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(54) Title: TOILET DISCHARGE VALVE ASSEMBLY HAVING MOVEABLE BUOYANT FLOAT THEREIN

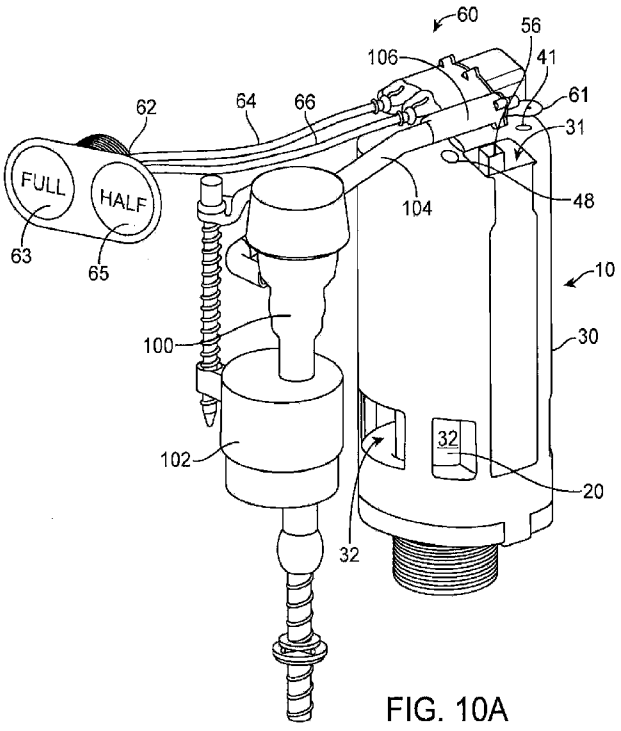

FIG. 10A

(57) Abstract: A toilet flush valve that has a moveable buoyant float therein, wherein the float has an open bottom end to trap air therein and wherein the housing includes controls to selectively release air to allow the float to move upwardly therein to permit flushing. By timing when one or two air vents on the housing are open, the duration and volume of the flush can be controlled, with the buoyancy provided by the water lifting the float to open the flush valve. This provides a flushing system with minimal activation energy.

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TOILET DISCHARGE VALVE ASSEMLY HAVING MOVEABLE BUOYANT FLOAT THEREIN

RELATED APPLICATIONS:

[0001] The present invention claims priority to U.S. Provisional Patent Application S.N. 61/775,398, entitled DISCHARGE VALVE USING AIR HOUSING WITH MOVEABLE FLOAT THEREIN, filed March 8, 2013; and to U.S. Provisional Patent Application S.N. 61/760,851, filed February 5, 2013 entitled DISCHARGE VALVE UTILIZING POTENTIAL AND KINETIC ENERGY OF FLUID FLOW; and to U.S. Provisional Patent Application S.N. 61/675,642, entitled DISCHARGE VALVE UTILIZING POTENTIAL AND KINETIC ENERGY OF FLUID FLOW, filed July 25, 2012; the entire disclosures of which are incorporated herein by reference in their entirety.

TECHNICAL FIELD:

[0002] The present invention relates to toilet discharge valve assemblies, including both partial and full-flush designs.

BACKGROUND OF THE INVENTION:

[0003] Numerous discharge (i.e.: flush) valve systems currently exist. All of these systems use various actuators that mechanically cause the flush valve to open and close. Some of these designs selectively permit either partial flushing or full flushing. Although many of these designs are generally acceptable, they often require considerable energy to operate their actuators.

[0004] What is instead desired is a discharge flush valve system that requires only minimal energy to operate. The present invention provides such a system. This is because the present system uses the buoyancy of the water itself in the toilet tank to control the operation of the discharge valve flushing.

SUMMARY OF THE INVENTION:

[0005] The present invention provides a discharge valve assembly that uses the water's own buoyancy in conjunction with an air release mechanism to turn on and off the flushing.

[0006] In one preferred aspect, the present invention provides a flush valve, comprising: (a) a housing dimensioned to be positioned over a drain in a toilet tank; (b) a float assembly being vertically moveable within the housing, the float assembly configured to seal the drain when the float assembly is in a lowered position, and to open the drain when the float assembly is in a raised position, wherein the float assembly comprises a hollow float having an open bottom end to trap air therein, and wherein an air chamber is formed between the interior of the housing and the exterior of the float assembly; (c) an air passageway connecting the air chamber in the housing to external ambient air; and (d) an actuator for selectively opening and closing the air passageway.

[0007] The float is similar to an upside-down cup. In operation, air becomes trapped inside the float with air entering under the bottom of the float at the end of a flush. This causes the float to become buoyant (when later surrounded by water). However, air trapped in a chamber in the housing above the float keeps the float in its "pre-flush" lowered position, thereby sealing the drain. At this "pre-flush" time, the float is surrounded by water. By releasing air trapped above the float in the housing, the buoyant float then lifts while the tank water flows underneath the float and into the drain, thereby flushing the toilet. The air passageway out of the housing can be selectively opened and closed. Opening the air passageway lets air escape from the housing, thus causing the buoyant float to rise. As the tank water passes under the float and down the drain, the water level drops and the float becomes less buoyant. The float will therefore naturally fall back down to seal the drain. However, in an alternate aspect, air is prevented from re-entering the space in the housing above the float after the float has lifted. This will keep the float at a raised position, thereby prolonging the duration of the flush.

[0008] The advantage of the present system is that it uses very, very little energy to operate. Simply by opening and closing an air vent at proper times, the flushing of the toilet bowl can be activated, and the duration of the flush can easily be controlled. Moreover, there is no need to pump air into the valve assembly. Rather, air simply enters the valve assembly when the water leaves the tank during a flush. Thus, the system is always ready for re-use for one flush after another.

[0009] In its various preferred embodiments, systems are also provided to have air enter the housing at more than one height such that the buoyancy (and movement) of the float within the chamber can be controlled. Specifically, when air is permitted to enter the housing at a higher location, the float will fall sooner, thus providing a half flush. Blocking this air path will cause the air to enter the housing later, thus providing a full flush.

[0010] In addition, in various preferred embodiments of the invention, a venting path between the interior of the float and the ambient air outside the housing is provided. This venting path system has the advantage of keeping the buoyancy of the float constant as the height of the water in the tank around the float changes.

BRIEF DESCRIPTION OF THE DRAWINGS:

[0011] Figs. 1 to 5 show sectional views of a simplified embodiment of the present invention such that its operation during a flush can be understood.

[0012] Figs. 6, 7 and 8 show sectional views of an alternate embodiment of the invention having a venting system allowing air to freely pass from the interior of the float to the external ambient air.

[0013] Figs. 9A and 9B show an embodiment of the present invention having a siphon skirt.

[0014] Fig. 10A is a perspective view of the present invention.

[0015] Fig. 10B is a sectional side elevation view of the interior of housing 30 showing the operation of the full and half venting systems.

[0016] Fig. 11 is a top plan schematic of the control system of the present invention at rest.

[0017] Fig. 12 is a top plan schematic of the control system of the present invention during a full flush.

[0018] Fig. 13 is a top plan schematic of the control system of the present invention during water refilling.

[0019] Fig. 14A is a bottom plan view of the control system during a half flush.

[0020] Fig. 14B is a bottom plan view of the control system during a full flush.

[0021] Fig. 15A is a perspective view of an alternate embodiment of the present invention.

[0022] Fig. 15B is a close up of the flush control module of 15A prior to a flush.

[0023] Fig. 15C is a close up of the flush control module of 15A during a half flush.

[0024] Fig. 15D is a close up of the flush control module of 15A during a full flush.

[0025] Fig. 16 A is a perspective view of an alternate embodiment of the present invention prior to a flush.

[0026] Fig. 16 B is a perspective view of an alternate embodiment of the present invention in a flush mode.

DETAILED DESCRIPTION OF THE DRAWINGS:

[0027] Figs. 1 to 5 show the operation of a simplified embodiment of the invention such that the advantages of present the buoyant float can clearly be understood, as follows.

[0028] First, Fig. 1 shows a float assembly 10 positioned over a drain D in a toilet tank T. The toilet bowl (not shown) is positioned below drain D. Float assembly 10 comprises a buoyant float 20 that is moveable up and down within a housing 30. Water surrounds float assembly 10 prior to a flush. Float 20 seals drain D (thereby keeping water in tank T) when in its lowered position, preferably by way of a sealing member 21 wrapping around the open bottom end of the float, as shown.

[0029] Float 20 is hollow and has an open bottom end that traps air thereunder. Specifically, air is trapped within the open bottom end of float 20. An air chamber 25 is also found within housing 30 above float 20. An air passageway 40 is found that permits air trapped in air chamber 25 to move to the external ambient air when an actuator switch 42 is opened. Switch 42 is mounted onto the outside wall of the toilet tank (as shown), in the common position where a toilet flush handle is normally located. In various embodiments, air passageway 40 may comprise a tube extending to the exterior of the toilet tank, or it may simply comprise an air passageway that opens on the exterior of housing 30, such that the ambient air is the air within the tank.

[0030] Fig. 2 illustrates the start of a flush. At this time, switch 42 is opened, permitting air A to move out of chamber 25 (i.e. out through passageway 40 exiting at or near switch 42). Since float 20 is buoyant, it will now move upwards in the surrounding water as the air escapes from chamber 25. As a result, the water W in tank T will then pass under float 20, down into drain D, and then down into the toilet bowl below. As a result, flushing commences. As can be seen in this sectional view, the bottom portion of housing 30 has flow openings 32 permitting tank water to pass therethrough and into the drain below the housing when the float assembly is in the raised position.

[0031] In various preferred embodiments, the switch 42 that selectively opens and closes the air passageway 40 may comprise a flush button 43 or lever positioned on the exterior of the toilet tank. Switch 42 may also optionally comprise a proximity sensor 44 positioned on the exterior

of the toilet tank. An advantage of using such a proximity sensor is that a user need only put their hand near the switch 43 on the toilet tank to cause the toilet to flush.

[0032] In various optional embodiments, the air passageway 40 may connecting air chamber 25 in housing 30 to external ambient air by way of a tube extending from the housing to an external outlet on the toilet tank, as shown. Alternatively, the air passageway may simply be a passageway through to the external surface of housing 30, accessing external ambient air within the toilet tank itself. In this second embodiment, a flush actuation control switch or lever 42 will still be positioned on the exterior of the tank T for a user to flush the toilet.

[0033] If air passageway 40 is simply kept open after the flushing commences, float 20 will simply drop back into position to close drain D as the water in tank T empties. This is one method of normal contemplated operation. This method has the benefit of ease of operation as the only thing the system needs to flush the toilet is for switch 42 to open air passageway 40 and hold it open. After the water is fully drained from the tank, float 20 will fall along with this dropping water level, such that float 20 re-seals the opening to the drain. At that time, air passageway 40 can again be closed, sealing air within chamber 25, resulting in the return to the pre-flush position shown in Fig. 1.

[0034] However, Figs. 3 and 4 show another method of normal contemplated operation. Specifically, after the air has escaped from air chamber 25, switch 42 is closed, thereby preventing air from freely moving back from the external ambient environment into air chamber 25. As a result, a partial vacuum will form in air chamber 25, holding float 20 in a raised (or partially raised) position as the surrounding water level drops around housing 30. By holding float 20 upwards as the water level is falling around the float, the duration of the flush can be prolonged. Finally, as shown in Fig. 5, the water level in the tank will drop to such a low level that air A will break into the (partial) vacuum in air chamber 25 by entering the bottom end of air chamber 25. At such time, float 20 will then quickly descend, stopping the flush.

[0035] Stated another way,. a prolonged flush can also be obtained by opening the switch 42 again to let air entering the air chamber and breaking the vacuum, the float 20 will drop and stop the flush. By altering the duration time between the first opening of the switch 42 and the second opening of the switch 42, the flush volume can be adjusted. The longer this time interval, the more volume will be discharged. The shorter, the less volume. This method can be used to control a full and partial flush.

[0036] As can be appreciated, by controlling the times when air passageway 40 is opened, the duration of the flush itself can be controlled. As a result, the flush volume can be controlled by keeping air passageway 40 closed (as shown in Figs. 3 and 4) for a desired period of time after initially opening it (as shown in Fig. 2). For example, a full flush can be achieved by holding float 20 in its upward position until air enters the bottom of air chamber 25 as seen in Fig. 5. However, a partial flush may instead be achieved by simply permitting air to enter chamber 25 prior to this point in time (or even by allowing air to continuously enter the housing as was seen in Fig. 3). Therefore, by controlling the interval of time between the two openings of switch 42, the duration of time during which air can not flow freely through air passageway 40 is controlled. This controls the duration of the flush, which in turn controls the flush volume. A longer interval of time can correspond to a full flush and a shorter interval of time can correspond to a partial flush.

[0037] Fig. 6 shows an alternate embodiment of the invention having a second air passageway 41 also connecting air chamber 25 in housing 30 to external ambient air. As can be seen, second air passageway 41 enters air chamber 25 at a tube end position 47 below where first air passageway 40 enters air chamber 25. As will be shown in several embodiments of the invention, a switch or other actuator can be used to selectively control the opening and closing of the second air passageway 41. As will also be shown, multiple air paths (at different heights) into air chamber 25 can also be used to control float movement.

[0038] In operation, this embodiment would be quite similar to the entering air chamber 25 as was seen in Fig. 5. However, in Fig. 6, the air would instead enter chamber 25 when the

water lever is higher than it was in Fig. 5. Specifically, when the surrounding water level drops below position 47, air will enter air chamber 25 through second air passageway 41. This will break the vacuum in air chamber 25, causing float 20 to immediately drop. As a result, float 20 would drop sooner in Fig. 6 than in Fig. 5 (assuming air passageway 40 is kept closed in both cases). As can be appreciated, air A enters chamber 25 at the higher water line (i.e.: at 47) in Fig. 6 than the lower water line (i.e.: through lower flow openings 32) shown in Fig. 5. As a result, air passageway 41 may be selectively opened to result is a shorter flush (i.e.: a "partial" flush), whereas it may instead be kept closed to result in a longer (i.e.: "full" flush). It is to be understood that in accordance with the present invention, additional air openings may be provided to connect air chamber 25 to the external ambient air. These openings / air passageways may be at different heights and they may be selectively opened and closed at different times. All of this provides additional systems and approaches to control float buoyancy and flush times.

[0039] Figs. 7 and 8 show an alternate embodiment of the invention having a venting system allowing air to freely pass from the interior of the float to the external ambient air, as follows. In various embodiments, an air passageway 50 between the interior of float 20 and the ambient air is provided. This air passageway 50 ensures that the air pressure within float 20 is kept at ambient conditions regardless of the water height in tank T. This makes it easier to calibrate the flushing sequence of operations, as will be explained.

[0040] In one embodiment, air passageway 50 comprises: a venting tube 52 having an open top end disposed within the hollow float 20; a venting base 54 connected to the bottom of venting tube 52; and a venting chamber 56 to the external ambient air. The venting chamber 56 is connected to venting base 54. Air flows freely between the venting tube 52, base 54 and chamber 56 such that the air in the interior of hollow float 20 remains at ambient pressure during a flush. It is to be understood that structures 52, 54 and 56 may be separate structures, or they may be portions of one long tubing flow path structure. For example, air passageway 50 may even be a single J-shaped structure (in which the lower end of the "J" is positioned within the

float and the upper end of the "J" positioned outside or at the top of the housing 30. Note as well that venting tube 52 is different from the above described second air passageway 41 (i.e.: Figs. 6 and 7 are rotated slightly from one another to show different exemplary embodiments of the invention).

[0041] In optional preferred embodiments, venting tube 52 has an open top end 53, which may be fluted outwardly as shown. Venting base 54 preferably has a bottom opening 55. Therefore, should any water in float 20 enter open top end 53, it will simply drain out through opening 55 into the drain below. Similarly, any tank water (accidentally) entering the top of venting chamber 56 will also drain out through bottom opening 55. As a result, water will be kept out of air passageway 50, permitting the free flow of air therethrough. In one optional embodiment, venting chamber 56 passes through a standard overflow tube 31 passing through housing 30 (as seen in Fig. 10).

[0042] Fig. 8 shows the water levels at the start of a flush. Specifically, once air passageway 40 is opened, the air will escape from air chamber 25 and float 20 will lift. At this time, the water will flow under the open bottom end of float 20 and pass down into the drain. Since air is free to flow from the inside of float 20 to the ambient air through air passageway 50, water will enter the bottom of the float, rising partially up into the interior of the float, as shown. Note: should the water level rise too far within float 20, the water will simply drain into open top end 53, and then down the drain through bottom opening 55.

[0043] Fig. 9A shows a sectional view of an embodiment of the invention having a siphon skirt 34 prior to a flush. Siphon skirt 34 is disposed around the at least one flow opening 32. Fig. 9B shows the action of siphon skirt 34 during a flush. The siphon skirt 34 operates to pull tank water into the drain during the flush, thereby fully drawing almost all of the water out of the tank T. Specifically, the water level in the tank will be drained down to the level of the lower lip of the siphon skirt.

[0044] Fig. 10A is a perspective view of the present float assembly 10 positioned next to a fill valve 100. The operation of float assembly 10 is controlled by control module 60. Control module 60 includes an activation button panel 62 mounted on the outside of the toilet tank (not shown). Activation button panel 62 includes a full flush button 63 and a half flush button 65. Buttons 63 and 65 are connected (pneumatically or by cables) through lines 64 and 66 to control module 60. Fill valve 100 includes a float 102 and a water refill line 104. When the water level in the tank falls, float 102 falls, thereby turning on the fill valve 100 to supply water from the building mains through line 104 both into the tank T (to refill the tank) and into the housing 30 (through line 104 to activate a hydraulic cylinder 106 in the control module 60), as will be explained.

[0045] Control module 60 operates to rotate vent cover 61 so that it either opens or closes the top opening of second air passageway 41. As was explained with respect to Fig. 6, when second air passageway 41 is closed, a full flush occurs. However, when second air passageway 41 is open, air is instead able to enter air chamber 25 through at tube end position 47, resulting in a half flush. Hole 48 is a full flush vent hole which can best be understood by viewing Fig. 10B, as follows.

[0046] As was explained above with regard to Fig. 6, second air passageway 41 permits a half flush (when the water drops to the level of tube end 47). At this time, when the water level drops to the level of tube end 47, air rushes into air chamber 25, breaking the vacuum and causing the float 20 to drop, stopping the flush. As seen in Fig. 10B, another air passageway is provided by hole 48, which extends down into a tube with an open bottom end at 49. When second air passageway 41 is closed, the water level will instead have to drop down to the level of tube end 49 before air rushes into air chamber 25, breaking the vacuum and causing the float 20 to drop, stopping the flush. Since end 49 is positioned below end 47, a greater volume of water will have to drain from the tank before air can pass through end 49. This greater volume of water is the "full flush".

[0047] Further details of the operation of control mechanism 60 are seen in Figs. 11 to 14B, as follows. Fig. 11 is a top plan schematic of the control system of the present invention at rest. An air valve 70 is disposed on the top of housing 30. Air valve 70 is connected to air chamber 25 and acts to vent air directly out the top of housing 30 (to the ambient air within the tank) when opened. Thus, air valve 70 operates the same as switch 42 in the embodiments of the invention in Figs. 1 to 9B. Simply put, opening air valve 70 permits air to escape from air chamber 25. As will be explained, control mechanism 60 controls the opening and closing of air valve 70 the same way that actuator switch 42 controlled the opening and closing of air passageway 40 (i.e.: valve 70 and switch 42 both let air out of air chamber 25 when opened). A piston 90 is moved by pneumatic tube 65 when button 63 is pushed. Similarly, a piston 92 is moved by pneumatic tube 66 when button 65 is pushed. The movement of the pistons 90 and 92 cause valve 70 to open.

[0048] Fig. 12 is a top plan schematic of the control system of the present invention during a full flush (when pneumatic button 63 has been pushed). Pushing button 63 moves air through tube 65 which moves piston 92 which in turn opens valve 70. At this time, air begins to escape from internal air chamber 25 (through open valve 70 on the top of housing 30). As will be shown, control mechanism 60 rotates a crank 108 which rotates a cam 109 (Fig. 14A and 14B). The rotation of cam 109 moves vent cover 61 into a position such that it closes second air passageway 41. This results in a full flush. At this same time, water is supplied through refill line 104, passing down into housing 30 through hole 105 into housing 30 to refill the tank.

[0049] Fig. 13 is a top plan schematic of the control system of the present invention when water is fed from one outlet of the fill valve to the hydraulic piston to power the piston. At this time, piston 107 is pushed back by the force of the refilling water such that cam 109 remains rotated to a position where its lugs 110 prevent movement of pistons 90 or 92. As a result, an operator is not able to push pistons 90 or 92 and is thus not able to open air release valve 70 during the re-filling of the tank.

[0050] For a half flush, button 65 is pushed so that air escaped from internal air chamber 25 (through open valve 70 on the top of housing 30). However, control mechanism 60 does not move vent cover 61 over second air passageway 41 in the case of a half flush. This results in the half flush since air is able to enter air chamber 25 through second air passageway 41 when the water level drops to the position of tube end 47 in Fig. 6.

[0051] Fig. 14A is a bottom plan view of the control system 60 during a half flush, and Fig. 14B is a bottom plan view of the control system 60 during a full flush, showing further structural details, as follows. As can be seen, the force of refill water passing through refill line 104 moves piston 107 to a retracted position (Fig. 14A). This in turn rotates crank 108 and cam 109 to lock pistons 90 and 92 to prevent them from opening air valve 70 (i.e.: by pushing buttons 63 or 65) when water is being supplied from a fill valve 100 into flush valve 10. This is necessary to maintain the partial vacuum in air chamber 25 prior to the desired time at which float 20 is to drop (and stop the flush). Once the hydraulic force on piston 107 has stopped, cam 109 will rotate back to its unlocked position such that a user is then free to push either of buttons 63 or 65 again.

[0052] Fig. 15A is a perspective view of an alternate embodiment of the present invention. This embodiment is similar in operation to that of Fig. 10A, however, air escapes back through switch 42 through passageways 40 and 41. Switch 42 comprises a full flush button 63 and a half flush button 65. When either of buttons 63 or 65 are pushed, air escapes from air chamber 25 by way of passageway 40 (as was explained with respect to Figs. 1 to 5). When button 63 is pushed, a full flush is selected and air is blocked from moving through second air passageway 41. Conversely, when button 65 is pushed, a half flush is selected and air flows through second air passageway 41 (as was explained with respect to Fig. 10A).

[0053] Fig. 15B is a close up of three views of the flush control module 42 of 15A prior to a flush. At this time, passageway 41 is open for air flow. Flush control module 42 includes a valve pin 70 and a closed check valve 72.

[0054] Fig. 15C is a close up of the flush control module 42 of 15A during a half flush when button 65 has been depressed. At this time, spring 73 will bend, pushing pin 70 down and opening check valve 72 (permitting the air to flow out of passageway 40, thus releasing air from chamber 25). At the same time, pushing the partial flush button 65 will open up the shuttle valve 74 and allow air to go through the passageway 41 (as was explained with respect to Fig. 10A).

[0055] Fig. 15D is a close up of the flush control module 42 of 15A during a full flush when button 63 has been depressed. At this time, spring 73 will bend, pushing pin 70 down and opening check valve 72 (permitting the air to flow out of passageway 40, thus releasing air from chamber 25). At this same time, pushing button 63 will close the shuttle valve 74 and air is blocked from moving through second air passageway 41.

[0056] Fig. 16A is a perspective view of an alternate embodiment of the present invention in half flush mode; and Fig. 16B is a perspective view of this alternate embodiment of the present invention in full flush mode. This embodiment is also similar in operation to the embodiment previously described in Fig. 10A. However, the primary difference is that a hydraulic pinch valve 100 is provided. The operation of hydraulic pinch valve 100 is similar to the operation of the locking cam mechanism described in Figs. 14A and 14B. Specifically, when refill water is entering housing 30 through refill tube 104, the force of the water will move the plunger in hydraulic pinch valve 130 down (see Fig. 16B) to choke off the flow of air through an air passageway tube 132. As a result, buttons 63 and 65 are disabled during the refilling of the tank. This prevents the operator from releasing air from air chamber 25 when the tank is refilling (similar to the function of lugs 110 in Figs 14A and 14B).

WHAT IS CLAIMED IS:

1. A flush valve, comprising:

(a) a housing dimensioned to be positioned over a drain in a toilet tank;

(b) a float assembly being vertically moveable within the housing, the float assembly configured to seal the drain when the float assembly is in a lowered position, and to open the drain when the float assembly is in a raised position, wherein the float assembly comprises a float having an open bottom end to trap air therein, and wherein an air chamber is formed between the interior of the housing and the exterior of the float assembly;

(c) an air passageway connecting the air chamber in the housing to external ambient air; and

(d) an actuator for selectively opening and closing the air passageway.

2. The flush valve of claim 1, wherein the float assembly comprises a hollow float with an open bottom end.

3. The flush valve of claim 1, wherein the actuator for selectively opening and closing the air passageway comprises a flush button positioned on the exterior of the toilet tank.

4. The flush valve of claim 1, wherein the actuator for selectively opening and closing the air passageway comprises a triggering sensor.

5. The flush valve of claim 1, wherein the air passageway connecting the air chamber in the housing to external ambient air comprises a tube extending from the air chamber in the housing to an external ambient air outlet on the toilet tank.

6. The flush valve of claim 1, wherein the air passageway connecting the air chamber in the housing to external ambient air comprises a passageway through the housing to external ambient air within the toilet tank.

7. The flush valve of claim 1, further comprising:

(e) an air passageway connecting the interior of the float to external ambient air.

8. The flush valve of claim 7, wherein the air passageway connecting the interior of the float to external ambient air comprises:

(i) a venting tube having an open top end disposed within the float;

(ii) a venting base connected to the bottom of the venting tube; and

(iii) a venting chamber to the external ambient air, the venting chamber being connected to the venting base,

wherein air flows freely between the venting tube, base and chamber such that the air in the interior of the float remains constant at ambient pressure.

9. The flush valve of claim 8, wherein the venting chamber passes through an overflow tube passing through the housing.

10. The flush valve of claim 8, wherein the venting base has a bottom opening permitting water entering the venting tube to drain out through the venting base into the drain in the toilet tank.

11. The flush valve of claim 1, further comprising:

(e) a second air passageway connecting the air chamber in the housing to external ambient air, wherein the second air passageway enters the air chamber at a position below where the first air passageway enters the air chamber.

12. The flush valve of claim 10, further comprising:

(f) an actuator for selectively opening and closing the second air passageway.

13. The flush valve of claim 12, wherein the actuator for selectively opening and closing the second air passageway comprises a pneumatic or cable activated control module.

