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(54) **Toilet flushing system**

(57) A flushing system (10) for a toilet comprises a storage tank (12), an inlet conduit (14) in fluid connection with the interior of the storage tank for supplying water to the storage tank, and an outlet conduit (16) in fluid connection with the interior of the storage tank for emptying water from the storage tank. The outlet conduit is a siphon. A bell (20) is arranged above the inlet portion

(14a) of the inlet conduit and the outlet portion (16a) of the outlet conduit. The bell is movable in a vertical direction between an upper end position and a lower end position. The bell is provided with a valve element (24) adapted to close the inlet conduit (14) when the bell is in its upper end position. A safe and cost-efficient flushing system is thereby provided.

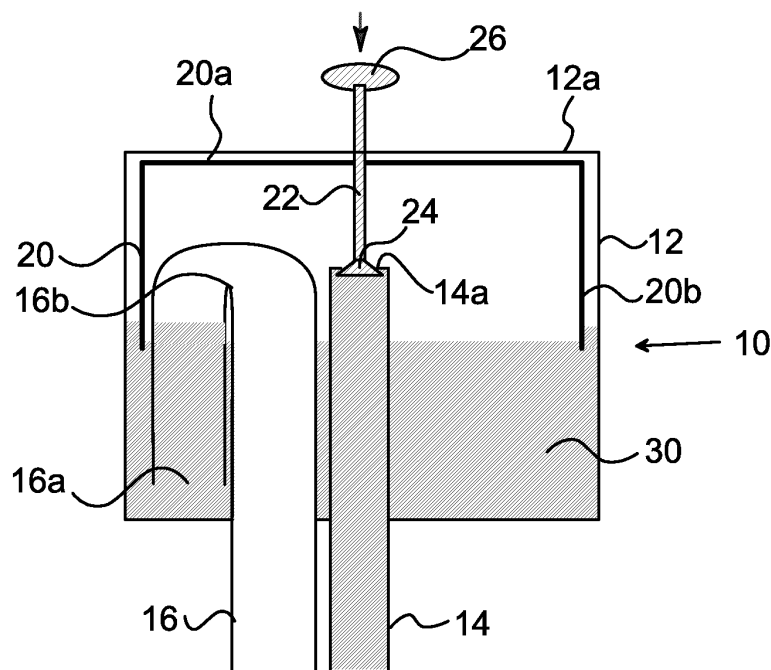


Fig. 2a

Description

Technical field

[0001] The present invention relates generally to toilet flushing systems and more particularly to a valve mechanism that improves the reliability of the system and which prevents leakage.

Background art

[0002] Flushing toilets are today common across the world. Basically, they consist of a bowl and a water storage tank provided at a higher elevation as compared to the bowl. The storage tank is usually mounted directly upon the bowl, although some tanks are mounted on the wall a few feet above the bowl in an attempt to increase the flush water pressure as it enters the bowl. A flushing system provides a large flow of water into the bowl. In such tank based systems, the storage tank or cistern collects between 3 and 7 liters of water over a period of time.

[0003] Water storage tanks with a so-called flapper-flush valve are known, wherein the outlet at the bottom of the tank is covered by a buoyant, such as plastic or rubber cover, or flapper, which is held in place against a fitting by water pressure. To flush the toilet, the user pushes a lever, which lifts the flush valve from the valve seat. The valve then floats clear of the seat, allowing the tank to empty quickly into the bowl. As the water level drops, the floating flush valve descends back to the bottom of the tank and covers the outlet pipe again.

[0004] One problem associated with the flapper-flush valve tanks is that the valve eventually starts to leak, leading to increased water consumption and costs for replacing the valve mechanism.

[0005] Water storage tanks with a so-called siphon-flush valve are also known, wherein the user pushes a lever or button, forcing the water up into the tank siphon passageway which then empties the water in the tank into the bowl. These valves can sometimes be more difficult to operate than a "flapper"-based flush valve because the lever requires more torque than a flapper-flush-valve system.

