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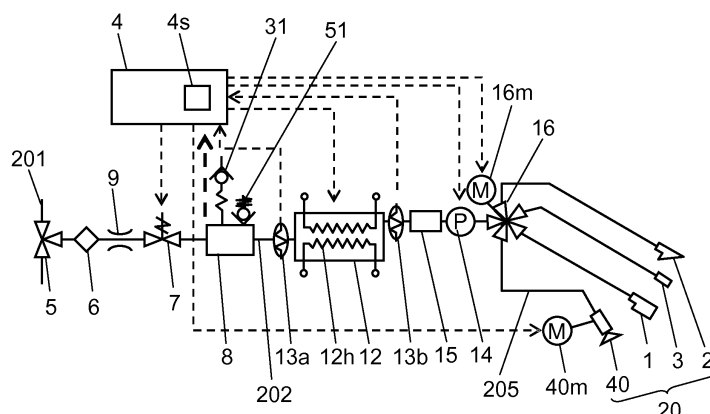
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(54) **SANITARY CLEANSING DEVICE**

(57) A sanitary cleansing device of the present invention includes: a cleansing nozzle; and a cleansing water flow passage (202) configured to allow cleansing water to flow toward the cleansing nozzle. The cleansing water flow passage (202) has: a displacement pump (14) configured to control a flow rate of the cleansing water; an atmosphere open part (8) disposed at an upstream side of the displacement pump (14), configured to open a part of the cleansing water flow passage (202) to at-

mosphere, and having a tank for storing the cleansing water, and a water level sensor for detecting a water level in the tank; a solenoid valve (7) configured to pass and block the cleansing water supplied to the atmosphere open part (8); and a controller (4) configured to control the displacement pump (14) and the solenoid valve (7). Consequently, no flow sensor is needed, and it is possible to realize a downsized sanitary cleansing device with no gap with a set flow rate.

FIG. 3



Description

TECHNICAL FIELD

[0001] The present invention relates to flow rate control of cleansing water in a sanitary cleansing device.

BACKGROUND ART

[0002] Heretofore, in order to jet cleansing water to a private part of a human body at a proper temperature and a proper flow rate, various sanitary cleansing devices including high-precision flow sensors are developed (e.g., see PTL 1).

[0003] A sanitary cleansing device described in PTL 1 includes a flow sensor at an upstream side of a heat exchanger for heating cleansing water. The flow sensor is configured by a swirl chamber in which cleansing water flows in a substantially U-shape, a rotor having a swirler, a photo interrupter, and the like. Then, the photo interrupter detects light interruption by the swirler rotated by the cleansing water that flows in the swirl chamber of the flow sensor, and detects a flow rate. Consequently, it is possible to detect the flow rate of the cleansing water with high detection precision, and to heat the cleansing water to a proper temperature with a heater of the heat exchanger.

[0004] However, in the above conventional configuration, a flow sensor having a complicated configuration is separately needed, and therefore a size of the sanitary cleansing device cannot be made compact, and there is a problem in costs. Additionally, there is a problem that a detection error is caused by bubbles mixed in the flow sensor along with the cleansing water.

Citation List

Patent Literature

[0005] PTL 1: Japanese Patent No. 3,620,215

SUMMARY OF THE INVENTION

[0006] In order to solve the above problems, a sanitary cleansing device of the present invention includes: a cleansing nozzle configured to discharge cleansing water; and a cleansing water flow passage configured to allow the cleansing water from a supply source to flow toward the cleansing nozzle. The cleansing water flow passage has: a displacement pump configured to control a flow rate of the cleansing water discharged from the cleansing nozzle; an atmosphere open part disposed at an upstream side of the displacement pump, configured to open a part of the cleansing water flow passage to atmosphere, and having a tank for storing the cleansing water, and a water level sensor for detecting a water level in the tank to output a signal; a solenoid valve configured to pass and block the cleansing water supplied from the

supply source to the atmosphere open part; and a controller configured to control the displacement pump and the solenoid valve. Furthermore, the controller calculates flow rate of the cleansing water supplied per unit time from the supply source based on the signal of the water level sensor, and corrects control of the displacement pump.

[0007] According to this configuration, the displacement pump is disposed downstream of the atmosphere open part, so that a number of rotations of the displacement pump is controlled with no influence of supply pressure of the water supply source, and the flow rate of the cleansing water discharged from the cleansing nozzle is controlled. Furthermore, the water level sensor measures a flow rate of cleansing water that has actually passed, and feeds back the measured flow rate to the controller, so that the control of the displacement pump is corrected. Consequently, the flow rate detected by the water level sensor is corrected, and the flow rate of the cleansing water jetted from the displacement pump can be controlled with no influence of variations in components, aged deterioration, or the like. As a result, it is possible to perform accurate and stable flow rate control over a long period without providing any flow sensor or flow control valve, and to realize a sanitary cleansing device that has a simple configuration and has a good feeling in use.

BRIEF DESCRIPTION OF DRAWINGS

[0008]

FIG. 1 is a perspective view of a toilet device mounted with a sanitary cleansing device according to a first exemplary embodiment of the present invention. FIG. 2 is a front view of a remote controller of the sanitary cleansing device according to the first exemplary embodiment.

FIG. 3 is a schematic diagram showing a configuration of a main body of the sanitary cleansing device according to the first exemplary embodiment.

FIG. 4 is a schematic diagram showing an example of an atmosphere open part of the sanitary cleansing device according to the first exemplary embodiment. FIG. 5 is a sectional view of a displacement pump of the sanitary cleansing device according to the first exemplary embodiment.

FIG. 6 is a time chart showing an example of operation of the sanitary cleansing device according to the first exemplary embodiment.

FIG. 7 is a block diagram of a water level controller of a controller of the sanitary cleansing device according to the first exemplary embodiment.

FIG. 8 is a flowchart showing correction operation of water level controller of the controller of the sanitary cleansing device according to the first exemplary embodiment.

FIG. 9 is a schematic diagram of an atmosphere

open part of a sanitary cleansing device according to a second exemplary embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0009] Hereinafter, a sanitary cleansing device and a toilet device according to exemplary embodiments of the present invention will be described with reference to the drawings. It should be noted that the present invention is not limited by these exemplary embodiments.

FIRST EXEMPLARY EMBODIMENT

[0010] Hereinafter, a sanitary cleansing device according to a first exemplary embodiment of the present invention, and a toilet device with the same will be described with reference to FIG. 1.

[0011] FIG. 1 is a perspective view of the toilet device mounted with the sanitary cleansing device according to the first exemplary embodiment of the present invention. Toilet device 1000 is installed in a toilet room.

[0012] As shown in FIG. 1, toilet device 1000 of this exemplary embodiment includes at least sanitary cleansing device 100, toilet bowl 700, room entry detection sensor 600, and the like, and is mounted with sanitary cleansing device 100 on toilet bowl 700.

[0013] Sanitary cleansing device 100 is configured by main body 200, remote controller 300, toilet seat 400, lid 500, and the like. Main body part 200 incorporates a cleansing water supply mechanism (see FIG. 3) that is controlled by sitting sensor 610 and controller 4 provided on a front upper part, and is openably mounted with toilet seat 400 and lid 500. Sitting sensor 610 is configured by, for example, a reflective infrared sensor, and detects an infrared ray reflected from a human body, to detect whether or not a user is present on toilet seat 400.

[0014] The cleansing water supply mechanism incorporated in main body 200 has one end connected to toilet bowl nozzle 40 provided on a front lower part of main body 200 and the other end connected to a tap water piping. FIG. 1 shows a state where toilet bowl nozzle 40 protrudes inside toilet bowl 700. Consequently, the cleansing water supply mechanism supplies cleansing water supplied from the tap water piping to toilet bowl nozzle 40. In a case of pre-cleansing of the toilet bowl, the supplied cleansing water is jetted from toilet bowl nozzle 40 into a wide range of an inner surface of toilet bowl 700. In a case of back part cleansing of the toilet bowl, the cleansing water is jetted from toilet bowl nozzle 40 to a rear surface side of the inner surface of toilet bowl 700.

[0015] Furthermore, a cleansing water supply mechanism incorporated in main body 200 is connected to nozzle part 20 configured by buttock nozzle 1 that serves as a private part cleansing nozzle, bidet nozzle 2 that serves as a bidet cleansing nozzle, nozzle cleansing nozzle 3, toilet bowl nozzle 40, and the like, which configure a

cleansing nozzle (see FIG. 3). Consequently, the cleansing water supply mechanism supplies cleansing water supplied from a tap water piping, to nozzle part 20. Then, the supplied cleansing water is jetted from buttock nozzle 1, bidet nozzle 2, or the like to a private part of a user. Additionally, cleansing water supplied to nozzle cleansing nozzle 3 of nozzle part 20 is jet to nozzle part 20 such as buttock nozzle 1 and bidet nozzle 2, thereby cleansing the nozzles.

[0016] Operation part such as remote controller 300 has a plurality of switches for selecting cleansing modes of cleansing a plurality of cleansing nozzles, and is mounted on, for example, a place where the user sitting on toilet seat 400 can operate.

[0017] Room entry detection sensor 600 is configured by, for example, a reflective infrared sensor, and is mounted on an entrance of the toilet room or the like. In a case where room entry detection sensor 600 detects an infrared ray reflected from the human body, room entry detection sensor 600 detects that the user entered the toilet room.

[0018] Controller 4 (see FIG. 3) of main body 200 controls operation of respective parts of sanitary cleansing device 100 based on signals transmitted from remote controller 300, room entry detection sensor 600, and sitting sensor 610.

[0019] Hereinafter, a configuration of remote controller 300 of sanitary cleansing device 100 according to this exemplary embodiment will be described with reference to FIG. 2.

[0020] FIG. 2 is a front view of the remote controller of the sanitary cleansing device according to this exemplary embodiment.

[0021] As shown in FIG. 2, remote controller 300 includes wide cleansing switch 305, rhythm cleansing switch 306, water force setting switches 307 and 308, move cleansing switch 309, and cleansing position setting switches 310 and 311 which are provided on an upper part of controller main body 301, and stop switch 302 for instructing cleansing operation, buttock switch 303, and bidet switch 304 which are provided on a lower part of controller main body 301.

[0022] As shown in FIG. 1, when the user operates the respective switches of the operation part of remote controller 300, predetermined signals according to the respective switches of main body 200 are transmitted from remote controller 300, for example, by radio. Controller 4 (see FIG. 3) of main body 200 controls operation of respective components of main body 200 and toilet seat 400 based on the received signals. For example, in a case where the user depresses buttock cleansing button 303 or bidet cleansing button 304, controller 4 moves nozzle part 20 of main body 200, such as buttock nozzle 1 and bidet nozzle 2, jets cleansing water, and cleanses the private part of the user. At this time, the user sets one of a plurality of water force levels from cleansing water force "weak" to cleansing water force "strong" with water force setting switches 307 and 308, at a time of buttock

cleansing and at a time of bidet cleansing. Then, in accordance with set water force, controller 4 controls quantity of cleansing water to be jetted from nozzle part 20, to cleanse the private part.

[0023] Hereinafter, configurations and actions of a water supply system and a control system in main body 200 of sanitary cleansing device 100 of this exemplary embodiment will be described with reference to FIG. 3.

