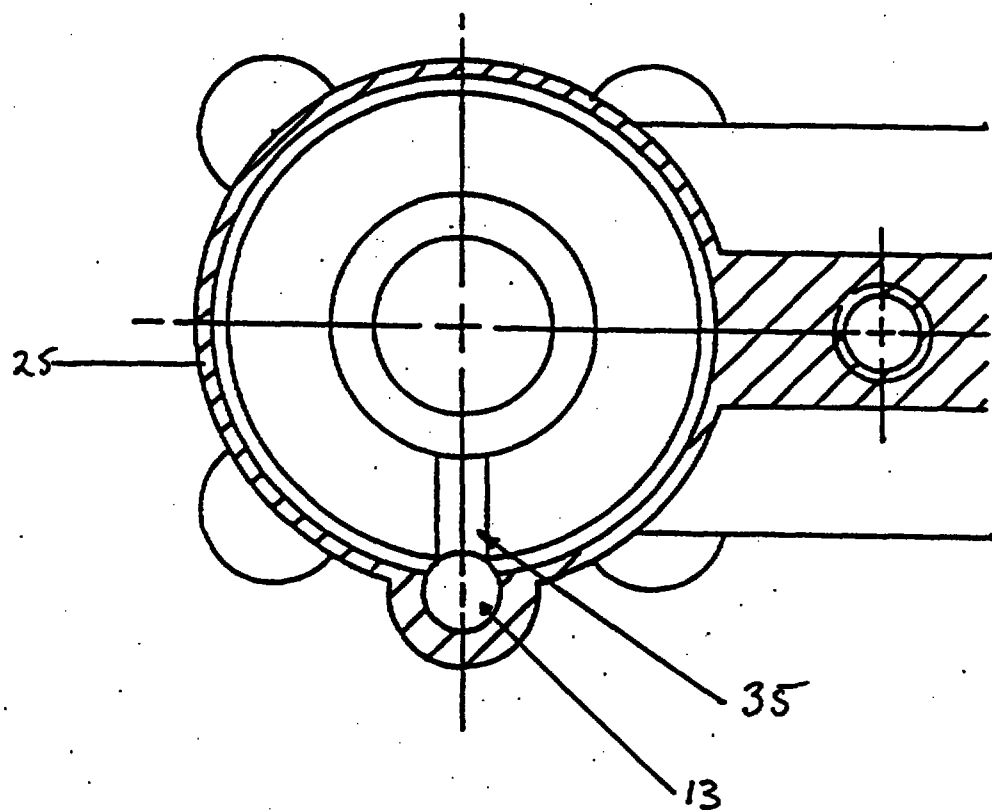


Fig 1

Fig 2

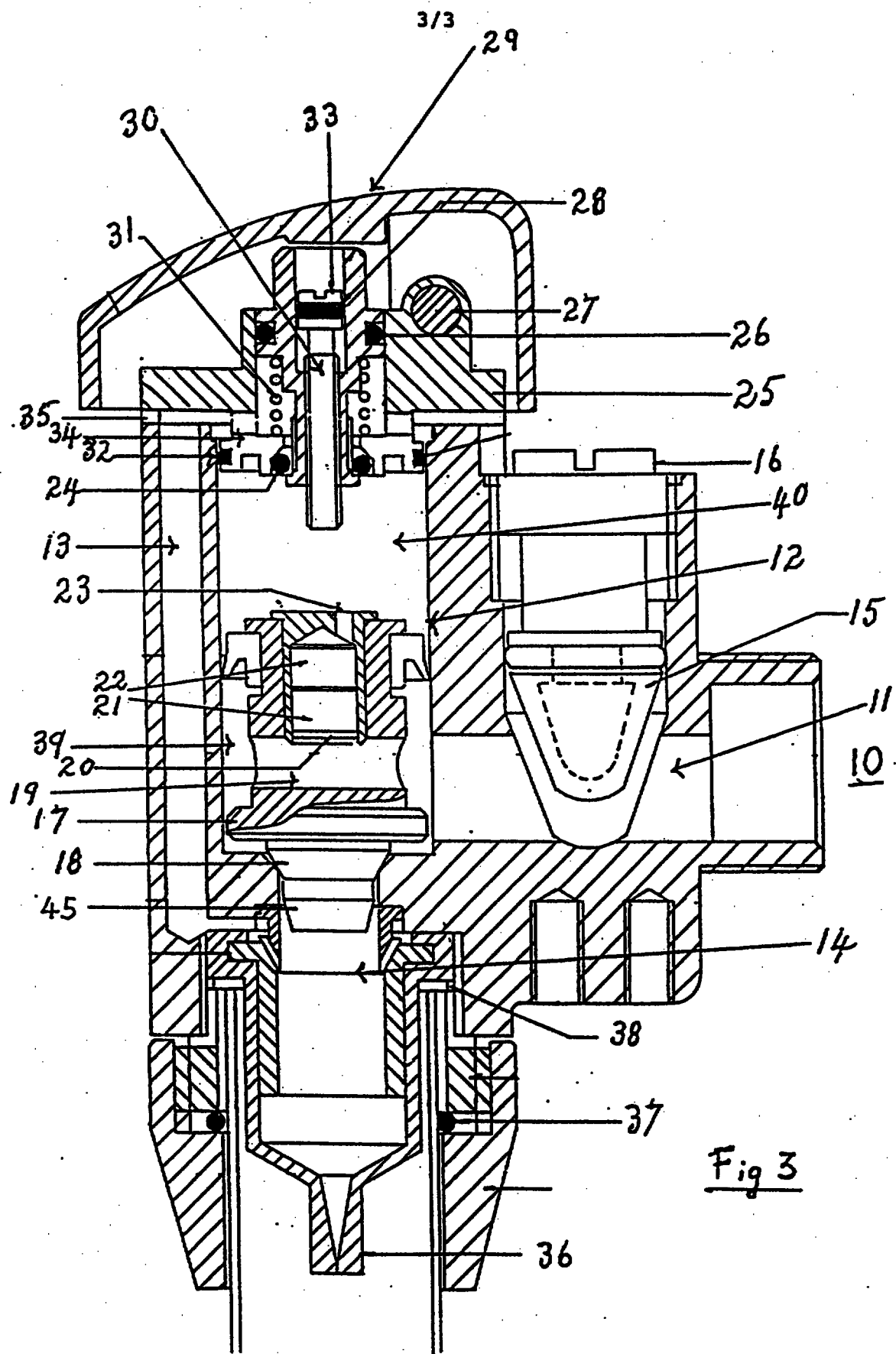


Fig 3

Australian patent number 577932 describes a self close flush valve which is intended to operate at lower than mains pressure as one of several similar valves, each servicing a separate toilet, where the water supply for each is one large header tank. This valve allows the delivery of a fixed volume of water and its particular advantage is stated to be that the volume of water delivered can be easily varied. This valve is, however, not appropriate for connection directly to a mains pressure water system.

That valve has a principal valve which controls the flow of water from the inlet to the outlet by the pressure of water in an inner chamber. By releasing the pressure of water in the inner chamber through a valve contained within the principal valve, the principal valve opens (allowing water to flow from the inlet through to the outlet). While that water flows through to the outlet, some of that water is diverted into the inner chamber which increases the water pressure in the inner chamber and thus causes the principal valve to close again.

Accordingly investigations have been carried out in an attempt to provide an improved mains pressure valve to permit the delivery of a predetermined (although variable) volume of water from a mains pressure water system.

20 Description of the Invention

According to this invention, there is provided a mains pressure valve which comprises:

- (a) a main chamber having an inlet for fluid and an outlet for fluid;
- (b) a non-return valve located downstream of the outlet and adapted to provide resistance to fluid flowing therethrough;
- (c) a piston located in the main chamber which is movable into and out of sealing engagement with the outlet of the main chamber and having an internal passageway which communicates between an upper portion of the main chamber and the inlet;
- (d) a port in the upper portion of the main chamber above the piston which permits fluid to flow therethrough; and
- (e) a valve associated with the port to regulate the flow of fluid through the port.