Summary of invention

[0006] An object of the present invention is to provide a flushing system for toilets wherein the drawbacks of the prior art flushing systems are eliminated or at least mitigated.

[0007] The invention is based on the realization that the combination of a siphon conduit and a bell provided above the siphon conduit and the inlet conduit will result in a flushing system which is safe and cost-efficient, since it comprises very few parts.

[0008] In a first aspect of the invention, there is provided a flushing system for a toilet comprising a storage

tank, an inlet conduit in fluid connection with the interior of the storage tank for supplying water to the storage tank, and an outlet conduit in fluid connection with the interior of the storage tank for emptying water from the storage tank, wherein the outlet conduit is a siphon, the flushing system being characterized by a bell arranged above the inlet conduit and the outlet conduit, wherein the bell is movable in a vertical direction between an upper end position and a lower end position, and wherein the bell is provided with a valve element adapted to close the inlet conduit when the bell is in its upper end position. This provides a flushing system which requires little force to start the flushing process while the siphon-shaped outlet conduit prevents accidental leakage.

[0009] In a preferred embodiment, the flushing system comprises a piston fixedly attached to the bell wherein the valve element is provided at the piston for sealingly abutting an inlet portion of the inlet conduit when the bell is in an upper end position. This provides a suitable arrangement for opening and closing the inlet conduit.

[0010] In a preferred embodiment, the flushing system comprises a button suitable for being pushed downward by a user of the toilet during flushing and being provided at an upper end of the piston. This button provides a simple mechanism for lowering the bell during the flushing procedure.

[0011] In a preferred embodiment, the walls of the bell are impermeable to air. Thereby, it is ensured that the head of water inside the periphery of the bell is pushed down when the bell is lowered and that the bell rises with the head of water in the storage tank after the flushing.

[0012] In a preferred embodiment, the area inside the periphery of the bell is substantially larger than the area in the storage tank outside of the periphery of the bell. Thereby, a small distance of downward movement of the bell results in a larger rising of the water surface outside of the bell.

[0013] In a preferred embodiment, the cross-sectional area of the inlet conduit is substantially smaller than the cross-sectional area of the outlet conduit. Thereby, the amount of water exiting the storage tank is substantially larger than the amount of water entering the storage tank during the flushing, ensuring that the flushing procedure ends by substantially emptying the storage tank.

[0014] In a preferred embodiment, the outlet conduit is provided with a bend, wherein the cross-section of the bend substantially deviates from a circle. The diameter of the bend in the horizontal direction is then preferably substantially larger than the diameter of the bend in the vertical direction. This ensures an adequate siphoning effect.

[0015] In a preferred embodiment, the storage tank is provided as an insert adapted to be installed in existing tanks. This makes it possible to upgrade existing toilets with a new flushing system, thereby avoiding the costs of replacing the entire toilet.

[0016] In a preferred embodiment, an inlet portion of the inlet conduit is provided at a higher level than a bend

(16b) of the outlet conduit. Thereby, it is avoided to have polluted water being drawn back into the inlet conduit.

[0017] In a preferred embodiment, the ratio between the area of the outlet conduit and the area of the inlet conduit is in the range of 10-20. This provides a flushing operation with adequate emptying and filling of the tank.

[0018] According to a second aspect of the invention, a toilet is provided comprising a bowl and a connection to a waste pipe, the toilet being characterized by a flushing system according to the invention, wherein the water storage tank is provided at a higher elevation as compared to the bowl and the outlet conduit is connected to the bowl.

Brief description of drawings

[0019] The invention is now described, by way of example, with reference to the accompanying drawings, in which:

[0020] Fig. 1a is an overall, partly sectional side view of a first embodiment of a flushing system according to the invention connected to a toilet bowl,

[0021] Fig. 1b is a back sectional view of the flushing system shown in Fig. 1a,

[0022] Figs. 2a-e are front sectional views of a flushing system according to the invention in different steps of operation,

[0023] Fig. 3a is an overall, partly sectional side view of a second embodiment of a flushing system according to the invention mounted to a toilet bowl, and

[0024] Fig. 3b is a back sectional view of the flushing system shown in Fig. 3a.