[0024] FIG. 3 is a schematic diagram showing a configuration of the main body of the sanitary cleansing device according to this exemplary embodiment.

[0025] As shown in FIG. 3, main body 200 of sanitary cleansing device 100 is configured by controller 4 having water level controller 4s, branch faucet 5, strainer 6, solenoid valve 7, atmosphere open part 8, flow regulating valve 9, heat exchanger 12, temperature sensors 13a and 13b, displacement pump 14, buffer tank 15, switching valve 16, nozzle part 20, toilet bowl nozzle motor 40m, and the like. As described above, nozzle part 20 of main body 200 is configured by buttock nozzle 1, bidet nozzle 2, and nozzle cleansing nozzle 3, toilet bowl nozzle 40, and the like, and switching valve 16 includes switching valve motor 16m.

[0026] As shown in FIG. 3, branch faucet 5 is inserted into tap water piping 201 that serves as a supply source of cleansing water, and is connected to cleansing water flow passage 202 that reaches buttock nozzle 1 and bidet nozzle 2 which configure the cleansing nozzle. Into cleansing water flow passage 202, flow regulating valve 9, strainer 6, solenoid valve 7, atmosphere open part 8 having tank 8a including vacuum braker 31 and relief valve 51, temperature sensor 13a, heat exchanger 12, temperature sensor 13b, buffer tank 15, displacement pump 14, and switching valve 16 are sequentially inserted from branch faucet 5.

[0027] Furthermore, toilet bowl nozzle 40 that configures nozzle part 20 is connected to an end of toilet bowl cleansing water flow passage 205 branched from cleansing water flow passage 202 by switching valve 16. Toilet bowl nozzle 40 is mounted with toilet bowl nozzle motor 40m.

[0028] Now, flow of cleansing water in main body 200 of sanitary cleansing device 100, and control of the respective components of main body 200 by controller 4 will be described with reference to FIG. 3.

[0029] First, as shown in FIG. 3, tap water that flows through tap water piping 201 is supplied to strainer 6 as cleansing water by branch faucet 5. Then, strainer 6 removes dust, impurities, and the like included in the cleansing water.

[0030] Controller 4 controls solenoid valve 7 to switch a supply state of the cleansing water. At this time, pressure of cleansing water that passes through flow regulating valve 9 formed from a rubber variable orifice having an orifice diameter changed by action water pressure, and flows in cleansing water flow passage 202 is reduced.

[0031] The cleansing water controlled by solenoid

valve 7 is supplied to heat exchanger 12 having a heater provided downstream of atmosphere open part 8, and upstream of displacement pump 14, via atmosphere open part 8 which is hereinafter described in detail.

[0032] Heater 12h of heat exchanger 12 heats the cleansing water supplied through cleansing water flow passage 202 to a predetermined temperature (temperature set by a cleansing temperature setting part (not shown) of the operation part such as the remote controller), for example, 39°C. At this time, displacement pump 14 (hereinafter, referred to as a "displacement pump") that serves as a pulsation pump connected to heat exchanger 12 is driven and controlled by water level controller 4s of controller 4, and cleansing water having a flow rate according to operation speed of displacement pump 14 is discharged from buttock nozzle 1 or bidet nozzle 2 that serves as the cleansing nozzle. Therefore, controller 4 controls heating operation by heater 12h of heat exchanger 12 based on measured temperature values measured by temperature sensors 13a and 13b and a flow rate of cleansing water controlled by displacement pump 14.

[0033] The cleansing water heated by heater 12h of heat exchanger 12 is pumped to switching valve 16 through buffer tank 15 by displacement pump 14. Then, switching valve 16 is switched to buttock nozzle 1 or bidet nozzle 2 that serves as the human body cleansing nozzle, or nozzle cleansing nozzle 3 for cleansing a nozzle, by controller 4. Additionally, switching valve 16 is switched to toilet bowl nozzle 40 that discharges the cleansing water to a toilet bowl surface in order to perform the pre-cleansing of the toilet bowl, back part cleansing of the toilet bowl, and the like.

[0034] At this time, buffer tank 15 acts as a temperature buffer part of the heated cleansing water. That is, the cleansing water pumped to switching valve 16 controls generation of temperature irregularity. Total capacity of heat exchanger 12 and buffer tank 15 is preferably from 15 cc to 30 cc, and more preferably from 20 cc to 25 cc. Consequently, in a general sanitary cleansing device, temperature fluctuation of cleansing water can be suppressed with optimum responsiveness.

[0035] Then, controller 4 controls operation of switching valve motor 16m, switching valve 16 is switched to any of buttock nozzle 1, bidet nozzle 2, nozzle cleansing nozzle 3, and toilet bowl nozzle 40, which configure nozzle part 20 of the cleansing nozzle, and the cleansing water pumped from displacement pump 14 is supplied. Consequently, the cleansing water is jetted from any of buttock nozzle 1, bidet nozzle 2, nozzle cleansing nozzle 3, and toilet bowl nozzle 40.

[0036] Buttock nozzle 1, and bidet nozzle 2 are used to cleanse the private part of the user. Nozzle cleansing nozzle 3 is used to cleanse parts of buttock nozzle 1 and bidet nozzle 2 that protrude inside toilet bowl 700. Furthermore, toilet bowl nozzle 40 is used to cleanse the inside of the toilet bowl.

[0037] Now, the atmosphere open part provided in the

main body of the sanitary cleansing device according to this exemplary embodiment will be described with reference to FIG. 4.

[0038] FIG. 4 is a schematic diagram showing an example of the atmosphere open part of the sanitary cleansing device according to this exemplary embodiment.

[0039] As shown in FIG. 4, atmosphere open part 8 is configured by at least tank 8a having water inlet 8b, water outlet 8d, and atmosphere open hole 8c, water level sensor 11, vacuum braker 31, relief valve 51, and the like. Water inlet 8b of tank 8a is provided at an upstream side of tank 8a, and cleansing water such as tap water is injected in tank 8a via solenoid valve 7 of main body 200. Water outlet 8d of tank 8a flows cleansing water to heat exchanger 12 that is provided at a downstream side of tank 8a. Water level sensor 11 detects a water level of cleansing water stored in tank 8a, to output, for example, a conduction signal. Atmosphere open hole 8c of tank 8a is provided on an upper part of vacuum braker 31 provided in tank 8a, and an upper part of inside of tank 8a is opened to atmosphere, so that air layer 8e is formed. Although the figure does not show, a pipe that guides cleansing water overflowed from tank 8a due to failure into toilet bowl 700 is connected to atmosphere open hole 8c of tank 8a.

[0040] At this time, tank 8a that configures atmosphere open part 8 temporarily stores cleansing water such as tap water supplied from a supply source, in which a temperature is fluctuated depending on a surrounding environment, and suppresses the temperature to almost an indoor environment temperature. That is, tank 8a acts as an inflow water temperature buffer part of cleansing water. Therefore, temperature dispersion of cleansing water that enters from the supply source is buffered to some extent, and cleansing water whose temperature is not rapidly changed can be supplied from tank 8a to heat exchanger 12. Consequently, a burden of electric power or the like can be reduced, when heater 12h of heat exchanger 12 heats cleansing water. Additionally, it is possible to further reduce discharge temperature irregularity of cleansing water along with temperature buffer action of buffer tank 15.

[0041] Vacuum braker 31 is provided on an upper part of tank 8a, and prevents external leakage of the cleansing water in tank 8a in a case where tank 8a falls. Relief valve 51 is provided on the upper part of tank 8a, and opens (reduces) internal pressure in a case where internal pressure of tank 8a reaches predetermined pressure or more. Water level sensor 11 is configured by, for example, three electrodes of first sensor 11b, second sensor 11a, and third sensor 11c, lengths of which are different. Tip positions of first sensor 11b, second sensor 11a, and third sensor 11c are set so as to detect an upper limit water level or a lower limit water level by contact with cleansing water inside tank 8a. For example, the lower limit water level is detected by a state where the longest second sensor 11a of water level sensor 11 is soaked in the cleansing water, and middle first sensor 11b is not soaked

in the cleansing water, namely, by non-conduction between second sensor 11a and first sensor 11b. At this time, the tip position of first sensor 11b is disposed at at least the same position as, or a higher position than an upper end position 12g of heater 12h of heat exchanger 12 shown in FIG. 4. On the other hand, the upper limit water level is detected in a case where tip positions of all of three first, second, third sensors 11b, 11a, and 11c are soaked in the cleansing water.

[0042] As described above, water level sensor 11 shown in FIG. 4 is configured such that first sensor 11b, second sensor 11a, and third sensor 11c whose lengths are different are placed so as to protrude from the upper part of tank 8a in tank 8a, but is not limited to this. For example, water level sensor 11 may be configured such that three sensors (not shown) whose lengths are the same are disposed at positions corresponding to the tip positions of first sensor 11b, second sensor 11a, and third sensor 11c whose lengths are different, shown in FIG. 4, for example, high, middle and low height positions from side surface 8f of tank 8a. Consequently, the water level sensor can be configured by a single kind of sensors whose lengths are the same and short without using three kinds of sensors whose lengths are different. As a result, components that configure the sensors can be standardized from the three kinds to the single kind, and the sensors are configured by short sensors, thereby enabling reduction in a maintenance cost and a material cost.

[0043] Relief valve 51 may be disposed at an upstream side of atmosphere open part 8, and may be integrated with solenoid valve 7. Consequently, atmosphere open part 8, a main body of the sanitary cleansing device, or the like can be made compact.

[0044] Now, a configuration and operation of the displacement pump that serves as the pulsation pump provided in the main body of the sanitary cleansing device will be described with reference to FIG. 5.

[0045] FIG. 5 is a sectional view of the displacement pump of the sanitary cleansing device according to this exemplary embodiment.

[0046] As shown in FIG. 5, displacement pump 14 is configured by at least pump main body 81 having columnar space 82, pressure feeding piston 83, motor 86, link mechanism 89, and the like. At this time, pressure feeding piston 83 divides columnar space 82 of pump main body 81 into pump chamber 82a and pump chamber 82b.

[0047] Pump main body 81 has one side part provided with inflow parts 84 of cleansing water, and the other side part provided with outflow parts 85 of cleansing water. Inflow parts 84 are connected to heat exchanger 12 via cleansing water flow passage 202, and outflow parts 85 are connected to switching valve 16 via cleansing water flow passage 202.

[0048] Gear 87 mounted on a rotational shaft of motor 86, and gear 88 connected to link mechanism 89 mesh with each other, so that rotary motion of motor 86 is converted into reciprocating motion of pressure feeding piston 83 via link mechanism 89. That is, when motor 86

rotates, pressure feeding piston 83 reciprocates via gear 87, gear 88, and link mechanism 89.

[0049] Consequently, displacement pump 14 performs following operation.

[0050] When pressure feeding piston 83 moves downward, and capacity of pump chamber 82a increases, pressure of pump chamber 82a becomes lower than pressure of inflow parts 84. Therefore, cleansing water inside heat exchanger 12 is supplied from inflow part 84a to pump chamber 82a.

[0051] On the other hand, when pressure feeding piston 83 moves upward and capacity of pump chamber 82a is reduced, the pressure of pump chamber 82a becomes higher than pressure of outflow parts 85. Therefore, cleansing water supplied to pump chamber 82a is discharged to outflow part 85a.