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Date: 23 FEB 1996

REPLACEMENT SHEETS		SG
☒	Description	: paged 2,3,7,1a to paged 9
☒	Claim(s)	: paged 9 to paged 9
☐	Drawing(s)	: paged 9 to paged 9
☐	Abstract	: paged 9 to paged 9
DATE OF RECEIPT 23 FEB 1996		

In a preferred embodiment of the invention, the valve further comprises an inlet chamber communicating with the inlet of the main chamber. Additionally or alternatively, the valve further comprises a discharge chamber communicating with the outlet of the main chamber.

- 5 In another preferred embodiment of the invention, the valve further comprises a bypass passageway communicating between the port in the upper portion of the main chamber and the discharge chamber.

- 10 In another preferred form of the invention, a stop tap is located in the inlet chamber and adapted to vary the amount of water flowing through the inlet chamber into the main chamber. Further, the stop tap can be closed completely to prevent any flow of water through the valve. This feature would be particularly relevant for maintenance for example. Typically the stop tap may be raised or lowered to obstruct the flow of water from the mains pressure system into the main chamber. By
15 allowing less water into the main chamber, less water is able to flow through the valve to the outlet during the period the valve is open.

- In another preferred embodiment of the invention, the valve can be controlled by an actuation means which can be mechanical or electrical. The actuating means for the delivery of water may preferably be adapted
20 so that there are two predetermined volumes of water which the valve may deliver (one being approximately double the other) to allow for the well known "dual flush" mode of operation. A "dual-flush" operation can be achieved by altering the period of activation of the mechanical means (such as holding the handle down for a short period before releasing it as
25 opposed to a mere push and release) or, in the case of electrical means,

This is the replacement sheet

Date: 23 FEB 1996

spindle 30 and then flow into passageway 13. The passageway 13 is opposite the inlet chamber 11 in contrast to figures 1 and 2.