Description of embodiments

[0025] In the following, a detailed description of different embodiments of a flushing system according to the invention will be provided.

[0026] An overall view of a toilet, generally designated 1, is shown in Figs. 1a and 1b. The toilet comprises a bowl 1a and a connection 1b to a waste pipe, as is common. A flushing system 10 comprising a water storage tank 12 is provided at a higher elevation as compared to the bowl. In this embodiment, the toilet is a so-called wall-hung toilet, wherein the bowl 1a is provided on one side of a wall and the flushing system and the waste pipe connection are provided on the other side of the wall, out of sight of the user.

[0027] The flushing system comprises an inlet conduit 14 in fluid connection with the interior of the storage tank and provided with an inlet portion 14a for supplying water to the storage tank. The flushing system further comprises an outlet conduit 16 in the form of a siphon in fluid connection with the interior of the storage tank and provided with an outlet portion 16a for emptying water from the storage tank. Finally, a bell 20 is arranged above the inlet portion 14a of the inlet conduit and the outlet portion 16a of the outlet conduit. This bell will be described in

more detail below.

[0028] The operation of the flushing system will now be described in detail with reference to Figs. 2a-e, which show the interior of the storage tank 12. The bell is made up of an upper wall 20a and a side wall 20b, approximately conforming to the interior wall of the storage tank 12 but leaving a small gap between the bell and the storage tank to allow smooth vertical displacement of the bell. Thus, the bell is essentially cup shaped with the opening facing downward. The walls of the bell are impermeable to air and are preferably made of plastic. A piston 22 is fixedly attached to the bell at the center of the upper wall 20a thereof. At the lower end of the piston 22 a valve element 24 is provided to close the inlet portion 14a of the inlet conduit 14 by sealingly abutting it when the bell 20 is in an upper end position shown in Fig. 2a. A button 26 or similar device suitable for being pushed downward by a user of the toilet during flushing is provided at the opposite, upper end of the piston 22. The piston 22 extends through a lid 12a of the storage tank 12 and the button 26 is thus provided outside of the storage tank. It will be appreciated that this button 26 has to be pushed indirectly through a mechanical arrangement in the embodiment of the toilet shown in Figs. 1a and 1b, where the flushing system 10 is provided behind a wall.

[0029] Starting with Fig. 2a, the flushing system 10 is shown in a state wherein the storage tank 12 is filled with water 30 and is ready for emptying during flushing of the toilet. The bell 20 is then in the upper end position wherein the valve element 24 seals the inlet conduit 14, i.e., no water enters into the storage tank. The bell 20 floats on the surface of the water in the storage tank, generally designated 30 in the figures.

[0030] It should be noted that the bend 16b of the siphon shaped outlet conduit 16 starts above the head of the water. Therefore, no water exits from the storage tank 12. Also, in order to avoid polluted water being drawn back into the inlet conduit 14, the inlet portion 14a is in the preferred embodiment provided at a higher level than the highest possible head of water in the storage tank 10, i.e., above the bend 16b.

[0031] Turning now to Fig. 2b, this figure shows the flushing system 10 immediately after a user has started to push the button 26 and thereby the bell 20 downward. This forces the head of the water inside the periphery of the bell downward. Since the area inside the periphery of the bell is substantially larger than the area in the storage tank 12 outside of the periphery of the bell, a small distance of downward movement of the bell 20 results in a larger rising of the water surface outside of the bell. The head of the water outside of the bell 20 also controls the head of the water inside the siphon-shaped outlet conduit 16.

