

A PISTON FLUSH VALVE

Field of Invention

The present invention relates to a piston flush valve that is suitable for, but not limited to, connecting to a sanitary fixture such as a water closet (WC) for carrying out a flushing action.

Background Art

The following discussion of the background to the invention is intended to facilitate an understanding of the present invention only. It should be appreciated that the discussion is not an acknowledgement or admission that any of the material referred to was published, known or part of the common general knowledge of the person skilled in the art in any jurisdiction as at the priority date of the invention.

A flush valve is a type of self-closing valve mechanism designed to release of flush fluid when activated. This mechanism is often used to flush a toilet or urinal. The flush valve is usually located within the toilet tank or in the body of the urinal. Most toilets have a lever or push-button activator to operate the flush valve.

Conventional piston flush valves would typically include a seal positioned to prevent undesired fluid leakage. A general problem associated with such piston flush valves is the production of hammering noise caused by vibration that could amplify and resonate during fluid travel within pipes. This problem could be exacerbated by the loosening of the seal over time because the seal is typically attached to movable part(s) of the piston flush valve. This will be discussed later in further detail with reference to Figure 1.

Moreover conventional piston flush valves in the market are typically made of metal such as copper. Although copper, as compared to other metals, is relatively well protected against corrosion due to a semi-protective film that forms on its surface, breakdown of the protective film even in a small area can result in corrosion. This eventually causes perforation of the valve wall and leakages to occur. Corrosion erodes flush valves over time and worn flush valves cause toilets to leak fluid, create noise and waste.

As will also be discussed later in further detail with reference to Figure 1, one problem with conventional piston flush valve products is that they adopt an integrated design, thereby making it difficult to create various types of flush valves with different configurations and functionalities.

- 5 It can be appreciated by the foregoing paragraphs that there are various problems associated with conventional piston flush valves and there therefore exists a need for a solution which ameliorates at least some of the aforementioned problems.

Summary of the Invention

10 In accordance with a first aspect of the disclosure, there is provided a piston flush valve suitable/adaptable for use with a sanitary fixture, comprising: a housing shaped and dimensioned to form an inlet portion and an outlet portion; a piston assembly capable of actuated so as to move between a closed configuration and an open configuration; and a primary seal carried within the housing, wherein the primary seal is in a fixed relationship with its surroundings during the movement of the piston
15 assembly between the closed configuration and the open configuration.

Preferably, the housing is made of plastic.

Preferably, the plastic housing is made of materials selected from a group consisting of Polyphenylene Sulfide, Polybutylene terephthalate, Polyphthalamide, Glass Fiber Reinforced Polyamide and Polyether Ether Ketone. In the context of the present
20 disclosure, plastic is environmental friendly and is more resistant to corrosion caused especially by seawater.

Preferably, the housing is further shaped and dimensioned to define an opening portion between the inlet portion and the outlet portion, and wherein the opening portion comprises a rim part shaped and dimensioned to carry the primary seal.

25 Preferably, the piston flush valve further comprises a plastic strainer located on a top portion of the piston assembly.

Preferably, the piston flush valve comprises a screw nut having a plurality of ribs for guiding movement of the piston assembly.

30 In accordance with another aspect of the disclosure, there is a modular valve assembly of a sanitary fixture for carrying out a flushing action, the valve assembly being customizable to operate based on one of a plurality of configuration options, the valve

assembly comprising: a piston flush valve operable for controlling fluid movement; an actuator ; and at least one control module associated with a configuration option based on which the valve assembly is configured to operate in, the control module coupling the actuator and the piston flush valve, wherein the actuator can be operated to
5 activate the control module to operate the piston flush valve based on the configuration option associated with the control module. The modular valve assembly allows various configuration options and functionalities to cater for different user's requirements.

Preferably, the actuator is associated with one or more operation modes, wherein the one or more operation modes include sensor activation, contact manual user
10 activation and/or remote manual user activation.

Preferably, the sensor activation operation mode of the actuator is implemented by an electromechanical solenoid.

Preferably, the contact manual user activation operation mode of the actuator is implemented by a push button providing a linear actuating force on the piston flush
15 valve. This achieves precise step-less adjustment at the precision level of 0.1mm; addresses the technical difficulties in regulating the fluid volume in retractable valve stem; and configures the modules of the rotary button structure to form a single button or a dual button structure, which accordingly provide different functionalities.

Preferably, the push button has a plurality of parts wherein each part is associated
20 with a different flush mode.

Preferably, the push button is divided into two parts providing dual flush modes: a first part providing a full flush mode and a second part providing a partial flush mode. Dual flush toilet systems provide a partial flush feature, i.e. an option to the toilet user to use lesser volume of fluid to flush away liquid waste and small amounts of waste.