[0052] Consequently, when the cleansing water in pump chamber 82a is discharged from outflow part 85a, the cleansing water is supplied into pump chamber 82b from inflow part 84b. Then, when the cleansing water in pump chamber 82a is supplied from inflow part 84a, the cleansing water in pump chamber 82b is discharged from outflow part 85b.

[0053] That is, by the upward and downward motion of pressure feeding piston 83, pressure is alternately applied to the cleansing water in pump chamber 82a and the cleansing water in pump chamber 82b. Additionally, reciprocating speed of pressure feeding piston 83 is changed during a single rotation, so that periodical pulsation can be applied to the cleansing water of inflow parts 84. At this time, as to pulsation pressure of the cleansing water, minimum pressure during pulsation is nearly equal to inflow pressure of displacement pump 14. On the other hand, maximum pressure of the pulsation pressure becomes pressure corresponding to a load of displacement pump 14 and speed of capacity change of displacement pump 14. Consequently, the cleansing water to which the pulsation pressure is applied is discharged from outflow parts 85 of displacement pump 14.

[0054] At this time, as shown in FIG. 3, opening to the atmosphere is allowed on an upstream side with respect to displacement pump 14 by atmosphere open part 8 inserted in cleansing water flow passage 202. That is, the inflow pressure of the cleansing water that flows into displacement pump 14 becomes atmospheric pressure (corresponding to 0 MPa at gauge pressure of an atmospheric pressure reference) without being affected by supply pressure of tap water being a supply source.

[0055] Therefore, for example, in a case where switching valve 16 switches to toilet bowl nozzle 40, cleansing water having a flow rate and pulsation pressure according to rotational speed of motor 86 of displacement pump 14 controlled by controller 4 are supplied to toilet bowl nozzle 40. Consequently, a jet flow of the cleansing water can be stably discharged into the toilet bowl from toilet bowl nozzle 40 at arbitrary pressure or an arbitrary flow rate without being affected by the supply pressure of the tap water being the supply source. As a result, the jet

flow of the cleansing water discharged from toilet bowl nozzle 40 can be prevented from splashing outside the toilet bowl. An installation position in a height direction of displacement pump 14 is preferably installed at a position lower than a water level of atmosphere open part 8. Consequently, pump head capacity of displacement pump 14 is reduced, and an energy loss can be reduced.

[0056] That is, sanitary cleansing device 100 of this exemplary embodiment includes displacement pump 14 provided on an upstream side with respect to toilet bowl nozzle 40, atmosphere open part 8 that allows a part of cleansing water flow passage 202 disposed on the upstream side with respect to displacement pump 14 to be open to the atmosphere, and controller 4 that controls each part. Therefore, the flow rate of the cleansing water jetted from toilet bowl nozzle 40 and the maximum pressure of pulsation are not affected by supply pressure of tap water supplied from the tap water piping serving as the supply source. That is, the flow rate of the cleansing water jetted from toilet bowl nozzle 40 and the maximum pressure of pulsation can be arbitrarily adjusted in accordance with operation speed of displacement pump 14 by controller 4. Consequently, the jet flow of the cleansing water discharged from toilet bowl nozzle 40 can be prevented from splashing outside the toilet bowl. Additionally, the toilet bowl surface is previously wetted by the jet flow of the cleansing water from toilet bowl nozzle 40, so that it is possible to prevent adhesion of feces. Furthermore, dirt already adhered to the toilet bowl surface can be effectively removed by the jet flow of the cleansing water from toilet bowl nozzle 40.

[0057] Hereinafter, reasons why the above operation and effects are obtained will be described.

[0058] Generally, in a case where the supply pressure of tap water acts on inflow parts 84 of displacement pump 14, the minimum pressure of the pulsation of displacement pump 14 becomes the supply pressure of tap water. At this time, when a load is constant at the maximum pressure of pulsation, the load is hardly changed, and therefore a pulsation width is reduced.

[0059] However, as in this exemplary embodiment, when opening to the atmosphere is allowed on the upstream side with respect to displacement pump 14 by atmosphere open part 8 of cleansing water flow passage 202, the pressure of inflow parts 84 of displacement pump 14 becomes nearly atmospheric pressure. Therefore, the minimum pressure of the pulsation of displacement pump 14 becomes the atmospheric pressure. On the other hand, the maximum pressure of pulsation of the displacement pump 14 is changeable by a number of rotations of motor 86 of displacement pump 14, and the pulsation width can be increased.

[0060] In this exemplary embodiment, the toilet bowl is cleansed by the jet of the cleansing water from toilet bowl nozzle 40. However, the present invention is not limited thereto. For example, the present invention may be applied to nozzle cleansing in a case where the private part of the human body is cleansed by buttock nozzle 1

or bidet nozzle 2 that serves as the cleansing nozzle, and operation and effects similar to those described below can be obtained.

[0061] That is, as described above, cleansing water on a primary side of displacement pump 14 is open to the atmosphere; therefore minimum pressure of pulsation pressure of cleansing water discharged from displacement pump 14 is atmospheric pressure, and maximum pressure is changeable by a number of rotations of motor 86 of displacement pump 14. Therefore, the flow rate is reduced by low speed rotation of motor 86 of displacement pump 14, so that it is possible to perform private part cleansing at small pressure amplitude of pulsation pressure with softer cleansing feeling. On the other hand, the flow rate of the cleansing water supplied to nozzle part 20 is increased by high speed rotation of motor 86 of displacement pump 14, so that pressure amplitude of pulsation pressure is increased, and it is possible to perform strong private part cleansing with stimulation feeling. That is, the pulsation width can be increased as the flow rate is increased. As a result, it is possible to provide a wider range of cleansing feeling to the user without being affected by the supply pressure of the tap water being the supply source.

[0062] Then, the number of rotations of displacement pump 14 is controlled, so that the flow rate of the cleansing water discharged from the cleansing nozzle is controlled, and controller 4 controls the number of rotations of motor 86 to a flow rate according to water force set by water force setting switches 307 and 308 of the operation part of remote controller 300. With this control, a user's desired flow rate is precisely maintained, thereby enabling an optimum flow rate in each cleansing. As a result, it is possible to realize a sanitary cleansing device with a good feeling in use.

[0063] As described above, sanitary cleansing device 100 of this exemplary embodiment performs variable control of the number of rotations of motor 86 of displacement pump 14 without providing any flow sensor or flow control valve, so that the flow rate of cleansing water can be controlled, and pulsation is applied to the cleansing water.

[0064] As shown in FIG. 4, sanitary cleansing device 100 of this exemplary embodiment includes water level sensor 11 that detects a water level of tank 8a, air layer 8e that opens the upper part of the inside of tank 8a to atmosphere, vacuum braker 31 that prevents external leakage of cleansing water in tank 8a, relief valve 51 that release the internal pressure of tank 8a, and the like, on an upper part of atmosphere open part 8 having tank 8a that stores cleansing water. For example, in a case where tank 8a is inclined to be turned upside down, and the cleansing water in tank 8a is about to be flown out when sanitary cleansing device 100 is detached from toilet bowl 700, and clean the toilet bowl, vacuum valve body 31a of vacuum braker 31 closes upper valve seat 31d. Consequently, it is possible to close a flow passage that allows cleansing water to leak from tank 8a to outside. As

a result, cleansing water can be prevented from leaking/dropping from tank 8a onto a floor or the like.

[0065] While vacuum valve body 31a made of, for example, rubber, of vacuum braker 31 is generally in contact with lower valve seat 31b by gravity, so that the inside of tank 8a is brought into a seal state, lower valve seat 31b of vacuum braker 31 includes communication slit 31c that serves as air vent. Therefore, communication slit 31c opens an upper part of the inside of tank 8a to the atmosphere to form air layer 8e.

[0066] Vacuum braker 31 of this exemplary embodiment is provided in tank 8a. Therefore, in a case where a side close to the tap water piping that is the supply source becomes negative pressure, air is sucked from vacuum braker 31 provided in the upper part of tank 8a. As a result, cleansing water at the downstream side with respect to tank 8a can be prevented from flowing back to the tap water piping that is the supply source of the cleansing water.

[0067] Relief valve 51 of this exemplary embodiment is configured by relief valve body 51a and relief spring 51b. Then, when tank 8a is turned upside down, set pressure of relief spring 51b of relief valve 51 is set to, for example, 0.1 MPa such that relief valve body 51a is not opened at water head pressure of the cleansing water. On the other hand, relief valve 51 is set so as to be opened at pressure lower than pressure at which tank 8a is damaged (for example, 0.4 MPa). Consequently, internal pressure of tank 8a is suppressed to a predetermined pressure or less, and reliability is enhanced.

[0068] Hereinafter, operation of the sanitary cleansing device of this exemplary embodiment will be described with reference to FIG. 1, FIG. 3, FIG. 6 and FIG. 7.

[0069] FIG. 6 is a time chart showing an example of operation of the sanitary cleansing device according to the first exemplary embodiment. FIG. 7 is a block diagram of the water level controller of the controller of the sanitary cleansing device according to the first exemplary embodiment.

[0070] FIG. 6 shows a flow of operation from when a user enters a toilet room until when the user leaves a seat and leaves the room, in time series from time t1 to time t22. Each item of operation of solenoid valve 7, a water level of tank 8a, output of a signal for regulating a flow rate from water level controller 4s, an operation mode of displacement pump 14, a switching flow passage of switching valve 16, and heater 12h of heat exchanger 12, shown in FIG. 6 shows operation corresponding to time series from time t1 to time t22.

[0071] As shown in FIG. 6 and FIG. 7, in time t1, when room entry detection sensor 600 detects that the user has entered the toilet room, third sensor 11c of water level sensor 11 detects whether or not an amount of cleansing water in tank 8a is at the upper limit water level. Generally, the sanitary cleansing device is used, and after the user leaves the seat, water is supplied until the water level of tank 8a reaches a full level (upper limit water level) (until third sensor 11c detects the cleansing

water), and preparation is made for next use. However, in a case where the water level of tank 8a does not reach the full level (upper limit water level) when the entry of the user is detected, solenoid valve 7 is turned on and water is supplied until third sensor 11c detects the cleansing water.

[0072] Then, when the cleansing water in tank 8a is at the upper limit water level, displacement pump 14 is driven, and switching valve 16 is switched to a flow passage for toilet bowl cleansing to start toilet bowl cleansing. At the same time, heater 12h of heat exchanger 12 is energized, and "preheating" for previously heating the cleansing water in tank 8a is performed.

[0073] In time t2 during toilet bowl cleansing, when the cleansing water is reduced up to first sensor 11b that detects the lower limit water level, flow rate calculator 4s2 of water level controller 4s calculates a flow rate (referred to as flow rate reading in the figure), outputs a signal corresponding to the flow rate, and adjusts the number of rotations of displacement pump 14 through pump controller 4s3. At this time, displacement pump 14 is driven at the number of rotations previously set in a cleansing mode of toilet bowl cleansing. However, a gap between a flow rate actually discharged, and a set flow rate previously set in the toilet bowl cleansing may be caused by aged deterioration, variations in components, or the like. Therefore, flow rate calculator 4s2 first calculates an actual flow rate per unit time from reduction speed of the water level of tank 8a. Then, when a gap between the actual flow rate and the set flow rate in toilet bowl cleansing is present, the number of rotations of displacement pump 14 or the like is corrected to be adjusted based on a value of the calculated flow rate. Consequently, it is possible to pump out cleansing water from inside of tank 8a at a more accurate flow rate.