14. The flush valve of claim 13, wherein the control module has a locking mechanism that prevents a user from opening the first air passageway when water is being supplied from a fill valve into the flush valve.

15. The flush valve of claim 13, wherein the control module has a locking mechanism that prevents a user from opening the second air passageway when water is being supplied from a fill valve into the flush valve.

16. The flush valve of claim 1, wherein the housing comprises:

at least one flow opening permitting tank water to pass therethrough and into the drain below the housing when the float assembly is in the raised position.

17. The flush valve of claim 16, further comprising:

a siphon skirt disposed around the at least one flow opening.

18. The flush valve of claim 1, wherein the float assembly comprises a sealing member between the float and the drain.

19. A method of controlling flow through a flush valve, comprising:

(a) providing a flush valve assembly comprising:

(i) a housing dimensioned to be positioned over a drain in a toilet tank;

(ii) a float assembly being vertically moveable within the housing, the float assembly configured to seal the drain when the float assembly is in a lowered position, and to open the drain when the float assembly is in a raised position, wherein the float assembly comprises a float having an open bottom end to trap air therein, and wherein an air chamber is formed between the interior of the housing and the exterior of the float;

(iii) an air passageway connecting the air chamber in the housing to external ambient air; and

(iv) an actuator for selectively opening and closing the air passageway;

(b) opening the air passageway, thereby permitting air to escape from the housing, thus permitting the float to rise, thereby causing a flush with water passing under the float and into the drain.

20. The method of claim 19, further comprising:

(c) subsequently closing the air passageway, thereby preventing air from entering the housing, thus preventing the float from falling, thereby prolonging the flush.

21. The method of claim 20, further comprising:

(d) controlling the interval of time between steps (b) and (c) to thereby select flush volume.

22. The method of claim 21, wherein a longer interval of time corresponds to a full flush and a shorter interval of time corresponds to a partial flush.

23. The method of claim 20, further comprising:

(d) subsequently opening the air passageway, thereby permitting air to enter the housing, thus permitting the float to fall, thereby ending the flush.

24. The method of claim 20, further comprising:

(d) while keeping the air passageway closed, permitting air to enter the housing, thus permitting the float to fall, thereby ending the flush.

25. The method of claim 19, further comprising:

(c) providing air passageway connecting the interior of the float to the external ambient air, thereby keeping the air pressure in the interior of the float at ambient conditions.

26. The method of claim 19, further comprising providing a second air passageway connecting the air chamber in the housing to the external ambient air, wherein the second air passageway enters the air chamber at a position below the first air passageway, and

(c) opening the second air passageway, thereby causing the float to fall.

27. The method of claim 26, wherein opening the second air passageway corresponds to providing a partial flush, whereas keeping the second air passageway closed corresponds to providing a full flush.