25 Preferably, the remote manual user activation operation mode of the actuator is implemented by a push-pull mechanism.

Preferably, the housing and the actuator are made of plastic.

Preferably, the plastic is selected from a group consisting of Polyphenylene Sulfide, Polybutylene terephthalate, Polyphthalamide, Glass Fiber Reinforced Polyamide and
30 Polyether Ether Ketone.

Preferably, the valve assembly further comprises an inlet connected to a stopcock for controlling supply of fluid from a supply pipe into the valve assembly.

Preferably, the stopcock houses an anti-siphon mechanism for preventing fluid movement from the valve assembly back into the supply pipe. Vacuum suction happens when several flush valves are placed along a fluid supply pipe. When one flush valve is activated, it will draw fluid from the supply pipe. The fluid pressure in the supply pipe will drop and sometimes cause a siphon effect to draw fluid from the adjacent flush valve. This will cause the adjacent flush valve to falsely activate. The anti-siphon mechanism will prevent fluid from flowing backwards when the pressure in the supply pipe is lower than the fluid pressure in the piston flush valve.

Other aspects of the disclosure will become apparent to those of ordinary skill in the art upon review of the following description of specific embodiments of the disclosure in conjunction with the accompanying figures.

Brief Description of the Drawings

The present disclosure will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1a shows a cutaway view of a conventional piston flush valve.

Figure 1b shows conventional flush valve products that have an integrated design.

Figure 2a shows a cutaway view of a piston flush valve, according to an embodiment of the disclosure.

Figure 2b shows that the piston flush valve of Figure 2a, when in use, can either be in an open configuration or a closed configuration, according to an embodiment of the disclosure.

Figure 3 shows a partial cutaway of a modular flush valve assembly which includes an actuator, according to an embodiment of the disclosure.

Figure 4 shows a variation of the modular flush valve assembly, having a stopcock, of Figure 3, according to an embodiment of the disclosure.

Figure 5 shows another variation of the modular flush valve assembly, having a stopcock, of Figure 3, according to an embodiment of the disclosure.

Figure 6a and 6b show an example of the actuator of Figure 3, according to an embodiment of the disclosure.

- 5 Figure 7 illustrates a table listing exemplary configuration options associated with the modular flush valve assembly of Figure 3, according to an embodiment of the disclosure.

Figure 8 shows that the stopcock of Figure 4 and Figure 5 can be installed in three possible positions.

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Description of Embodiments of the Invention

Particular embodiments of the present disclosure will now be described with reference to the accompanying drawings. The terminology used herein is for the purpose of describing particular embodiments only and is not intended to limit the scope of the present disclosure. Other definitions for selected terms used herein may be found
15 within the detailed description of the disclosure and apply throughout the description. Additionally, unless defined otherwise, all technical and scientific terms used herein have the same meanings as commonly understood by one of ordinary skill in the art to which this disclosure belongs. Where possible, the same reference numerals are
20 used throughout the figures for clarity and consistency.

Throughout the specification, unless the context requires otherwise, the word “comprise” or variations such as “comprises” or “comprising, will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

- 25 Furthermore, throughout the specification, unless the context requires otherwise, the word “include” or variations such as “includes” or “including” will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

Although mentioned earlier that the present disclosure relates to a piston flush valve
30 that is generally suitable for use with sanitary fixture, it should be appreciated that the

piston flush valve need not necessarily be limited to only such use. For example, the piston flush valve can be suitable/adapted for use with fluid dispenser type consumer machines/apparatuses (e.g., portable coffee machines, drinking fountains etc.).

Figure 1a depicts a conventional piston flush valve 10 having a housing 11, a piston assembly 12, a first seal 13 and a second seal 19. In general, the piston assembly 12, the first seal 13 and the second seal 19 can be carried within the housing 11. Moreover, the housing 11 can be shaped and dimensioned to form an inlet portion 10a and an outlet portion 10b. As mentioned earlier, conventional piston flush valves are typically made of metal. Specifically, the conventional piston flush valve 10 is made of metal. More specifically, the housing 11 is made of metal.

The piston assembly 12 can include a screw nut 14, a piston rod 18, a first portion to which the first seal 13 can be attached and a second portion to which the second seal 19 can be attached. Moreover, the first seal 13 can be in contact with the screw nut 14. In one exemplary orientation, as shown in Figure 1, the first portion can be a lower portion of the piston assembly 12 and the second portion can be an upper portion of the piston assembly 12.

In use, the piston flush valve 10, at the inlet portion 10a can be connected to a fluid inlet source (not shown). The piston flush valve 10 can be further connected, at the outlet portion 10b, to a fluid pipe (not shown). Fluid (e.g., water) from the fluid inlet source can flow from the inlet portion 10a, via the piston assembly 12, to the fluid pipe connected to the outlet portion 10b.