[0074] In time t3, controller 4 stops the toilet bowl cleansing and the preheating.

[0075] Then, a human body is detected, and in time t4 after, for example, 6 seconds, the user sits on a toilet seat.

[0076] After the user has relieved himself/herself, in time t5, when the user presses down buttock switch 303 (or bidet switch 304) of the operation part such as remote controller 300, nozzle cleansing nozzle 3 first performs nozzle cleansing at a position where buttock nozzle 1 (or bidet nozzle 2) is housed in a main body of the sanitary cleansing device. Then, after the nozzle cleansing is performed for a predetermined time, buttock nozzle 1 is made to protrude toward inside of the toilet bowl from the main body to a cleansing position, in time t6, and starts human body cleansing in time t7.

[0077] At this time, during the nozzle cleansing, the cleansing water in tank 8a is used, and displacement pump 14 and switching valve 16 are driven in accordance with a cleansing mode of each cleansing nozzle. Additionally, heater 12h of heat exchanger 12 is energized to heat cleansing water during use of the cleansing water.

[0078] Following description covers an example of a case where the user first sets cleansing water force

"weak" with the operation part such as remote controller 300 such as remote control, starts human body cleansing for a period from time t7 to time t12, changes cleansing water force to "strong", and performs human body cleansing for a period from time t12 to time t16.

[0079] When the water level of the inside of tank 8a is reduced up to first sensor 11b in time t8 during the human body cleansing with cleansing water force "weak", solenoid valve 7 is turned on while the human body cleansing is continued, and water is supplied till time t9 when third sensor 11c detects the upper limit water level (full level) of cleansing water.

[0080] Then, during buttock cleansing with cleansing water force "weak", water flow rate calculator 4s2 of level controller 4s of controller 4 calculates an actual flow rate per unit time that is used during human body cleansing with "weak", at timing of time t10 when the water level of the inside of tank 8a is reduced from third sensor 11c to second sensor 11a, and outputs a signal corresponding to the flow rate. At this time, when a gap between a set flow rate with water force of buttock cleansing "weak" previously set, and an actual flow rate is present, water level controller 4s of controller 4 controls displacement pump 14 through pump controller 4s3, and corrects the number of rotations or the like to perform adjustment. Consequently, it is possible to accurately adjust a jetting amount of cleansing water controlled by displacement pump 14. In time t8, when the water level of the cleansing water in tank 8a is lowered up to first sensor 11b that detects the lower limit water level, water supply is needed. However, in this case, the flow rate is not adjusted. This reason is that when the water level of the inside of tank 8a is lowered from the upper limit water level of third sensor 11c up to the lower limit water level of first sensor 11b, the control is performed during transition between a cleansing mode of the nozzle cleansing and a cleansing mode of the buttock cleansing with cleansing water force "weak". That is, during a period from water supply to next water supply, in a case where flow rate control by the number of rotations of displacement pump 14 is in transition between different cleansing modes, or includes a lapse of time such as driving for protruding a nozzle, the flow rate reading is not performed. That is, only in a case where the water level of the cleansing water in tank 8a is lowered from the upper limit water level of third sensor 11c to the lower limit water level of first sensor 11b in a single cleansing mode, the flow rate reading is performed, and adjustment by flow rate correction or the like is performed. Consequently, it is possible to accurately perform pumping at an accurate flow rate in each cleansing mode.

[0081] Generally, it is estimated that standard cleansing time for continuing a single human body cleansing is around 30 seconds. Therefore, an installation position is determined such that stored water quantity (capacity) of cleansing water between third sensor 11c and first sensor 11b of tank 8a is 60 cc. This reason is that, even in a case where the human body cleansing is performed, for

example, at a minimum flow rate of about 300 cc/min (in a case where the buttock cleansing is performed with cleansing water force "weak") for only 15 seconds, a flow rate is always adjusted at least once.

[0082] Then, in a case where the human body cleansing is performed with cleansing water force "strong" for a period from time t12 to time t16, when it is detected that the water level of the cleansing water in tank 8a is reduced in time t13, water is supplied to tank 8a. However, in this case, as described above, cleansing water is reduced during transition between different cleansing modes (from cleansing water force "weak" to cleansing water force "strong") of flow rate setting, and therefore the flow rate is not adjusted.

[0083] Thereafter, in a period from time t14 to time t15, in a case where the cleansing water in tank 8a is reduced, the control is in the same cleansing mode of the human body cleansing with cleansing water force "strong", and therefore water level controller 4s calculates a flow rate, and corrects the number of rotations of displacement pump 14 as necessary to perform adjustment.

[0084] In time t16, when the user presses down stop switch 302 of the operation part such as remote controller 300, controller 4 and water level controller 4s stop driving of displacement pump 14, and heater 12h of heat exchanger 12. At this time, water is supplied until the water level of the cleansing water in tank 8a reaches the full level that is the upper limit water level (detected by third sensor 11c).

[0085] In a period from time t16 to time t17, controller 4 moves the cleansing nozzle from a protruding position to a housing position of the inside of the main body. Thereafter, in a period from time t17 to time t18, the nozzle that has been used at the housing position is after-cleansed, and the operation is stopped.

[0086] In a period from time t19 to time t20, when the user leaves the toilet seat, nozzle cleansing after the leaving from the toilet seat is performed.

[0087] In order to prepare for use by a next user after the user leaves the toilet room, during the nozzle cleansing after the leaving from the toilet seat, or after the nozzle cleansing after the leaving from the toilet seat, in a period from time t21 to time t22, water level controller 4s of controller 4 opens solenoid valve 7, and supplies cleansing water into tank 8a to make the cleansing water reach the full level.

[0088] Thus, a series of operation of the sanitary cleansing device of this exemplary embodiment is performed.

[0089] At this time, water level controller 4s of controller 4 suitably performs correction by a flow rate value measured by water level sensor 11, while basically controlling a flow rate of cleansing water discharged by displacement pump 14. The correction is not necessarily performed in each cleansing mode every time, but may be performed in a case where a flow rate gap is caused by variations in components, an influence of aged deterioration during use for a long period, or the like. Conse-

quently, a proper flow rate can be jetted from the cleansing nozzle according to each cleansing mode for a long period.

[0090] Hereinafter, a configuration of water level controller 4s of controller 4 of sanitary cleansing device of this exemplary embodiment will be described in detail with reference to FIG. 7.

[0091] Controller 4 of sanitary cleansing device of this exemplary embodiment has a microcomputer (not shown), and previously stores an optimum flow rate in each cleansing mode, and an optimum flow rate in water force selected by the user. Then, controller 4 corrects the number of rotations of displacement pump 14 or the like based on output of water level sensor 11 to perform driving such that the flow rate becomes a flow rate corresponding to the cleansing mode.

[0092] As shown in FIG. 7, water level controller 4s of controller 4 of the sanitary cleansing device has at least time detector 4s1, flow rate calculator 4s2, pump controller 4s3, water level detector 4s4, and solenoid valve controller 4s5. Time detector 4s1 measures time until the water level of tank 8a reaches the lower limit water level from the upper limit water level, based on a signal of water level sensor 11. Flow rate calculator 4s2 calculates a flow rate discharged by displacement pump 14 by dividing a capacity from the upper limit water level to the lower limit water level of tank 8a (corresponding to a capacity of cleansing water) by the time measured by time detector 4s1. Pump controller 4s3 corrects and adjusts operation speed (the number of rotations, or the like) of displacement pump 14 such that the flow rate becomes a flow rate selected with water force setting switches 307 and 308 of the operation part by the user, based on a value of the flow rate calculated by flow rate calculator 4s2. Water level detector 4s4 detects the water level of the cleansing water in tank 8a, based on the signal detected by water level sensor 11 provided in tank 8a. Solenoid valve controller 4s5 controls solenoid valve 7 so as to maintain the cleansing water in tank 8a within a range from the upper limit water level to the lower limit water level, and supplies tap water into tank 8a.

[0093] Hereinafter, correction operation of the pump controller of the water level controller of the controller in the sanitary cleansing device of this exemplary embodiment will be described with reference to FIG. 7 and FIG. 8.

[0094] FIG. 8 is a flowchart showing the correction operation of the water level controller of the controller in the sanitary cleansing device of this exemplary embodiment.

[0095] FIG. 8 illustrates the correction operation of the water level controller in a case where the flow rate is reduced for a period from time t2 to time t3 of FIG. 6, as an example.

[0096] As shown in FIG. 8, controller 4 first protrudes buttock nozzle 1 (or bidet nozzle 2) instructed by the operation part such as the remote controller 300, into toilet bowl 700 (nozzle protrusion). Then, a flow passage that leads to buttock nozzle 1 (or bidet nozzle 2) instructed

by switching valve 16 is opened, and cleansing is started (Step S1).

[0097] Next, water level controller 4s causes water level detector 4s4 to determine whether or not third sensor 11c of water level sensor 11 is soaked in the cleansing water (Step S2). Second sensor 11a of water level sensor 11 is installed at the lowest position of a common sensor (is always soaked in the water).

[0098] In a case where third sensor 11c of water level sensor 11 is soaked in the cleansing water (YES in Step S2), the water level of the cleansing water is at the upper limit water level of tank 8a. This state is determined by detection of a current between second sensor 11a and third sensor 11c of water level sensor 11 by water level detector 4s4.

[0099] Then, solenoid valve controller 4s5 of water level controller 4s controls so as to maintain a state where solenoid valve 7 is closed (turn off solenoid valve 7) (Step S3).

[0100] On the other hand, in a case where third sensor 11c of water level sensor 11 is not soaked in the cleansing water (NO in Step S2), a signal is output to solenoid valve controller 4s5 when water level detector 4s4 detects the lower limit water level at which first sensor 11b does not detect the cleansing water (not shown), solenoid valve 7 is turned on, and water is supplied up to the upper limit water level (Step S11).

[0101] Then, time detector 4s1 of water level controller 4s starts counting time from the state where third sensor 11c of water level sensor 11 is soaked in the cleansing water (Step S4). At this time, displacement pump 14 jets the cleansing water from buttock nozzle 1, so that the water level of the cleansing water in tank 8a is gradually lowered.

[0102] Water level controller 4s causes water level detector 4s4 to determine whether or not first sensor 11b of water level sensor 11 is soaked in the cleansing water (Step S5). At this time, in a case where first sensor 11b of water level sensor 11 is not soaked in the cleansing water (NO in Step S5), the water level of the cleansing water is at the lower limit water level of tank 8a. That is, water level detector 4s4 does not detect a current between first sensor 11b and second sensor 11a. On the other hand, in a case where first sensor 11b of water level sensor 11 is soaked in the cleansing water (YES in Step S5), water level detector 4s4 waits until first sensor 11b is not soaked in the cleansing water.

[0103] When first sensor 11b of water level sensor 11 is not soaked in the cleansing water, time detector 4s1 of water level controller 4s terminates the counting of the time (Step S6). Consequently, time t during which the cleansing water in tank 8a is reduced from the upper limit water level detected by third sensor 11c to the lower limit water level detected by first sensor 11b is measured.