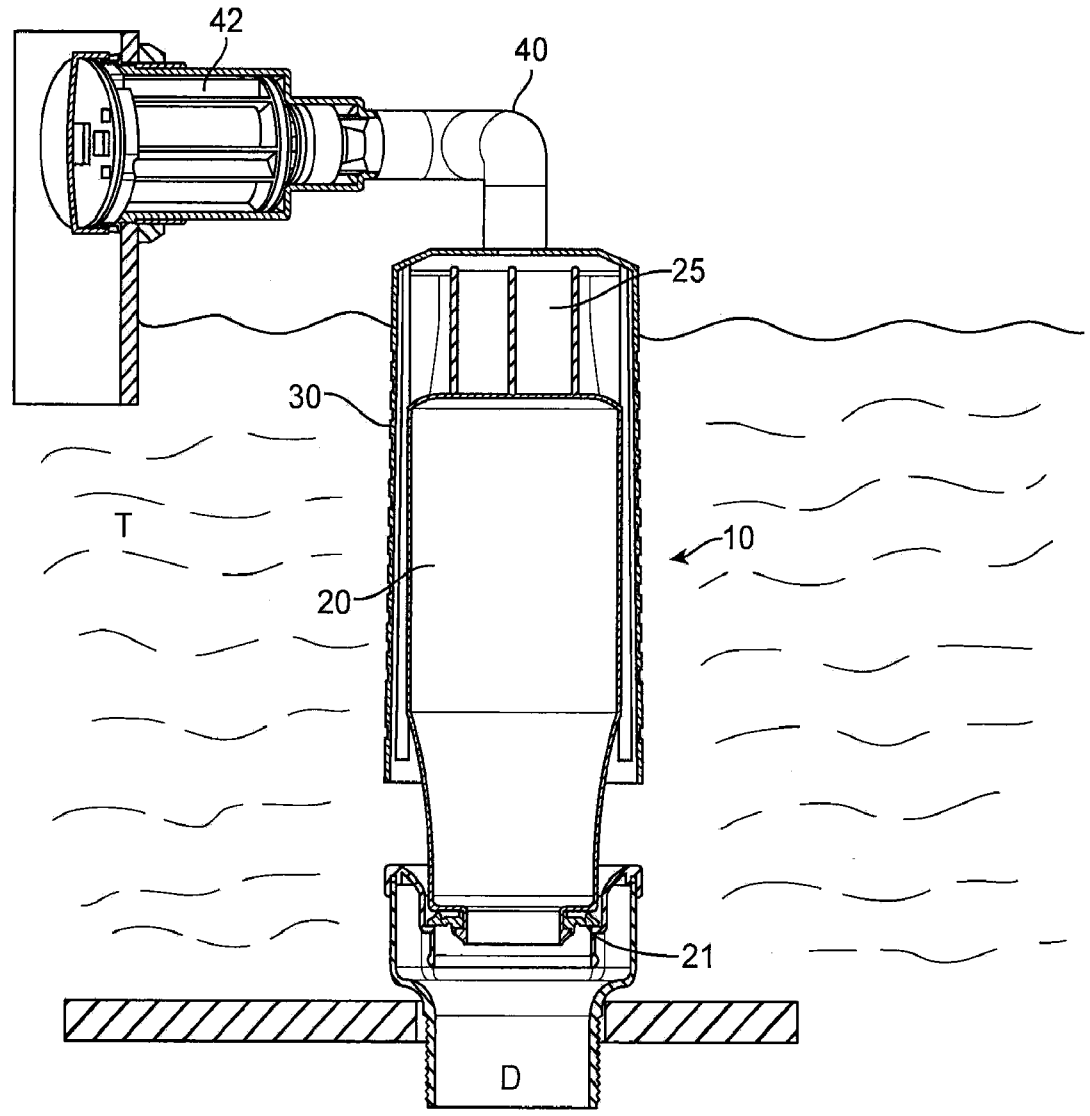

FIG. 1

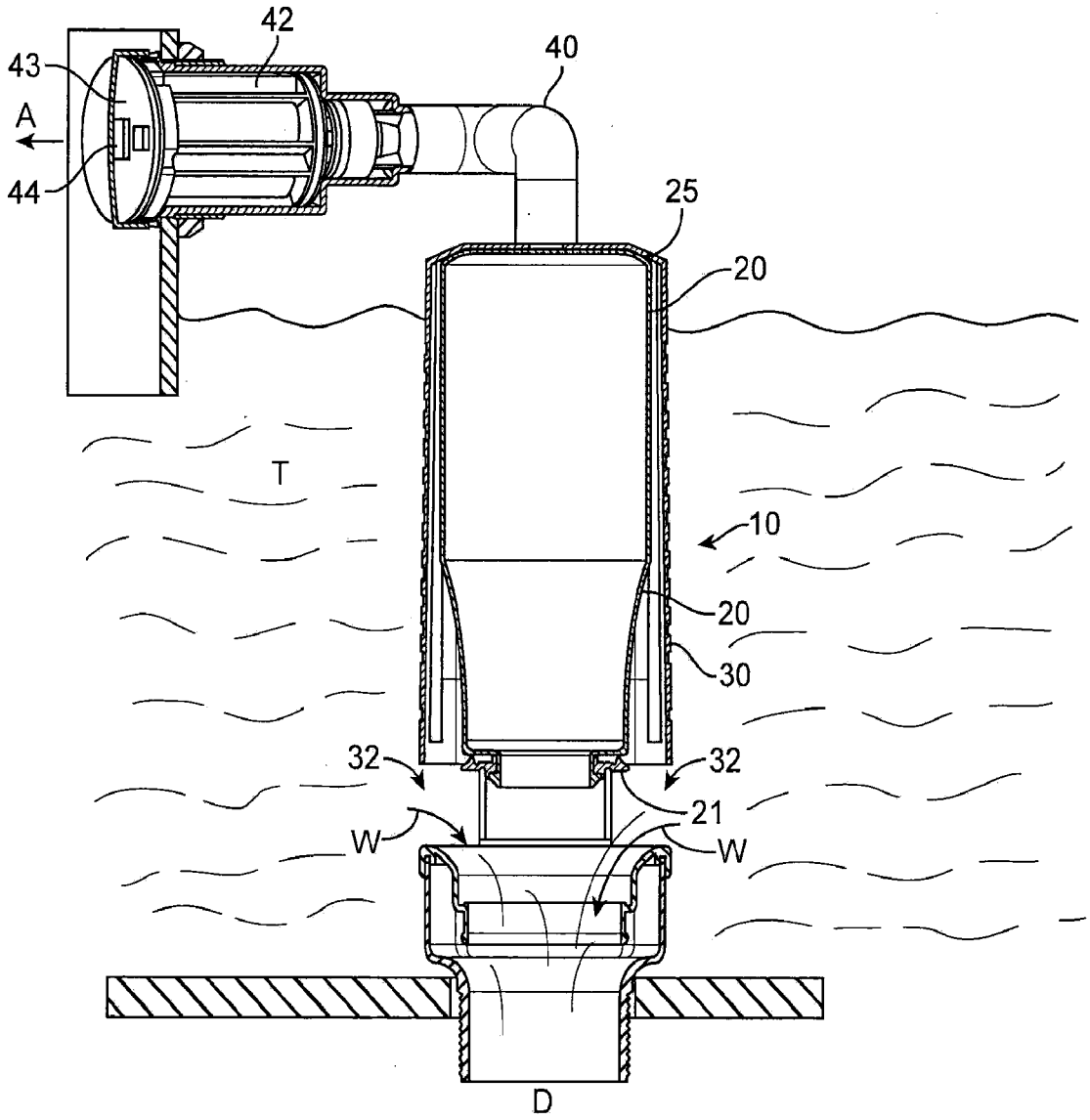

FIG. 2

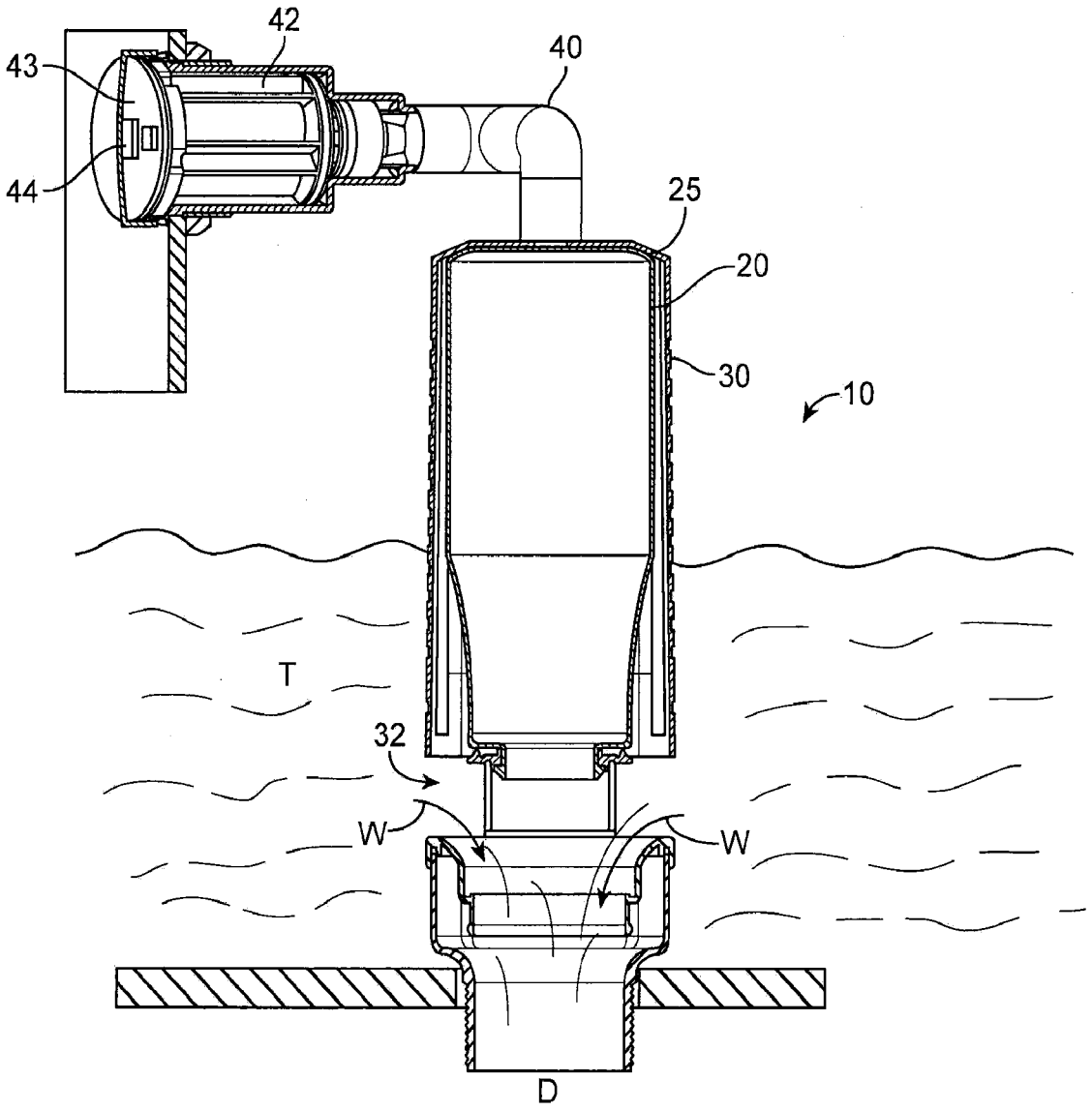

FIG. 3

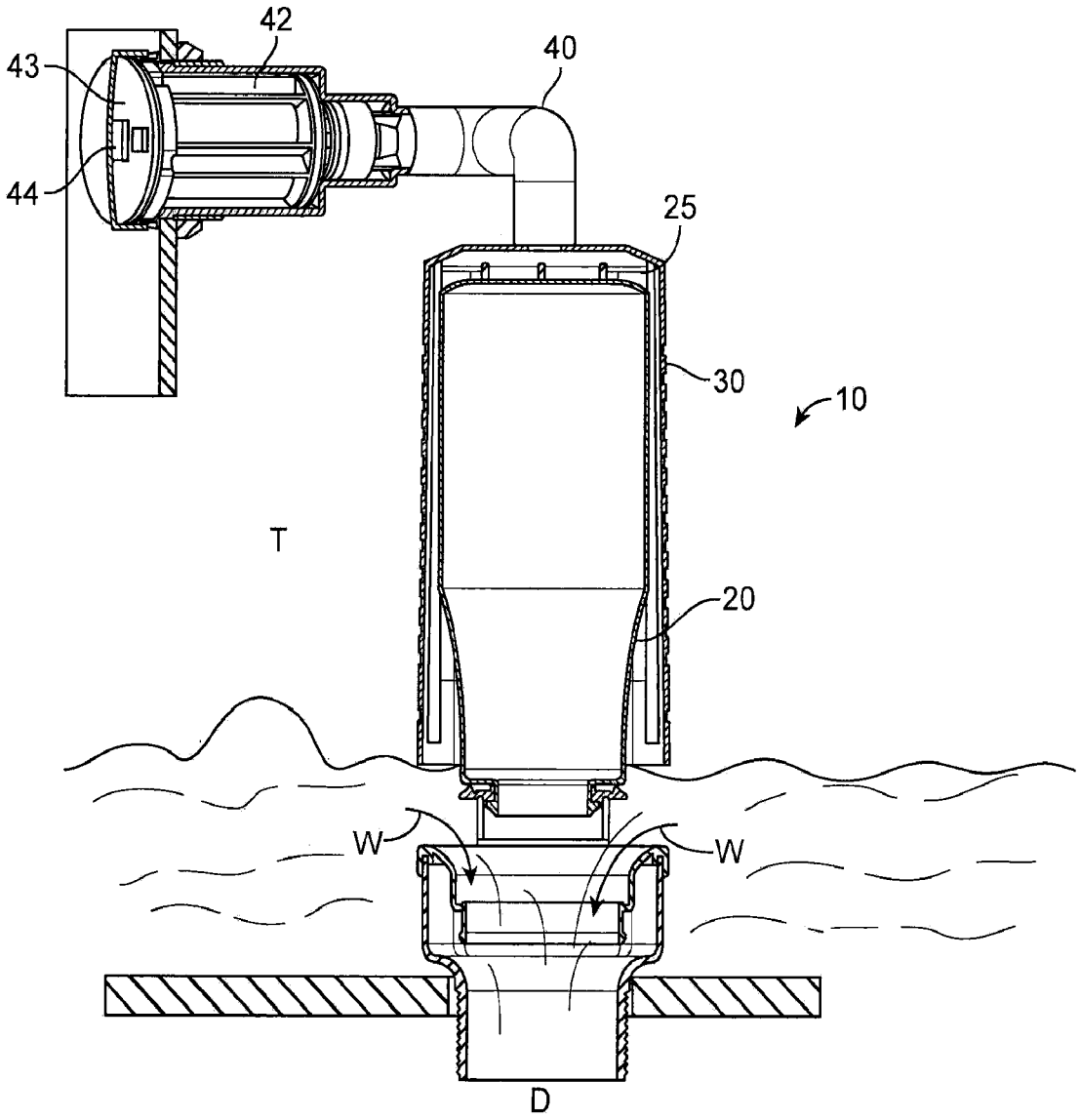

FIG. 4

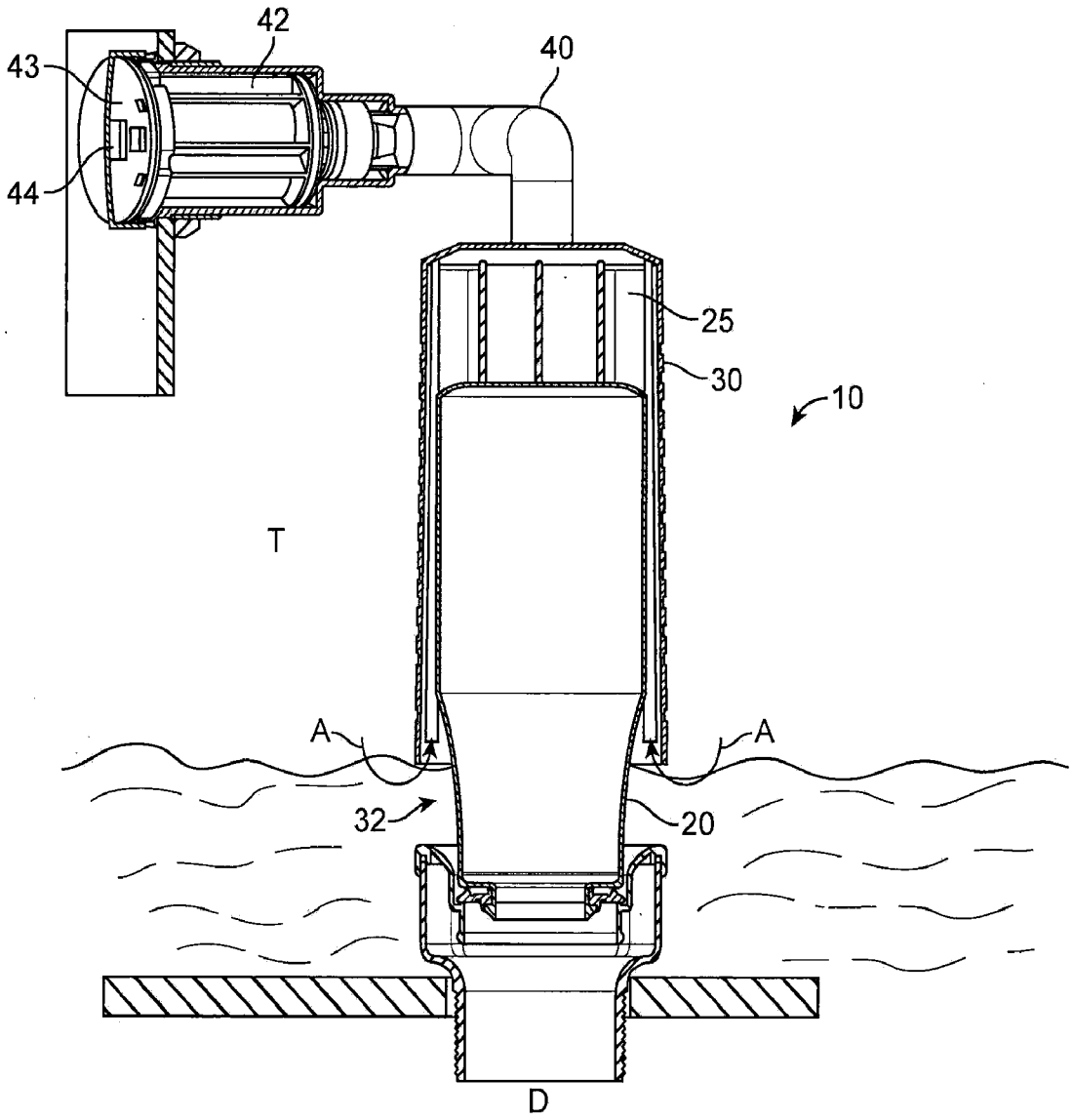

FIG. 5

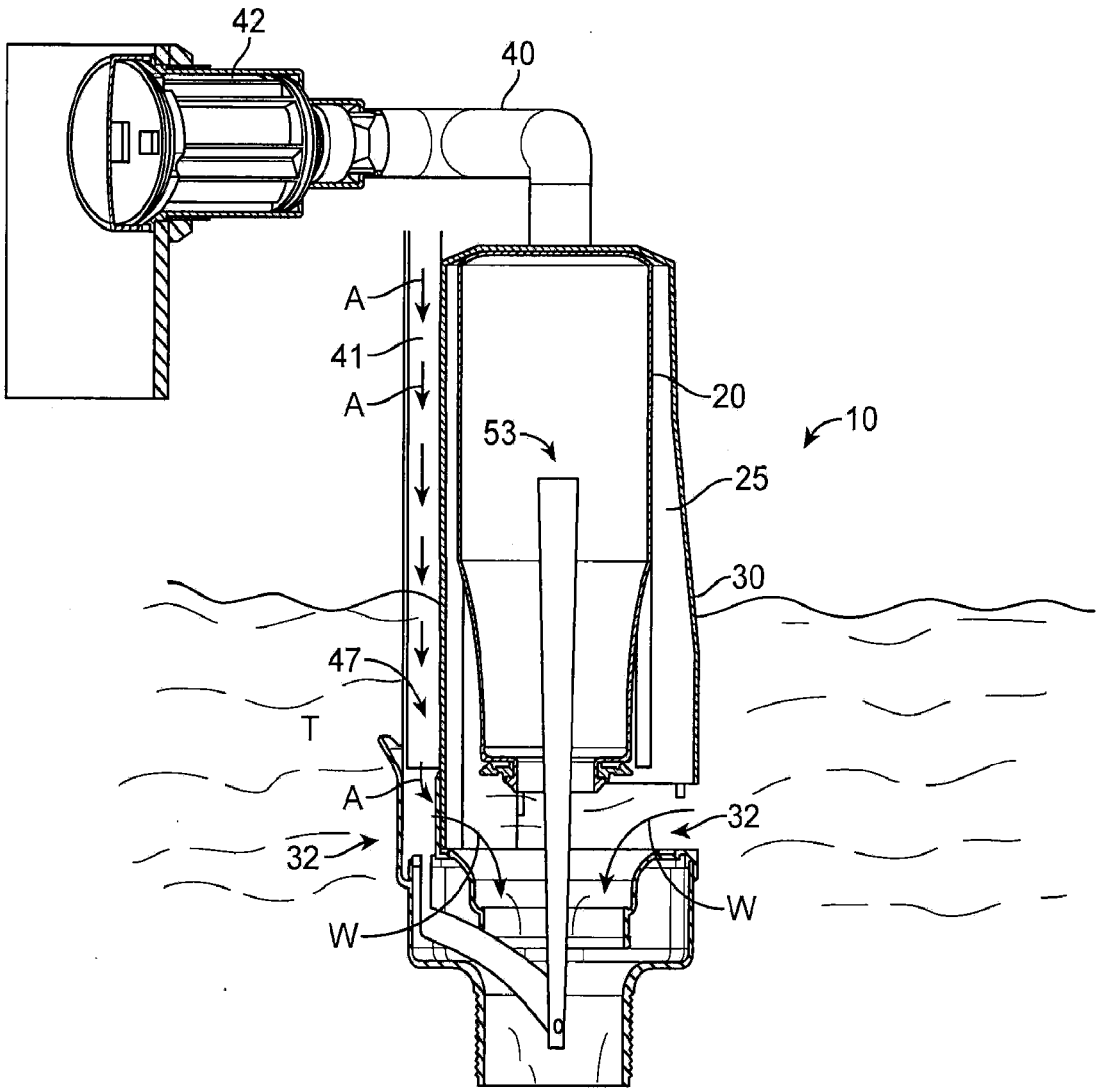

FIG. 6

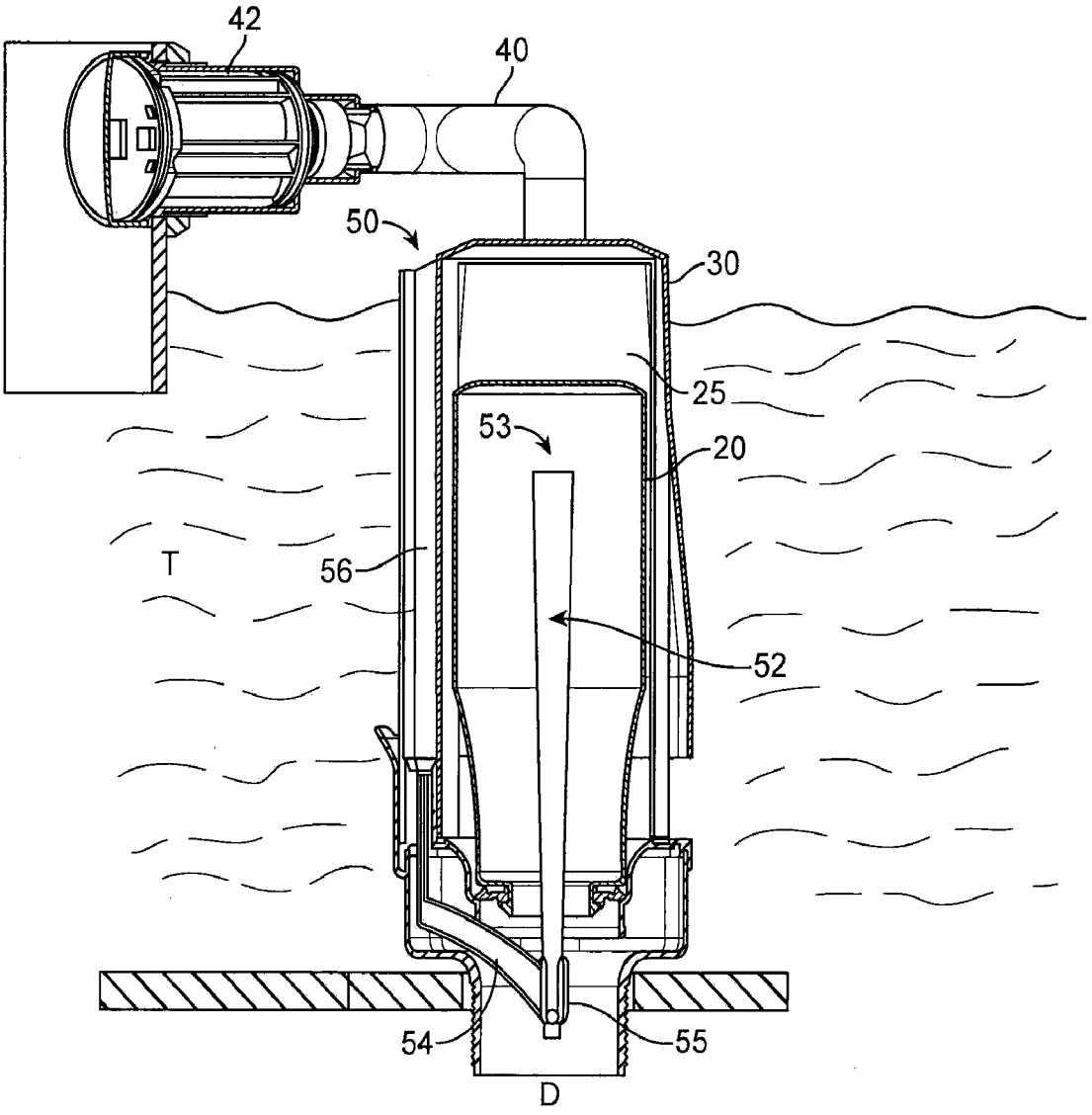

FIG. 7

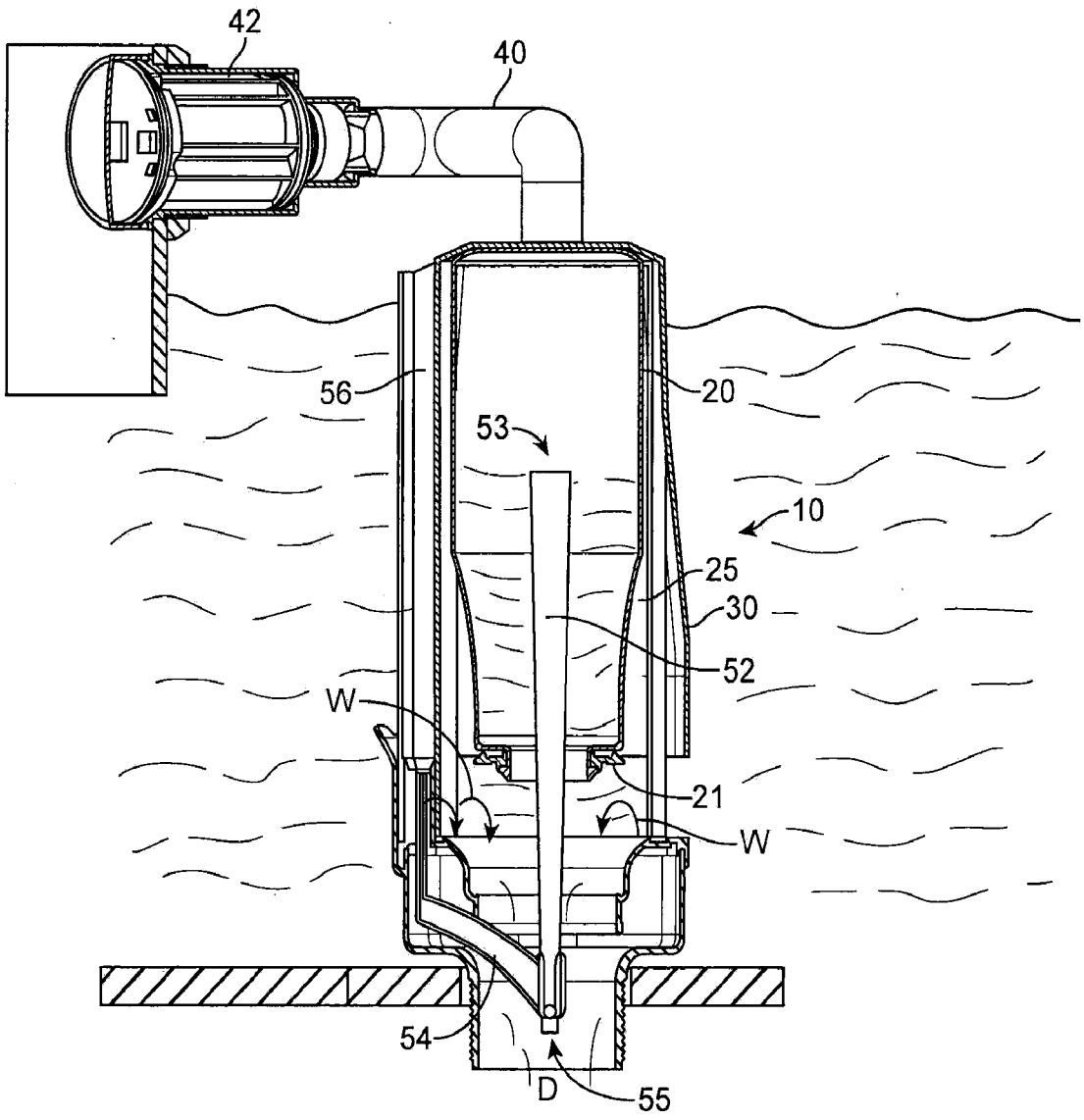

FIG. 8

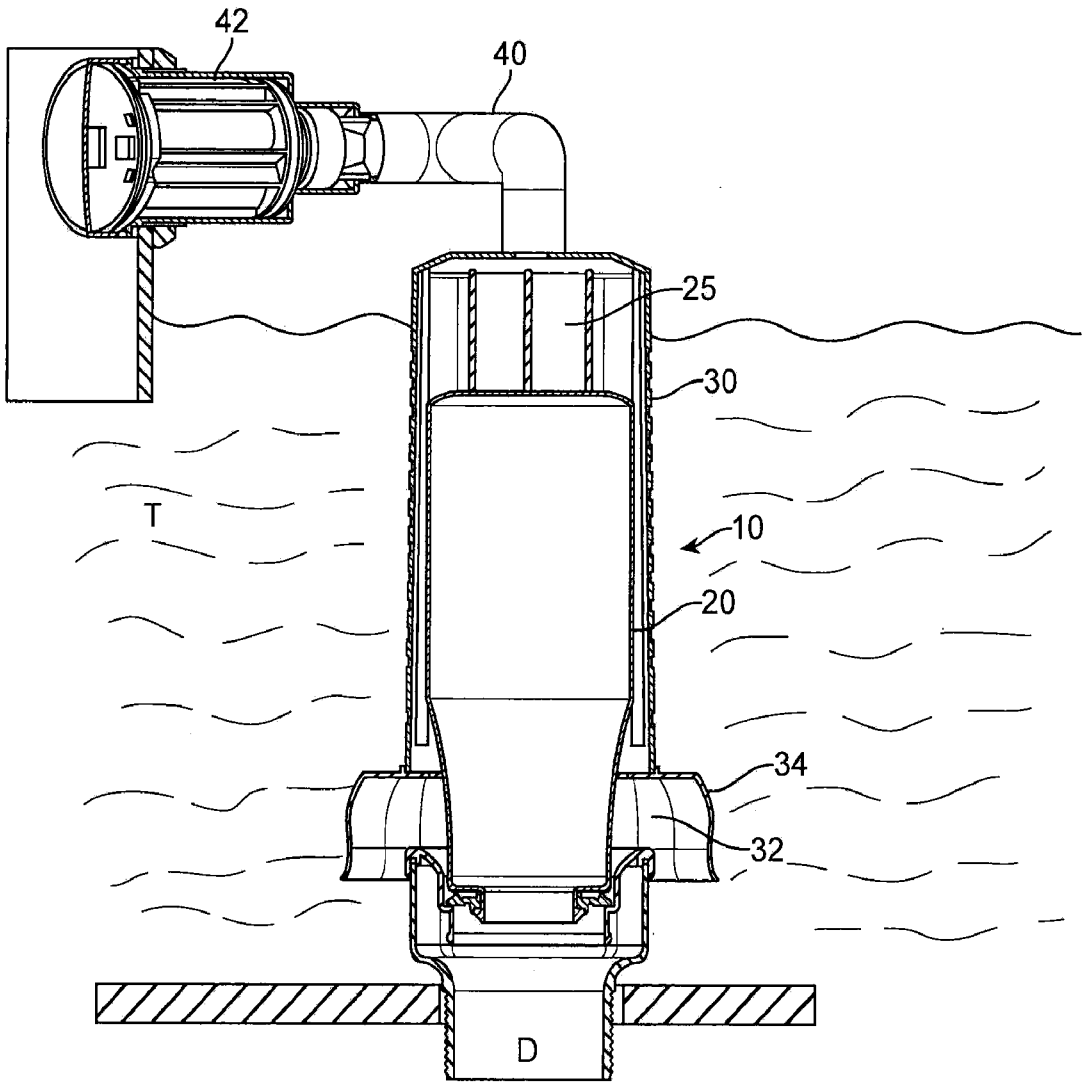

FIG. 9A

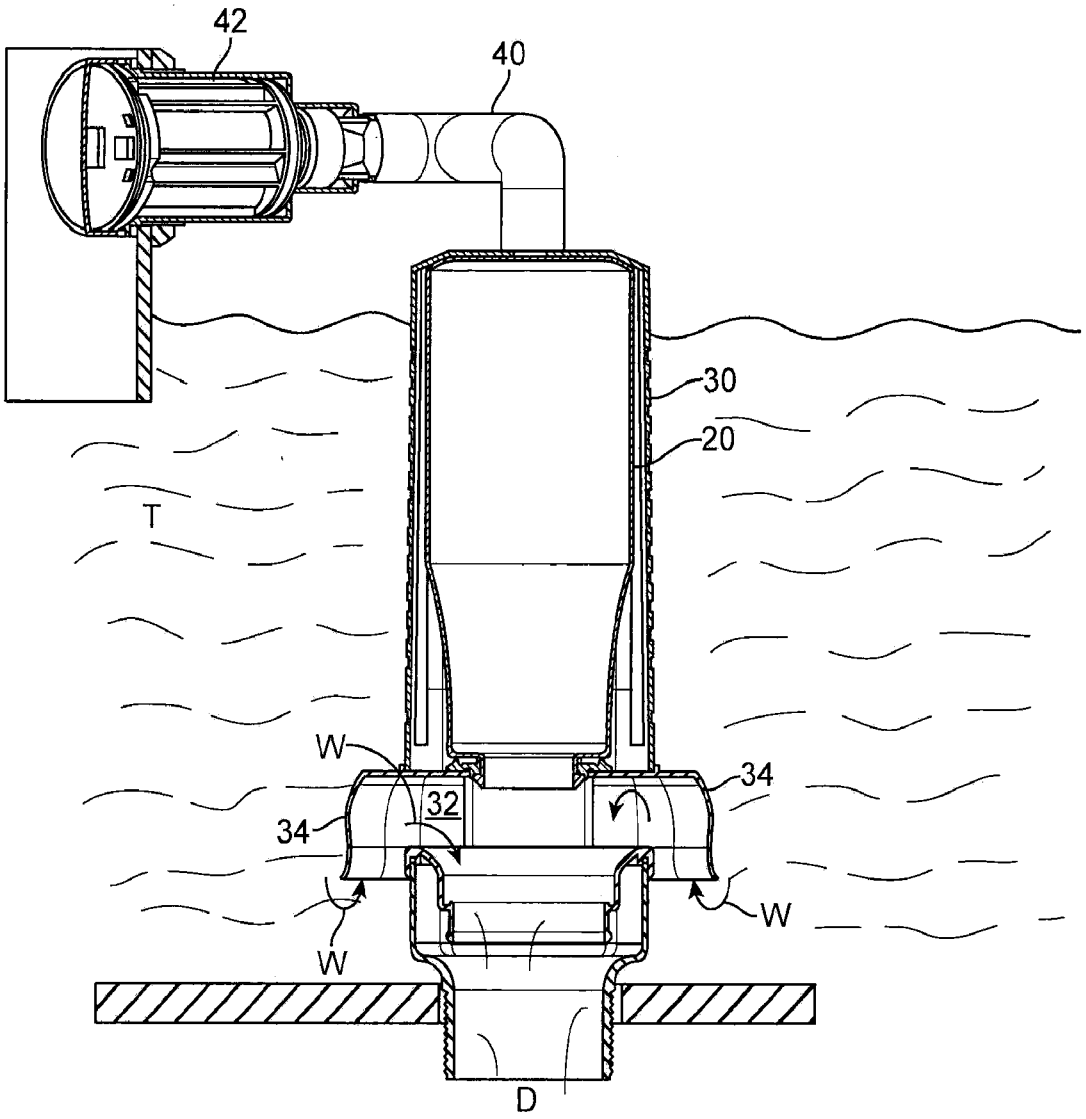

FIG. 9B

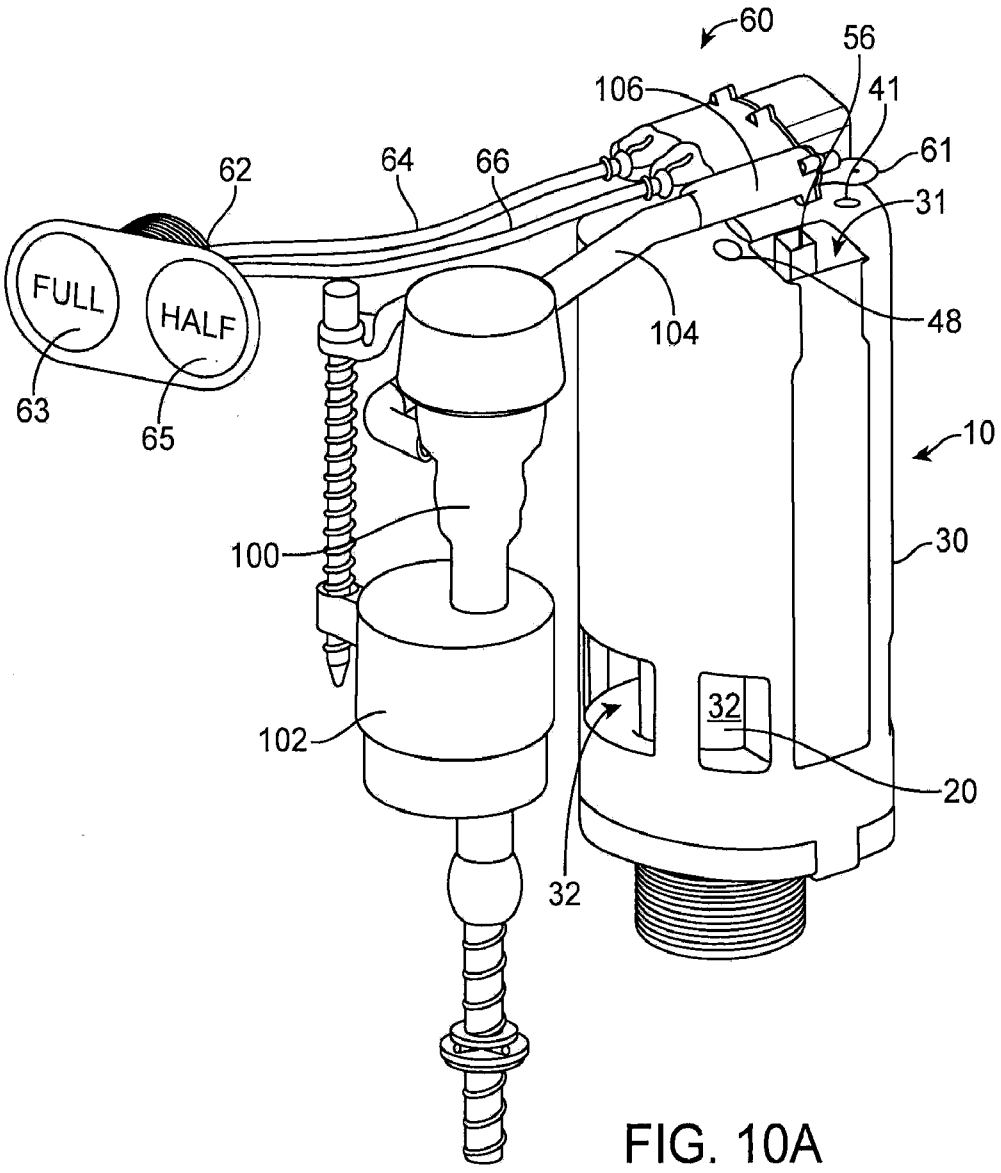
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FIG. 10A