The piston assembly 12 can be actuated so as to be movable within the housing 11 to one of impede and allow fluid flow from the inlet portion 10a to the outlet portion 10b. For example, the piston assembly 12 can be actuated in a manner so as to be capable of moving along a longitudinal axis (as depicted by arrow 10c) within the housing 11.

Appreciably, as the piston assembly 12 moves within the housing 11, the screw nut 14 might inevitably become loosened over time. In consequence to the screw nut 14 being loosened, the first seal 13 (which is in contact with the screw nut 14) may also become loosened. This may generate minute vibration when the piston flush valve 10 is in use (i.e., during flow of fluid from the inlet portion 10a to the outlet portion 10b through the piston assembly 12). Moreover, such generated minute vibration might

become amplified due to travel of fluid through the fluid pipe, thus generating hammering noise.

Figure 1b shows various product forms (10d, 10e and 10f) associated with the piston flush valve 10 of Figure 1a. As shown, product forms are each of integrated design form.

Figure 2a illustrates a piston flush valve 20 according to an aspect of the disclosure. Preferably, the piston flush valve 20 is suitable for use with a sanitary fixture (not shown). The piston flush valve 20 can be further suitable/adaptable for use with a portable fluid dispensing machine/apparatus (e.g., a portable coffee machine).

The piston flush valve 20 includes a housing 21, a piston assembly 22, a primary seal 23 and a secondary seal 29. The piston assembly 22 includes a screw nut 24 and a piston rod 28. Preferably, the housing 21 is made of plastic. More preferably, the housing 21 is made entirely of plastic.

The housing 21, the piston assembly 22, the secondary seal 29, the screw nut 24 and the piston rod 28 of Figure 2a can, in certain but not all aspects, be analogous, respectively, to the housing 11, the piston assembly 12, the second seal 19, the screw nut 14 and the piston rod 18 of Figure 1a.

In this regard, relevant portions of the earlier discussion concerning Fig. 1a can analogously apply to Figure 2a. In one example, as shown in Figure 2a, the housing 21 can be shaped and dimensioned in a manner so as to carry the piston assembly 22. In another example, the piston flush valve 20 can include an inlet portion 20a connected to a fluid inlet source (not shown) and an outlet portion 20b connected to a fluid pipe (not shown).

The piston flush valve 20, in accordance with an embodiment of the disclosure, can differ from the conventional piston flush valve 10 of Figure 1a in at least material from which housing 21 (per Figure 2) is made and material from which housing 11 (per Figure 1) is made. Specifically, the housing 21 (per Figure 2) is made of plastic whereas the housing 11 (per Figure 1) is made of material other than plastic (i.e., metal).

Moreover, the piston flush valve 20, in accordance with an embodiment of the disclosure, can differ from the conventional piston flush valve 10 of Figure 1a in at

least seal arrangement. This will be discussed in further detail with reference to Figure 2b hereinafter.

Figure 2b shows that the piston flush valve 20 can, when in use, either be in an open configuration 30a or a closed configuration 30b.

- 5 In general, the piston assembly 22 can be actuated so that it can be moved between a first position and a second position within the housing 21. For example, the piston assembly 22 can be moved along a longitudinal axis (e.g., as depicted by arrow 20c of Figure 2a) within the housing 21 so that the piston flush valve 20 is in one of the open configuration 30a and the closed configuration 30b.
- 10 The housing 21 can be further shaped and dimensioned in a manner such that an opening portion 31a can be defined between the inlet portion 20a and the outlet portion 20b for allowing fluid flow from the inlet portion 20a to the outlet portion 20b (i.e., as indicated by directional arrows 31b) when the piston flush valve 20 is in the open configuration 30a. The opening portion 31a can include a rim part 31c which can be
- 15 shaped and dimensioned to carry the primary seal 23. In this regard, the primary seal 23 can be considered to be carried along the edge of the opening portion 31a.

Moreover, in the open configuration 30a, it is appreciable that the piston assembly 22 is moved away from the primary seal 23 so as to allow flow of fluid from the inlet portion 20a to the outlet portion 20b (as indicated by directional arrows 31b). In contrast, in

20 the closed configuration 30b, it is appreciable that the piston assembly 22 abuts the primary seal 23 so as to block/close the opening portion 31a and impede flow of fluid from the inlet portion 20a to the outlet portion 20b (as indicated by directional arrows 31d).

In this regard, the piston assembly 22 can be actuated so as to be movable in a

25 manner to either abut (i.e., make substantially full contact with) the primary seal 23 (i.e., closed configuration 30b) or move away from the primary seal 23 (i.e., open configuration 30a).