5 With either embodiments when the valve is in the closed position, inlet chamber 11 and main chamber 12 are filled with water. In this state, the total force exerted on the top of the piston 17 by the water contained in the upper portion 40 of the main chamber 12 is greater than the force exerted by the water in the lower portion 39 of the main chamber 12 because the piston 17 has greater surface area exposed to the upper portion 40. In this state, the valve is closed because seal 18 prevents
10 water flowing from inlet chamber 11 to discharge chamber 14.

Upon actuation (by either mechanical or electrical means), water is permitted to flow from upper portion 40 through to port 35 and passageway 13 and into discharge chamber 14. Consequently, the force of the water on the top of piston 17 in the upper portion 40 of the main
15 chamber becomes less than the force exerted by the water in the lower portion 39. This causes piston 17 to rise and permits water to flow from inlet chamber 11 through discharge chamber 14 and through the non-return valve 36. Water discharged from passageway 13 into discharge chamber 14 is drawn (by a venturi effect by the water flowing
20 from the inlet chamber 11 to discharge chamber 14) down discharge chamber 14. The non-return valve 36 provides some resistance to the water flowing through discharge chamber 14 which reduces any vacuum force created by the flowing of water through the outlet and which would otherwise cause piston 17, at normal operating pressures, to be
25 prematurely drawn down, closing the valve prior to the action of the closing mechanism explained below. Further, where the non-return valve is constructed of flexible and elastic material, it can provide an appropriate degree of resistance over the range of water flow-rates experienced in the discharge chamber 14. In this state, water from inlet
30 chamber 11 will still flow into channel 19, through filter 20, through flow valves 21 and 22 and then through channel 23 into upper portion 40.

Upon release of the actuating means (which in normal use would be very shortly after actuation), water is no longer able to pass through from upper portion 40 to passageway 13. Thus, water flowing through

This is the replacement sheet

Date: 23 FEB 1996

piston 17 into upper portion 40 will force piston 17 back down to its initial position in the "closed" state. As seal 18 nears its seat in main body 10, the flow of water from inlet chamber 11 to discharge chamber 14 will slowly decrease. Non-return valve 36 maintains some resistance to the water being discharged by elastically contracting due to the lower flow-rate (and thus lower pressure inside the non-return valve).

Projection 45, the choke, slows the downward movement of the piston 12 by further decreasing the water flow-rate through discharge chamber 14. This assists in the seal 18 coming to rest on its corresponding seat gently. A sudden or violent reseating of piston 12 would cause an undesirable noise and may also set up dangerous hydraulic vibrations. The flow of water through the valve finally stops upon seal 18 again forming a seal with its corresponding seat in main body 10 preventing the flow of water from inlet chamber 11 to discharge chamber 14. Air-vent 38 from discharge pipe 44 will enable any remaining water in discharge pipe 44 to drain away. This creates an air-break between the valve and the downstream end of discharge pipe 44.

This is the replacement sheet

Date: 23 FEB 1996

Claims

The claims defining the invention are as follows:

1. A mains pressure valve which comprises:
 - 5 (a) a main chamber having an inlet for fluid and an outlet for fluid;
 - (b) a non-return valve located downstream of the outlet and adapted to provide resistance to fluid flowing therethrough;
 - 10 (c) a piston located in the main chamber which is movable into and out of sealing engagement with the outlet of the main chamber and having an internal passageway which communicates between an upper portion of the main chamber and the inlet;
 - 15 (d) a port in the upper portion of the main chamber above the piston which permits fluid to flow therethrough; and
 - (e) a valve associated with the port to regulate the flow of fluid through the port.
2. A valve according to claim 1 further comprising an inlet chamber communicating with the inlet of the main chamber.
- 20 3. A valve according to either claims 1 or 2 further comprising a discharge chamber communicating with the outlet of the main chamber.
4. A valve according to claim 3 further comprising a bypass passageway communicating between the port in the upper portion of the main chamber and the discharge chamber.
- 25 5. A valve according to claim 4 in which the piston includes a flow valve located in the internal passageway of the piston to regulate the passage of fluid from the inlet of the main chamber to the upper portion of the main chamber.



This is the replacement sheet

Date: 23 FEB 1996

6. A valve according to any one of claims 2 to 5 further comprising a stop tap located in the inlet chamber and movable to vary the amount of water flowing through the inlet chamber.
- 5 7. A valve according to any one of claims 1 to 6 further comprising adjustment means to control the distance of upward movement of the piston in the main chamber.
8. A valve according to claim 7 wherein the adjustment means comprises a movable spindle projecting into the upper portion of the main chamber.
- 10 9. A valve according to any one of claims 3 to 8 wherein the discharge chamber includes an air-vent.
10. A valve according to any one of claims 3 to 8 wherein piston further comprises a depending projection of slightly smaller diameter than the discharge chamber.
- 15 11. A valve according to any one of claims 1 to 10 further comprising mechanical and/or electrical actuation means to control fluid flow in and through the valve.