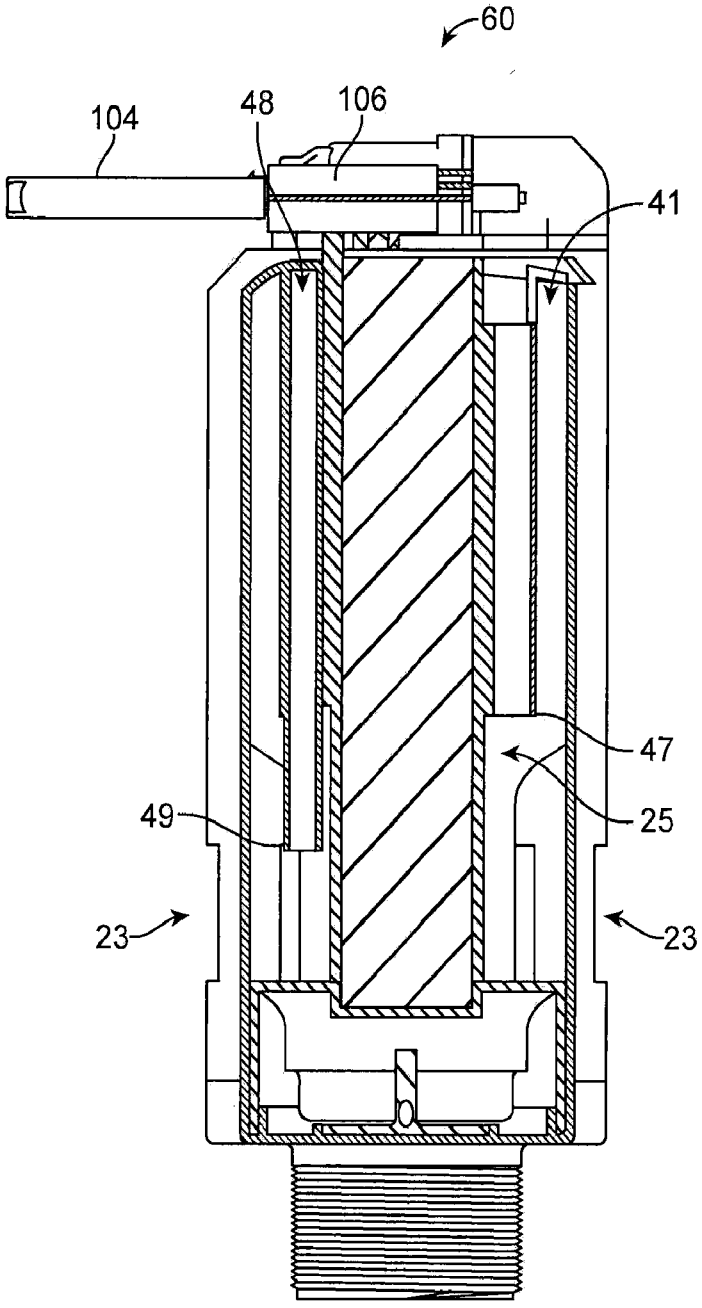

FIG. 10B

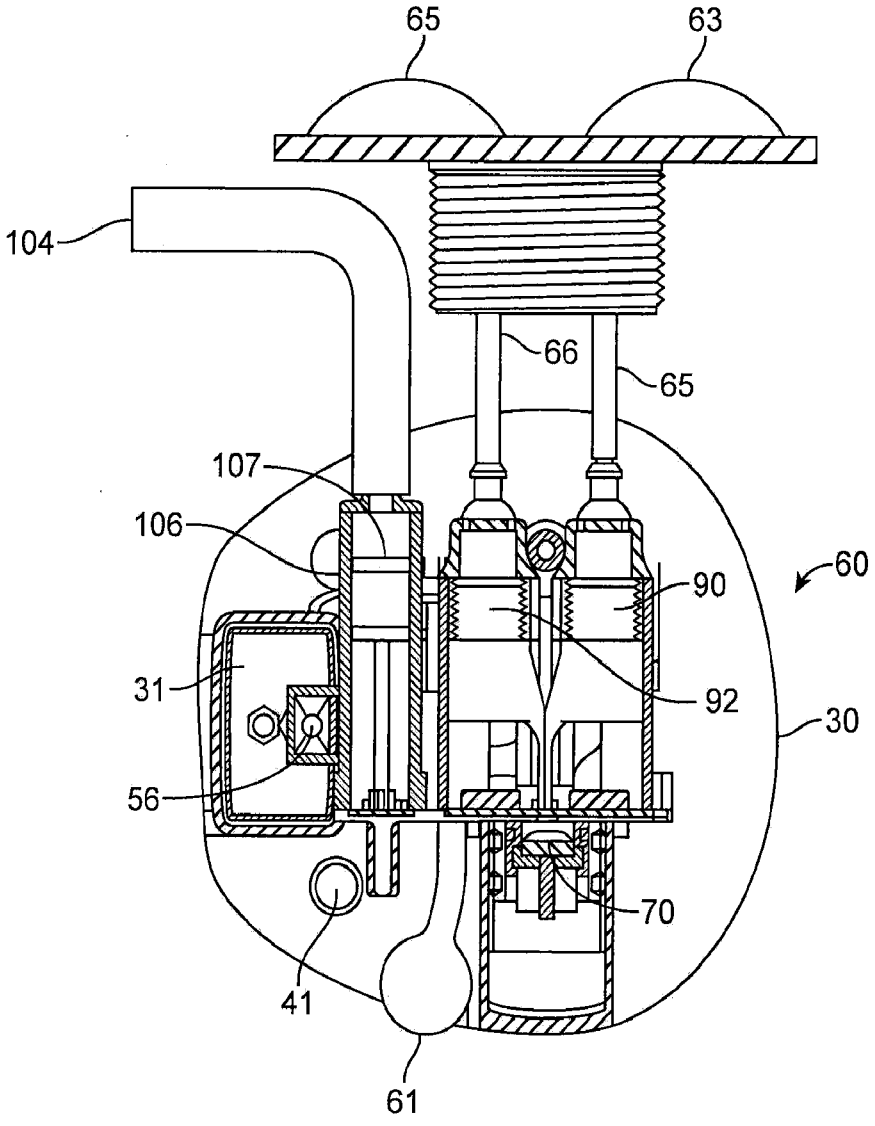

FIG. 11

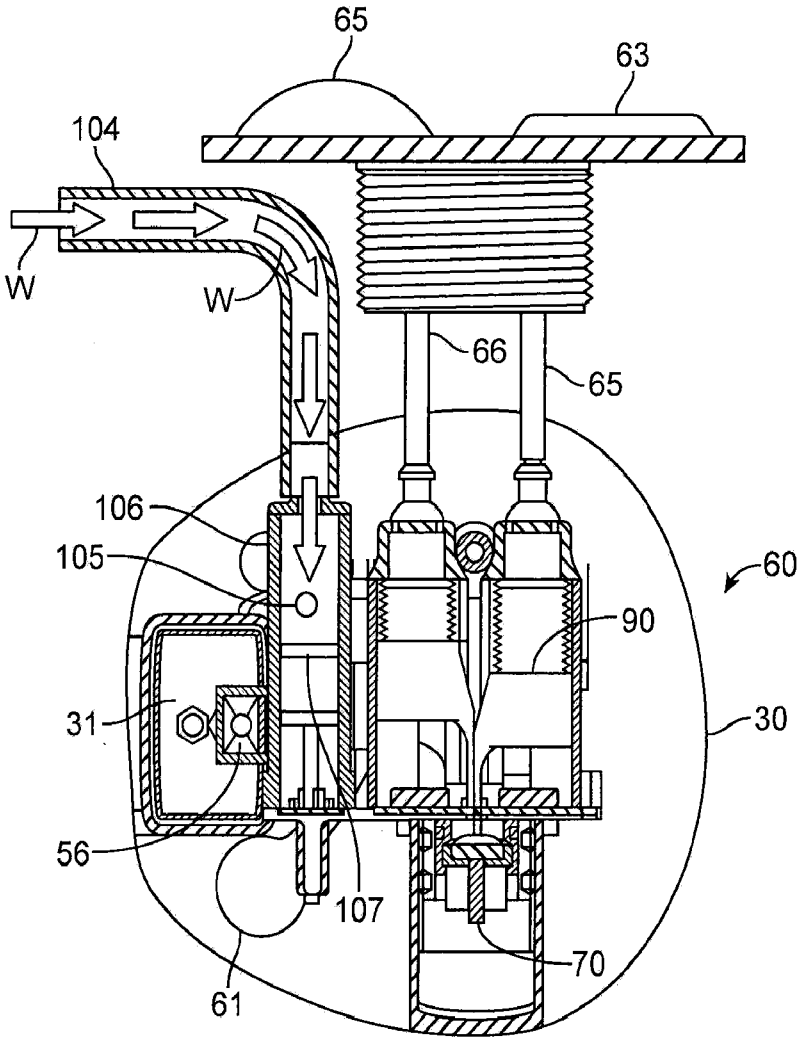

FIG. 12

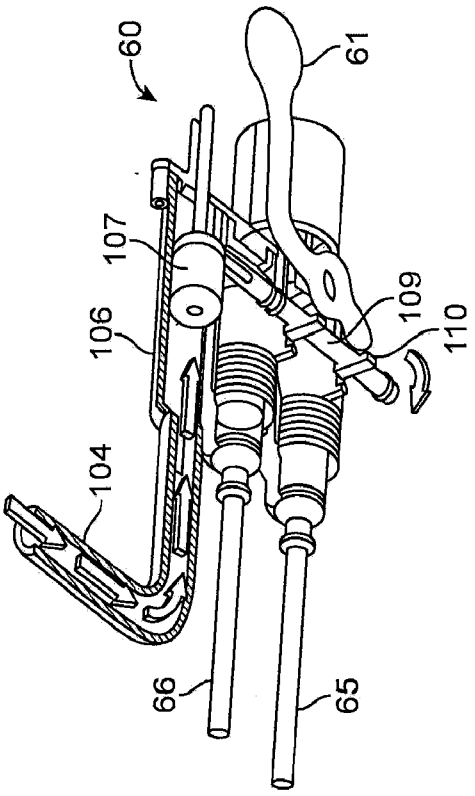

FIG. 14A

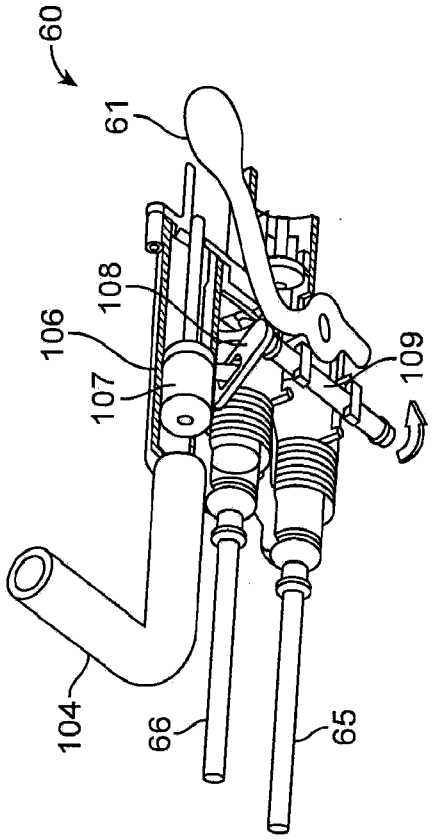

FIG. 14B

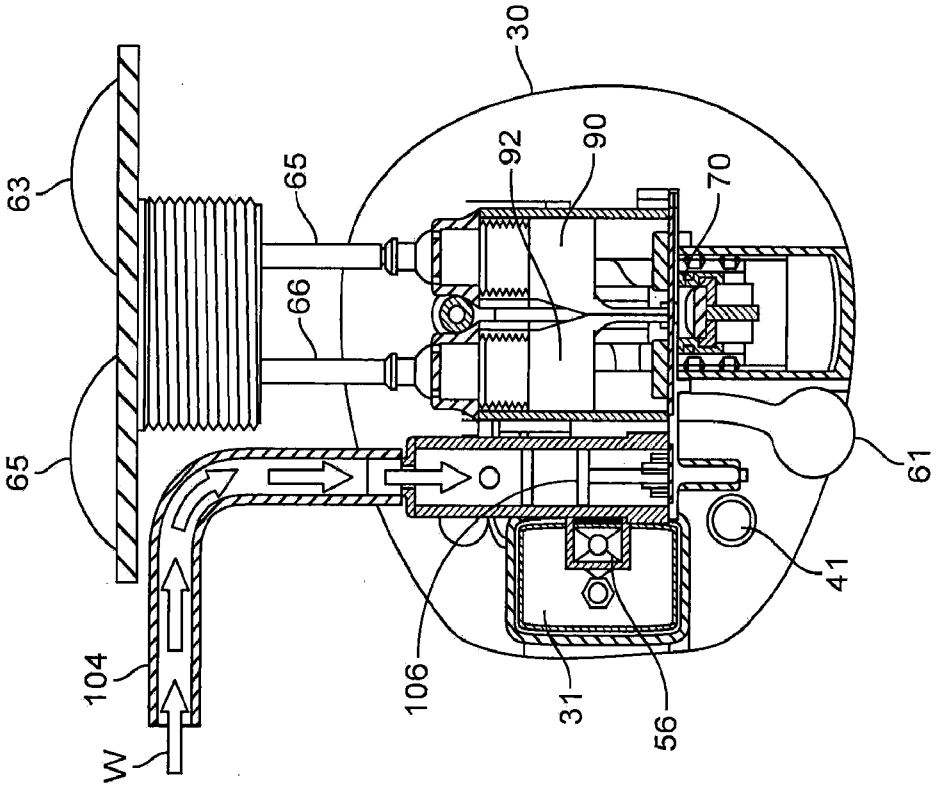

FIG. 13

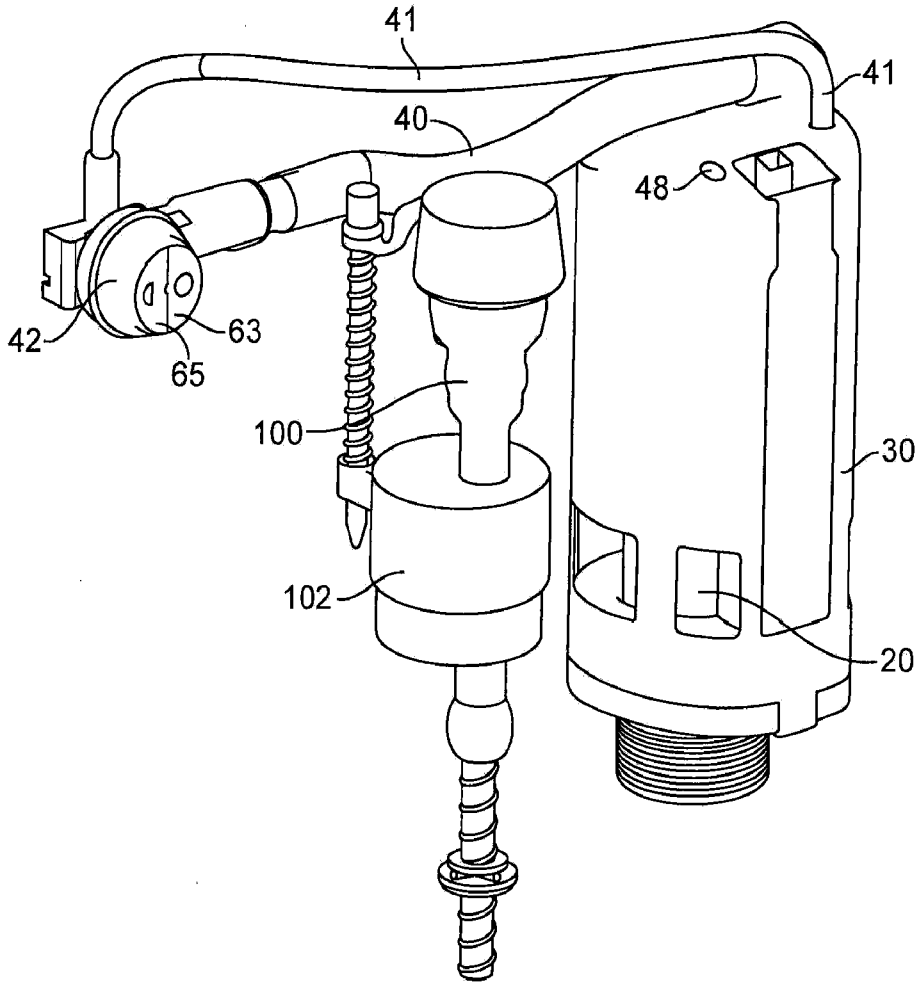

FIG. 15A

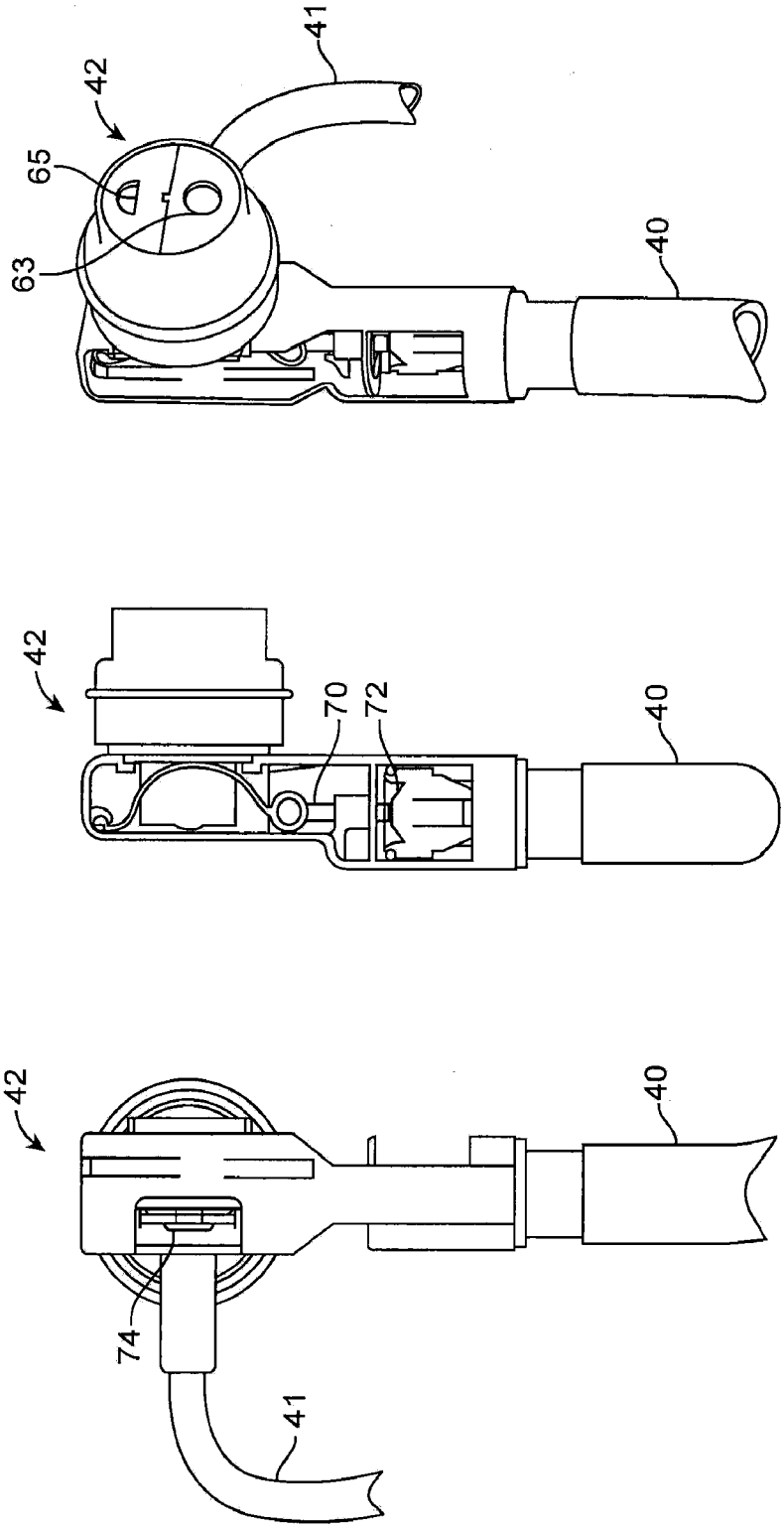

FIG. 15B

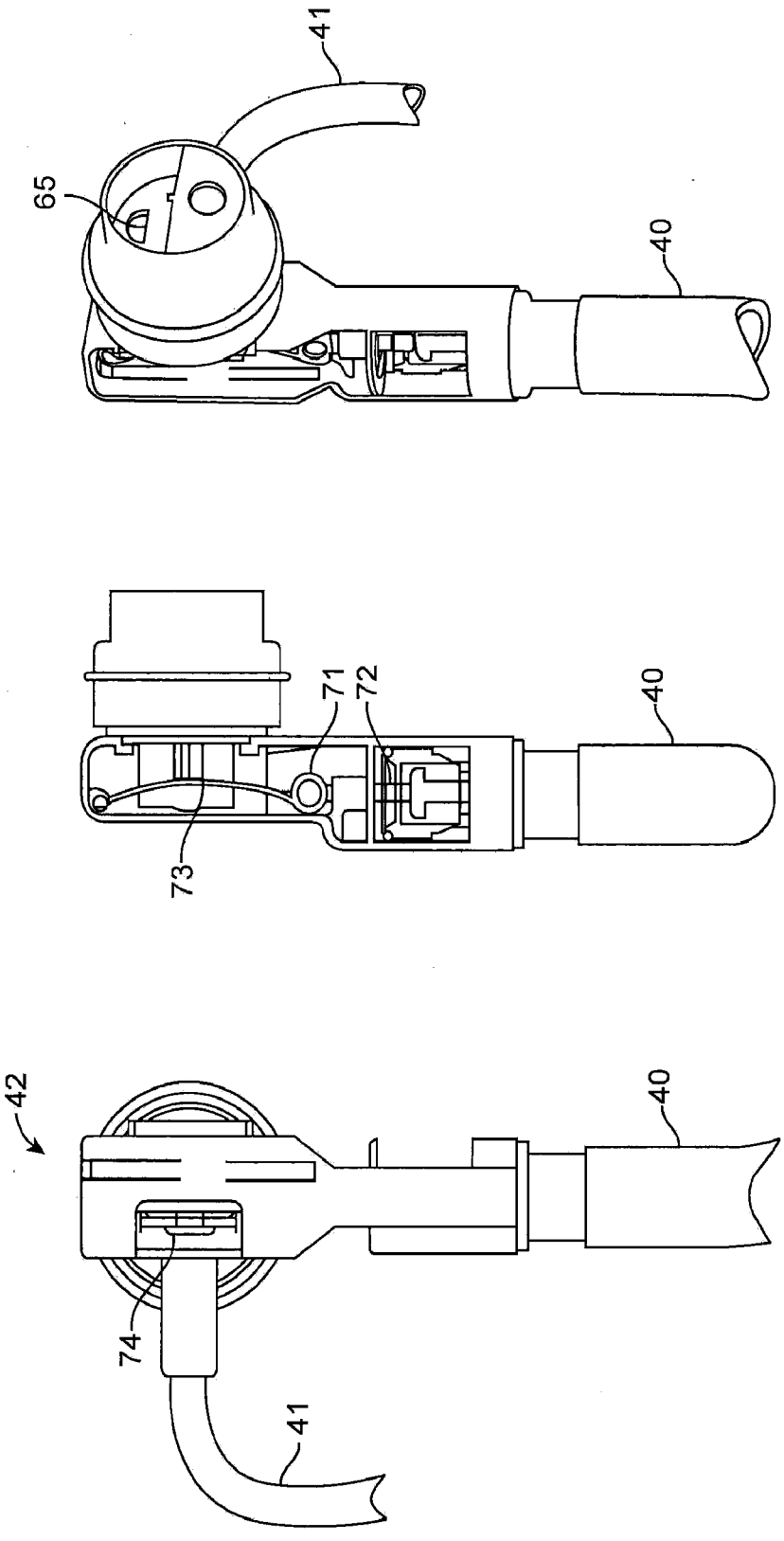

FIG. 15C

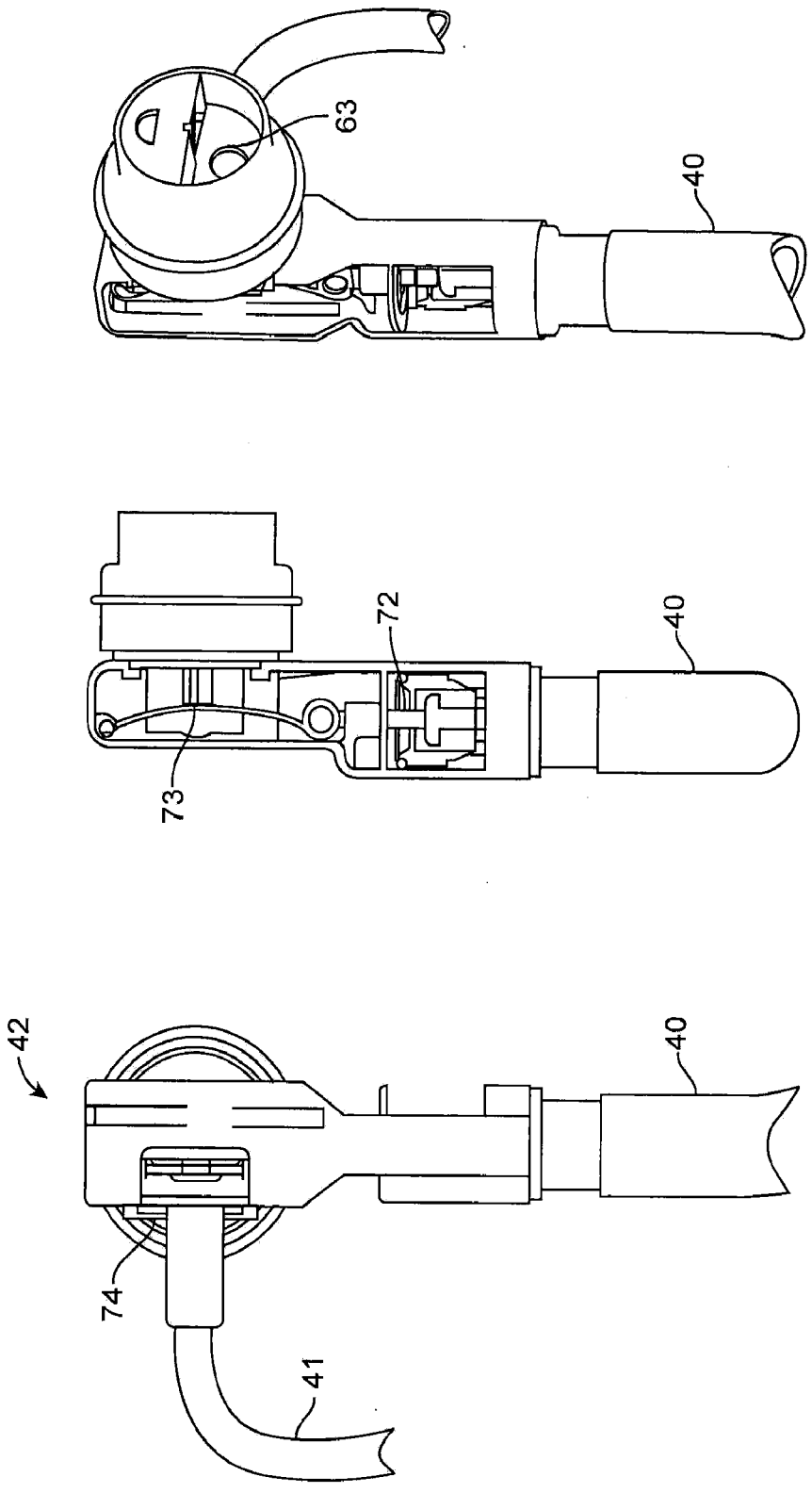

FIG. 15D

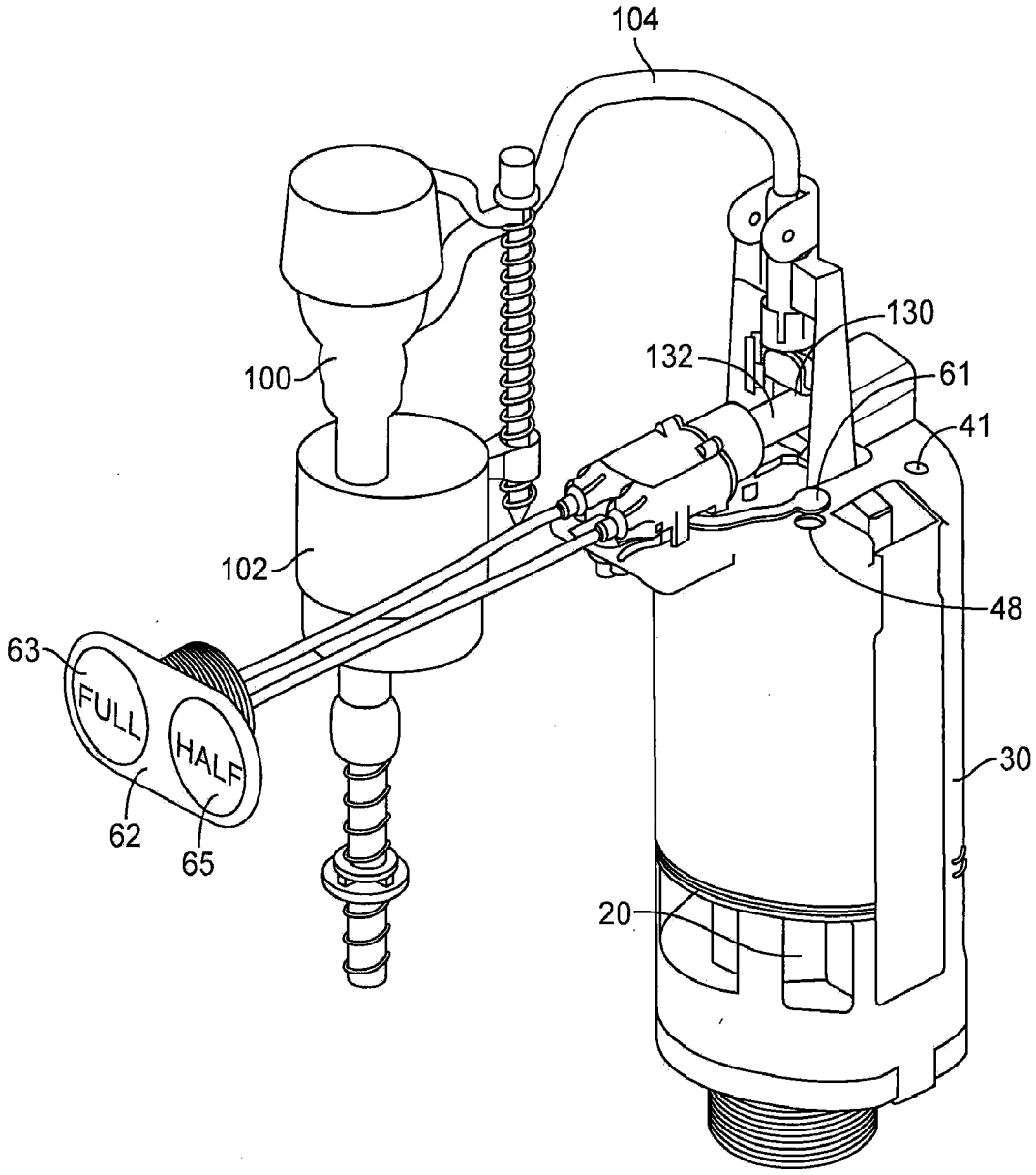

FIG. 16A

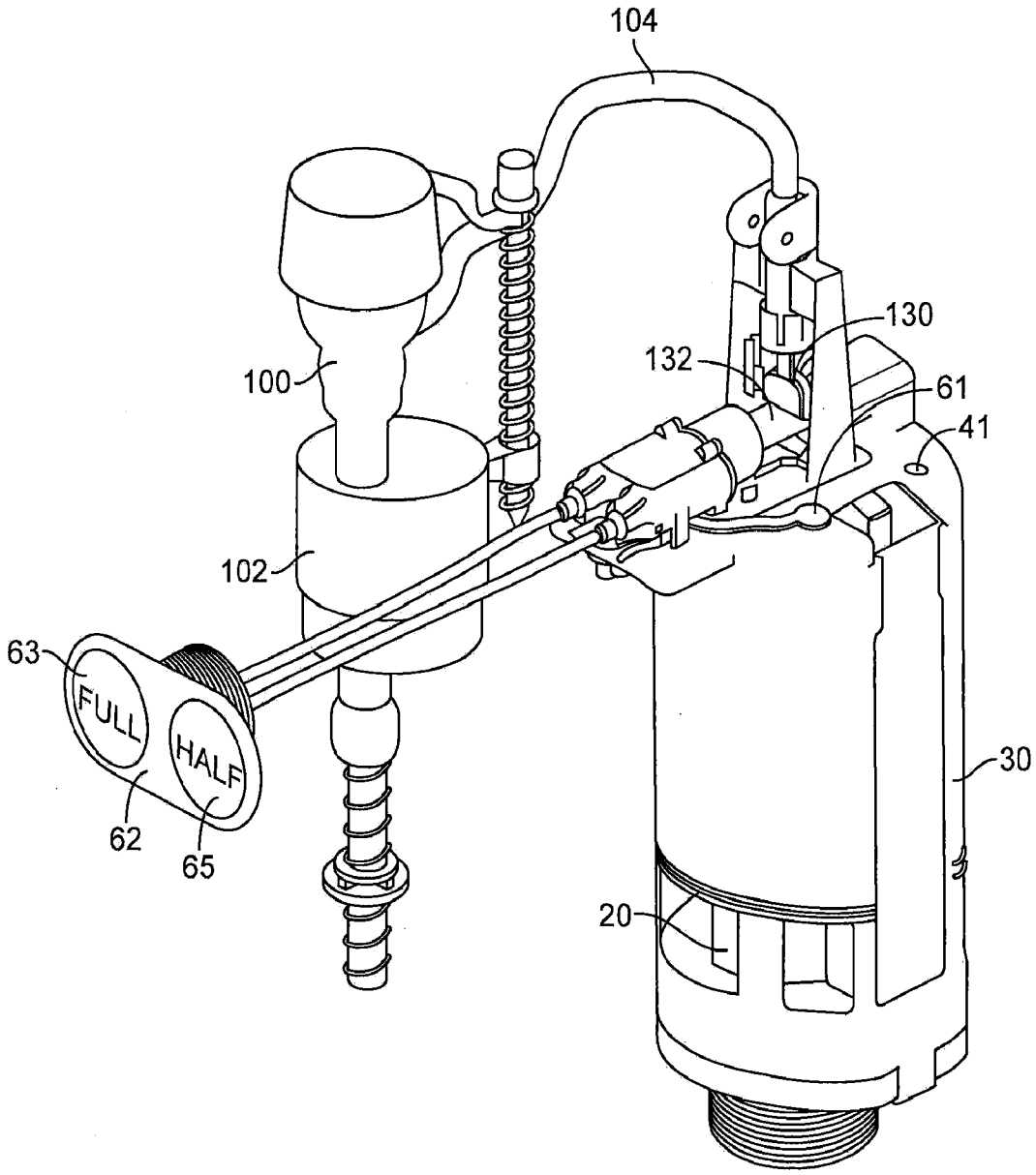

FIG. 16B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/050903

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - E03D 5/02 (2013.01)
USPC - 4/407
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)
IPC(8) - E03D 1/35, 5/02 (2013.01)
USPC - 4/249, 378, 380, 391, 394, 407