In one embodiment, when in the open configuration 30a, the piston assembly 22 can be moved away from the primary seal 23 such that there is still partial contact between

30 the piston assembly 22 and the primary seal 23. However, it is appreciable that such

partial contact does not impede flow of fluid from the inlet portion 20a to the outlet portion 20b.

In another embodiment, when in the open configuration 30a, the piston assembly 22 can be moved away from the primary seal 23 such that there is no contact between the piston assembly 22 and the primary seal 23.

Therefore in the context of the earlier discussed exemplary orientation in Figure 1a, the secondary seal 29, similar to the conventional design of Figure 1a, can be attached to an upper portion of the piston assembly 22. However, in comparison to the conventional piston flush valve 10 of Figure.1 in which the first seal 13 is attached to the piston assembly 12, the primary seal 23 is not attached to the piston assembly 22. Instead, the primary seal 23 (e.g., made of rubber) is located at a base (i.e, rim part 31c) of the inlet portion 20a, functioning to stop any fluid flow when the piston assembly 22 is moved to close the opening portion 31a defined between the inlet portion 20a and the outlet portion 20b. In other words, the primary seal 23 remains in fixed position within the housing 21 relative to movement of the piston assembly 22 (i.e., the primary seal 23 does not move with the piston assembly 22 and the screw nut 24). In this regard, the primary seal 23 can be considered to be in a fixed relationship with the housing 21 during the movement of the piston assembly 22.

More specifically, the primary seal 23 can be fixably carried within the housing 21. Yet more specifically, the primary seal 23 can be carried with the housing 21 in a fixed and stable manner so that the primary seal 23 remains substantially in place within the housing 21 despite movement of the piston assembly 22. Therefore, the primary seal 23 is considered to be in a fixed relationship with its surroundings (i.e., within the housing 21) during movement of the piston assembly 22.

In this regard, it is appreciable that the seal arrangement associated with the piston flush valve 20 of Figure 2, according to an embodiment of the disclosure, can be distinguished from that of conventional piston flush valve 10.

Appreciably, since the possibility of the primary seal 23 becoming loosened (i.e., due to piston assembly 22 movement) is substantially reduced, the possibility of the aforementioned minute vibration and/or hammering noise being generated would consequently be substantially reduced. The primary seal 23 may be made of ethylene propylene diene monomer (EPDM) rubber or Nitrile butadiene rubber (NBR).

Moreover, as mentioned earlier, the piston flush valve 20 (i.e., Figure 2) can differ from the conventional piston flush valve 10 (i.e., Figure 1a) in that the housing 21 of the piston flush valve 20 is made of plastic (more preferably, made entirely of plastic) whereas the housing 11 of the conventional piston flush valve 10 is made of metal.

5 Appreciably, the problem of corrosion associated with conventional piston flush valves, as earlier discussed, can be substantially mitigated.

In accordance with an embodiment of the disclosure, the screw nut 24 can include a plurality of ribs 25 for guiding movement of the piston assembly 22 within the housing 21 (i.e., between the open and closed configurations 30a/30b). Additionally, the piston
10 assembly 22 can further include a plastic strainer 26 which functions as a filter to prevent unwanted materials such as sand particles from entering the piston flush valve 20. The plastic strainer 26 can, for example, be located/positioned at the second portion (e.g., upper portion) of the piston assembly 12.

Figure 3 shows the piston flush valve 20 as a part of a modular flush valve assembly, according to another aspect of the disclosure. Preferably, the piston flush valve 20
15 can be a part of a modular flush valve assembly of, for example, a sanitary fixture for carrying out a flushing action, according to an embodiment of the disclosure. In this regard, the modular flush valve assembly can be considered to include the piston flush valve 20.

20 Preferably, the modular flush valve assembly can be a customizable type of flush valve assembly in terms of usage. Specifically, the piston flush valve 20 (more specifically the piston assembly 22) can be flexibly controlled in a manner so as to be operable based on one or more configurations. In this regard, the modular flush valve assembly can be considered to be a customizable modular flush valve assembly in that the
25 piston assembly 22 can be flexibly controlled to operate based on one or more configurations as will be discussed later in further detail with reference to Figure 7).

The modular flush valve assembly can include a cap 32 (e.g., a top cap) which includes a screw 33. The modular flush valve assembly can further include an actuator 38. As shown, the cap 32, the actuator 38 and the piston flush valve 20 can be carried by the
30 housing 21. Specifically, the piston assembly 22 can be carried within the housing 21, and the cap 32 and actuator 38 can be carried outside of the housing 21.

A portion of the housing 21 in Figure 3 has been removed partially to illustrate that the primary seal 23 and the piston assembly 22 can be carried within the housing 21, and can be arranged to be distinctly positioned relative to each other. In one embodiment, the primary seal 23 is not in contact with the piston assembly 22 (i.e., when in the open configuration 30a).

