DEVICE FOR DISCHARGING DOSES OF LIQUID

Abstract: The device comprises a housing (10) having an inlet (12) for coupling to a supply (14) of pressurized liquid and an outlet (16). A spring-loaded plunger (23) defines a dosing chamber (24) within the housing (10). An inlet valve (41) closes the inlet (12). An outlet valve (27) closes the outlet (16). The inlet valve (41) is opened when operation of the device is required. The outlet valve (27) is closed when the inlet valve (41) is initially opened, thereby to allow pressurized liquid to enter the dosing chamber (24) against the tension of the plunger spring (25). The inlet valve (41) is closed and the outlet valve (27) is opened when a predetermined volume of liquid has entered the dosing chamber (24). Tension in the plunger spring (25) then drives the plunger (23) in a direction to dispel a dose of liquid of a predetermined volume through the outlet (16).
before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

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DEVICE FOR DISCHARGING DOSES OF LIQUID

Field of the invention

The present invention relates to a device for discharging doses of liquid of a predetermined volume, and in particular to a cistern device for flushing toilets.

Background of the invention

Conventionally toilets are flushed from a cistern comprising a housing having an inlet connected to a supply of pressurized water, usually with a pressure of at least 1.5 bar ($1.5 \times 10^5$ Pa). An inlet valve such as a ball valve controls the flow of water into the housing to a predetermined volume. An outlet is connected to a down pipe leading to the toilet bowl, and a manually operable siphon device is provided for discharging the stored water through the outlet to flush the toilet bowl.

Such an arrangement occupies considerable space, and because the flushing water passes by gravity to the toilet bowl, there are restrictions on where the cistern can be located. Also, the limited flow rate of water into the toilet bowl under gravity can mean that flushing of the toilet is not as efficient as might be desired. Social and environmental pressures to reduce the usage of mains water, do not enable these disadvantages to be overcome by simply increasing the volume of flushing water used.

Furthermore, in the rest position a volume of exposed water may remain in the cistern for some time, leading to the risk of bacterial deterioration of the quality of the water unless special measures are taken.

It is an object of the invention to overcome these disadvantages, and to provide a device which can have general applicability for discharging doses of liquid of a
SUMMARY OF THE INVENTION

According to the invention, there is provided a device for discharging doses of liquid of a predetermined volume, the device comprising a housing having an inlet for coupling to a supply of pressurized liquid, an inlet valve for closing the inlet, an outlet and an outlet valve for closing the outlet, characterised by a spring-loaded plunger within the housing defining a dosing chamber therein, means for opening the inlet valve when operation of the device is required, means for closing the outlet valve when the inlet valve is initially opened, thereby to allow pressurized liquid to enter the dosing chamber against the tension of the plunger spring, and means for closing the inlet valve and for opening the outlet valve when a predetermined volume of liquid has entered the dosing chamber, thereby to allow tension in the plunger spring to drive the plunger in a direction to dispel a dose of liquid of a predetermined volume through the outlet.

The invention is particularly applicable to a toilet cistern, the inlet being adapted to be connected to a supply of pressurized water, and the outlet being adapted to be connected to a flush tube, leading to a toilet bowl.

The device according to the invention has the advantage that it may be located remote from the toilet bowl, for example in a vanity sink unit, in the free space under one end of a bath or even in a separate secure location to reduce the risk of vandalism in publicly accessible facilities.

The dosing chamber is preferably cylindrical, e.g. with a circular cross-section.

The inlet valve may be in the form of a switch, having a
first switch position allowing the flow of pressurised liquid into the housing and a second switch position blocking the flow of pressurised liquid into the housing.

Preferably, the outlet valve is a normally open valve, adapted to be closed upon the initial flow of pressurized liquid into the housing.

The means for opening the inlet valve when operation of the device is required, may comprise a solenoid, single or double acting.

The outlet valve may include a valve member having a seating surface for closing the outlet and an opposed actuating surface positioned to be acted upon by pressurized liquid within an actuating chamber defined within the housing. A by-pass passage is preferably defined to enable pressurized liquid within the actuating chamber to pass to the outlet when the inlet valve is closed.

The means for closing the inlet valve and for opening the outlet valve when a predetermined volume of liquid has entered the dosing chamber, may comprise a timing device. Alternatively or additionally, the plunger may carry a magnet, with micro-switches being located at appropriate points outside the housing, to be triggered by the magnet as the plunger moves to each position corresponding to a predetermined volume of liquid in the dosing chamber.

The device is preferably capable of discharging doses of liquid of more than one predetermined volume according to choice. To this end, the device may further comprise means for selecting the volume of pressurized liquid to be allowed to enter then dosing chamber before the inlet valve is closed.
The device according to the invention may include one or more of the following preferred features.