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
CPC - E03D 5/024 (2013.01)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Delphion, Orbit, Google

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3,662,408 A (KNUDTSON) 16 May 1972 (16.05.1972) entire document	1-5, 16-24
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Y		6
Y	US 4,149,283 A (KNUDTSON) 17 April 1979 (17.04.1979) entire document	6
A	US 3,987,501 A (ANDERSON) 26 October 1976 (26.10.1976) entire document	1-27

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
02 December 2013	12 DEC 2013
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

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(71)申请人 芙洛玛斯特公司
地址 美国加利福尼亚州
(72)发明人 图安·勒 史蒂夫·库克
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(74)专利代理机构 北京律盟知识产权代理有限责任公司 11287
代理人 林彦
(51)Int.Cl.
E03D 5/02(2006.01)

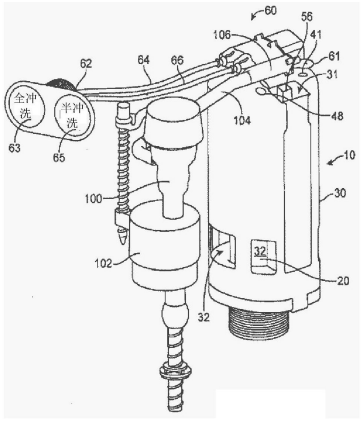
权利要求书3页 说明书7页 附图21页

(54)发明名称

其中具有可移动有浮力浮标的马桶放泄阀组合件

(57)摘要

一种其中具有可移动有浮力浮标的马桶冲洗阀，其中所述浮标具有用于在其中捕获空气的敞开底端，且其中外壳包含用于选择性地释放空气以允许所述浮标在其中向上移动以便准许冲洗的控制件。通过安排所述外壳上的一个或两个通气孔敞开的时间，可控制所述冲洗的持续时间及体积，其中由水提供的浮力使所述浮标上浮以敞开所述冲洗阀。这提供一种具有最小激活能的冲洗系统。



CN 104619928 A

1. 一种冲洗阀，其包括：

(a) 外壳，其经定尺寸以定位在马桶水箱中的排水口上方；

(b) 浮标组合件，其在所述外壳内可垂直地移动，所述浮标组合件经配置以在所述浮标组合件处于降低位置时密封所述排水口，且在所述浮标组合件处于升高位置时敞开所述排水口，其中所述浮标组合件包括具有用于在其中捕捉空气的敞开底端的浮标，且其中空气室形成在所述外壳的内部与所述浮标组合件的外部之间；

(c) 空气通道，其将所述外壳中的所述空气室连接到外部环境空气；及

(d) 致动器，其用于选择性地敞开及闭合所述空气通道。

2. 根据权利要求 1 所述的冲洗阀，其中所述浮标组合件包括具有敞开底端的空心浮标。

3. 根据权利要求 1 所述的冲洗阀，其中用于选择性地敞开及闭合所述空气通道的所述致动器包括定位在所述马桶水箱的外部上的冲洗按钮。

4. 根据权利要求 1 所述的冲洗阀，其中用于选择性地敞开及闭合所述空气通道的所述致动器包括触发传感器。

5. 根据权利要求 1 所述的冲洗阀，其中将所述外壳中的所述空气室连接到外部环境空气的所述空气通道包括从所述外壳中的所述空气室延伸到所述马桶水箱上的外部环境空气出口的管。

6. 根据权利要求 1 所述的冲洗阀，其中将所述外壳中的所述空气室连接到外部环境空气的所述空气通道包括通过所述外壳到所述马桶水箱内的外部环境空气的通道。

7. 根据权利要求 1 所述的冲洗阀，其进一步包括：

(e) 空气通道，其将所述浮标的内部连接到外部环境空气。

8. 根据权利要求 7 所述的冲洗阀，其中将所述浮标的所述内部连接到外部环境空气的所述空气通道包括：

(i) 通气管，其具有安置在所述浮标内的敞开顶端；

(ii) 通气基部，其连接到所述通气管的底部；及

(iii) 到所述外部环境空气的通气室，所述通气室连接到所述通气基部，

其中空气在所述通气管、所述通气基部与所述通气室之间自由地流动，使得在环境压力下所述浮标的所述内部中的所述空气保持恒定。

9. 根据权利要求 8 所述的冲洗阀，其中所述通气室穿过溢流管，所述溢流管穿过所述外壳。

10. 根据权利要求 8 所述的冲洗阀，其中所述通气基部具有准许排出进入所述通气管的水使其通过所述通气基部到所述马桶水箱中的所述排水口中的底部开口。

11. 根据权利要求 1 所述的冲洗阀，其进一步包括：

(e) 第二空气通道，其将所述外壳中的所述空气室连接到外部环境空气，其中所述第二空气通道在所述第一空气通道进入所述空气室之处下方的位置处进入所述空气室。

12. 根据权利要求 10 所述的冲洗阀，其进一步包括：

(f) 致动器，其用于选择性地敞开及闭合所述第二空气通道。

13. 根据权利要求 12 所述的冲洗阀，其中用于选择性地敞开及闭合所述第二空气通道的所述致动器包括气动或缆索激活的控制模块。

14. 根据权利要求 13 所述的冲洗阀，其中所述控制模块具有在水从注水阀供应到所述冲洗阀中时防止用户敞开所述第一空气通道的锁定机构。

15. 根据权利要求 13 所述的冲洗阀，其中所述控制模块具有在水从注水阀供应到所述冲洗阀中时防止用户敞开所述第二空气通道的锁定机构。

16. 根据权利要求 1 所述的冲洗阀，其中所述外壳包括 ：

至少一个流动开口，其在所述浮标组合件处于所述升高位置时准许水箱中的水穿过所述至少一个流动开口并到所述外壳下方的所述排水口中。

17. 根据权利要求 16 所述的冲洗阀，其进一步包括 ：

虹吸裙部，其安置在所述至少一个流动开口周围。

18. 根据权利要求 1 所述的冲洗阀，其中所述浮标组合件包括所述浮标与所述排水口之间的密封构件。

19. 一种控制通过冲洗阀的流动的方法，其包括 ：

(a) 提供冲洗阀组合件，其包括 ：

(i) 外壳，其经定尺寸以定位在马桶水箱中的排水口上方 ；

(ii) 浮标组合件，其在所述外壳内可垂直地移动，所述浮标组合件经配置以在所述浮标组合件处于降低位置时密封所述排水口，且在所述浮标组合件处于升高位置时敞开所述排水口，其中所述浮标组合件包括具有用于在其中捕捉空气的敞开底端的浮标，且其中空气室形成在所述外壳的内部与所述浮标组合件的外部之间 ；

(iii) 空气通道，其将所述外壳中的所述空气室连接到外部环境空气 ；及

(iv) 致动器，其用于选择性地敞开及闭合所述空气通道 ；

(b) 敞开所述空气通道，从而准许空气从所述外壳逸出，因此准许所述浮标升高，从而引起冲洗，其中水通过所述浮标下方并到所述排水口中。

20. 根据权利要求 19 所述的方法，其进一步包括 ：

(c) 随后闭合所述空气通道，从而防止空气进入所述外壳，因此防止所述浮标降落，从而延长所述冲洗。

21. 根据权利要求 20 所述的方法，其进一步包括 ：

(d) 控制步骤 (b) 与 (c) 之间的时间间隔，从而选择冲洗体积。

22. 根据权利要求 21 所述的方法，其中较长时间间隔对应于全冲洗，且较短时间间隔对应于部分冲洗。

23. 根据权利要求 20 所述的方法，其进一步包括 ：

(d) 随后敞开所述空气通道，从而准许空气进入所述外壳，因此准许所述浮标降落，从而结束所述冲洗。

24. 根据权利要求 20 所述的方法，其进一步包括 ：

(d) 在使所述空气通道保持闭合时，准许空气进入所述外壳，因此准许所述浮标降落，从而结束所述冲洗。

25. 根据权利要求 19 所述的方法，其进一步包括 ：

(c) 提供将所述浮标的内部连接到所述外部环境空气的空气通道，从而使所述浮标的所述内部中的空气压力保持处于环境条件。

26. 根据权利要求 19 所述的方法，其进一步包括提供将所述外壳中的所述空气室连接

到所述外部环境空气的第二空气通道，其中所述第二空气通道在所述第一空气通道下方的位置处进入所述空气室，及

(c) 敞开所述第二空气通道，从而致使所述浮标降落。

27. 根据权利要求 26 所述的方法，其中敞开所述第二空气通道对应于提供部分冲洗，而使所述第二空气通道保持闭合对应于提供全冲洗。

其中具有可移动有浮力浮标的马桶放泄阀组合件

[0001] 相关申请案

[0002] 本发明主张下列申请案的优先权：2013 年 3 月 8 日申请的名为使用其中具有可移动浮标的空气外壳的放泄阀 (DISCHARGE VALVE USING AIR HOUSING WITH MOVEABLE FLOAT THEREIN) 的美国临时专利申请案第 61/775,398 号；及 2013 年 2 月 5 日申请的名为利用流体流的势能及动能的放泄阀 (DISCHARGE VALVE UTILIZING POTENTIAL AND KINETIC ENERGY OF FLUID FLOW) 的美国临时专利申请案第 61/760,851 号；以及 2012 年 7 月 25 日申请的名为利用流体流的势能及动能的放泄阀 (DISCHARGE VALVE UTILIZING POTENTIAL AND KINETIC ENERGY OF FLUID FLOW) 的美国临时专利申请案第 61/675,642 号；上列申请案的全部揭示内容的全文是以引用方式并入本文中。

技术领域

[0003] 本发明涉及马桶放泄阀组合件，包含部分冲洗设计及全冲洗设计两者。

背景技术

[0004] 当前存在众多放泄（即：冲洗）阀系统。所有这些系统使用机械地致使冲洗阀敞开及闭合的各种致动器。这些设计中的一些选择性地准许部分冲洗或全冲洗。尽管许多这些设计为大体上可接受的，但其常常需要大量能量来操作其致动器。

[0005] 代替地期望一种仅需要最小能量来操作的放泄冲洗阀系统。本发明提供此类系统。这是因为本发明的系统使用马桶水箱中的水自身的浮力来控制放泄阀冲洗的操作。

发明内容

[0006] 本发明提供一种放泄阀组合件，其结合空气释放机构而使用水自身的浮力来开启及关闭冲洗。

[0007] 在一个优选方面中，本发明提供一种冲洗阀，其包括：(a) 外壳，其经定尺寸以定位在马桶水箱中的排水口上方；(b) 浮标组合件，其在外壳内可垂直地移动，浮标组合件经配置以在浮标组合件处于降低位置时密封排水口，且在浮标组合件处于升高位置时敞开排水口，其中浮标组合件包括具有用于在其中捕获空气的敞开底端的空心浮标，且其中空气室形成在外壳的内部与浮标组合件的外部之间；(c) 空气通道，其将外壳中的空气室连接到外部环境空气；及 (d) 致动器，其用于选择性地敞开及闭合空气通道。

[0008] 浮标与倒置杯相似。在操作中，空气被捕获在浮标内部，其中空气在冲洗结束时进入浮标的底部下方。这致使浮标变得有浮力（在稍后被水包围时）。然而，在浮标上方被捕获在外壳中的室中的空气使浮标保持处于其“预冲洗”降低位置，从而密封排水口。在这个“预冲洗”时间，浮标被水包围。通过释放在外壳中被捕获在浮标上方的空气，有浮力浮标接着上浮，同时水箱中的水流动到浮标下方并到排水口中，从而冲洗马桶。在外壳外的空气通道可选择性地敞开及闭合。敞开空气通道会使空气从外壳逸出，因此致使有浮力浮标升高。随着水箱中的水穿过浮标下方并沿着排水口向下，水位降低且浮标的浮力变小。因此，浮标

将自然地回落以密封排水口。然而，在替代方面中，在浮标已上浮之后防止空气在浮标上方再进入外壳中的空间。这将使浮标保持处于升高位置，从而延长冲洗的持续时间。

[0009] 本发明的系统的优点在于其使用极其小的能量来操作。仅通过在适当时间敞开及闭合通气孔，就可激活马桶便池的冲洗，且可容易控制冲洗的持续时间。此外，无需将空气抽送到阀组合件中。更确切地，在冲洗期间空气仅在水离开水箱时进入阀组合件。因此，系统总是准备好再用于接连的冲洗。

[0010] 在本发明的各个优选实施例中，还提供一种用于使空气在一个以上高度处进入外壳使得可控制室内浮标的浮力（及移动）的系统。具体来说，在准许空气在较高位置处进入外壳时，浮标将提前降落，因此提供半冲洗。阻挡这个空气路径将致使空气稍后进入外壳，因此提供全冲洗。

[0011] 此外，在本发明的各个优选实施例中，在浮标的内部与外壳外部的环境空气之间提供通气路径。这个通气路径系统具有随着水箱中在浮标周围的水的高度改变而使浮标浮力保持恒定的优点。

附图说明

[0012] 图 1 到 5 展示本发明的简化实施例的截面图，使得可理解本发明在冲洗期间的操作。

[0013] 图 6、7 及 8 展示本发明的替代实施例的截面图，其具有允许空气从浮标的内部自由地传到外部环境空气的通气系统。

[0014] 图 9A 及 9B 展示本发明的实施例，其具有虹吸裙部。

[0015] 图 10A 为本发明的透视图。

[0016] 图 10B 为外壳 30 的内部的截面侧视图，其展示全通气系统及半通气系统的操作。

[0017] 图 11 为在静止状态下的本发明的控制系统的俯视示意图。

[0018] 图 12 为在全冲洗期间的本发明的控制系统的俯视示意图。

[0019] 图 13 为在再注水期间的本发明的控制系统的俯视示意图。

[0020] 图 14A 为在半冲洗期间的控制系统的仰视图。

[0021] 图 14B 为在全冲洗期间的控制系统的仰视图。

[0022] 图 15A 为本发明的替代实施例的透视图。

[0023] 图 15B 为在冲洗之前的 15A 的冲洗控制模块的近视图。

[0024] 图 15C 为在半冲洗期间的 15A 的冲洗控制模块的近视图。

[0025] 图 15D 为在全冲洗期间的 15A 的冲洗控制模块的近视图。

[0026] 图 16A 为在冲洗之前的本发明的替代实施例的透视图。

[0027] 图 16B 为在冲洗模式下的本发明的替代实施例的透视图。

具体实施方式

[0028] 图 1 到 5 展示本发明的简化实施例的操作，使得可清楚地理解本发明的有浮力浮标的优点，如下所述。

[0029] 首先，图 1 展示定位在马桶水箱 T 中的排水口 D 上方的浮标组合件 10。马桶便池（未展示）定位在排水口 D 下方。浮标组合件 10 包括在外壳 30 内可上下移动的有浮力浮

标 20。在冲洗之前，水包围浮标组合件 10。浮标 20 在处于其降低位置时优选地借助于密封构件 21 来密封排水口 D（从而使水保持在水箱 T 中），密封构件 21 环绕浮标的敞开底端，如所展示。

[0030] 浮标 20 为空心浮标且具有在其下方捕获空气的敞开底端。具体来说，空气被捕获在浮标 20 的敞开底端内。空气室 25 还存在于浮标 20 上方的外壳 30 内。已发现，在致动器开关 42 敞开时，空气通道 40 准许被捕获在空气室 25 中的空气移动到外部环境空气。开关 42 在马桶冲洗柄通常被定位的常见位置中安装到马桶水箱的外壁上（如所展示）。在各个实施例中，空气通道 40 可包括延伸到马桶水箱的外部的管，或其可仅包括在外壳 30 的外部上敞开使得环境空气为水箱内的空气的空气通道。

[0031] 图 2 说明冲洗的开始。此时，开关 42 敞开，从而准许空气 A 移出室 25（即，通过通道 40 移出而在开关 42 处或附近排出）。因为浮标 20 为有浮力浮标，所以其现在将随着空气从室 25 逸出而在周围水中向上移动。因此，水箱 T 中的水 W 接着将穿过浮标 20 下方，向下传到排水口 D 中，且接着向下传到下方的马桶便池中。因此，冲洗开始。在这个截面图中可看出，外壳 30 的底部部分具有流动开口 32，其在浮标组合件处于升高位置时准许水箱中的水穿过流动开口 32 并到外壳下方的排水口中。

[0032] 在各个优选实施例中，选择性地敞开及闭合空气通道 40 的开关 42 可包括定位在马桶水箱的外部上的冲洗按钮 43 或操纵杆。开关 42 还可视需要包括定位在马桶水箱的外部上的近程传感器 44。使用此类近程传感器的优点在于用户仅需要将其手放在马桶水箱上的开关 43 附近以致使冲洗马桶。

[0033] 在各个任选实施例中，空气通道 40 可借助于从外壳延伸到马桶水箱上的外部出口的管而将外壳 30 中的空气室 25 连接到外部环境空气，如所展示。替代地，空气通道可仅为通往外壳 30 的外部表面从而接近马桶水箱自身内的外部环境空气的通道。在这个第二实施例中，冲洗致动控制开关或操纵杆 42 仍将定位在水箱 T 的外部上以使用户冲洗马桶。

[0034] 如果空气通道 40 仅在冲洗开始之后保持敞开，那么随着水箱 T 中的水排空，浮标 20 将仅回降到闭合排水口 D 的位置中。这为一种正常预期操作方法。这种方法具有易于操作的益处，这是因为系统仅需要冲洗马桶以使开关 42 敞开空气通道 40 并使其保持敞开。在水从水箱完全地排出之后，浮标 20 将连同这个降低水位一起降落，使得浮标 20 将开口再密封到排水口。此时，空气通道 40 可再次闭合，从而将空气密封在室 25 内，从而导致返回到图 1 所展示的预冲洗位置。

[0035] 然而，图 3 及 4 展示另一正常预期操作方法。具体来说，在空气已从空气室 25 逸出之后，开关 42 闭合，从而防止空气从外部周围环境自由地移动到空气室 25 中。因此，在空气室 25 中将形成部分真空，从而随着周围水位在外壳 30 周围降低而使浮标 20 保持处于升高（或部分升高）位置。通过随着水位在浮标周围降落而使浮标 20 保持向上，可延长冲洗的持续时间。最后，如图 5 所展示，水箱中的水位将降低到使得空气 A 将通过进入空气室 25 的底端而侵入空气室 25 中的（部分）真空的低水位。此时，浮标 20 接着将快速地下沉，从而停止冲洗。

[0036] 换句话来说，还可通过再次敞开开关 42 以使空气进入空气室并破坏真空来获得延长的冲洗，浮标 20 将降低并停止冲洗。通过变更开关 42 的第一次敞开与开关 42 的第二次敞开之间的持续时间，可调整冲洗体积。这个时间间隔越长，所放泄的体积将越多。这个

时间间隔越短，所放泄的体积将越少。这种方法可用于控制全冲洗及部分冲洗。

[0037] 可了解到，通过控制空气通道 40 敞开的时间，可控制冲洗自身的持续时间。因此，通过在最初敞开空气通道 40 之后（如图 2 所展示）使其保持闭合（如图 3 及 4 所展示）达所期望时段，可控制冲洗体积。例如，通过使浮标 20 保持处于其向上位置直到空气进入空气室 25 的底部为止（如在图 5 中所见），可达成全冲洗。然而，通过在这个时间点之前仅准许空气进入室 25（或甚至通过允许空气连续地进入外壳，如在图 3 中所见），可代替地达成部分冲洗。因此，通过控制开关 42 的两次敞开之间的时间间隔，控制在其期间空气无法自由地流动通过空气通道 40 的持续时间。这控制冲洗的持续时间，其又控制冲洗体积。较长时间间隔可对应于全冲洗，且较短时间间隔可对应于部分冲洗。

[0038] 图 6 展示本发明的替代实施例，其具有也将外壳 30 中的空气室 25 连接到外部环境空气的第二空气通道 41。可看出，第二空气通道 41 在第一空气通道 40 进入空气室 25 之处下方的管端位置 47 处进入空气室 25。如将在本发明的若干实施例中所展示，开关或其它致动器可用于选择性地控制第二空气通道 41 的敞开及闭合。如还将展示，通向空气室 25 的多个空气路径（在不同高度处）也可用于控制浮标移动。

[0039] 在操作中，这个实施例将与如在图 5 中所见的进入空气室 25 颇为相似。然而，在图 6 中，在水位高于图 5 中的水位时，空气将代替地进入室 25。具体来说，在周围水位降低到低于位置 47 时，空气将通过第二空气通道 41 进入空气室 25。这将破坏空气室 25 中的真空，从而致使浮标 20 立即降低。因此，图 6 中的浮标 20 将降低得快于图 5 中的浮标 20（假设在两种情况中空气通道 40 保持闭合）。可了解到，空气 A 在图 6 中的较高水位线处（即：在 47 处）进入室 25，所述水位线高于图 5 所展示的较低水位线（即：通过下部流动开口 32）。因此，空气通道 41 可选择性地敞开以导致较短冲洗（即：“部分”冲洗），而其可代替地保持闭合以导致较长（即：“全”冲洗）。应理解，根据本发明，可提供额外空气开口以将空气室 25 连接到外部环境空气。这些开口 / 空气通道可处于不同高度，且其可在不同时间选择性地敞开及闭合。所有此类开口 / 空气通道提供用于控制浮标浮力及冲洗时间的额外系统及方法。

[0040] 图 7 及 8 展示本发明的替代实施例，其具有允许空气从浮标的内部自由地传到外部环境空气的通气系统，如下所述。在各个实施例中，在浮标 20 的内部与环境空气之间提供空气通道 50。这个空气通道 50 确保浮标 20 内的空气压力保持处于环境条件，而不管水箱 T 中的水位高度如何。这使较易于校准冲洗操作顺序，如将解释。

[0041] 在一个实施例中，空气通道 50 包括：通气管 52，其具有安置在空心浮标 20 内的敞口顶端；通气基部 54，其连接到通气管 52 的底部；及通向外部环境空气的通气室 56。通气室 56 连接到通气基部 54。空气在通气管 52、通气基部 54 与通气室 56 之间自由地流动，使得在冲洗期间空心浮标 20 的内部中的空气保持处于环境压力。应理解，结构 52、54 及 56 可为分离结构，或其可为一个长管道流动路径结构的部分。例如，空气通道 50 甚至可为单一 J 形结构（其中“J”的下端定位在浮标内，且“J”的上端定位在外壳 30 的顶部外或处）。还应注意，通气管 52 与上文所描述的第二空气通道 41 不同（即：图 6 及 7 的旋转彼此略有不同以展示本发明的不同示范性实施例）。

[0042] 在任选优选实施例中，通气管 52 具有敞开顶端 53，其可如所展示般向外凹陷。通气基部 54 优选地具有底部开口 55。因此，如果浮标 20 中的任何水进入敞开顶端 53，那么

水将仅通过开口 55 排出到下方的排水口中。相似地，（偶然地）进入通气室 56 的顶部的任何水箱中的水也将通过底部开口 55 排出。因此，水将保持在空气通道 50 外，从而准许空气通过空气通道 50 自由地流动。在一个任选实施例中，通气室 56 穿过标准溢流管 31，标准溢流管 31 穿过外壳 30（如在图 10 中所见）。

[0043] 图 8 展示在冲洗开始时的水位。具体来说，一旦空气通道 40 敞开，空气就将从空气室 25 逸出且浮标 20 就将上浮。此时，水将在浮标 20 的敞开底端下方流动且向下传到排水口中。因为空气从浮标 20 的内部通过空气通道 50 自由地流动到环境空气，所以水将进入浮标的底部，从而部分地升高到浮标的内部中，如所展示。应注意：如果水位在浮标 20 内升高得太远，那么水将仅排出到敞开顶端 53 中，且接着通过底部开口 55 沿着排水口向下。

[0044] 图 9A 展示在冲洗之前的本发明的实施例的截面图，其具有虹吸裙部 34。虹吸裙部 34 安置在至少一个流动开口 32 周围。图 9B 展示在冲洗期间的虹吸裙部 34 的动作。虹吸裙部 34 进行操作以在冲洗期间将水箱中的水牵引到排水口中，从而将几乎所有水从水箱 T 中抽出。具体来说，水箱中的水位将向下排出到虹吸裙部的下唇部的水平。

[0045] 图 10A 为经定位成紧挨着注水阀 100 的本发明的浮标组合件 10 的透视图。浮标组合件 10 的操作受到控制模块 60 控制。控制模块 60 包含安装在马桶水箱（未展示）的外部上的激活按钮面板 62。激活按钮面板 62 包含全冲洗按钮 63 及半冲洗按钮 65。按钮 63 及 65 通过管线 64 及 66（气动地或通过缆索）连接到控制模块 60。注水阀 100 包含浮标 102 及再注水管线 104。在水箱中的水位降落时，浮标 102 降落，从而开启注水阀 100 以将水从建筑物干管通过管线 104 供应到水箱 T 中（以对水箱再注水）及供应到外壳 30 中（通过管线 104 以激活控制模块 60 中的液压缸 106），如将解释。

[0046] 控制模块 60 进行操作以使通气盖 61 旋转，使得其敞开或闭合第二空气通道 41 的顶部开口。如关于图 6 所解释，在第二空气通道 41 闭合时，发生全冲洗。然而，在第二空气通道 41 敞开时，空气代替地能够在管端位置 47 处进入空气室 25，从而导致半冲洗。孔 48 为全冲洗通气孔，其可通过查看图 10B 予以最佳地理解，如下所述。

[0047] 如上文关于图 6 所解释，第二空气通道 41 准许半冲洗（在水降低到管端 47 的水平时）。此时，在水位降低到管端 47 的水平时，空气冲进空气室 25，从而破坏真空且致使浮标 20 降低，从而停止冲洗。如在图 10B 中所见，另一空气通道是由孔 48 提供，其向下延伸到在 49 处具有敞开底端的管中。在第二空气通道 41 闭合时，水位将代替地必须在空气冲进空气室 25 之前降低到管端 49 的水平，从而破坏真空且致使浮标 20 降低，从而停止冲洗。因为端 49 定位在端 47 下方，所以在空气可穿过端 49 之前较大体积的水将必须从水箱排出。此较大体积的水为“全冲洗”。