[0104] Water flow rate calculator 4s2 of level controller 4s calculates flow rate V by dividing capacity Q of the cleansing water in tank 8a from the upper limit water level detected by third sensor 11c to the lower limit water level

detected by first sensor 11b, by time t described above.

[0105] Next, for example, set flow rate V_i previously jetted from displacement pump 14 in the cleansing mode is compared with flow rate V calculated in the above measurement (Step S8). At this time, in a case where set water volume V_i is equal to calculated flow rate V (YES in Step S8), pump controller 4s3 of water level controller 4s maintains the number of rotations of displacement pump 14 (Step S9), returns to Step S2, and performs similar processes subsequent to Step S2.

[0106] On the other hand, in a case where set water volume V_i is different from calculated flow rate V (NO in Step S8), pump controller 4s3 of water level controller 4s corrects and adjusts the number of rotations of displacement pump 14 such that set water volume V_i is equal to calculated flow rate V (Step S10), returns to Step S2, and performs similar processes subsequent to Step S2.

[0107] As described above, water level controller 4s of the sanitary cleansing device of this exemplary embodiment includes water level controller 4s that has at least time detector 4s1, flow rate calculator 4s2, and pump controller 4s3. Consequently, the operation speed (the number of rotations or the like) of displacement pump 14 is automatically adjusted so as to maintain a desired flow rate set with water force setting switches 307 and 308 by the user, without any additional flow sensor. Furthermore, in a case where a flow rate per unit time can be calculated based on the flow rate measured by water level sensor 11, the number of rotations of displacement pump 14 or the like can be corrected by use of a calculated value to perform control. As a result, it is possible to realize a downsized, compact and low-cost sanitary cleansing device that does not cause a gap with a set flow rate, and has a good feeling in use.

[0108] In the sanitary cleansing device of this exemplary embodiment, relief valve 51 is not provided on a lower part or a bottom of tank 8a, but provided to face air layer 8e at the upper part of tank 8a. Therefore, valve seat contact surface 51c of relief valve body 51a is in the air in ordinary use, and therefore relief valve 51 is never exposed (soaked) to the cleansing water. In a case where relief valve 51 is provided on the lower part or the bottom of tank 8a, valve seat contact surface 51c of relief valve body 51a is exposed (soaked) to the cleansing water; therefore, there is a possibility of causing failure such as no operation due to adhesion of water scale, and no water heating of heat exchanger 12 caused by escaping of cleansing water in tank 8a and heat exchanger 12 due to generation of refuse clogging on valve seat contact surface 51c of relief valve body 51a. Therefore, relief valve 51 is not provided on the lower part or the bottom of tank 8a, but provided to face air layer 8e at the upper part of tank 8a, so that it is possible to further reduce a risk of no water heating by heat exchanger 12.

[0109] In a case where water level sensor 11 and water level detector 4s4 of water level controller 4s detect the lower limit water level of the cleansing water in tank 8a,

and in a case where the user leaves toilet seat 400 and a predetermined time elapses, controller 4 of this exemplary embodiment supplies water until the water level of the cleansing water in tank 8a reaches the upper limit water level (corresponding to a position of third sensor 11c), and thereafter solenoid valve controller 4s5 stops driving operation of solenoid valve 7 or the like. Consequently, the water level of the cleansing water in tank 8a can be made at a position higher than upper end position 12g of heater 12h of heat exchanger 12 shown in FIG. 4. As a result, heater 12h of heat exchanger 12 is not exposed from the cleansing water, so that it is possible to prevent no water burning by heater 12h (no water heating of heat exchanger 12).

[0110] Controller 4 of this exemplary embodiment causes the microcomputer of controller 4 to measure a predetermined time until the water level of the cleansing water in tank 8a normally sufficiently reaches the upper limit water level after solenoid valve 7 is opened (solenoid valve 7 is turned on). Then, in a case where solenoid valve 7 is not closed (solenoid valve 7 is not turned off) even when the measured predetermined time has elapsed, solenoid valve 7 is forcibly closed through solenoid valve controller 4s5 of water level controller 4s, and energization to heater 12h or the like is stopped. Consequently, even in a case where water level sensor 11 is broken, controller 4 can safely stop operation of main body 200 of the sanitary cleansing device. For example, in a case where water level sensor 11 is not operated, and tank 8a reaches the full level, vacuum valve body 31a of vacuum braker 31 closes upper valve seat 31d to allow sealing. When the inside of tank 8a reaches relief pressure or more, pressure in the tank is released from relief valve 51, and water is allow to escape into the toilet bowl.

[0111] Controller 4 of this exemplary embodiment has water level controller 4s that maintains the water level of the inside of tank 8a and air layer 8e within predetermined ranges, by opening solenoid valve 7 when the water level of tank 8a is at the lower limit water level, and closing solenoid valve 7 when the water level is at the upper limit water level. Then, water level controller 4s controls opening/closing of solenoid valve 7 with the signal from water level sensor 11, thereby enabling a simple configuration that needs no reducing valve. Consequently, a water surface of tank 8a is maintained between the upper limit water level and the lower limit water level, and water is stably supplied to displacement pump 14 at water pressure in which the inside of the tank is open to the atmosphere. As a result, it is possible to realize a downsized and compact sanitary cleansing device.

SECOND EXEMPLARY EMBODIMENT

[0112] Hereinafter, a sanitary cleansing device according to a second exemplary embodiment of the present invention, and a toilet device with the same will be described with reference to FIG. 9.

[0113] FIG. 9 is a schematic diagram of an atmosphere open part of the sanitary cleansing device according to the second exemplary embodiment of the present invention.

[0114] That is, the sanitary cleansing device of this exemplary embodiment is different from the sanitary cleansing device of the first exemplary embodiment in which atmosphere open part 8 and heat exchanger 12 are formed by separate components, in that atmosphere open part 8 and heat exchanger 12 are integrally formed. Other configurations are identical to those of the sanitary cleansing device of the first exemplary embodiment, and descriptions thereof are omitted.

[0115] That is, as shown in FIG. 9, in the sanitary cleansing device of this exemplary embodiment, heater 12h of heat exchanger 12 is incorporated in and integrally formed with tank 8a of atmosphere open part 8.

[0116] Consequently, a number of components of the sanitary cleansing device can be reduced. As a result, it is possible to implement a more compact and low-cost sanitary cleansing device.

[0117] As shown in FIG. 9, cleansing water is supplied so as to trace a surface of heater 12h of heat exchanger 12 from water inlet 8b of tank 8a. Consequently, heat exchange on the surface of heater 12h is facilitated, and the heat exchange efficiency to the cleansing water can be enhanced. As a result, warm water of the cleansing water stored in tank 8a is stirred, so that temperature irregularity of the cleansing water can be reduced. Other operation and effects are identical to those of the sanitary cleansing device of the first exemplary embodiment, and therefore descriptions thereof are omitted.

[0118] In the first exemplary embodiment, water inlet 8b is provided in the upper part of tank 8a so as to face air layer 8e. However, the position of water inlet 8b is not limited to this. For example, similarly to a configuration of the second exemplary embodiment, water inlet 8b may be provided at at least a position where the cleansing water is present from a lower part of a side surface of tank 8a, so that the cleansing water is supplied into tank 8a. Consequently, it is possible to prevent generation of water supply noise in a case where water is supplied from the upper part of tank 8a to air layer 8e, or mixing of bubbles into the cleansing water in tank 8a. Additionally, the mixing of bubbles into the cleansing water is suppressed, so that it is possible to enhance reliability of water level detection of the cleansing water in tank 8a by water level sensor 11, and to improve measurement accuracy of a flow rate.

[0119] In the second exemplary embodiment, water inlet 8b is provided on the lower part of the side surface of tank 8a. However, the position of water inlet 8b is not limited to this. For example, in a case where the generation of water supply noise, or the mixing of bubbles into the cleansing water in tank 8a is not a problem, water inlet 8b may be provided in the upper part of tank 8a so as to face air layer 8e. Consequently, the water supply noise can make the user recognize water supply of the

cleansing water.

[0120] In each of the above exemplary embodiments, the sanitary cleansing device includes the toilet bowl nozzle. However, the present invention is not limited to this. A sanitary cleansing device that includes no toilet bowl nozzle may be employed. Consequently, it is possible to realize a sanitary cleansing device having a simple configuration at a low cost.

[0121] As described above, a sanitary cleansing device of the present invention includes: a cleansing nozzle configured to discharge cleansing water; and a cleansing water flow passage configured to allow the cleansing water from a supply source to flow toward the cleansing nozzle. The cleansing water flow passage has: a displacement pump configured to control a flow rate of the cleansing water discharged from the cleansing nozzle; an atmosphere open part disposed at an upstream side of the displacement pump, configured to open a part of the cleansing water flow passage to atmosphere, and having a tank for storing the cleansing water, and a water level sensor for detecting a water level in the tank to output a signal; a solenoid valve configured to pass and block the cleansing water supplied from the supply source to the atmosphere open part; and a controller configured to control the displacement pump and the solenoid valve. Furthermore, the controller calculates a flow rate of the cleansing water supplied per unit time from the supply source based on the signal of the water level sensor, and corrects control of the displacement pump.

[0122] According to this configuration, the displacement pump is disposed downstream of the atmosphere open part, so that the number of rotations of the displacement pump is controlled with no influence of supply pressure of the water supply source, and the flow rate of the cleansing water discharged from the cleansing nozzle is controlled. Furthermore, the water level sensor measures a flow rate of water that has actually passed, and feeds back the measured flow rate to the controller, so that control of the displacement pump is corrected. Consequently, with the correction of the flow rate detected by the water level sensor, the displacement pump can be controlled with no influence of variations in components, aged deterioration, or the like. As a result, it is possible to perform accurate and stable flow rate control over a long period without providing any flow sensor or flow control valve, and to realize a sanitary cleansing device that has a simple configuration and has a good feeling in use.

[0123] The sanitary cleansing device of the present invention may include a heat exchanger having a heater for heating the cleansing water, between downstream of the atmosphere open part and upstream of the displacement pump, wherein the controller may control the heater.

[0124] According to this configuration, the water can be made to flow in the heat exchanger from the tank of the atmosphere open part by operation of the displacement pump, and therefore inflow water to the heat ex-

changer is stably controlled with no influence of supply pressure of the supply source. Furthermore, the displacement pump can reduce influence of a drawn flow rate due to an environmental factor of the supply source. Consequently, precision flow rate control improves precision of a heating temperature of the cleansing water by heating temperature control by the heater of the heat exchanger, and a stable jet can be discharged.

[0125] In the sanitary cleansing device of the present invention, the tank of the atmosphere open part may have a function of inflow water temperature buffer part.

[0126] According to this configuration, by the cleansing water that enters from the supply source is temporarily stored in the tank, the temperature dispersion can be buffered to some extent. Therefore, cleansing water with no rapid temperature change can be supplied from the tank to the heat exchanger by the buffered cleansing water. As a result, when the heater of the heat exchanger heats the cleansing water, a burden of electric power or the like can be reduced, and irregularity of a discharge temperature of the cleansing water can be prevented.