The cylindrical housing may be formed of an acrylic plastics material. The housing may be formed in three parts, a tube-shaped part, a base part and a cap part, held together by spaced tie rods, with the inlet provided in the cap part and the outlet provided in the base part. The cap part may include a vent hole.

The spring-loaded plunger may have a circular cross-section and may be acted upon by a corrosion resistant metal plunger spring. In place of one plunger spring, a number of plunger springs may be used, for example arranged radially equally spaced around the axis of the plunger. Suitable seals are preferably provided in the plunger where it may be in moving contact with the wall of the housing.

The outlet valve may be a normally open valve in the form of a spring-loaded double-headed sealing piston. The sealing piston may be located within a central tube which extends through a central bore through the plunger. Suitable seals are preferably provided in the sealing piston where it is in moving contact with the wall of the central tube. At one end, the sealing piston may include the seating surface for closing the outlet and at the other end an opposed actuating surface positioned to be acted upon by pressurized liquid within an actuating chamber defined within the housing. The sealing piston may be urged into its normally open position by a corrosion-resistant metal return spring.

The inlet valve may be in the form of a switch operated by a single-acting spring return solenoid and having two ports, such that in a first switch position one port connects the supply line to the inlet, allowing the flow of pressurised liquid into the housing, while in another switch position
the supply line is blocked and the other port connects the inlet to a first by-pass passage, passing to the outlet, downstream of the outlet valve, optionally via a liquid treatment unit and a non-return valve.

A second by-pass passage may be provided leading from the inlet into the dosing chamber. A check valve in the second by-pass passage may be used to prevent passage of liquid under pressure from the dosing chamber back to the actuating chamber.

A suitable control circuit for the device may comprise a mains power supply connected through a transformer to a switch box, in which operating buttons are provided. These operating buttons selectively connect power to timing devices, which when actuated supply power for a pre-set period of time to the solenoid to operate the switch.

Flushing of the toilet may be initiated by operating one the operating buttons to energise the solenoid and start the associated timing device. Actuation of the solenoid opens the switch allowing pressurized liquid from the supply line to pass through the inlet into the actuating chamber. The pressure of the liquid in the actuating chamber acts upon the actuating surface of the sealing piston, extending the piston into a position where the seating surface thereof closes the outlet. When pressure in the actuating chamber has reached a sufficient level to overcome the check valve in the second by-pass passage, liquid begins to pass along the second by-pass passage to fill the dosing chamber, forcing the plunger back against its spring. Air in the housing on the far side of the plunger from the dosing chamber is able to escape through the vent hole.

The dosing chamber continues to fill in this manner until the timing device actuates the solenoid to close the switch.
The switch is therefore closed when a predetermined volume of liquid has entered the dosing chamber. At this stage, the dosing chamber therefore contains the required volume of liquid, according to which of the operating buttons was pressed.

Closure of the switch connects the actuating chamber with the first by-pass passage allowing the liquid in the actuating chamber to pass via the non-return valve into the outlet. In doing so, this liquid passes through the liquid treatment unit which adds a cleansing and disinfecting agent thereto. Pressure in the actuating chamber therefore falls, allowing the return spring to retract the sealing piston, thereby opening the dosing chamber to the outlet. The plunger spring now drives the plunger in the direction to dispel the liquid in the dosing chamber through the outlet to flush the toilet bowl. Once this is done, the device is again in its rest position.

In an alternative embodiment of the invention, the means for opening the inlet valve when operation of the device is required, the means for closing the outlet valve when the inlet valve is initially opened, and the means for closing the inlet valve and for opening the outlet valve when a predetermined volume of liquid has entered the dosing chamber, can be constituted by a common switch, such as a double-acting solenoid operated switch, having a first switch position in which the outlet valve is closed and the inlet is connected to the dosing chamber to allow the filling thereof against the force of the plunger spring, and a second switch position in which the inlet valve is closed and the outlet valve is opened, allowing tension in the plunger spring to drive the plunger in a direction to dispel liquid from the dosing chamber into through the outlet. In this embodiment, it is convenient for the inlet and the outlet of the device to be adjacent.
The invention will now be further described, purely by way of example, with reference to the accompanying drawings, in which:

5 Figure 1 is a cross-sectional diagrammatic view of a cistern according to the present invention, in its rest position;

Figures 2, 3 and 4 are views similar to Figure 1, showing the sequence of operation of the cistern;

10 Figure 5 is a view of the cistern of Figures 1 to 4, taken from the direction "Y" in Figure 1;

Figure 6 is a view of the plunger of the cistern shown in Figures 1 to 5, as viewed from the direction "VI" in Figure 1;

15 Figure 7 is a view of the sealing piston of the cistern shown in Figures 1 to 5, as viewed from the direction "VII" in Figure 1;

Figure 8 shows the arrangement of the cistern shown in Figures 1 to 7, as coupled to a toilet bowl; and

20 Figure 9 shows a control circuit for the cistern shown in Figures 1 to 8.

The drawings show a toilet cistern for discharging doses of water of a predetermined volume.