[0048] 在图 11 到 14B 中看到控制机构 60 的操作的另外细节，如下所述。图 11 为在静止状态下的本发明的控制系统的俯视示意图。空气阀 70 安置在外壳 30 的顶部上。空气阀 70 连接到空气室 25，且在敞开时用于从外壳 30 的顶部中直接排出空气（到水箱内的环境空气）。因此，空气阀 70 的操作与图 1 到 9B 中的本发明的实施例中的开关 42 的操作相同。简单来说，敞开空气阀 70 会准许空气从空气室 25 逸出。如将解释，控制机构 60 以与致动器开关 42 控制空气通道 40 的敞开及闭合相同的方式控制空气阀 70 的敞开及闭合（即：阀 70 及开关 42 两者在敞开时均使空气离开空气室 25）。在按下按钮 63 时，由气动管 65 移动活塞 90。相似地，在按下按钮 65 时，由气动管 66 移动活塞 92。活塞 90 及 92 的移动可致

使阀 70 敞开。

[0049] 图 12 为在全冲洗期间（在已按下气动按钮 63 时）的本发明的控制系统的俯视示意图。按下按钮 63 会使空气移动通过管 65，这移动活塞 92，其又敞开阀 70。此时，空气开始从内部空气室 25 逸出（通过外壳 30 的顶部上的敞开阀 70）。如将展示，控制机构 60 使曲柄 108 旋转，其使凸轮 109 旋转（图 14A 及 14B）。凸轮 109 的旋转使通气盖 61 移动到使得其闭合第二空气通道 41 的位置中。这导致全冲洗。同时，通过再注水管线 104 供应水，从而向下传到外壳 30 中通过孔 105 到外壳 30 中以对水箱再注水。

[0050] 图 13 为在水从注水阀的一个出口注入到液压活塞以对所述活塞供以动力时的本发明的控制系统的俯视示意图。此时，活塞 107 是通过再注水的水力而推回，使得凸轮 109 保持旋转到其突缘 110 防止活塞 90 或 92 移动的位置。因此，操作员无法推动活塞 90 或 92，且因此无法在水箱的再注水期间敞开空气释放阀 70。

[0051] 对于半冲洗，按下按钮 65，使得空气从内部空气室 25 逸出（通过外壳 30 的顶部上的敞开阀 70）。然而，在半冲洗的情况下，控制机构 60 不在第二空气通道 41 上方移动通气盖 61。这导致半冲洗，这是因为在水位降低到图 6 中的管端 47 的位置时空气能够通过第二空气通道 41 进入空气室 25。

[0052] 图 14A 为在半冲洗期间的控制系统 60 的仰视图，且图 14B 为在全冲洗期间的控制系统 60 的仰视图，其展示另外结构细节，如下所述。可看出，穿过再注水管线 104 的再注水的水力使活塞 107 移动到缩回位置（图 14A）。这又使曲柄 108 及凸轮 109 旋转以锁定活塞 90 及 92，以在水从注水阀 100 供应到冲洗阀 10 中时防止活塞 90 及 92 敞开空气阀 70（即：通过按下按钮 63 或 65）。这是在浮标 20 降低（及停止冲洗）的所期望时间之前使部分真空维持在空气室 25 中所必需的。一旦已停止对活塞 107 的液压力，凸轮 109 就将旋转回到其未锁定位置，使得用户接着再次自由地按下按钮 63 或 65 中的任一者。

[0053] 图 15A 为本发明的替代实施例的透视图。这个实施例在操作上与图 10A 的实施例相似，然而，空气通过通道 40 及 41 而逸回通过开关 42。开关 42 包括全冲洗按钮 63 及半冲洗按钮 65。在按下按钮 63 或 65 中的任一者时，空气借助于通道 40 从空气室 25 逸出（如关于图 1 到 5 所解释）。在按下按钮 63 时，选择全冲洗且阻止空气移动通过第二空气通道 41。相反地，在按下按钮 65 时，选择半冲洗且空气流动通过第二空气通道 41（如关于图 10A 所解释）。

[0054] 图 15B 为在冲洗之前的 15A 的冲洗控制模块 42 的三个视图的近视图。此时，通道 41 敞开以使空气流动。冲洗控制模块 42 包含阀销 70 及闭合止回阀 72。

[0055] 图 15C 为在已压下按钮 65 时的半冲洗期间的 15A 的冲洗控制模块 42 的近视图。此时，弹簧 73 将弯曲，从而向下推动销 70 且敞开止回阀 72（准许空气流出通道 40，因此从室 25 释放空气）。同时，按下部分冲洗按钮 65 将敞开梭阀 74 且允许空气经过通道 41（如关于图 10A 所解释）。

[0056] 图 15D 为在已压下按钮 63 时的全冲洗期间的 15A 的冲洗控制模块 42 的近视图。此时，弹簧 73 将弯曲，从而向下推动销 70 且敞开止回阀 72（准许空气流出通道 40，因此从室 25 释放空气）。同时，按下按钮 63 将闭合梭阀 74 且阻止空气移动通过第二空气通道 41。

[0057] 图 16A 为在半冲洗模式下的本发明的替代实施例的透视图；且图 16B 为在全冲洗模式下的本发明的这个替代实施例的透视图。这个实施例也在操作上与先前在图 10A 中所

描述的实施例相似。然而，主要差别在于提供液压夹管阀 100。液压夹管阀 100 的操作与图 14A 及 14B 中所描述的锁定凸轮机构的操作相似。具体来说，在再注水通过再注水管 104 进入外壳 30 时，水力将使液压夹管阀 130 中的柱塞向下移动（参见图 16B）以抑制空气流动通过空气通道管 132。因此，在水箱的再注水期间停用按钮 63 及 65。这在对水箱再注水时防止操作员从空气室 25 释放空气（与图 14A 及 14B 中的突缘 110 的功能相似）。