[0127] In the sanitary cleansing device of the present invention, the cleansing nozzle has a nozzle part including at least a private part cleansing nozzle for performing private part cleansing, and a bidet cleansing nozzle, and the sanitary cleansing device further includes an operation part configured to allow selection of a cleansing mode by the nozzle part. The controller may control a jet flow rate of the cleansing water in accordance with the cleansing mode of the nozzle part selected by the operation part, and correct flow rate control of the displacement pump based on a flow rate detected by the water level sensor at a time of cleansing in the cleansing mode selected by the operation part.

[0128] According to this configuration, the flow rate discharged from the displacement pump is corrected based on the flow rate detected by the water level sensor, to be controlled and adjusted, according to the cleansing mode selected by the operation part. Consequently, the flow rate according to the cleansing mode can be more accurately controlled by the displacement pump.

[0129] In the sanitary cleansing device of the present invention, the water level sensor may detect an upper limit water level and a lower limit water level in the tank, the controller may have a water level controller configured to calculate a flow rate per unit time when the water level is changed from the upper limit water level to the lower limit water level, and a quantity of stored water from the lower limit water level to the upper limit water level may be set to be a quantity of water smaller than a total flow rate used for a single standard cleansing time in any one of a plurality of the cleansing modes.

[0130] According to this configuration, in a case of ordinary use, in a single cleansing, the water level of the inside of the tank is changed from the upper limit water level to the lower limit water level at least once. Therefore, the flow rate per unit time is calculated, and the displacement pump is controlled, so that the flow rate of the

cleansing water to be jetted is corrected. Therefore, the quantity of water stored in the tank can be minimized. Consequently, a main body can be downsized, and the flow rate can be suitably corrected without failure.

[0131] The sanitary cleansing device of the present invention may include a heater of a heat exchanger is disposed inside the tank of the atmosphere open part for heating at least the stored cleansing water. Consequently, it is possible to reduce the number of components of the sanitary cleansing device. As a result, it is possible to realize a compact and low-cost sanitary cleansing device.

INDUSTRIAL APPLICABILITY

[0132] The present invention is capable of stably supplying a jet flow having arbitrary pulsation from a cleansing nozzle, and therefore is useful not only for a warm water cleansing toilet seat, but a sanitary cleansing device for a face, a head, hands, feet, and the like, or a cleansing device for cleansing of animals such as pets or things other than living things.

REFERENCE MARKS IN THE DRAWINGS

[0133]

1	cleansing nozzle (buttock nozzle)
2	cleansing nozzle (bidet nozzle)
3	nozzle cleansing nozzle
4	controller
4s	water level controller
4s1	time detector
4s2	flow rate calculator
4s3	pump controller
4s4	water level detector
4s5	solenoid valve controller
5	branch faucet
6	strainer
7	solenoid valve
8	atmosphere open part
8a	tank
8b	water inlet
8c	atmosphere open hole
8d	water outlet
8e	air layer
8f	side surface
9	flow regulating valve
11	water level sensor
11a	second sensor
11b	first sensor
11c	third sensor
12	heat exchanger
12h	heater
12g	upper end position
13a, 13b	temperature sensor
14	pulsation pump (displacement pump)
15	buffer tank

16	switching valve
20	nozzle part
31	vacuum braker
31a	vacuum valve body
5 31b	lower valve seat
31c	communication slit
31d	upper valve seat
40	toilet bowl nozzle
51	relief valve
10 51a	relief valve body
51b	relief spring
51c	valve seat contact surface
81	pump main body
82	columnar space
15 82a, 82b	pump chamber
83	pressure feeding piston
84, 84a, 84b	inflow part
85, 85a, 85b	outflow part
86	motor
20 87, 88	gear
89	link mechanism
100	sanitary cleansing device
200	main body
201	tap water piping
25 202	cleansing water flow passage
205	toilet bowl cleansing water flow passage
300	remote controller
301	controller main body
302	stop switch
30 303	buttock switch
304	bidet switch
305	wide cleansing switch
306	rhythm cleansing switch
307	water force setting switch
35 309	move cleansing switch
310	cleansing position setting switch
400	toilet seat
500	lid
600	room entry detection sensor
40 610	sitting sensor
700	toilet bowl
1000	toilet device

45 Claims

1. A sanitary cleansing device comprising:

- | | |
|----|--|
| 50 | a cleansing nozzle configured to discharge cleansing water; |
| | a cleansing water flow passage configured to allow the cleansing water from a supply source to flow toward the cleansing nozzle; and |
| | a controller, wherein |
| 55 | the cleansing water flow passage has: |
| | a displacement pump configured to control a flow rate of the cleansing water dis- |

charged from the cleansing nozzle;
 an atmosphere open part disposed at an
 upstream side of the displacement pump,
 configured to open a part of the cleansing
 water flow passage to atmosphere, and
 having a tank for storing the cleansing wa-
 ter, and a water level sensor for detecting a
 water level in the tank to output a signal; and
 a solenoid valve configured to pass and
 block the cleansing water supplied from the
 supply source to the atmosphere open part,
 and

the controller calculates a flow rate of the cleans-
 ing water supplied per unit time from the supply
 source based on the signal of the water level
 sensor, and corrects control of the displacement
 pump.

2. The sanitary cleansing device according to claim 1, further comprising
 a heat exchanger having a heater for heating the
 cleansing water, between downstream of the atmos-
 sphere open part and upstream of the displacement
 pump, wherein
 the controller controls the heater.
3. The sanitary cleansing device according to claim 2,
 wherein
 the tank of the atmosphere open part has a function
 of an inflow water temperature buffer part.
4. The sanitary cleansing device according to claim 1,
 wherein
 the cleansing nozzle has a nozzle part including at
 least a private part cleansing nozzle for performing
 private part cleansing, and a bidet cleansing nozzle,
 the sanitary cleansing device further comprising
 an operation part configured to allow selection of a
 cleansing mode by the nozzle part, wherein
 the controller controls a jet flow rate of the cleansing
 water in accordance with the cleansing mode of the
 nozzle part selected by the operation part, and cor-
 rects flow rate control of the displacement pump
 based on a flow rate detected by the water level sen-
 sor at a time of cleansing in the cleansing mode se-
 lected by the operation part.
5. The sanitary cleansing device according to claim 4,
 wherein
 the water level sensor detects an upper limit water
 level and a lower limit water level in the tank,
 the controller has a water level controller configured
 to calculate a flow rate per unit time when the water
 level is changed from the upper limit water level to
 the lower limit water level, and
 a quantity of stored water from the lower limit water
 level to the upper limit water level is set to be a quan-

tity of water smaller than a total flow rate used for a
 single standard cleansing time in any one of a plu-
 rality of the cleansing modes.

6. The sanitary cleansing device according to claim 1,
 wherein the heater of the heat exchanger is disposed
 inside the tank of the atmosphere open part for heat-
 ing at least the stored cleansing water.