30 The device comprises a cylindrical housing 10 formed of an acrylic plastics material, having an inlet 12 coupled to a supply line 14 of pressurized water, for example under a pressure of at least 2 bar (2 x 10^8 Pa), and an outlet 16 connected to a flush tube 17, leading to a toilet bowl 18 (see Figure 8). The housing 10 is formed in three parts, a
tube-shaped part 19, a base part 11 which includes the outlet 16 and a cap part 20 which includes the inlet 12, the parts being held together by six equally spaced tie rods 21. The cap part 20 includes a vent hole 22. A central tube 29 extends between the base part 11 and cap part 20, and is provided with eight discharge ports 33 through the wall thereof, adjacent the base part 11.

A spring-loaded plunger 23 is provided within the housing 10 defining a cylindrical dosing or flushing chamber 24 therein (see Figure 3), with a circular cross-section and a maximum volume of about 9 litres. The plunger has an overall diameter of about 200 mm. The plunger 23 is formed with sleeve 13, having in internal diameter of about 50 mm, which defines a central bore through the plunger 23. To reduce weight and material while maintaining strength, the plunger 29 is formed with a number of radial webs 31.

The plunger 23 is acted upon by a gold-plated metal plunger spring 25, extending between the plunger 23 and the cap part 20 of the housing 10, the plunger having an overall movement of about 300 mm. Suitable seals 26 are provided in the plunger 23 where it is in moving contact with the wall of the housing 10 and the central tube 29.

As best seen in Figure 2, the outlet 16 opens from the dosing chamber 24, but can be closed by a normally open outlet valve 27 in the form of a spring-loaded double-headed sealing piston 28 which closes the outlet 16. The sealing piston 28 is located within the central tube 29 through the plunger 23. Suitable seals 30 are provided in the sealing piston 28 where it is in moving contact with the wall of the central tube 29. At one end, the sealing piston 28 includes a seating surface 32 for closing the outlet 16 and at the other end an opposed actuating surface 34 positioned to be acted upon by pressurized water within an actuating chamber.
38 defined within the housing 10. The sealing piston 28 is urged into its normally open position by a gold-plated metal return spring 40.

An inlet valve in the form of a switch 41 closes the inlet 12. The switch is operated by a single-acting spring return solenoid 44 and has two ports 46 and 48. In a first switch position the port 46 connects the supply line 14 to the inlet 12, allowing the flow of pressurised water into the housing 10, while in a second switch position the supply line 14 is blocked and the port 48 connects the inlet 12 to a first by-pass passage 49. The first by-pass passage 49 passes through a water treatment unit 50 and via a non-return valve 51 to the outlet 16, downstream of the outlet valve 27.

A second by-pass passage 52 leads from the inlet 12 into the dosing chamber 24, via a check valve 53.

As shown in Figure 9, the control circuit comprises a mains power supply 54 connected through a mains voltage to 12 volt transformer 56 to a switch box 58, in which are located two operating buttons 60, 61, representing full flush and half flush respectively. These operating buttons selectively connect power to one or the other of two timing switch devices 62, 63, which when actuated supply power for a preset period of time to the solenoid 44 to operate the switch 41. Figure 9 also shows micro-switches 64, 65, which are located at appropriate points outside the housing to be triggered by a magnet (not shown) on the plunger as it moves to each position corresponding to a predetermined volume of liquid in the dosing chamber.

The device operates as follows.

In the rest position (Figure 1), the switch 41 is in the
position closing the inlet 12, while the sealing piston 28 is in the position opening the outlet 16, the sealing piston 28 being held in the open position by its return spring 40. The plunger 23 is in its discharged position, with the dosing chamber 24 reduced to a insignificant volume.

Flushing of the toilet is initiated by operating one or other of the operating buttons 60, 61, to energise the solenoid 44 and start the timing device 62, 63. Actuation of the solenoid 44 opens the switch 41 allowing pressurized water from the supply line 14 to pass through the inlet 12 into the actuating chamber 38. The pressure of the water in the actuating chamber 38 acts upon the actuating surface 34 of the sealing piston 28, extending the piston into the position where the seating surface 32 thereof closes the outlet 16, as shown in Figure 2.