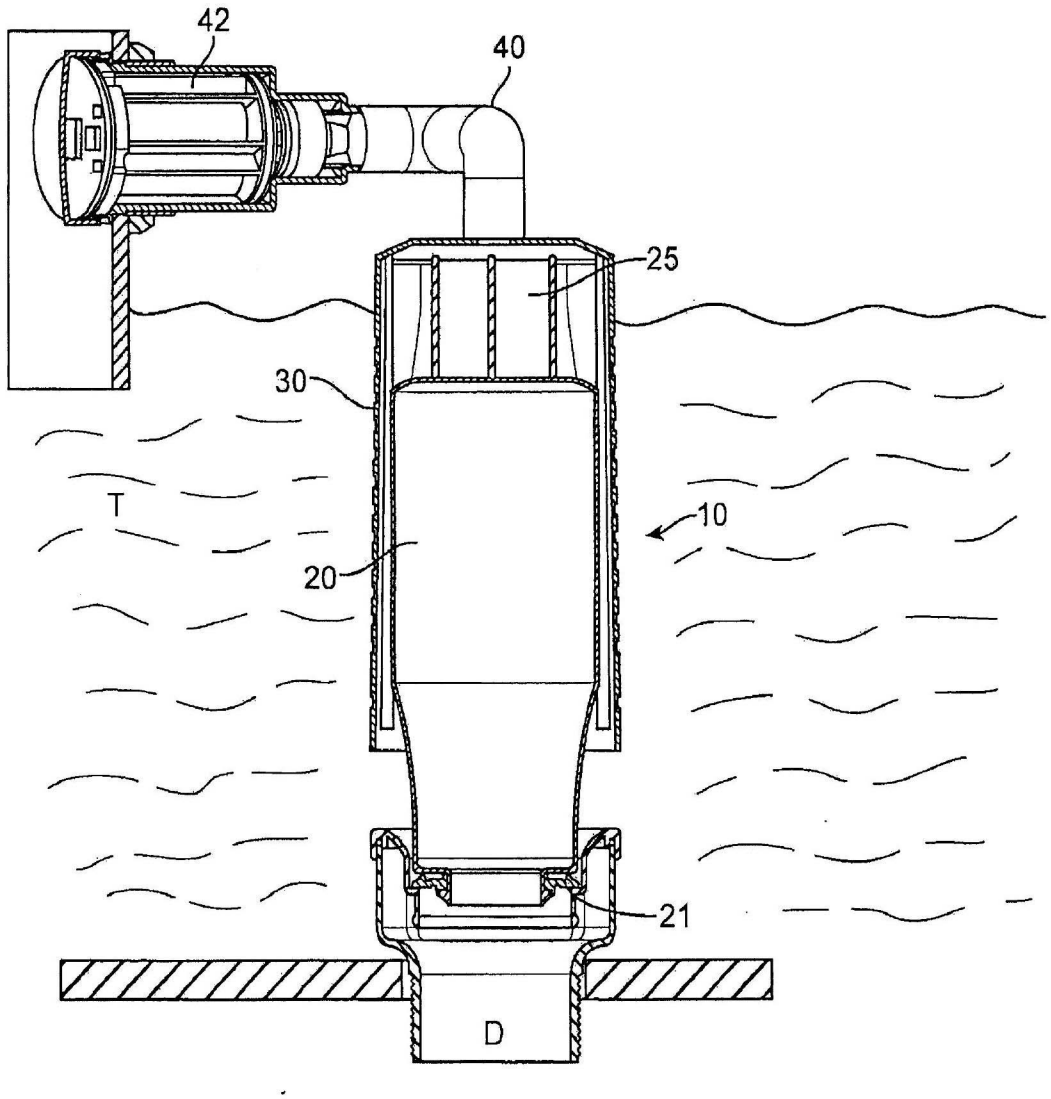


图 1

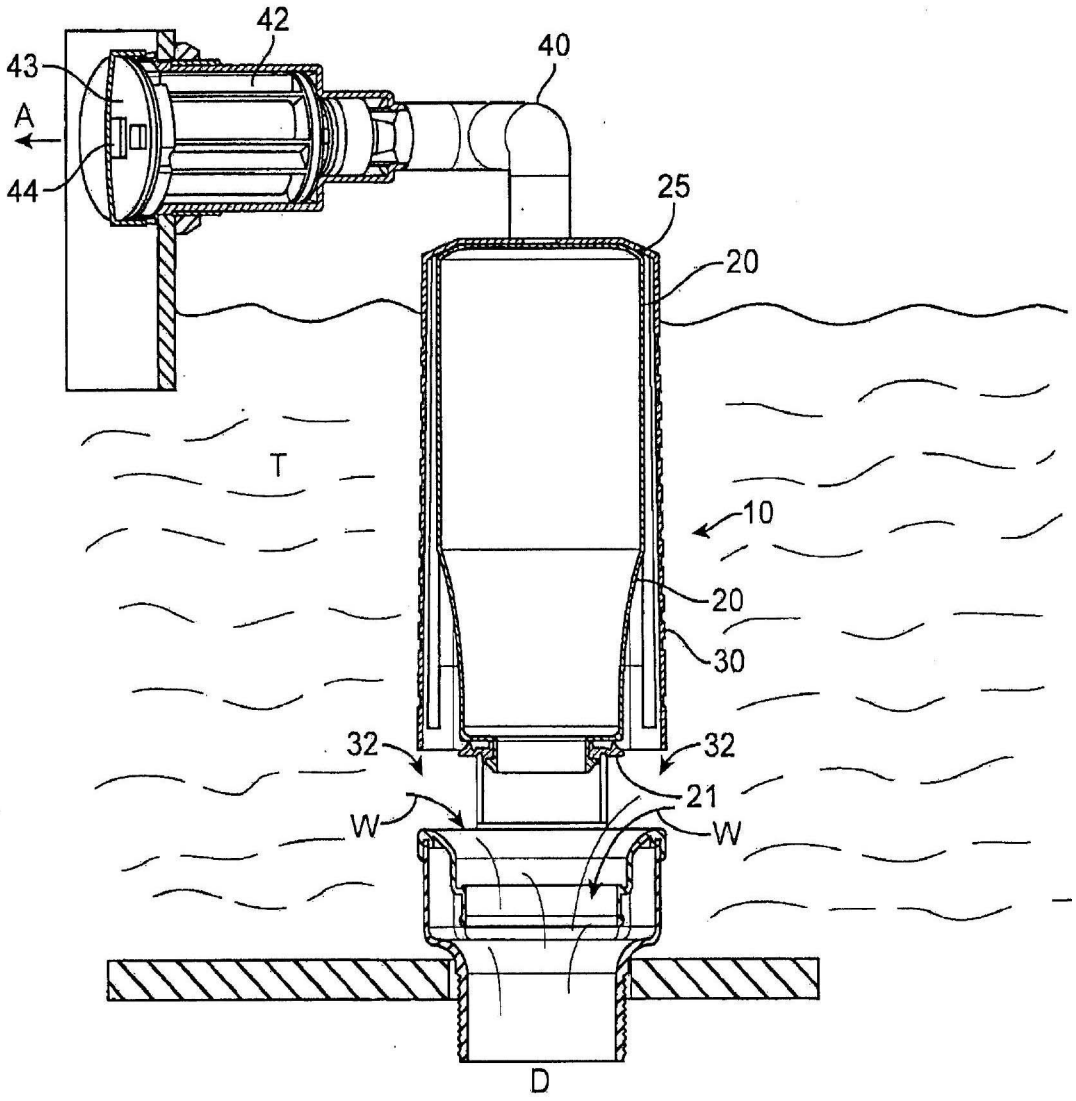


图 2

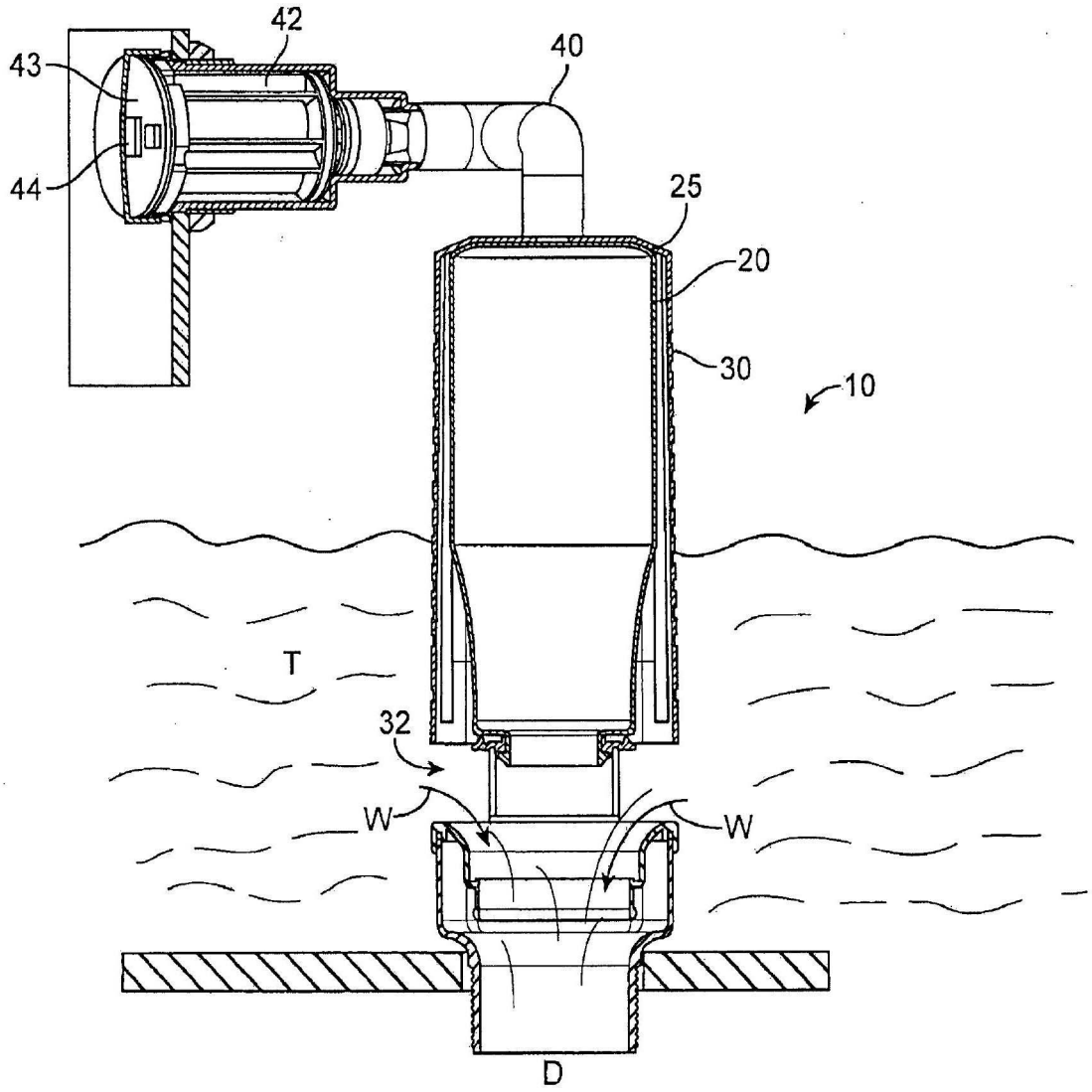


图 3

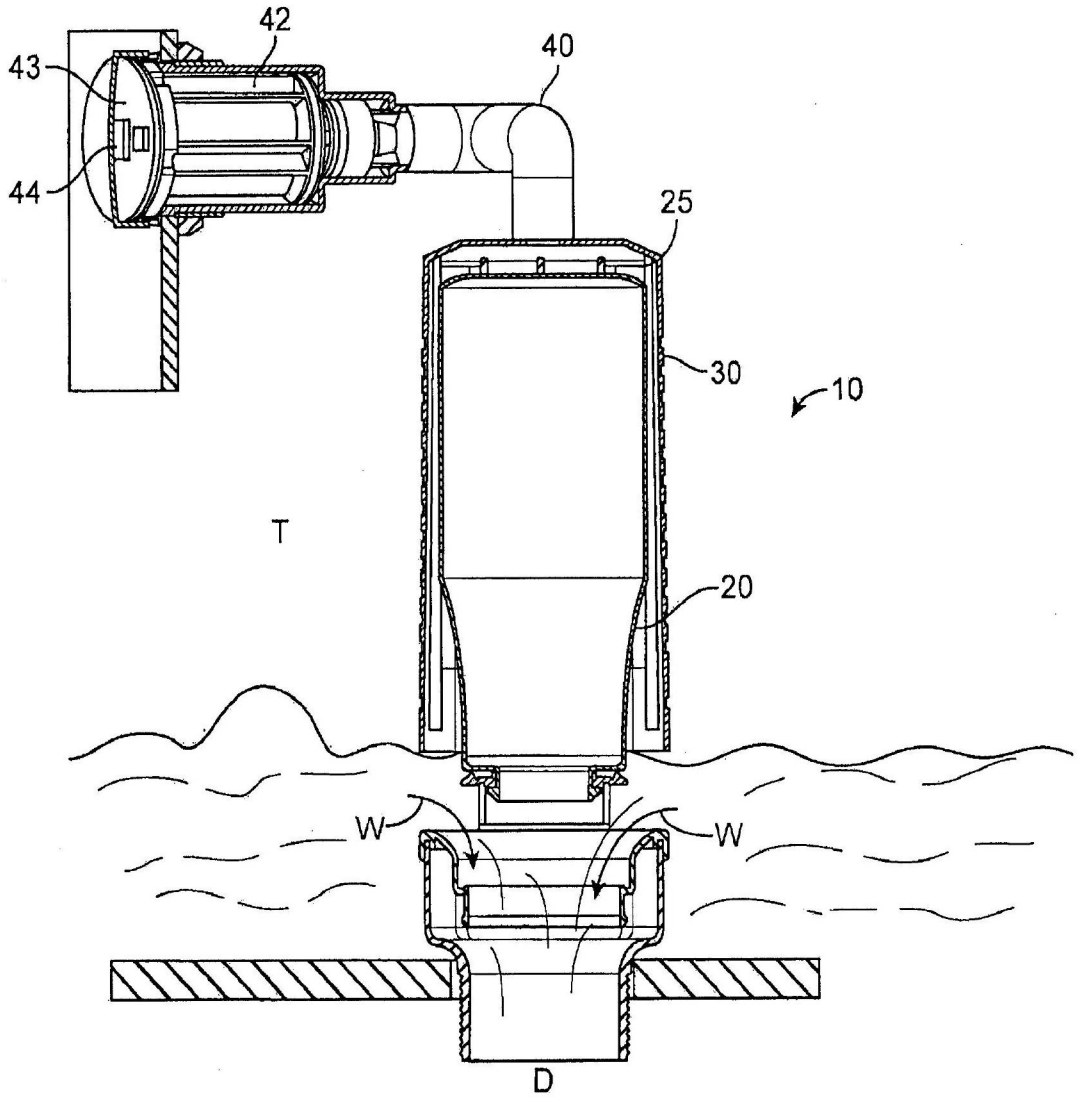


图 4

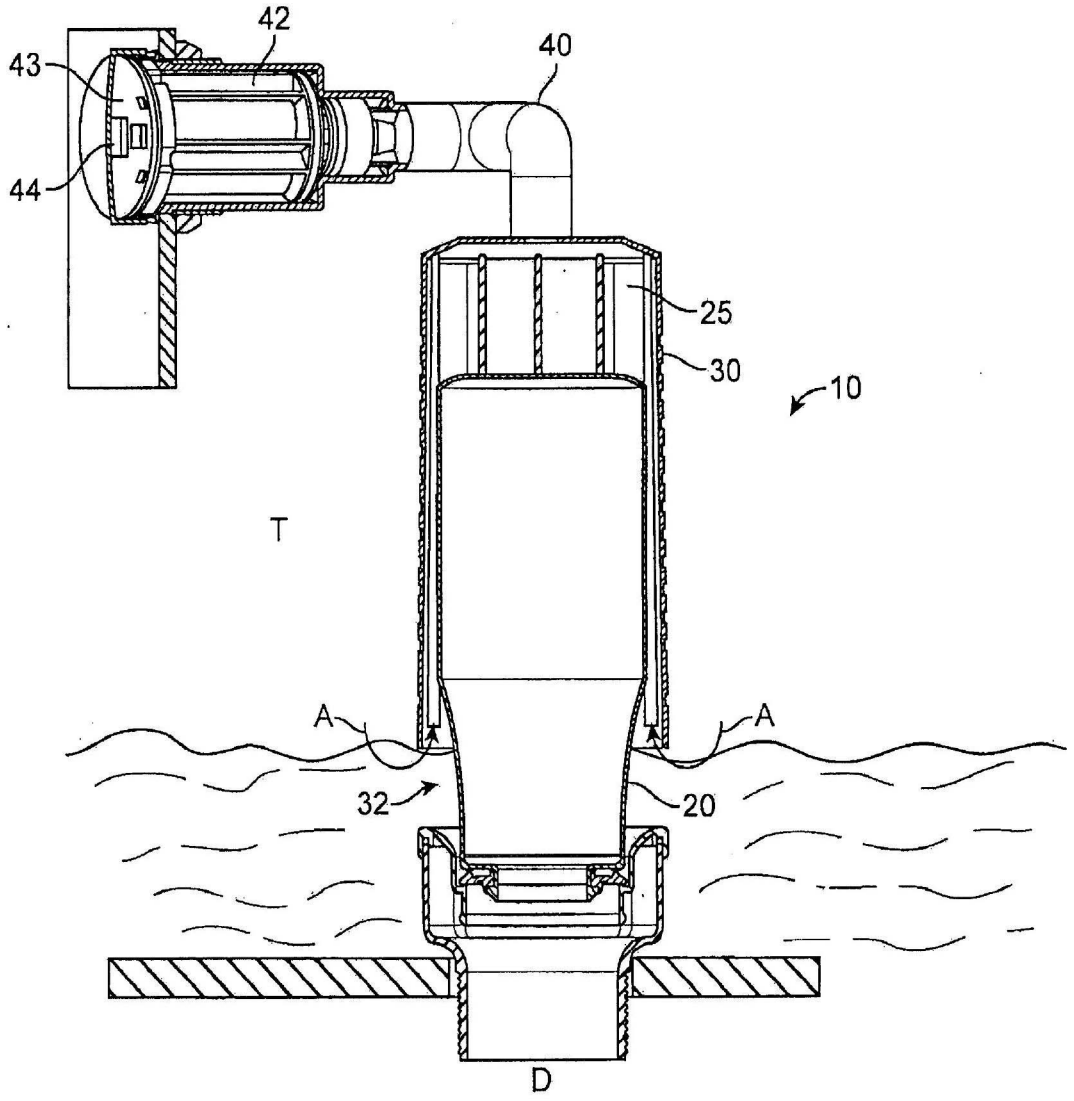


图 5

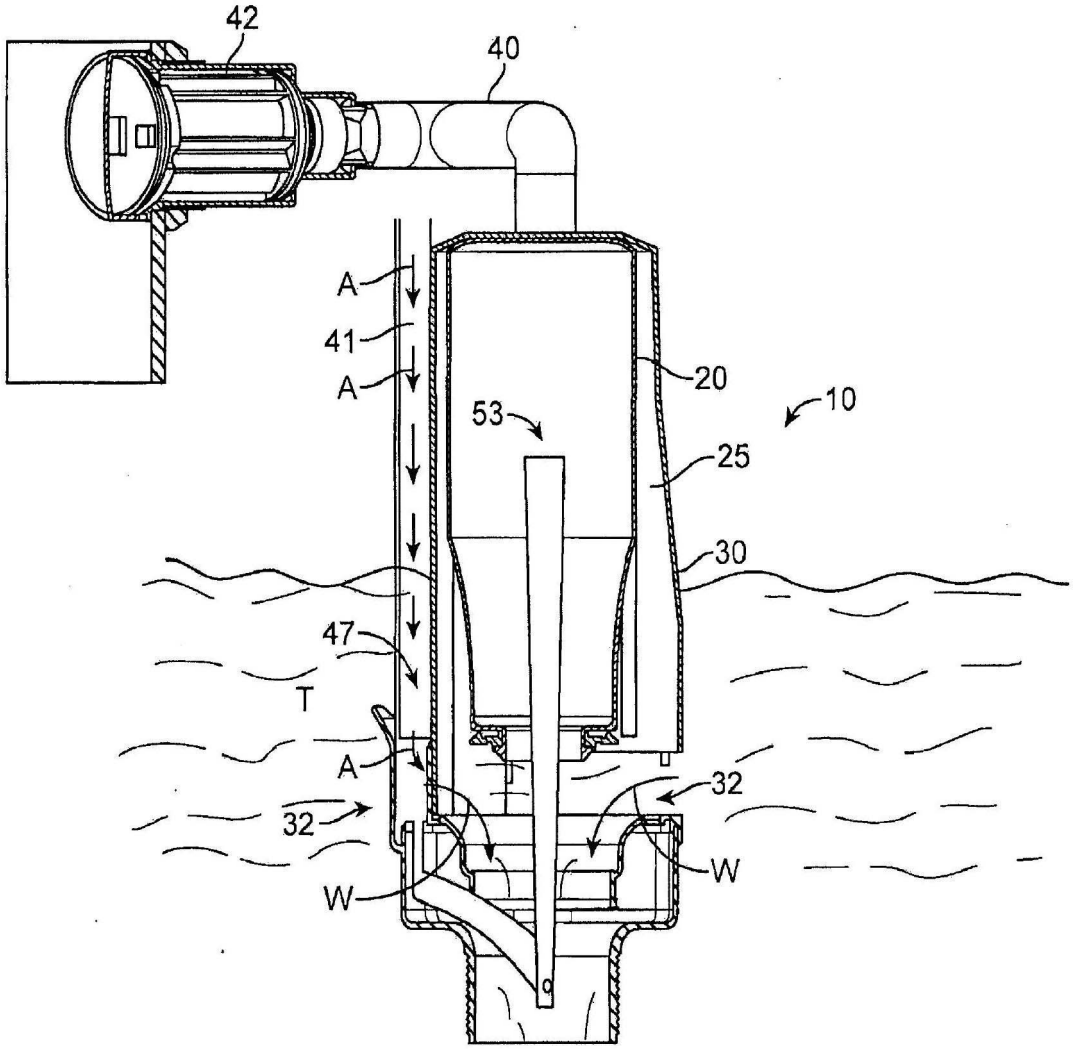


图 6

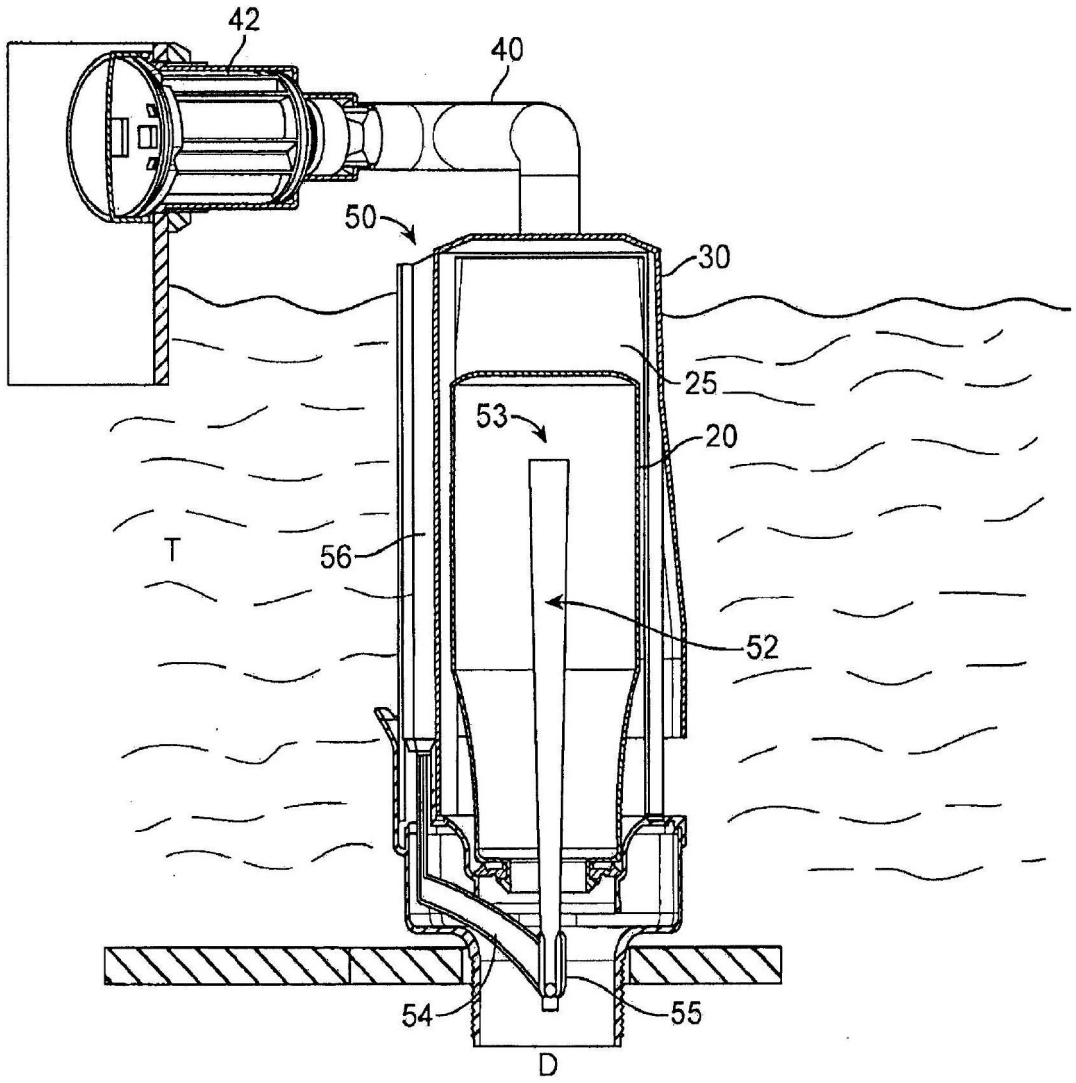


图 7

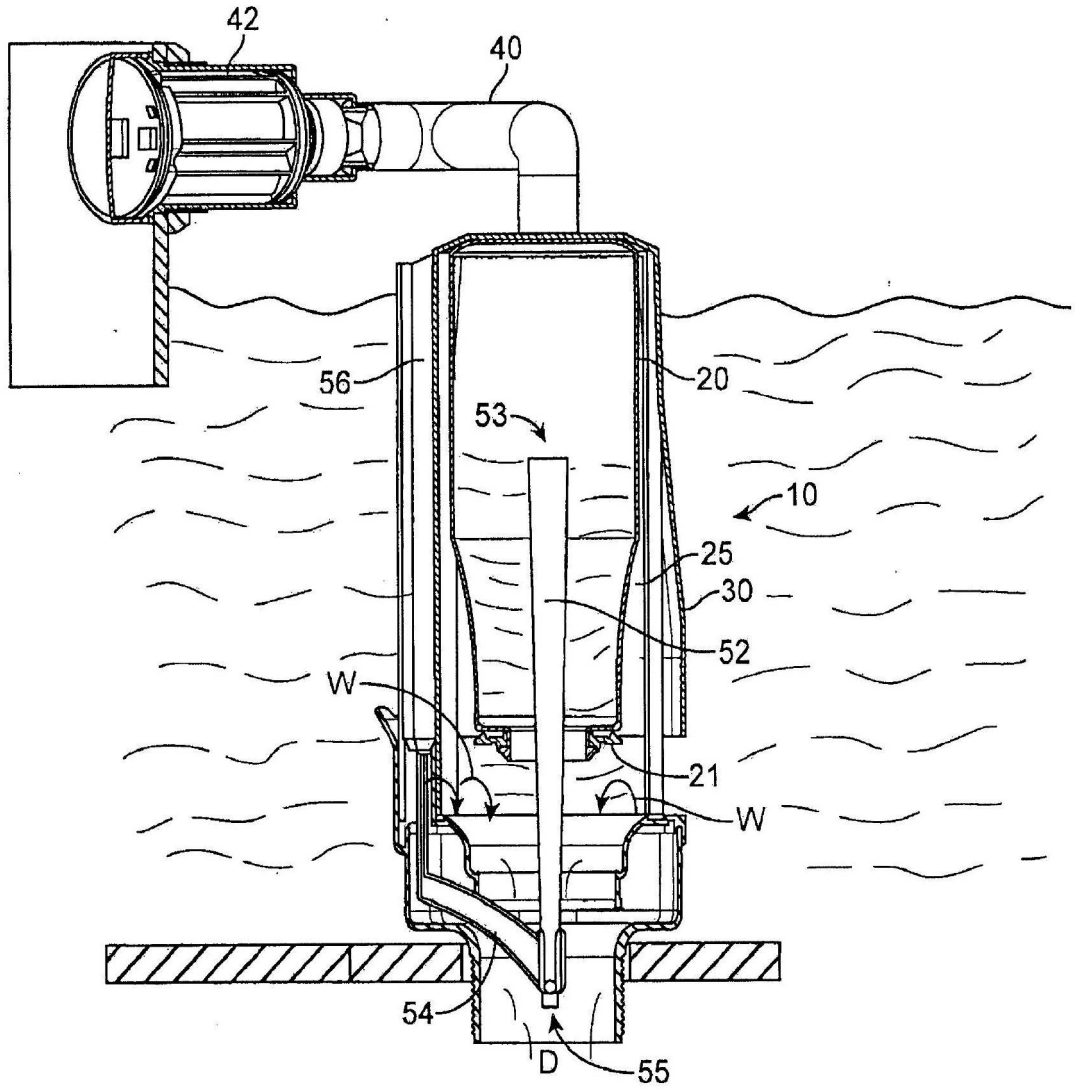


图 8

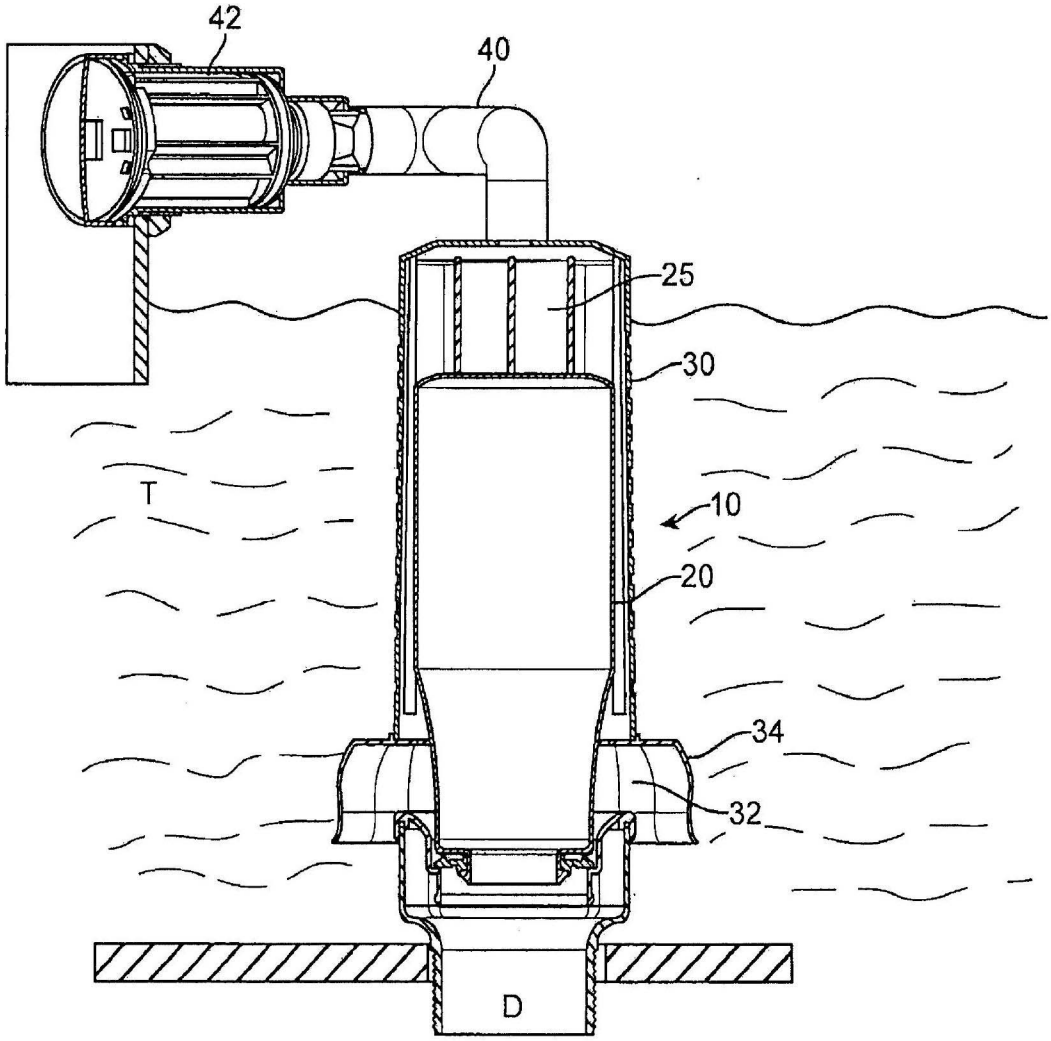


图 9A

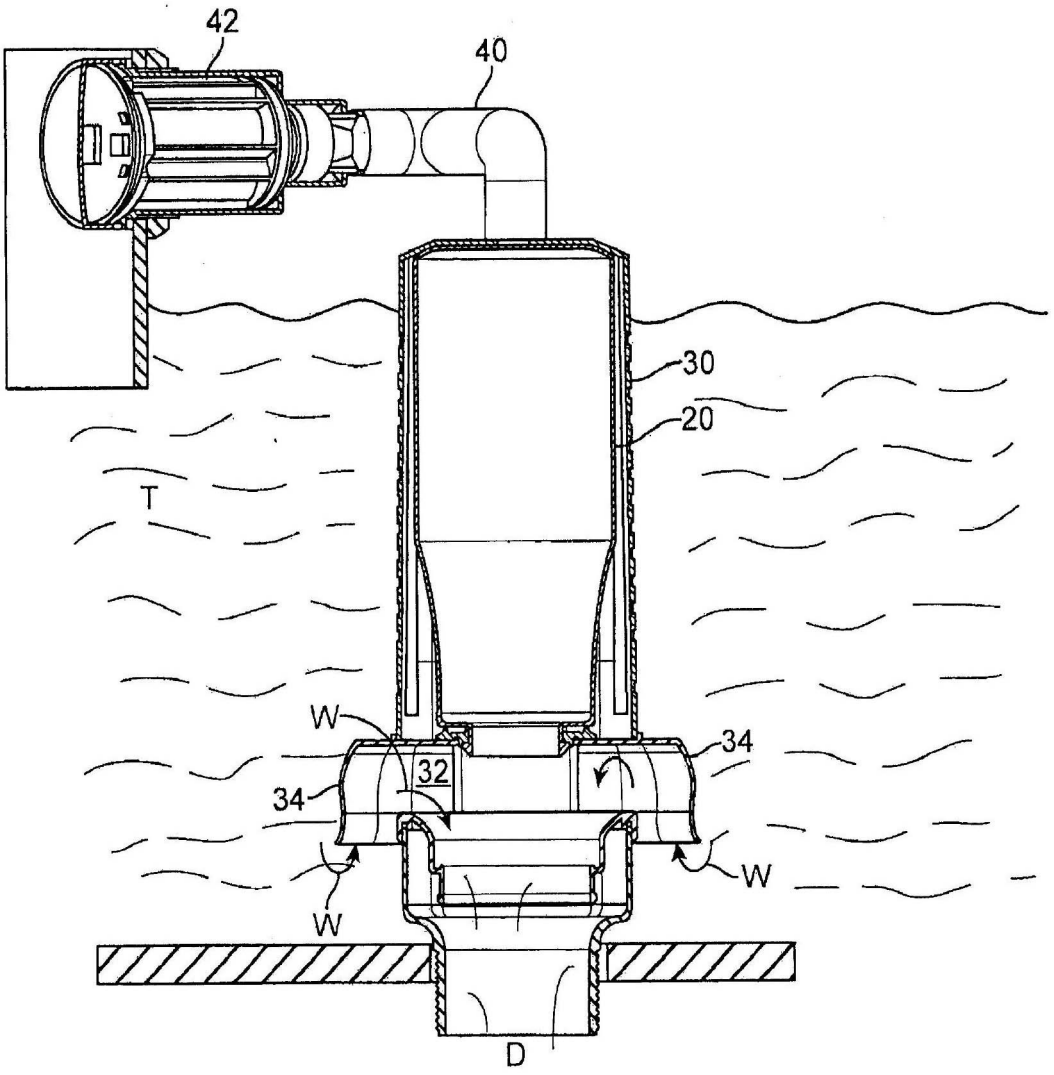


图 9B

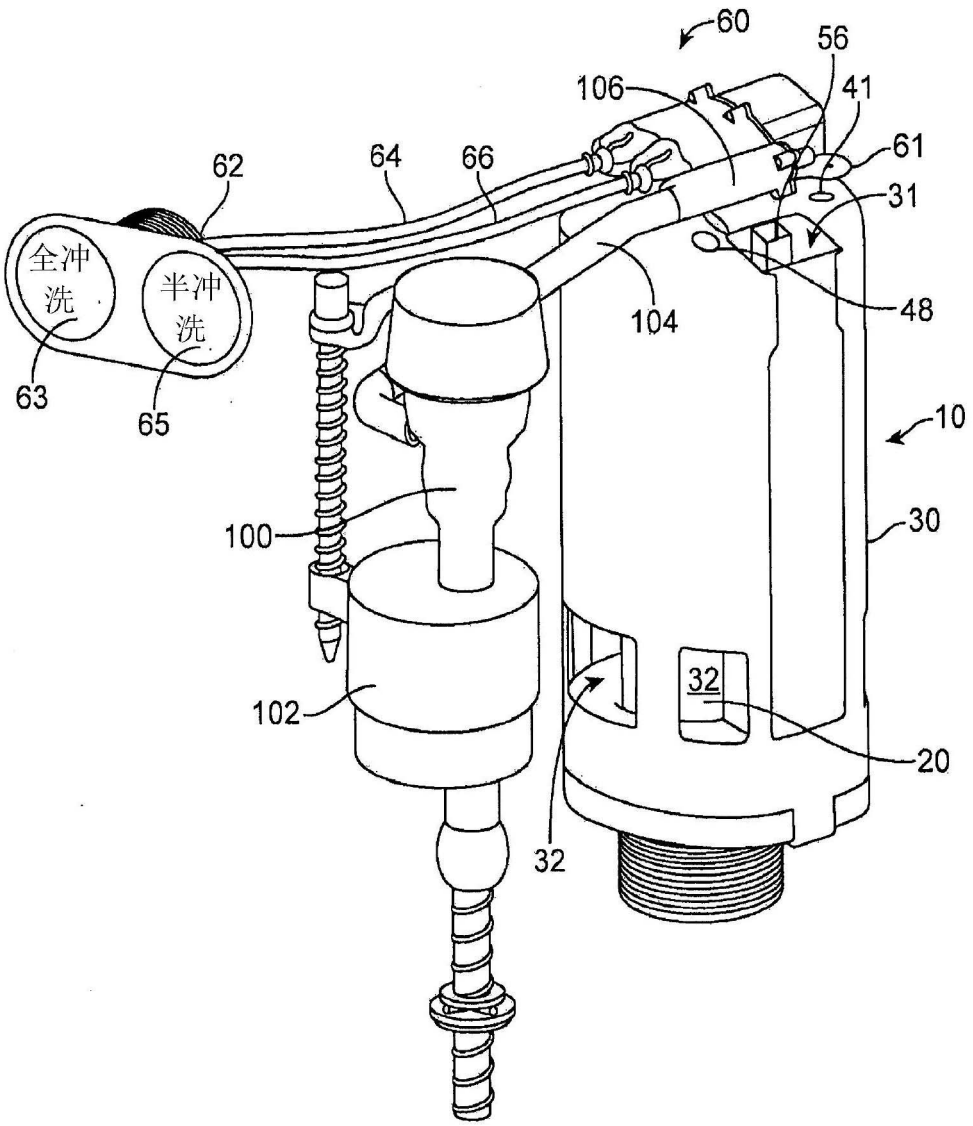

60
56
106
41
61
62
64
66
31
全冲洗
半冲洗
48
104
63
65
10
100
30
32
102
20
32