In general, the piston flush valve 20 can be coupled to the cap 32 and the actuator 38. More specifically, piston assembly 22 can be coupled to the cap 32 and the actuator 38.

As mentioned earlier, the cap 32 can have a screw 33. The screw 33 can be used for effecting minor adjustment of fluid discharge rate. This will be discussed later in further detail with reference to Figure 4 and Figure 5.

The actuator 38 can be operated for controlling the piston flush valve 20. Specifically, the actuator 38 can be operated to control the piston assembly 22 so that the piston flush valve 20 can be flexibly controlled in a manner so as to be operable in one or more configurations. This will be discussed later in further detail with reference to Figure 7.

Referring to Figure 4 and Figure 5, the modular flush valve assembly can be connected by a joint member 34 to a stopcock 35. A pipe joint 36 can be coupled to one end of the stopcock 35 and a handler 37 can be coupled to another end of the stopcock 35. The pipe joint 36 can be connected to a fluid (e.g., water) supply pipe (not shown). The handler 37 can be used for controlling the opening and the closing of the stopcock 35. Moreover, the stopcock 35 may house an anti-siphon mechanism (not shown) for preventing fluid movement from the modular flush valve assembly back to the fluid supply pipe.

Moreover, Figure 4 shows that the actuator 38 can be coupled to the piston flush valve 20 by manner of, for example, flexible wires 39. The actuator 38 can, for example, be in the form of a push type button having a plurality of push portions as will be discussed later in further detail with reference to Figure 6.

Additionally, as an option, as shown in Figure 4, the modular flush valve assembly can further include a sensor (not shown) and an electromechanical solenoid 40 having a solenoid coil 41. The sensor can be coupled to a sensor controller (not shown). The

electromechanical solenoid 40 can be coupled to the piston flush valve 20. A wire connector 42 can connect the electromechanical solenoid 40 to the sensor controller which can be configured to supply electrical energy to operate the solenoid coil 41 and hence the electromechanical solenoid 40. The push type button and the sensor can,
5 respectively, be for manual activation/actuation and automatic activation/actuation of the piston flush valve 20 as will be discussed later in further detail with reference to Figure 7.

Furthermore, as another option, as shown in Figure 5, the modular flush valve assembly can exclude the electromechanical solenoid 40. In place of the
10 electromechanical solenoid 40, a fluid way seal 43 can be provided to prevent undesired fluid leakage. This will be discussed in further detail with reference to Figure 7.

Figure 4 and Figure 5 will be discussed in the context of the screw 33 being used for effecting (minor) adjustment of fluid discharge rate hereinafter.

Figure 4 shows the screw 33 adjusted downwards (with reference to position of the screw 33 shown in Figure 5) whereas Figure 5 shows the screw 33 in an adjusted upwards position (with reference to position of the screw 33 shown in Figure 4). Adjustment of the screw 33 in the upwards position (per Figure 5) can be associated with increased fluid (e.g., water) discharge rate. Adjustment of the screw 33 in the
20 downwards position (per Figure 4) can be associated with reduced fluid (e.g., water) discharge rate.

In general, by adjusting the screw 33, the piston assembly 22 can be correspondingly adjusted in that the extent of separation between the piston assembly 22 and the primary seal 23 can be controlled when in the open configuration 30a. Specifically, by
25 adjusting the screw 33, the distance from which the piston assembly 22 is capable of being moved away from the primary seal 23 can be correspondingly adjusted when in the open configuration 30a. Appreciably, the further the piston assembly 22 is allowed to be moved away from the primary seal 23, the higher the allowable fluid discharge rate. Conversely, the more limited the extent of separation between the piston
30 assembly 22 and the primary seal 23, the lower the allowable fluid discharge rate.

In the above manner, it is appreciable that allowable fluid discharge rate can be controlled by manner adjusting the screw 33. Moreover, it is appreciable that control

of allowable fluid discharge rate can be considered to be an example of fluid movement control.

The present disclosure further contemplates that another example of fluid movement control can be by manner of controlling fluid flush volume. Additionally, as mentioned earlier, the actuator 38 can, for example, be in the form of a push type button having a plurality of push portions. These will be discussed in further detail hereinafter with reference to Figure 6a and Figure 6b.

Figure 6a and 6b show that the actuator 38 can, for example, be in the form of a push type button, having two push portions, which provides a linear actuating force on the piston flush valve 20. In this regard, the actuator 38 can be associated with a dual flushing function. In some embodiments, the actuator 38 can include an internal spring (not shown) that maintains the actuator 38 in an extended position so that the piston flush valve 20 is not activated. The flexible wires 39, when being pulled, translate the pull force linearly to depress the actuator 38 (i.e., depressed position), activating the piston flush valve 20. When the pull force on the flexible wires 39 is released, the internal spring pushes the actuator 38 back to its original state of position (i.e., extended position).