FIG. 1

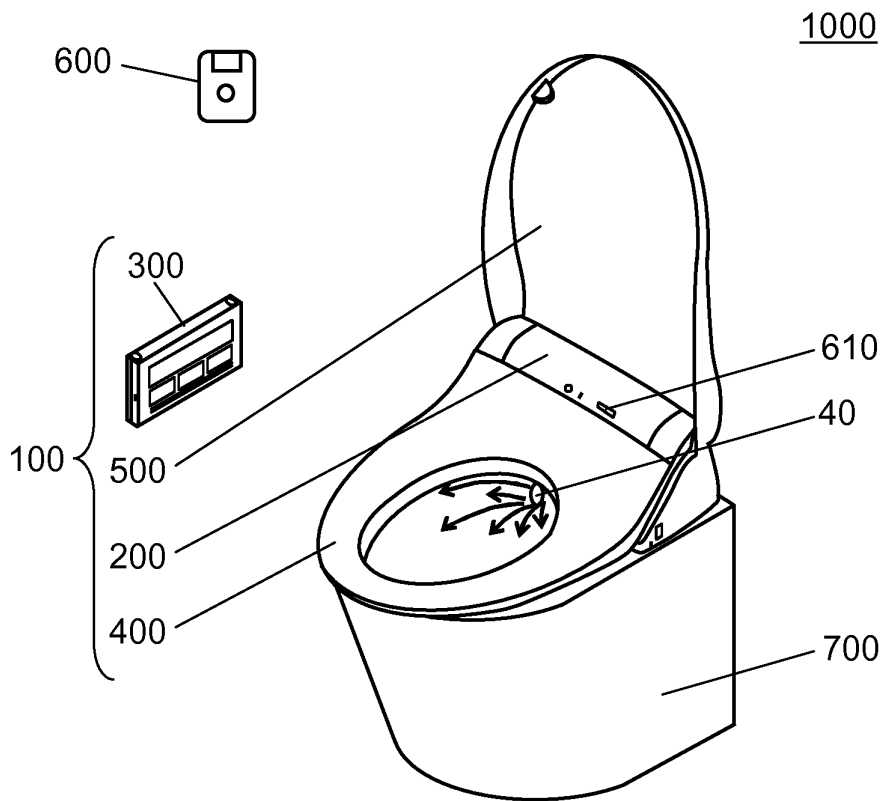


FIG. 2

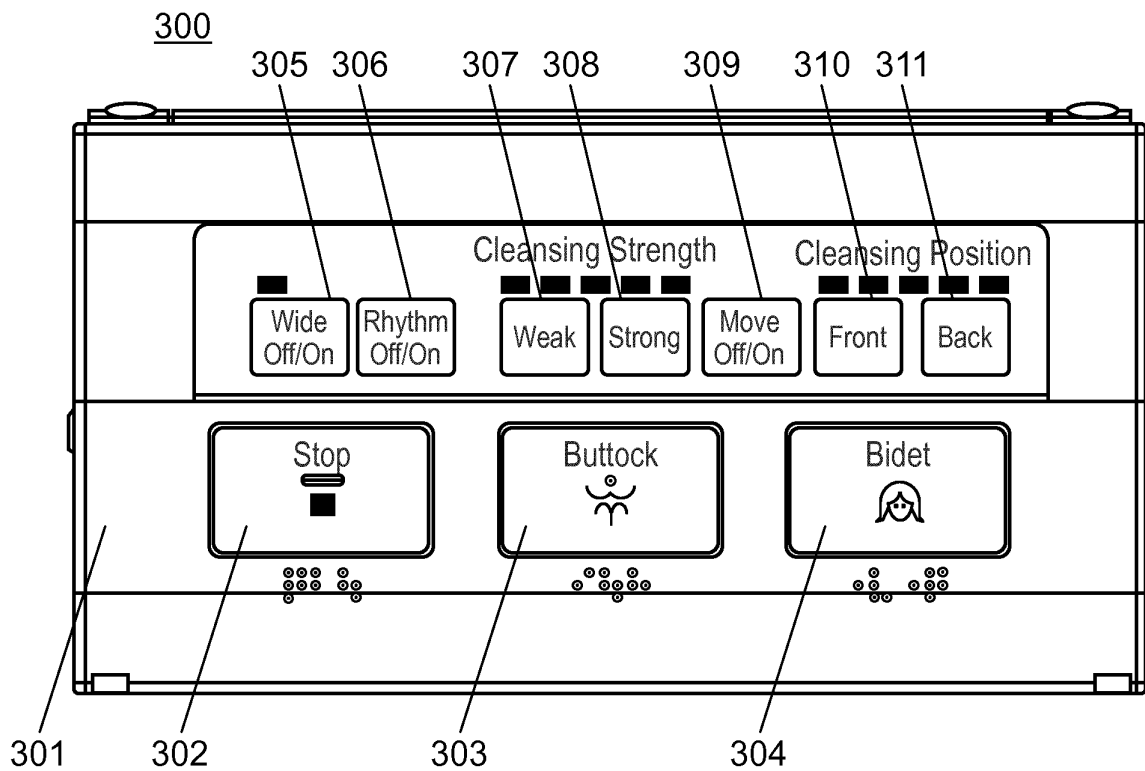


FIG. 3

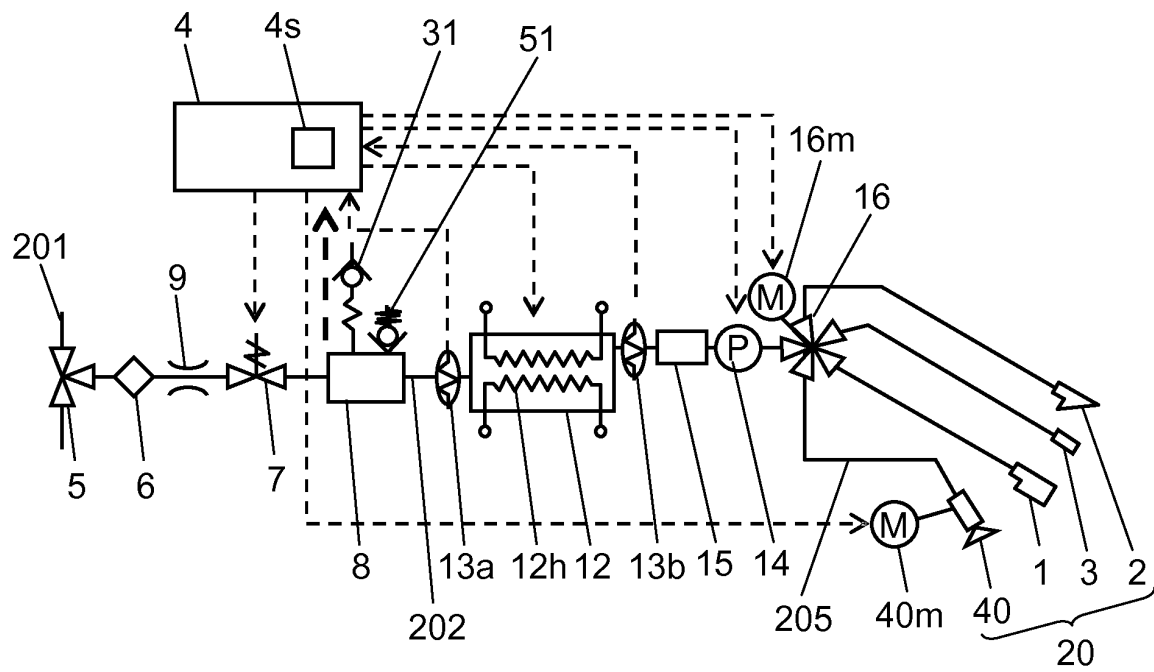


FIG. 4

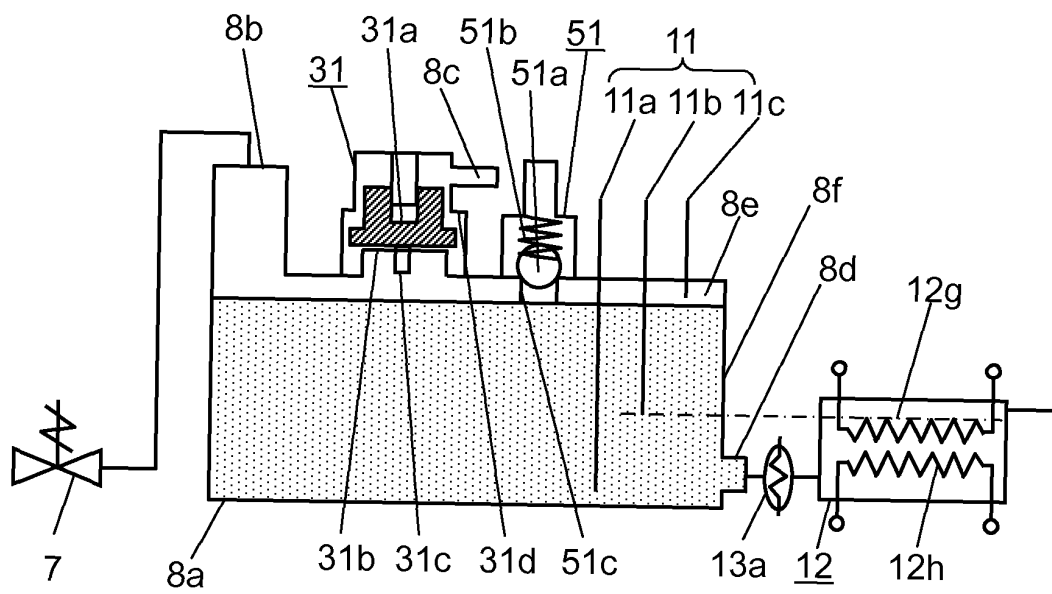


FIG. 5

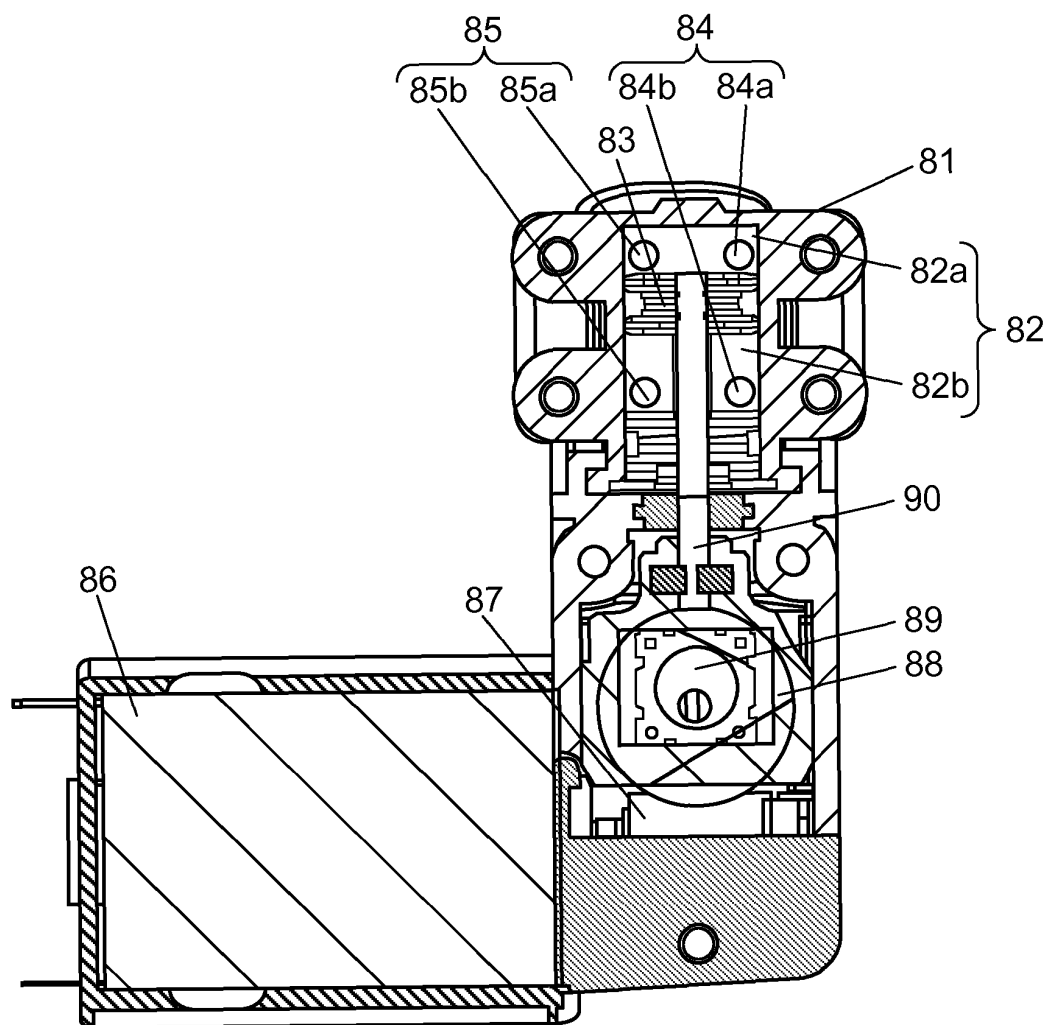


FIG. 6

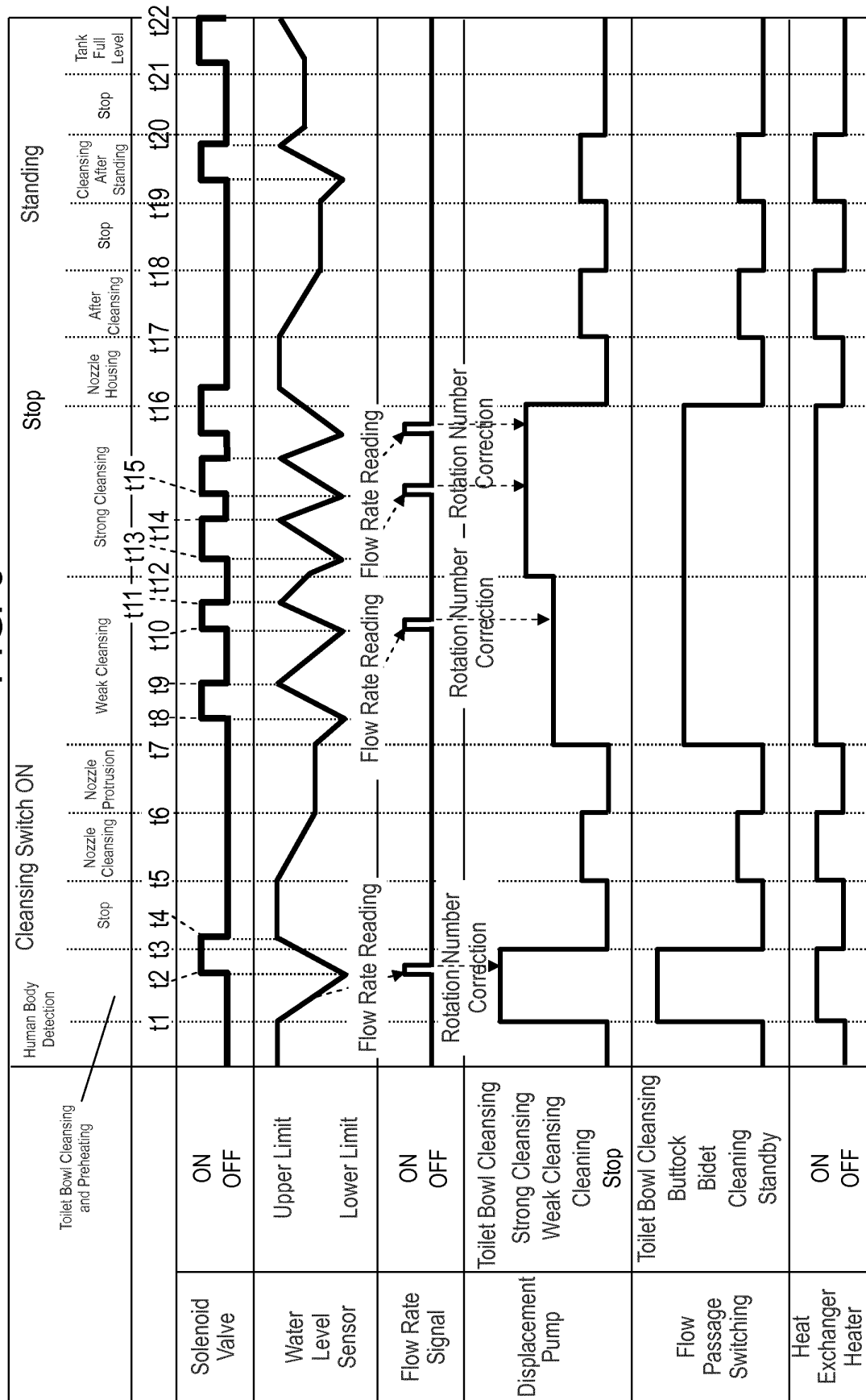


FIG. 7

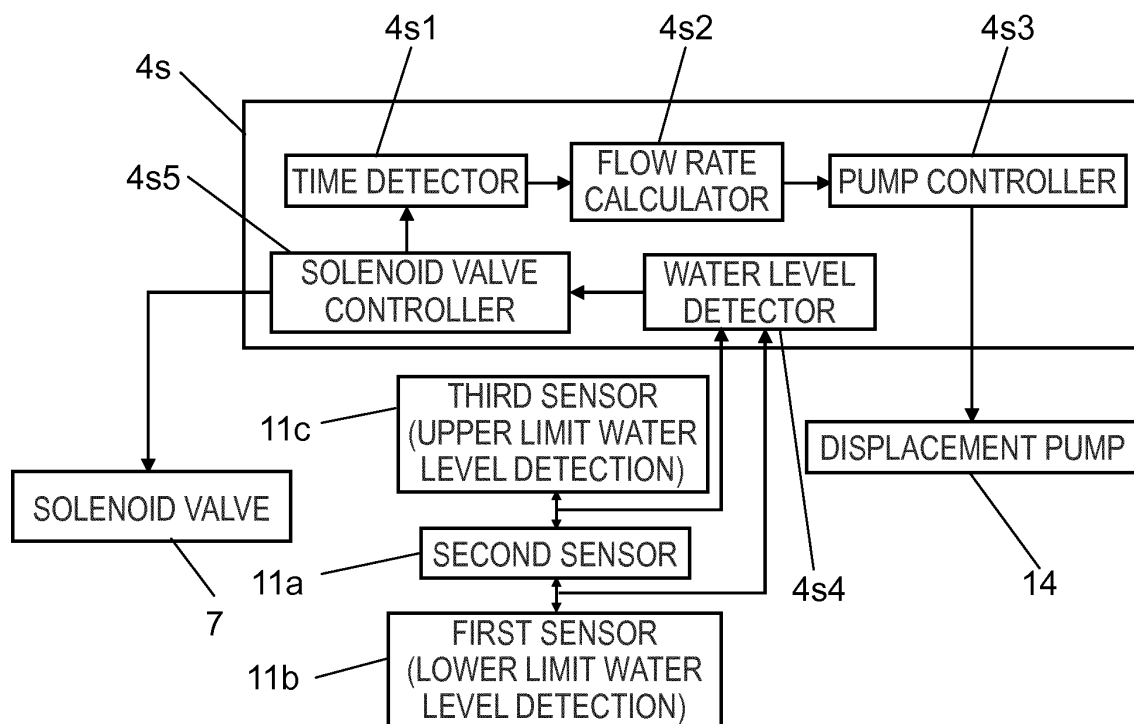


FIG. 8

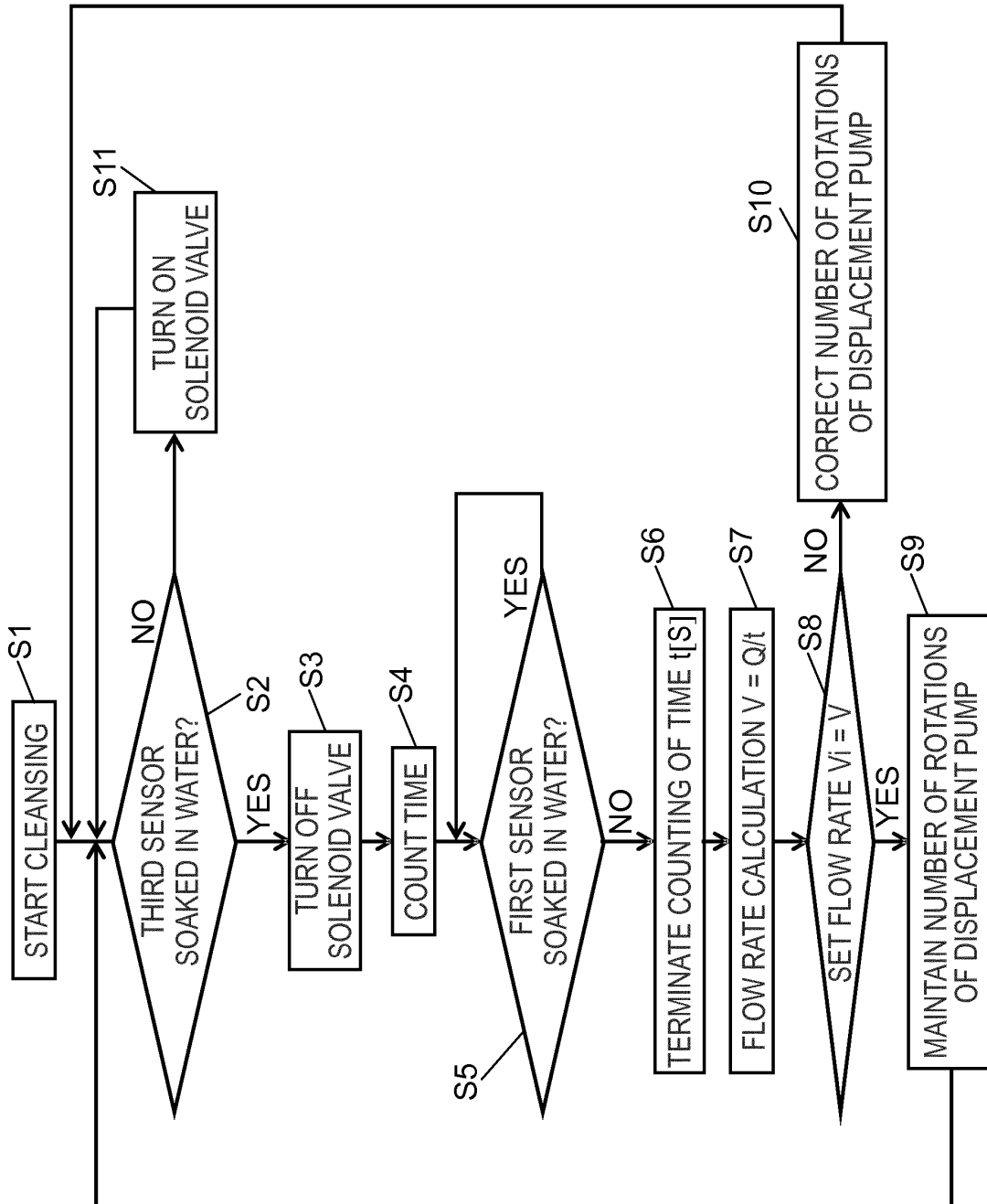
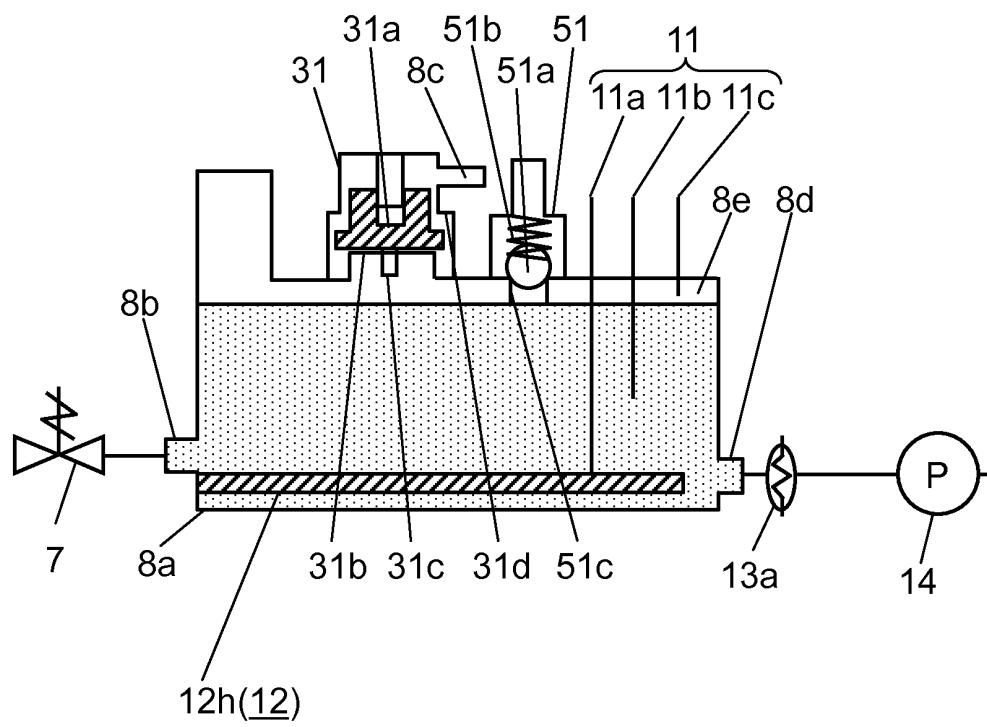


FIG. 9



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2013/001514

A. CLASSIFICATION OF SUBJECT MATTER

E03D9/08 (2006.01) i

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)

E03D9/08

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2013

Kokai Jitsuyo Shinan Koho 1971-2013 Toroku Jitsuyo Shinan Koho 1994-2013

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2009-2033 A (Panasonic Corp.), 08 January 2009 (08.01.2009), entire text; all drawings (Family: none)	1-6
A	JP 7-189318 A (Toto Ltd.), 28 July 1995 (28.07.1995), entire text; all drawings (Family: none)	1-6
A	JP 11-50971 A (Eagle Kogyo Co., Ltd.), 23 February 1999 (23.02.1999), entire text; all drawings (Family: none)	1-6

☒ Further documents are listed in the continuation of Box C.☐ See patent family annex.

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Date of the actual completion of the international search

09 April, 2013 (09.04.13)

Date of mailing of the international search report

23 April, 2013 (23.04.13)

Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2013/001514

5	C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
10	A	JP 10-131264 A (Matsushita Electric Works, Ltd.), 19 May 1998 (19.05.1998), entire text; all drawings (Family: none)	1-6
15	A	JP 2007-327307 A (TOTO Ltd.), 20 December 2007 (20.12.2007), entire text; all drawings (Family: none)	1-6
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Patent documents cited in the description

- JP 3620215 B [0005]