图 10A

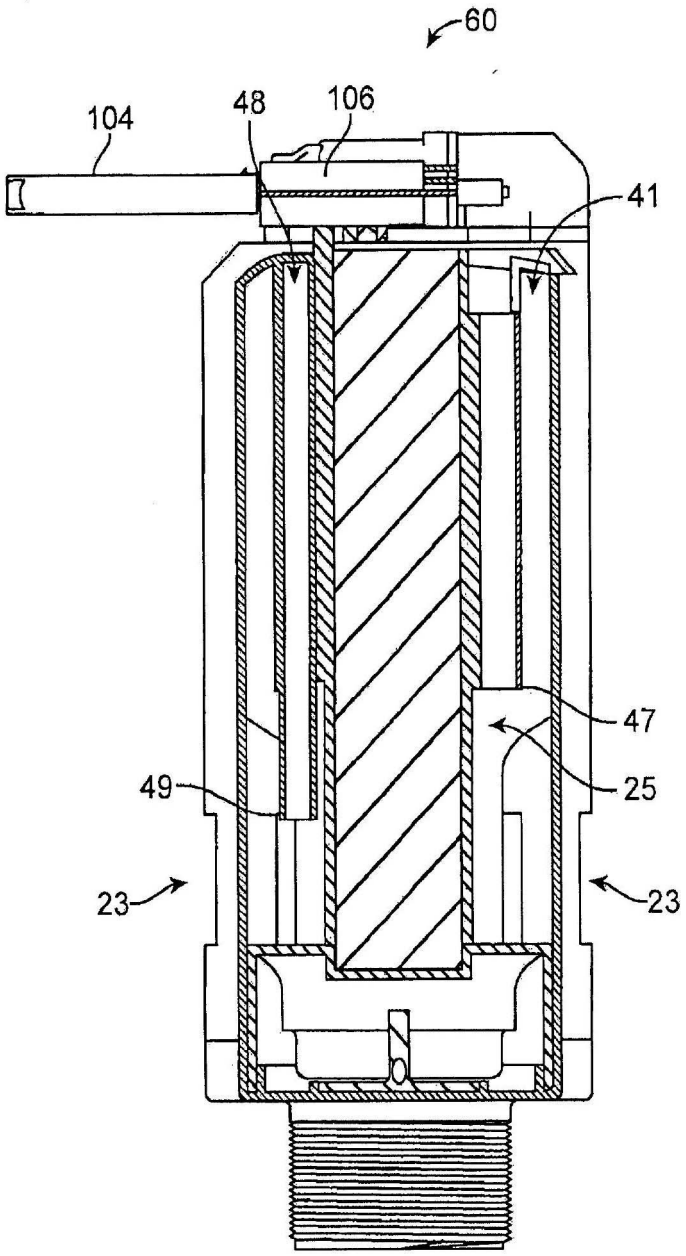


图 10B

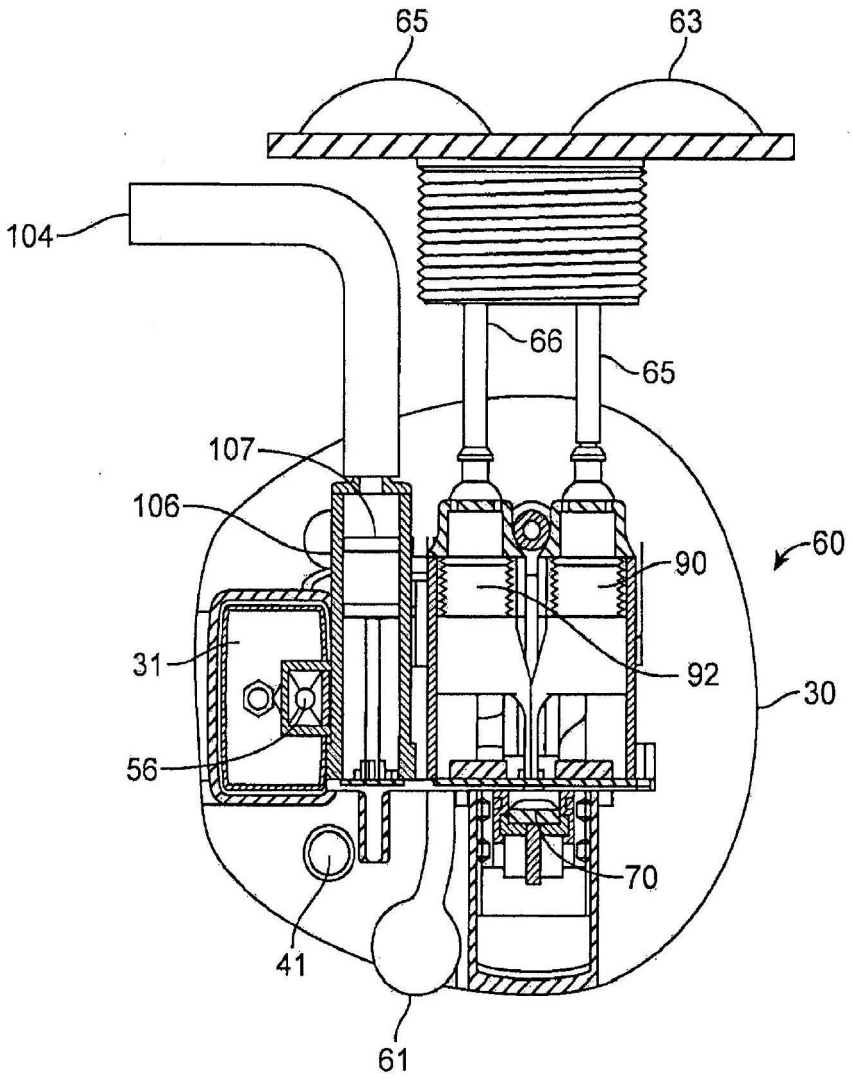


图 11

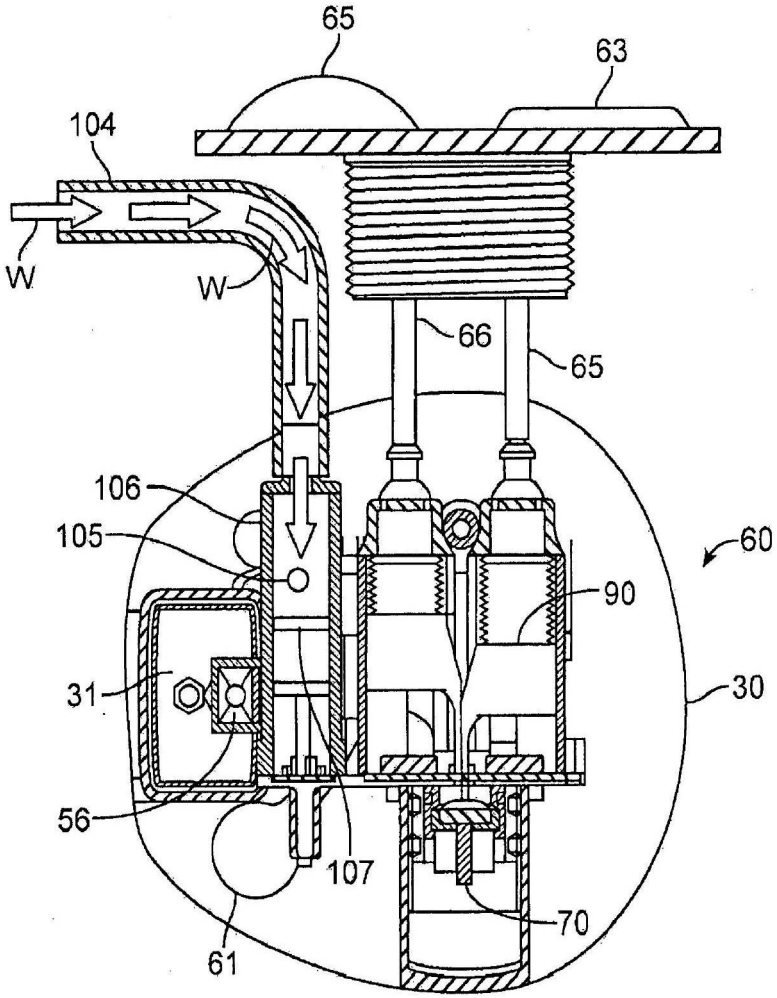


图 12

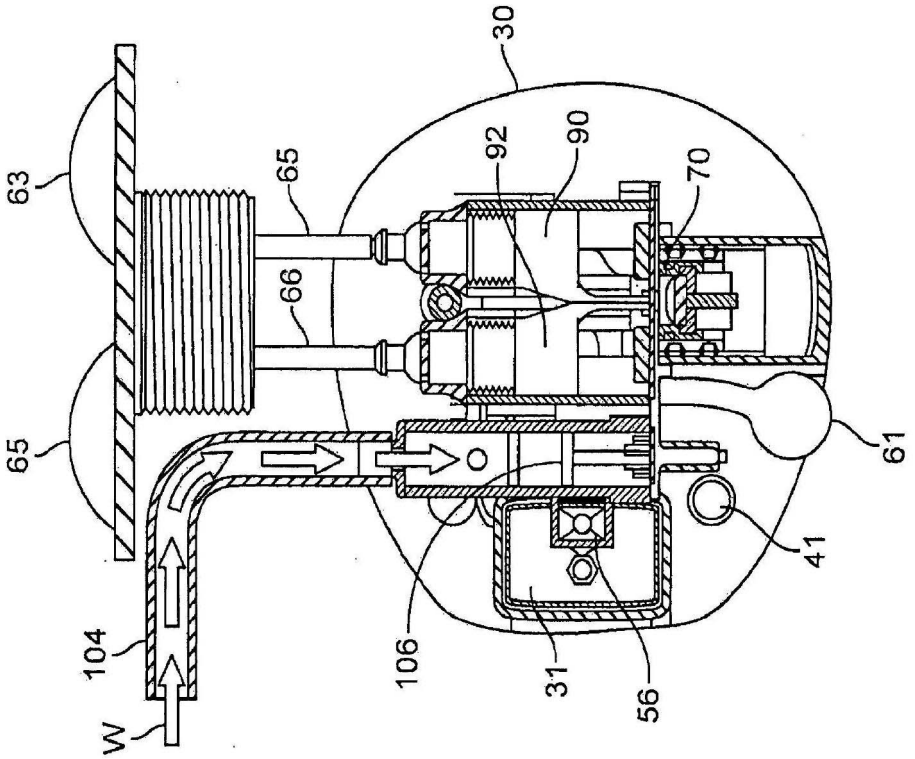


图 13

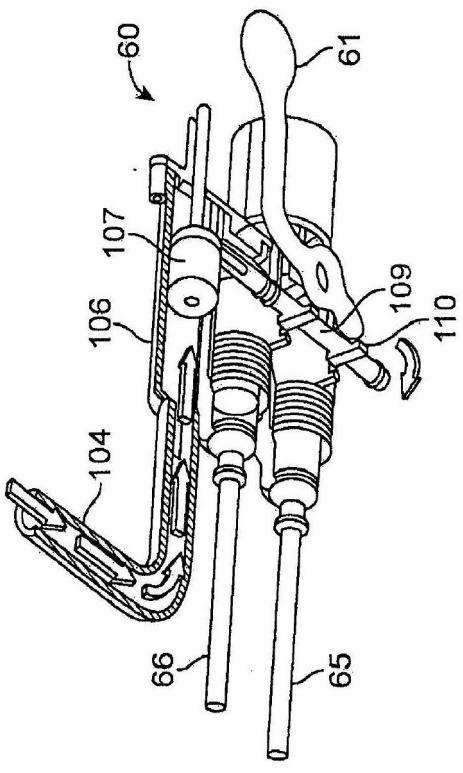


图 14A

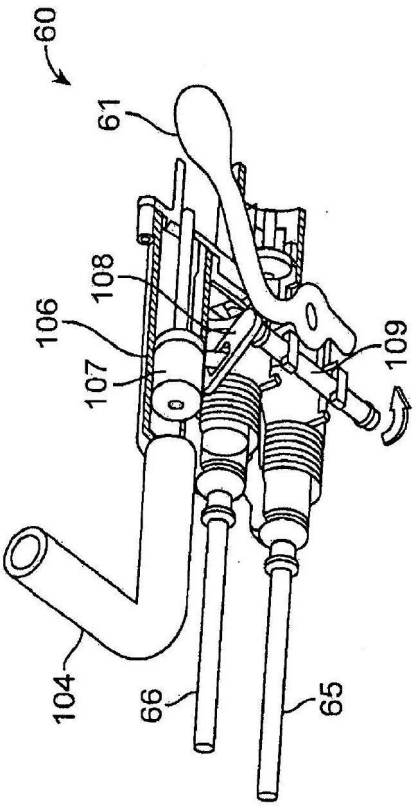


图 14B

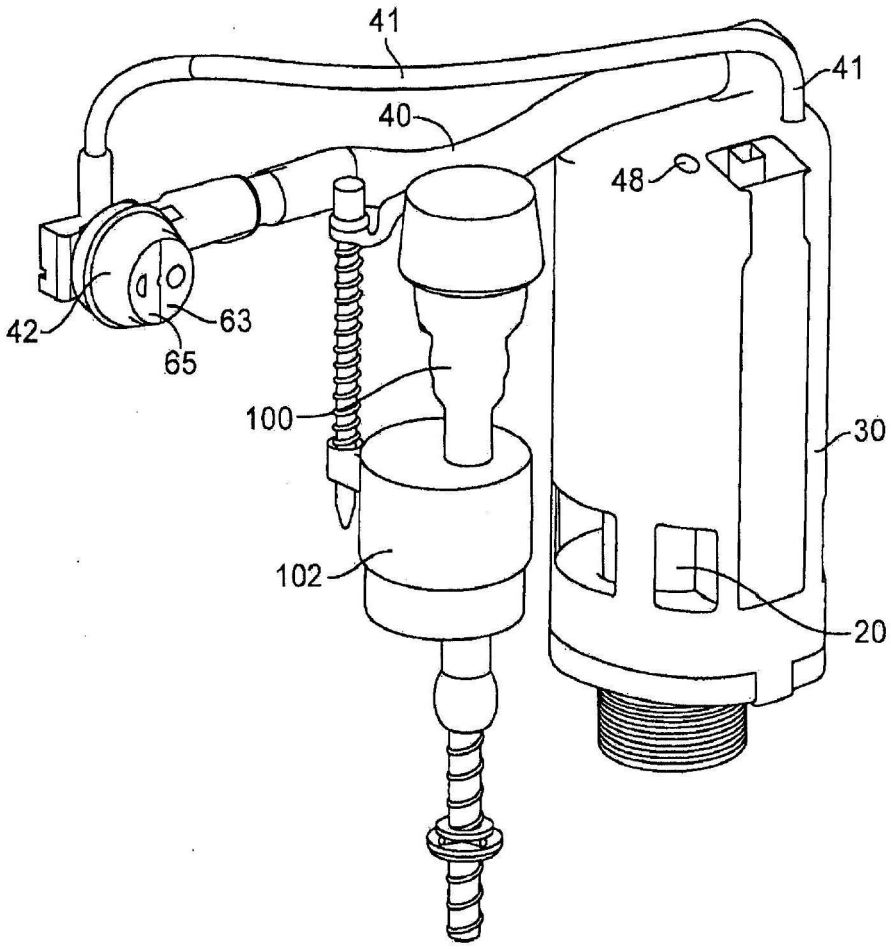


图 15A

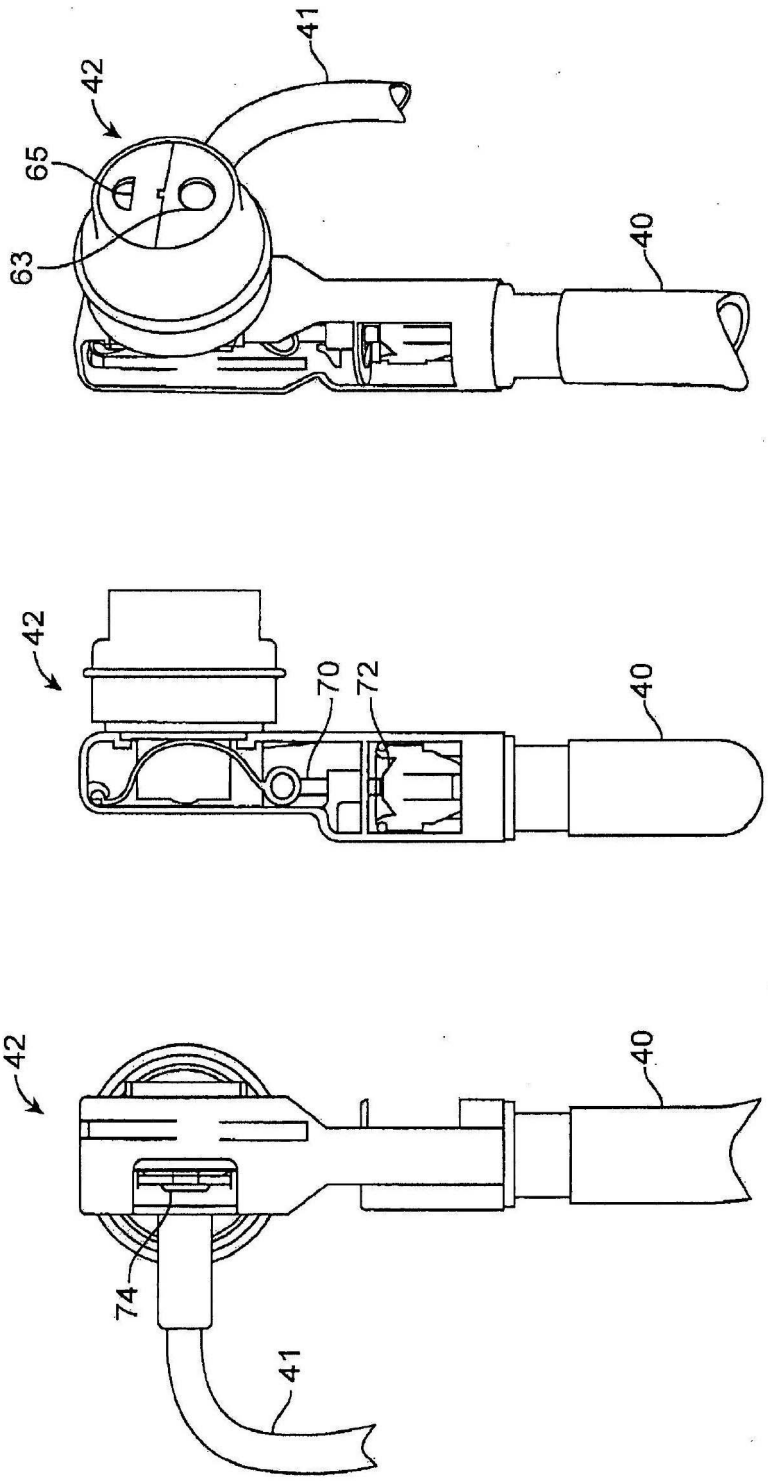


图 15B

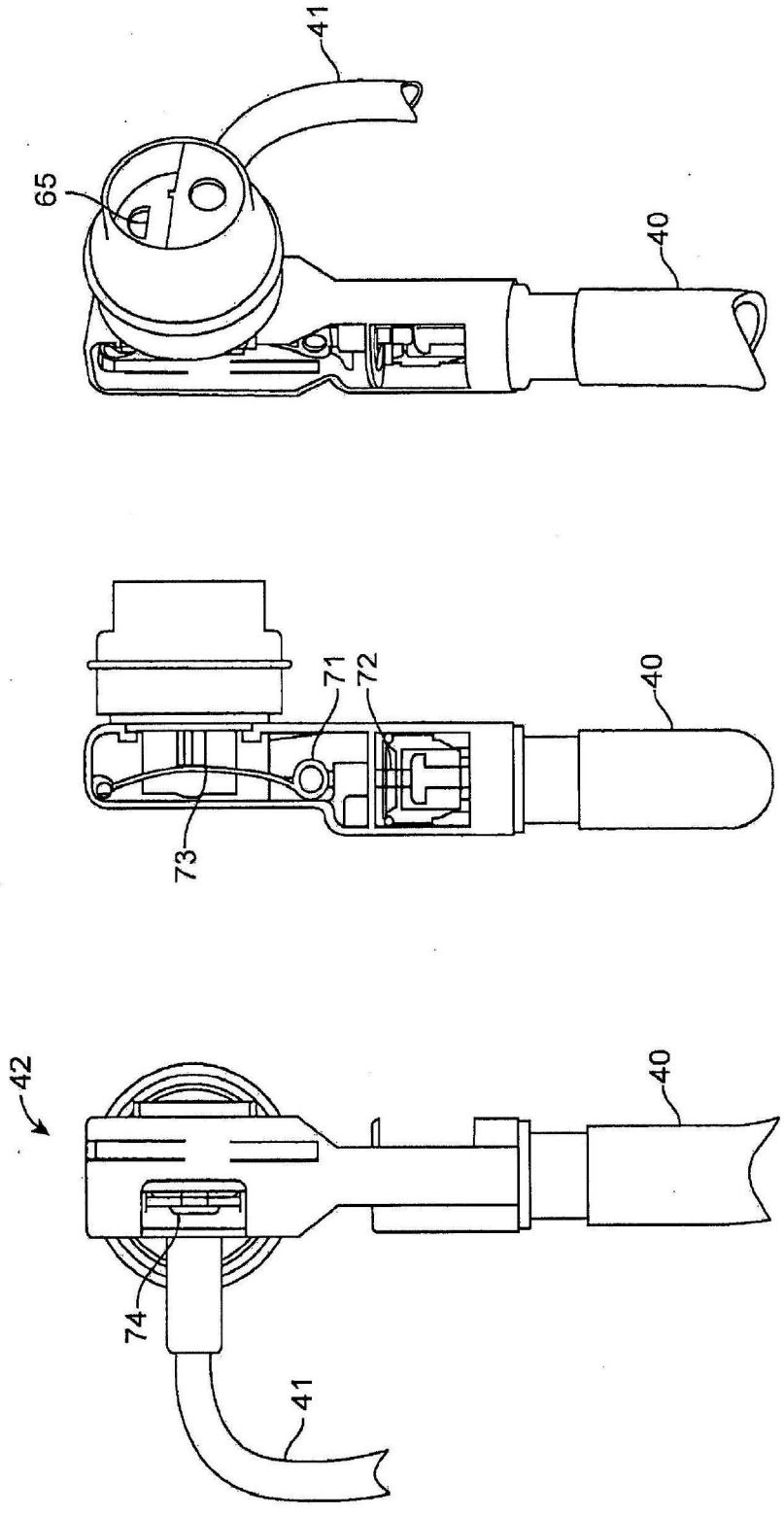


图 15C

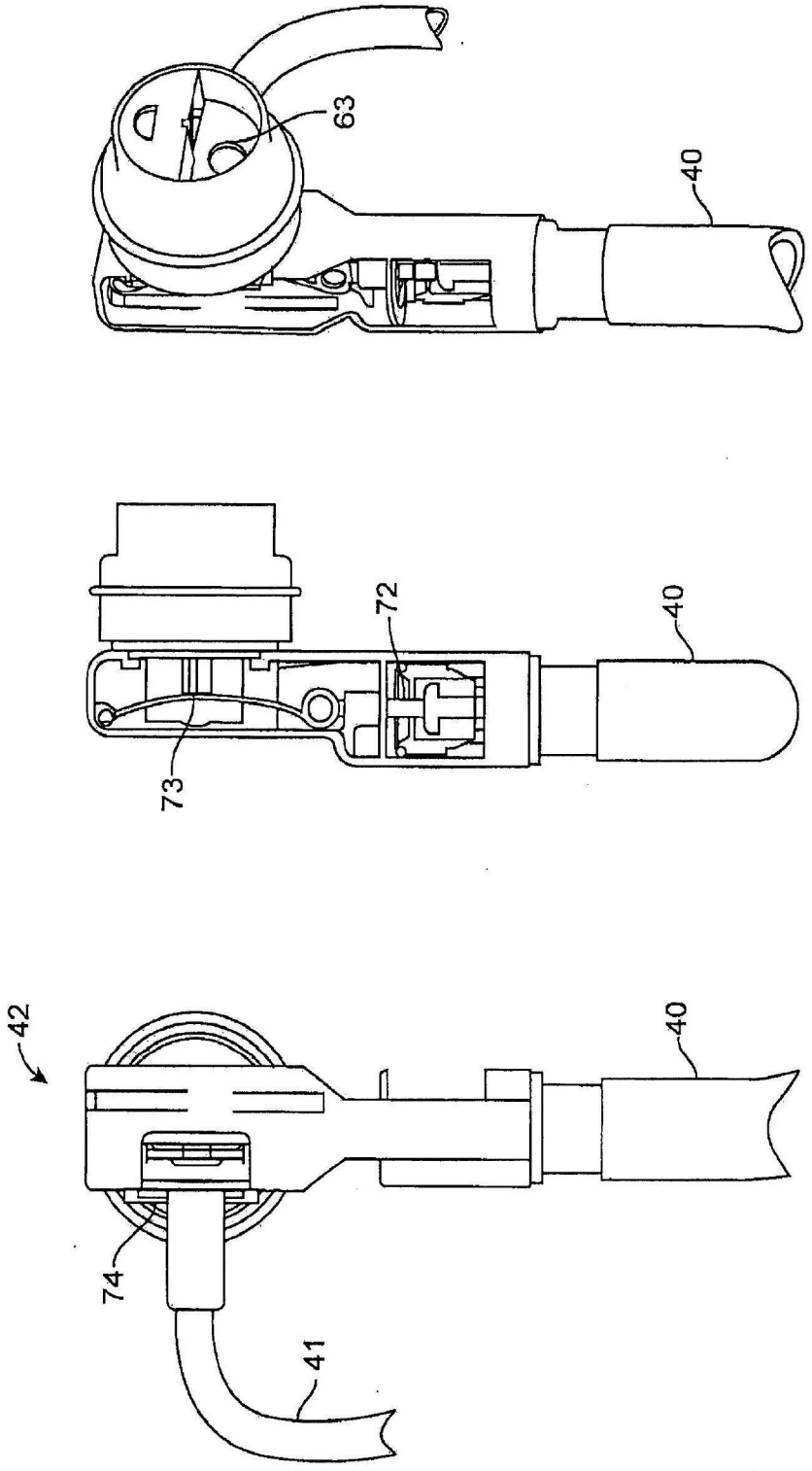


图 15D

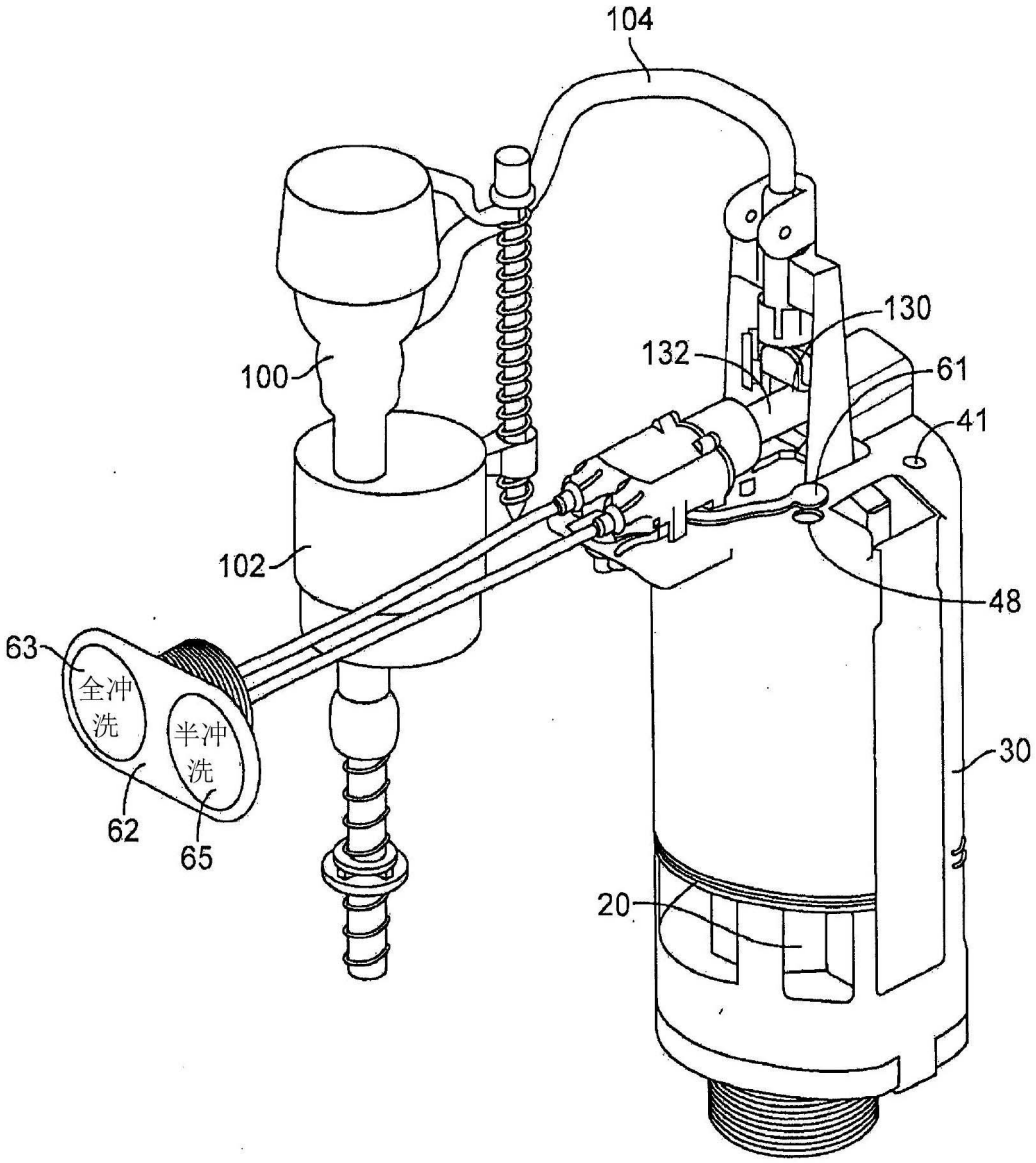


图 16A

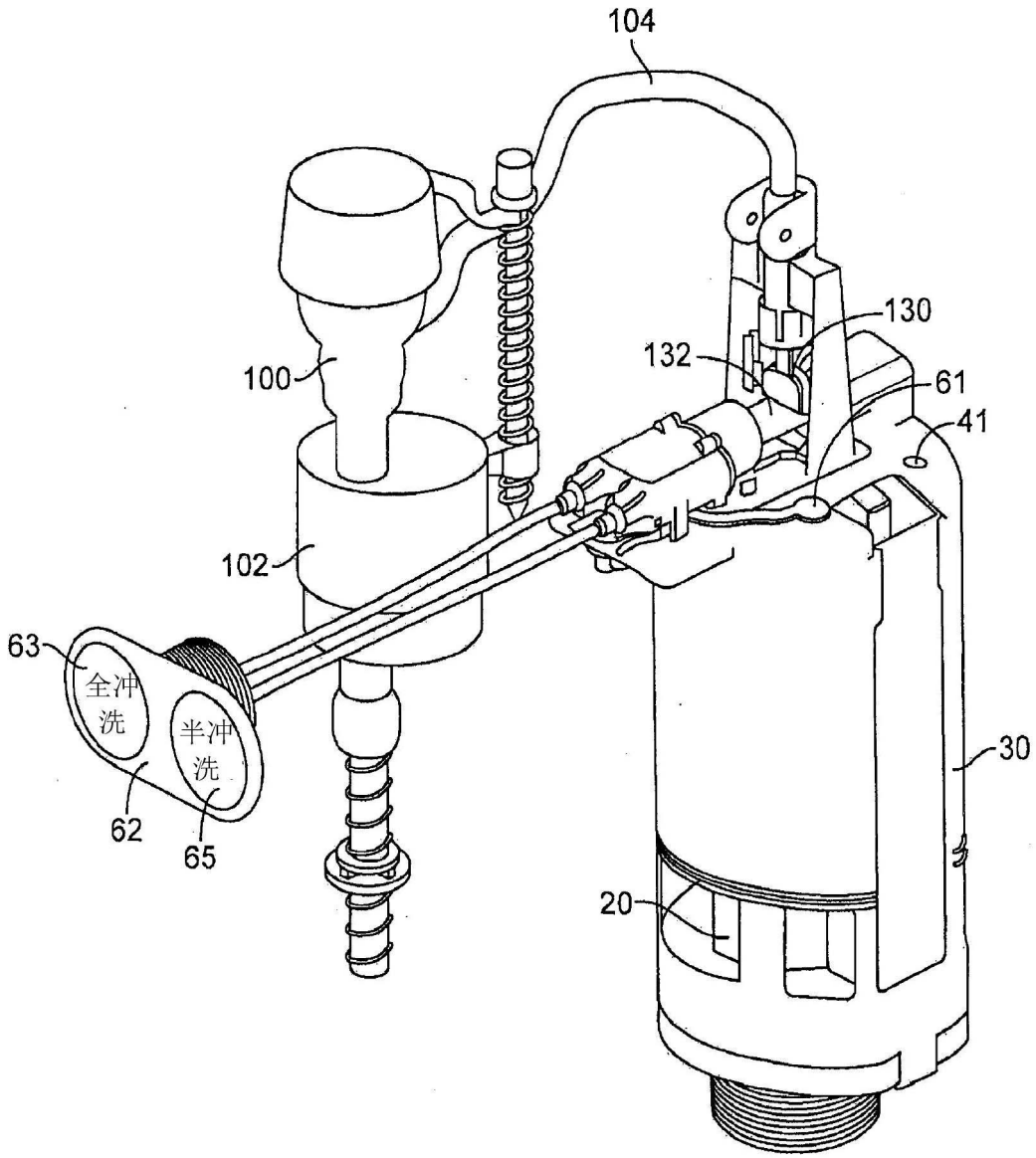


图 16B