The actuator 38 can be connected to a push plunger 62 which, depending on which part of the actuator 38 is being pushed, engages with the piston rod 28 of the piston assembly 22 with varying pressure and therefore selects the flush mode to achieve the desired fluid flush volume. A screw 63 can be provided for adjusting push plunger 62 angle.

For example, when the screw 63 is rotated clockwise, it causes the rotatory lever 64 to rotate, elevating the angle of the push plunger 62, which may increase the volume of the fluid flush. Alternatively, when the screw 63 is rotated anticlockwise, it causes the rotary level 64 to rotate in an opposite direction, lowering the angle of the push plunger 62, which may decrease the volume of fluid flush. Therefore, independent adjustment of the two push portions (i.e., each push portion can be adjusted independently) at a precision level of 0.1mm would be possible.

Therefore, it is appreciable that examples of fluid movement control can include controlling allowable fluid discharge rate and fluid flush volume. Further examples of fluid movement control can include impeding and/or allowing flow of fluid between the

inlet portion 20a and the outlet portion 20b as discussed earlier with reference to Figure 2.

Appreciably, by manner of, for example,

1) controlling allowable fluid discharge rate,

5 2) fluid flush volume, and/or

3) impeding and/or allowing flow of fluid between the inlet portion 20a and the outlet portion 20b,

the piston flush valve 20 can be operated in a manner so as to control fluid movement.

10 Earlier mentioned, the modular flush valve assembly can be considered to be a customizable modular flush valve assembly in that the piston flush valve 20 can be flexibly controlled to operate based on one or more configurations. This will be discussed in further detail with reference to Figure 7 hereinafter.

Referring to Figure 7, a number of configurations (i.e., configuration option) can be possible. Each configuration can be associated with one or more components. In one example configuration option 1 is associated with a combination of component 1 and component 2. In another example, configuration option 5 is associated with a combination of component 3, component 4 and component 2.

At least one control module (not shown) associated with one or more configuration options can be provided, and operable, for controlling the piston flush valve 20. A control module can be implemented by manner of one or both of hardware implementation and software implementation. In one example, the control module can be in the form of a hardware module (i.e., hardwiring, mechanical and/or discrete electronic sensor components). In another example, the control module can be in the form of a programmed integrated circuit module.

One or more control modules can be installed in the modular flush valve assembly. Specifically, one or more control modules can be carried by the housing 21. The actuator 38 can be coupled to one or more control modules which can, in turn, be coupled to the piston flush valve 20. In this regard, the actuator 38 can be coupled to the piston flush valve 20 via one or more control modules.

By appropriate operation of the actuator 38, one or more desired configuration options can be activated. Specifically, the actuator 38 can be operated to activate the control module(s) to operate the piston flush valve 20. More specifically, the actuator 38 can be operated to activate the control module(s) to operate the piston flush valve 20 based on the configuration option(s) associated with the control module(s).

In one example, operation of the actuator 38 can be by manner of manual activation such as manual push activation as discussed with reference to Figure 4 to Figure 6. In another example, operation of the actuator 38 can be by manner of automatic activation (in which case, the actuator 38 can be in the form of an electronic sensor such as a motion sensor, a light sensor or an optical sensor). In yet another example, operation of the actuator 38 can be by manner of both manual activation and automatic activation (in which case, the actuator 38 can be in the form of a module with a combination of a manual push activation portion such as a push button and a sensor activation portion).

Therefore, the piston flush valve 20 can be actuated by manner of one or both manually and automatically. Manual actuation is accomplished through a user initiated process, traditionally by interaction with a mechanical handle. Automatic actuation is accomplished through the use of sensors to determine when a user is present and to actuate the piston flush valve without the need for user initiation, for example when the user has completed usage of the fixture.

Preferably, the actuator 38 can be associated with one or more operation modes. The one or more operation modes can include sensor activation, contact manual user activation and/or remote manual user activation.

Appreciably, one way to manually actuate the piston flush valve 20 is via a push type activation where flushing can be activated by, for example, pressing the actuator 38. As mentioned earlier with reference to Figure 4, the actuator 38 can include, for example, two push portions. The first push portion can be for providing a full flush mode and the second push portion can be for providing a partial flush mode. Each push portion can be activated independently from the other. The push button 38 could have more than two push portions wherein each push portion can be associated with a different flush mode.

Further appreciably, one way to automatically actuate the piston flush valve 20 is by manner of sensor activation. Implementation of sensor activation can be by manner of the electromechanical solenoid 40 (having a solenoid coil 41) as discussed earlier with reference to Figure 4. For example after detecting (via the sensor) user movement or after a period of time has elapsed, an electrical signal is sent to the solenoid coil 41 to activate the flushing.