[0032] As soon as the bell 20 leaves its upper end position shown in Fig. 1a, the valve element 24 leaves its engagement with the inlet portion 14a of the inlet conduit 14 and water starts to enter the storage tank 12. However, since the cross-sectional area of the inlet conduit 14 is

substantially smaller than the cross-sectional area of the outlet conduit, the amount of water entering the storage tank 12 during the flushing procedure is insignificant compared to the amount of water leaving the tank through the outlet conduit 16. In one embodiment, the diameter of the inlet conduit 14 is 12 millimeters while the diameter of the outlet conduit 16 is 50 millimeter. This approximately corresponds to a cross-sectional area of the inlet conduit 14 of 450 mm² and a cross-sectional area of the outlet conduit 16 of 7850 mm², i.e., a ratio between the outlet area and the inlet area of approximately 17. Thus, it is preferred that this ratio is in the range of 10-20.

[0033] Turning now to Fig. 2c, this figure shows the flushing system 10 with the bell 20 in its lower end position, i.e., when the button has been fully depressed. Somewhere between the upper and lower end positions of the bell 20, the head of the water in the siphon-shaped outlet conduit has risen above the bend 16b of the outlet conduit and this has started the siphoning effect. Thus, the water 30 in the storage tank 12 empties itself from the storage tank as indicated by the large arrows in the outlet conduit 16. Since the bell 20 is below its upper end position, water enters the storage tank 12 through the inlet conduit 14, but due to the larger cross-sectional area of the outlet conduit 16, the amount of water exiting the storage tank 12 is significantly larger than the amount of water entering the storage tank 12 during flushing.

[0034] Referring now to Fig. 2d, when the head of the water 30 is below the outlet portion 16a of the outlet conduit 16, no more water exits the storage tank 12 and the outlet conduit 16 is emptied, ending the siphoning effect. The bell 20, still being in its lower end position, allows entering of water through the inlet conduit 14 and the head of the water 30 begins to rise, as shown in Fig. 2e. This process stops when the bell 20 reaches its upper end position shown in Fig. 2a and the flushing process is completed.

[0035] In Figs. 3a and 3b a second embodiment of a flushing system is shown. As in the first embodiment, the toilet comprises a bowl 1a and a connection 1b to the waste pipe. A flushing system 10 comprising a water storage tank 12 is provided at a higher elevation as compared to the bowl. However, in this embodiment the flushing system 10 is provided on top of the bowl 1a and the waste pipe connection 1b. This means that the button 26 is easily accessible to a user of the toilet, without any mechanical arrangement.

[0036] The flushing system 10 can be provided as an insert adapted to be installed in existing tanks.

[0037] In Figs. 2a-e, the siphon-shaped outlet conduit 16 has been shown as a pipe with uniform cross-section. In order to optimize the siphoning effect, it is advantageous if the cross-section is non-uniform, as shown in Figs. 1a, 1b and 2a, 1b. It is there shown that the cross-section of the bend 16b substantially deviates from a circle. Instead, the diameter in the horizontal direction is substantially larger than the diameter in the vertical direction.

[0038] Preferred embodiments of a flushing system for toilets have been described. It will be appreciated that these can be modified within the scope of the appended claims without deviating from the inventive idea.

Claims

1. A flushing system (10) for a toilet comprising a storage tank (12), an inlet conduit (14) in fluid connection with the interior of the storage tank for supplying water to the storage tank, and an outlet conduit (16) in fluid connection with the interior of the storage tank for emptying water from the storage tank, wherein the outlet conduit is a siphon, **characterized by** a bell (20) arranged above the inlet conduit and the outlet conduit, wherein the bell is movable in a vertical direction between an upper end position and a lower end position, and wherein the bell is provided with a valve element (24) adapted to close the inlet conduit (14) when the bell is in its upper end position.
2. The flushing system (10) according to claim 1, comprising a piston (22) fixedly attached to the bell and, wherein the valve element (24) is provided at the piston for sealingly abutting an inlet portion (14a) of the inlet conduit (14) when the bell (20) is in an upper end position.
3. The flushing system (10) according to claim 2, comprising a button (28) suitable for being pushed downward by a user of the toilet during flushing and being provided at an upper end of the piston (22).
4. The flushing system (10) according to any one of claims 1-3, wherein the walls of the bell (20) are impermeable to air.
5. The flushing system (10) according to any one of claims 1-4, wherein the area inside the periphery of the bell (20) is substantially larger than the area in the storage tank (12) outside of the periphery of the bell.
6. The flushing system (10) according to any one of claims 1-5, wherein the cross-sectional area of the inlet conduit (14) is substantially smaller than the cross-sectional area of the outlet conduit (16).
7. The flushing system (10) according to any one of claims 1-6, wherein the outlet conduit (16) is provided with a bend (16b), wherein the cross-section of the bend 16b substantially deviates from a circle.