When pressure in the actuating chamber 38 has reached a sufficient level to overcome the check valve 53, water begins to fill the dosing chamber 24, forcing the plunger 23 back against its spring 25, as shown in Figure 3. Air in the housing on the far side of the plunger 23 from the dosing chamber 24 is able to escape through the vent hole 22.

The dosing chamber 24 continues to fill in this manner until the timing device 62 or 63 de-activates the solenoid 44 to close the switch 41. Provided the water pressure remains fairly constant, the switch 41 is therefore closed when a predetermined volume of water has entered the dosing chamber 24. At this stage, the dosing chamber therefore contains the required volume of water, e.g. from 3 to 4 litres for a short flush, or 9 litres for a long flush, according to which of the operating buttons 60, 61 was pressed.

Closure of the switch 41 connects the actuating chamber 38
with the first by-pass passage 49 through the port 48 allowing the water in the actuating chamber 38 to pass via the non-return valve 51 into the outlet 16, as shown in Figure 4. In doing so, this water passes through the water treatment unit 50 which adds a cleansing and disinfecting agent thereto. Pressure in the actuating chamber 38 therefore falls, allowing the return spring 40 to retract the sealing piston 28, thereby opening the dosing chamber 24 to the outlet 16. The plunger spring 25 now drives the plunger 23 in the direction to dispel the water in the dosing chamber 24 through the outlet 16 to flush the toilet bowl 18. Once this is done, the device is again in its rest position shown in Figure 1.
CLAIMS

1. A device for discharging doses of liquid of a predetermined volume, the device comprising a housing (10) having an inlet (12) for coupling to a supply (14) of pressurized liquid, an inlet valve (41) for closing the inlet (12), an outlet (16) and an outlet valve (27) for closing the outlet (16), characterised by a spring-loaded plunger (23) within the housing (10) defining a dosing chamber (24) therein, means (44) for opening the inlet valve (41) when operation of the device is required, means (62, 63) for closing the outlet valve (27) when the inlet valve (41) is initially opened, thereby to allow pressurized liquid to enter the dosing chamber (24) against the tension of the plunger spring (25), and means (62, 63) for closing the inlet valve (41) and for opening the outlet valve (27) when a predetermined volume of liquid has entered the dosing chamber (24), thereby to allow tension in the plunger spring (25) to drive the plunger (23) in a direction to dispel a dose of liquid of a predetermined volume through the outlet (16).

2. A device according to claim 1, wherein the dosing chamber (24) is cylindrical.

3. A device according to claim 1, wherein the inlet valve is in the form of a switch (41), having a first switch position allowing the flow of pressurised liquid into the housing (10) and a second switch position blocking the flow of pressurised liquid into the housing (10).

4. A device according to claim 1, wherein the outlet valve is a normally open valve (27), adapted to be closed upon the initial flow of pressurized liquid into the housing (10).
5. A device according to claim 1, wherein the means for opening the inlet valve (41) when operation of the device is required, comprises a solenoid (44).

6. A device according to claim 1, wherein the outlet valve (27) includes a valve member (28) having a seating surface (32) for closing the outlet (16) and an opposed actuating surface (34) positioned to be acted upon by pressurized liquid within an actuating chamber (38) defined within the housing (10).

7. A device according to claim 6, wherein a by-pass passage (49) is defined to enable pressurized liquid within the actuating chamber (38) to pass to the outlet (16) when the inlet valve (41) is closed.

8. A device according to claim 1, wherein the means for closing the inlet valve (41) and for opening the outlet valve (27) when a predetermined volume of liquid has entered the dosing chamber (24), comprises a timing device (62, 63).

9. A device according to claim 1, capable of discharging doses of liquid of more than one predetermined volume according to choice, further comprising means (60, 61) for selecting the volume of pressurized liquid to be allowed to enter then dosing chamber (24) before the inlet valve (41) is closed.

10. A toilet cistern comprising a device according to claim 1, the inlet (12) being adapted to be connected to a supply (14) of pressurized water, and the outlet (16) being adapted to be connected to a flush tube (17), leading to a toilet bowl (18).
**INTERNATIONAL SEARCH REPORT**

### A. CLASSIFICATION OF SUBJECT MATTER

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According to International Patent Classification (IPC) or to both national classification and IPC

### B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

WPI Data, EPO-Internal

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>US 5 027 444 A (TSALS IZRAIL) 2 July 1991 (1991-07-02) column 4, line 23 -column 7, line 33; figures 3-6</td>
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Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

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**Date of the actual completion of the international search**

8 April 2002

**Date of mailing of the international search report**

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Movadat, R

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