As the piston flush valve assembly of the disclosure is modular, it means that the piston flush valve assembly can, for example, be customised to have different ways to activate the piston flush valve 20 according to the user requirement(s). Specifically, the piston flush assembly can be configured to operate in one or more configuration options. More specifically, the piston flush assembly can be customizably configured based on any one of the components (shown in Figure7) or any combination thereof.

In one example for users that want a simpler flush valve assembly, the electromechanical solenoid 40 of Figure 4 can be removed, resulting in the piston flush valve assembly shown in Figure. 5. As shown in Figure 5, a fluid way seal 43 can be provided in place of the electromechanical solenoid 40 for cover so as to prevent fluid leakage. In another example, a dual function type actuator 38 (i.e., with a plurality of push portions) as shown in Figure 4 may not be desired by the user. Therefore the dual function type actuator 38 can be replaced by a single function type actuator 38 shown in Figure 5 (i.e., with only one push portion). Therefore, any push/pull mechanism for allowing distant manual actuation of the piston flush valve 20 will not be necessary.

In Figure 7, :

- Component 1 can, for example, refer to a single-mode button;
- Component 2 can, for example, refer to a fluid way seal 43;
- Component 3 can, for example, refer to a dual-mode button;
- Component 4 can, for example, refer to a pull-push mechanism; and
- Component 5 can, for example, refer to a solenoid mechanism.

As mentioned earlier, at least one control module (associated with one or more configurations) can be provided and operable for controlling the piston flush valve 20.

In one example, in the case of configuration option 1 (i.e., combination of single-mode button and fluid way seal components), a control module in the form of a wired connection can be provided. That is, a wired connection can be provided for coupling the actuator 38 (i.e., in the form of a single push button) and the piston flush valve 20.

5 In another example, in the case of configuration option 2 (i.e., combination of single-mode button and solenoid mechanism components), a control module in the form of a wired connection and electronic circuitry can be provided. That is, a dual connection can be provided for coupling the actuator 38 and the piston flush valve 20. Specifically, the actuator can be in the form of a module having a combination of a push button and
10 sensor. The control module can therefore include a wired connection for connecting the push button to the piston flush valve 20 and electronic circuitry associated with the sensor for providing signals to be communicated (via one or both of wired and wireless communication) to the piston flush valve 20.

In yet another example, in the case of configuration option 2 (i.e., combination of
15 single-mode button and solenoid mechanism components), two control modules can be provided. One control module can be in the form of a wired connection and another control module can be in the form of an electronic circuitry module. That is, a dual connection can be provided for coupling the actuator 38 and the piston flush valve 20. Specifically, one connection can be based on the actuator 38 and the piston flush
20 valve 20 being coupled via one control module (i.e., wired connection), and another connection can be based on the actuator 38 and the piston flush valve 20 being coupled via another control module (i.e., via one or both of wired and wireless communication of signals from the electronic circuitry module).

The piston flush valve assembly can be connected to a sanitary fixture by any
25 conventional means of installation such as duct installation or sealed installation that is known by the man of skill in the art. The housing 21 and actuator(s) 38 are preferably made of plastic selected from a group consisting of Polyphenylene Sulfide, Polybutylene terephthalate, Polyphthalamide, Glass Fiber Reinforced Polyamide and Polyether Ether Ketone.

30 Therefore, it is appreciable that in accordance with an aspect of the disclosure. A modular valve assembly (e.g., suitable/adaptable for use with a sanitary fixture for carrying out a flushing action) is provided. The modular valve assembly can be

customized (i.e., flexibly configured) to operate in one of a plurality of configuration options (i.e., configuration options 1 to 6 as shown in Figure 7). The modular valve assembly can include a piston flush valve 20 which can be operated for controlling fluid movement (e.g., 1) controlling allowable fluid discharge rate, 2) fluid flush volume, and/or 3) impeding and/or allowing flow of fluid between the inlet portion 20a and the outlet portion 20b), an actuator 38 and at least one control module.

As mentioned earlier, the control module can be associated with a configuration option (i.e., the configuration option which the modular valve assembly is configured to be operated in). The actuator 38 can be coupled to the piston flush valve 20 by the control module. Moreover, the control module can be activated by the actuator so as to operate the piston flush valve based on the configuration option which is associated with the control module.

Therefore, the piston assembly 22 (of the piston flush valve 20) can be flexibly controlled in a manner so as to be operable in one or more configurations (e.g., configuration options 1 to 6 as shown in Figure 7).

Referring to Figure 8, the stopcock 35 can be installed in 3 different orientations.

1. With the fluid inlet facing downwards (Figure 8(b)).
2. With the fluid inlet facing backwards (Figure 8(a)).
3. With the fluid inlet facing upwards (Figure 8(c)).