8. The flushing system (10) according to claim 7, wherein the diameter of the bend (16b) in the horizontal direction is substantially larger than the diameter of the bend in the vertical direction. 5
9. The flushing system (10) according to any one of claims 1-8, wherein the storage tank (10) is provided as an insert adapted to be installed in existing tanks.
10. The flushing system (10) according to any one of claims 1-9, wherein an inlet portion (14a) of the inlet conduit (14) is provided at a higher level than a bend (16b) of the outlet conduit (16). 10
11. The flushing system (10) according to any one of claims 1-10, wherein the ratio between the area of the outlet conduit (16) and the area of the inlet conduit (14) is in the range of 10-20. 15
12. A toilet (1) comprising a bowl (1a) and a connection (1b) to a waste pipe, **characterized by** a flushing system (10) according to any of claims 1-11, wherein the water storage tank (12) is provided at a higher elevation as compared to the bowl and the outlet conduit (16) is connected to the bowl (1a). 20 25

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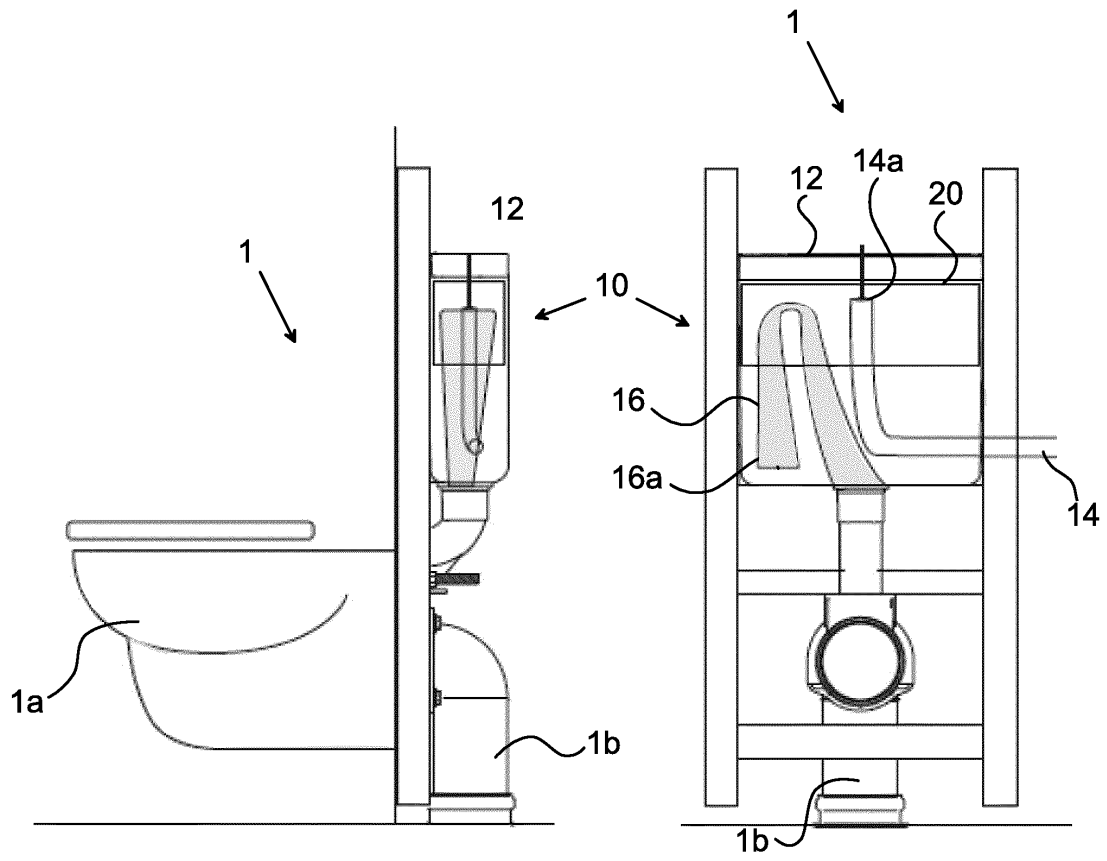


Fig. 1a

Fig. 1b

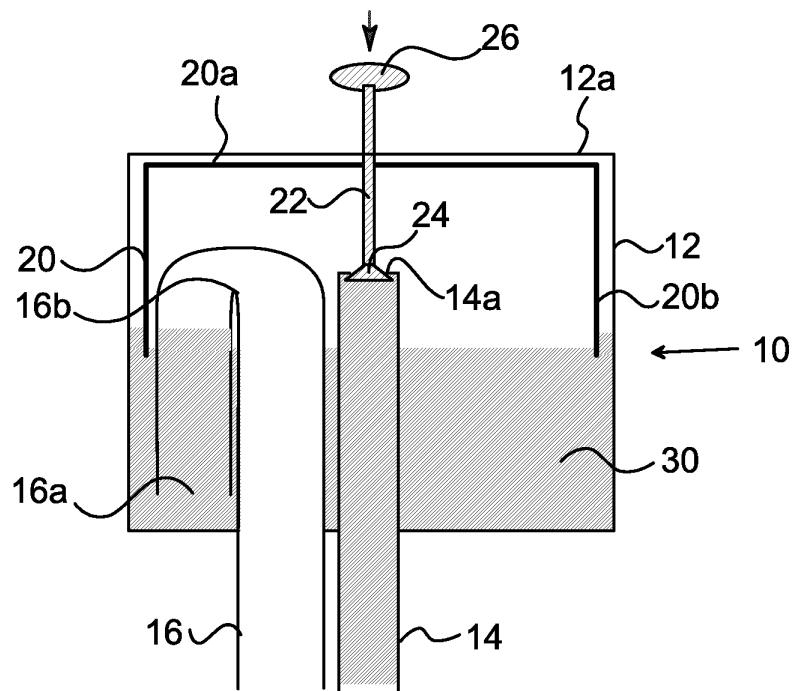


Fig. 2a

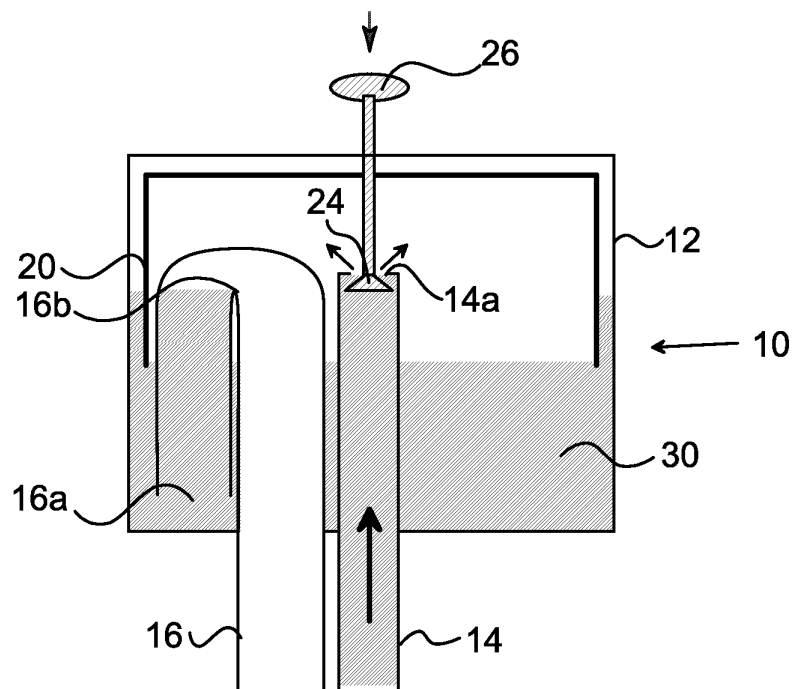


Fig. 2b

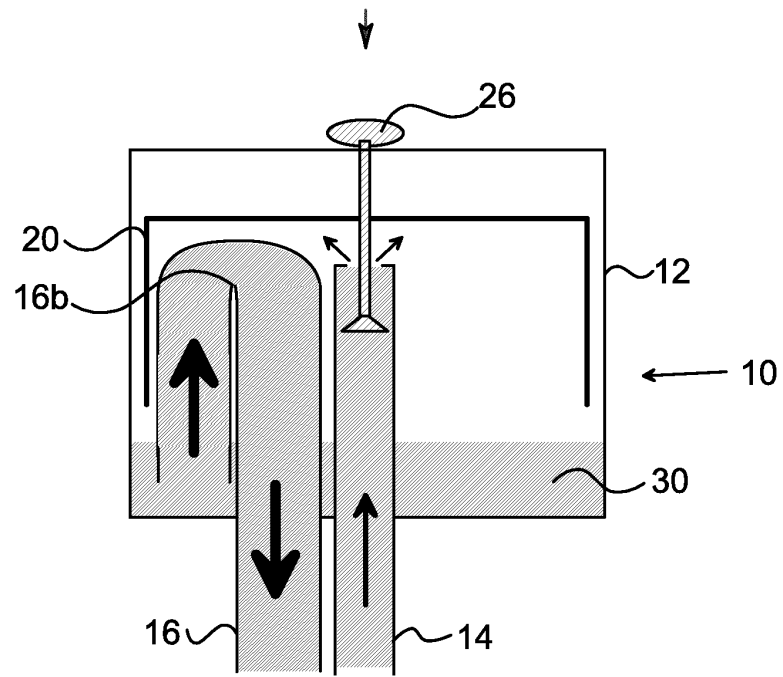


Fig. 2c

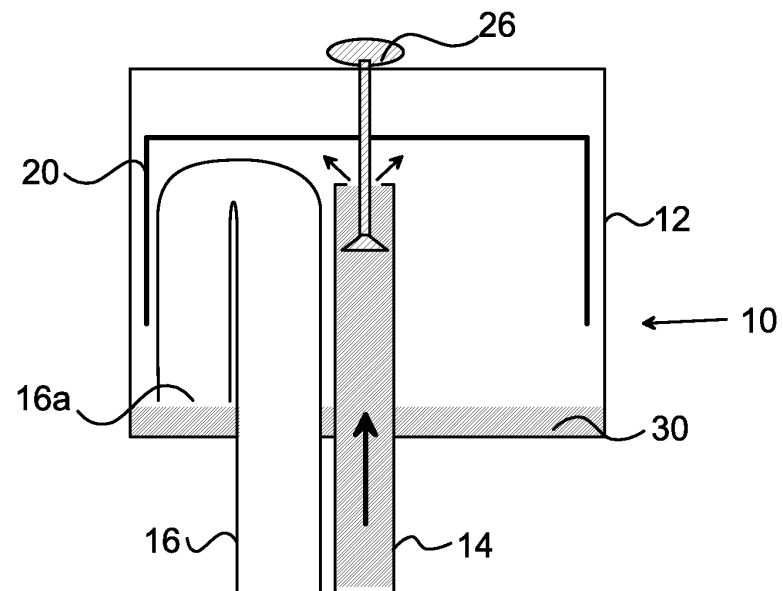


Fig. 2d

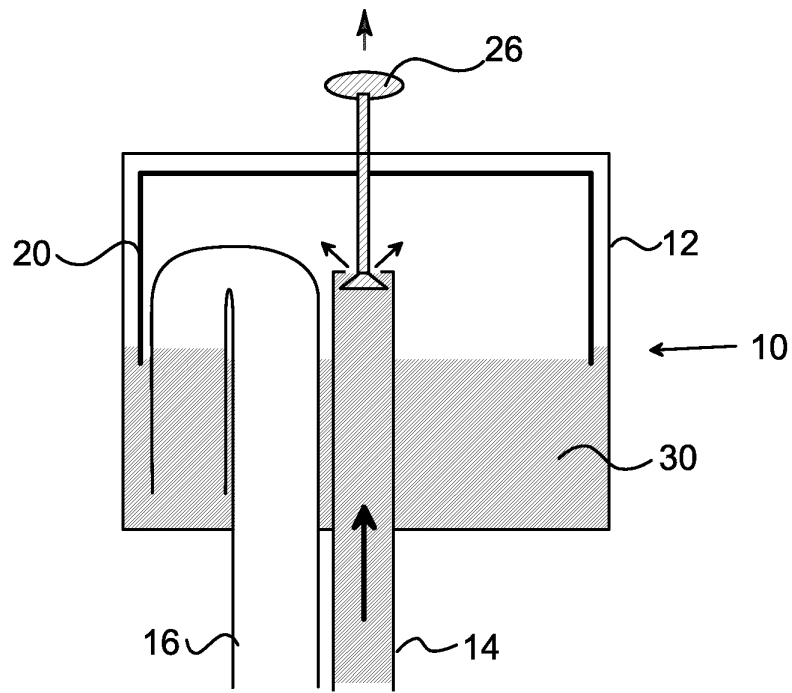