It should be further appreciated by the person skilled in the art that variations and combinations of features described above, not being alternatives or substitutes, may be combined to form yet further embodiments falling within the intended scope of the disclosure.

Furthermore, various embodiments of the disclosure are described for addressing at least one of the foregoing disadvantages. Such embodiments are intended to be encompassed by the following claims, and are not to be limited to specific forms or arrangements of parts so described and it will be apparent to one skilled in the art in view of this disclosure that numerous changes and/or modification can be made, which are also intended to be encompassed by the following claims.

In one example, although the actuator 38 has been discussed in the context of being in mechanical form (e.g., the form of a push type button as discussed with reference

to Figure 6), it is appreciable that the actuator 38 can, alternatively, be in electronic form (e.g., the aforementioned sensor coupled to the sensor controller which can be configured to supply electrical energy to operate the solenoid coil 41). Yet alternatively, the actuator 38 can be in a form of a module which includes both the push type button and the sensor. In this regard, the actuator 38 can be in one or both of mechanical and electronic form.

In another example, although Figure 7 shows components 1 to 5, it can be appreciated that more/less components can be possible. Moreover, although Figure 7 shows 6 configuration options, it can be appreciated that more/less configuration options can be possible. For example more configuration options can be possible based on different combinations of components (i.e, combinations which are different from those already shown in Figure 7).

In yet another example, the modular flush assembly can include a plurality of actuators and each actuator can be coupled to a corresponding control module.

Claims

1. A piston flush valve suitable for use with a sanitary fixture, comprising:
 - a housing shaped and dimensioned to form an inlet portion and an outlet portion;
 - 5 a piston assembly capable of actuated so as to move between a closed configuration and an open configuration; and
 - a primary seal carried within the housing,

wherein the primary seal is in a fixed relationship with its surroundings during the movement of the piston assembly between the closed configuration and the

 - 10 open configuration.
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2. A piston flush valve of Claim 1 wherein the housing is made of plastic.
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3. A piston flush valve of Claim 2 wherein the plastic housing is made of materials
15 selected from a group consisting of Polyphenylene Sulfide, Polybutylene terephthalate, Polyphthalamide, Glass Fiber Reinforced Polyamide and Polyether Ether Ketone.
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4. A piston flush valve of any preceding claim, wherein the housing is further
20 shaped and dimensioned to define an opening portion between the inlet portion and the outlet portion, and wherein the opening portion comprises a rim part shaped and dimensioned to carry the primary seal.
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5. A piston flush valve of any preceding claim further comprising a plastic strainer
25 located on a top portion of the piston assembly.
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6. A piston flush valve of any preceding claim further comprising a screw nut having a plurality of ribs for guiding movement of the piston assembly.

7. A modular valve assembly which is customizable to operate based on one of a plurality of configuration options, the modular valve assembly comprising:
a piston flush valve operable for controlling fluid movement;
an actuator ; and
5 at least one control module associated with a configuration option based on which the modular valve assembly is configured to operate in, the control module coupling the actuator and the piston flush valve,
wherein the actuator is operable to activate the control module to operate the piston flush valve based on the configuration option associated with the
10 control module.
8. A modular valve assembly of Claim 7, wherein the actuator is associated with at least one operation mode, wherein an operation mode corresponds to any one of sensor activation, contact manual user activation and remote manual
15 user activation.
9. A modular valve assembly of Claim 8 wherein the sensor activation operation mode of the actuator is implemented by an electromechanical solenoid.
- 20 10. A modular valve assembly of Claim 8 wherein the contact manual user activation operation mode of the actuator is implemented by a push button providing a linear actuating force on the piston flush valve.
- 25 11. A modular valve assembly of Claim 10 wherein the push button has a plurality of parts wherein each part is associated with a different flush mode.
- 30 12. A modular valve assembly of Claim 11 wherein the push button is divided into two parts providing dual flush modes: a first part providing a full flush mode and a second part providing a partial flush mode.
13. A modular valve assembly of Claim 8 wherein the remote manual user activation operation mode of the actuator is implemented by a push-pull mechanism.

14. A modular valve assembly of any of Claims 7 to 13, wherein the piston flush valve and the actuator are made of plastic.

5 15. A modular valve assembly of Claim 14 wherein the plastic is selected from a group consisting of Polyphenylene Sulfide, Polybutylene terephthalate, Polyphthalamide, Glass Fiber Reinforced Polyamide and Polyether Ether Ketone.

10 16. A modular valve assembly of Claim 7, wherein the valve assembly further comprises an inlet connected to a stopcock for controlling supply of fluid from a supply pipe into the valve assembly.

15 17. A modular valve assembly of Claim 16 wherein the stopcock houses an anti-siphon mechanism for preventing fluid movement from the valve assembly back into the supply pipe.

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