Fig. 2e

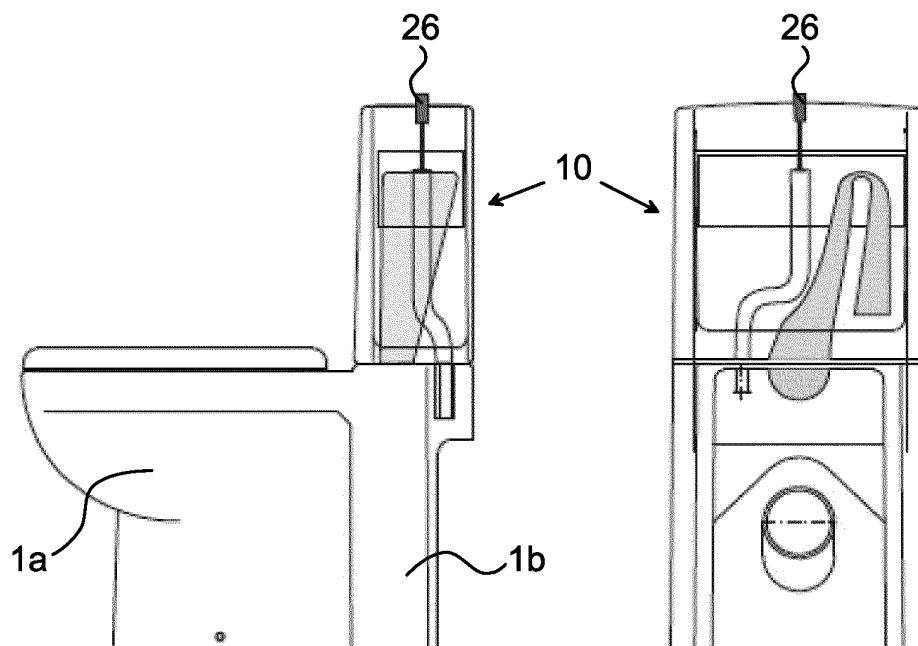


Fig. 3a

Fig. 3b



EUROPEAN SEARCH REPORT

Application Number
EP 13 16 7466

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			TECHNICAL FIELDS SEARCHED (IPC)
			E03D
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		23 October 2013	De Coene, Petrus
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 13 16 7466

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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23-10-2013

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